The Interface of Syntax and Information Structure

LFG Approaches

Detmar Meurers
(based on joint preparation with Kordula De Kuthy)
LING795K, OSU, Spring 2005

LFG approaches to information structure

- LFG in a nutshell

- Grammaticized discourse functions in the f-structure
  - Introducing the idea (Bresnan and Mchombo 1987)
  - Linking discourse functions to phrase structure positions
    (King 1995; Butt and King 1996)
  - Problems with discourse features as part of the f-structure (King 1997)

- Information structure as an independent projection
  - Introducing the idea (King 1997; Butt and King 2000)
  - NEW and PROM as discourse features (Choi 1999)

LFG in a nutshell

LFG (minimally) distinguishes two kinds of representation:

- *c-structure* (constituent structure):
  overt linear and hierarchical organization of words into phrases
- *f-structure* (functional structure):
  abstract functional organization of the sentence, explicitly representing
  syntactic predicate-argument structure and functional relations

LFG – The nature of f-structure

An f-structure is restricted by the principles of

- *completeness*: a predicate and all its arguments must be a part of the structure

- *coherence*: all arguments in the structure must be required by a predicate

- *uniqueness*: every attribute has a single value

LFG – How a string is licensed

- A context-free c-structure grammar licenses the c-structure of a string.

- The grammar is augmented with functional descriptions, which map the c-structure to an f-structure representation.

The setup is best illustrated with an example . . .

An example grammar I: The c-structure rules with annotations

(based on Kaplan and Bresnan 1995)

(1) a. S → NP VP
$(\uparrow \text{SUBJ}) = \downarrow$ $\uparrow = \downarrow$

b. NP → Det N
$\uparrow = \downarrow$ $\uparrow = \downarrow$

c. VP → V NP NP
$\uparrow = \downarrow$ $(\uparrow \text{OBJ}) = \downarrow$ $(\uparrow \text{OBJ2}) = \downarrow$
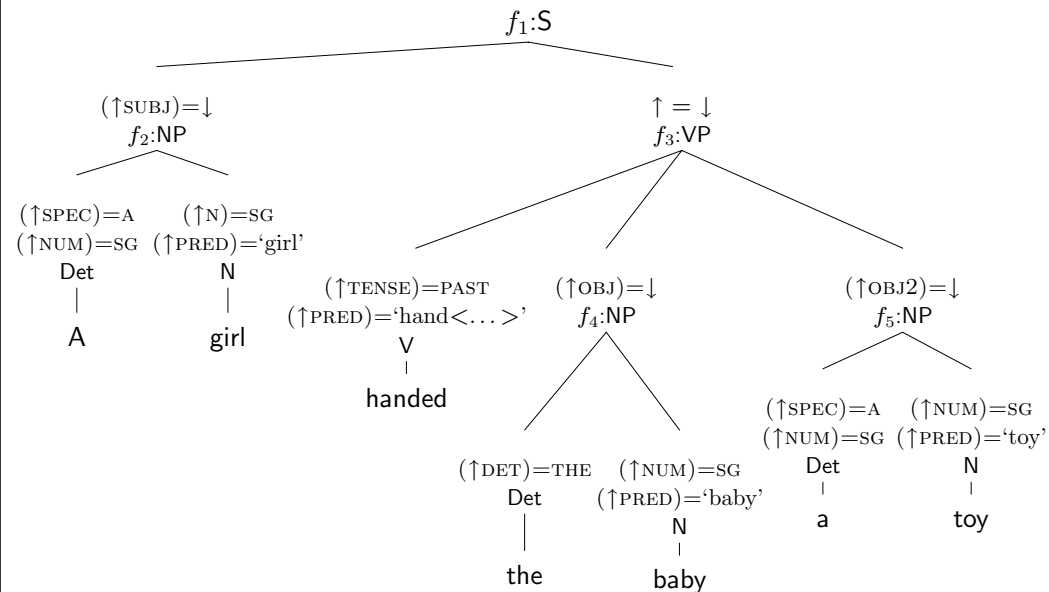

An example grammar II: The lexicon

(2) a. *a* Det $(\uparrow \text{SPEC}) = \text{A}$
$(\uparrow \text{NUM}) = \text{SG}$

b. *girl* N $(\uparrow \text{NUM}) = \text{SG}$
$(\uparrow \text{PRED}) = \text{'girl'}$

c. *handed* V $(\uparrow \text{TENSE}) = \text{PAST}$
$(\uparrow \text{PRED}) = \text{'hand} < (\uparrow \text{SUBJ}), (\uparrow \text{OBJ}), (\uparrow \text{OBJ2}) >\text{'}$

d. *the* Det $(\uparrow \text{SPEC}) = \text{THE}$

e. *baby* N $(\uparrow \text{NUM}) = \text{SG}$
$(\uparrow \text{PRED}) = \text{'baby'}$

f. *toy* N $(\uparrow \text{NUM}) = \text{SG}$
$(\uparrow \text{PRED}) = \text{'toy'}$

A sentence licensed by the example grammar

The f-structure resulting for the example sentence

$$f_1, f_3: \begin{bmatrix} \text{SUBJ} & f_2: \begin{bmatrix} \text{SPEC} & \text{A} \\ \text{NUM} & \text{SG} \\ \text{PRED} & \text{'girl'} \end{bmatrix} \\ \text{TENSE} & \text{PAST} \\ \text{PRED} & \text{'hand} <(\uparrow\text{SUBJ}), (\uparrow\text{OBJ}), (\uparrow\text{OBJ2})>\text{'} \\ \text{OBJ} & f_4: \begin{bmatrix} \text{SPEC} & \text{THE} \\ \text{NUM} & \text{SG} \\ \text{PRED} & \text{'baby'} \end{bmatrix} \\ \text{OBJ2} & f_5: \begin{bmatrix} \text{SPEC} & \text{A} \\ \text{NUM} & \text{SG} \\ \text{PRED} & \text{'toy'} \end{bmatrix} \end{bmatrix}$$

Grammaticized discourse functions in the f-structure

Bresnan and Mchombo (1987):

- Grammatical functions are partitioned into
  - argument functions (SUBJ, OBJ, OBJ2, ...)
  - non-argument functions (TOPIC, FOCUS, ...)

- Argument functions are directly mapped onto semantic or thematic roles in lexical predicate-argument structures.

- Non-argument functions must be linked to other grammatical functions by the

  Extended Coherence Condition:
  - All functions in the f-structure must be *bound*.
  - An argument function is bound if it is the argument of a predicator (PRED).
  - A topic or focus is bound whenever it is functionally identified with, or anaphorically binds, a bound function.

The discourse functions of topic and focus

Bresnan and Mchombo (1987) base discourse functions on the notions of topic and focus of Chafe (1976):

- The *topic* designates what is under discussion, whether previously mentioned or assumed in discourse.

  Grammaticized topics – constituents that bear the TOPIC function – designate discourse topics; but not all discourse topics are grammatically marked.

- A *focus* expresses contrast; it designates something that is not presupposed (relative to some context).

  As above, not all discourse foci are grammatically marked.

The syntactic role of TOPIC and FOCUS

Bresnan and Mchombo (1987) adopt three principles about the role of the TOPIC and FOCUS functions in the grammar:

1. In relative clauses, the relative pronoun or relativized constituent universally bears the TOPIC function.

   (3) The car [which you don't want ⎯] is a Renault.

              TOPIC   OBJ

2. In interrogative clauses, the interrogative pronoun or questioned constituent universally bears the FOCUS function.

   (4) I know [what   you want ⎯].

              FOCUS   OBJ

The syntactic role of TOPIC and FOCUS (cont.)

3. The same constituent cannot be both focus and topic of the same level of (functional) clause structure.

   But note that this does not hold for different levels of embedding, e.g., in cleft constructions, the same phrase is interpreted as both a focus and a topic:

   (5) [It is my car [that   you don't want ⎯]].
                 FOCUS   TOPIC   OBJ

   Such principles should ultimately be derived form the theory of the role and interpretation of these functions in discourse.

   Until that is the case, Bresnan and Mchombo (1987) postulate the above properties of the grammaticized discourse functions in order to derive explicit predictions.

Illustrating the analysis of Bresnan and Mchombo (1987)

An empirical issue:

In English, it is possible to embed a cleft construction in a question and question the clefted NP as in (6b) and (7b).

(6) a.   It was **a chicken** that Fred cooked.
      b.   (Mary asked) **what** it was that Fred cooked.

(7) a.   It was **John** that Marilyn suspected.
      b.   (I asked) **who** it was that Marilyn suspected.

It is less acceptable to embed the cleft construction in a relative clause where the clefted NP functions as the relative pronoun as in (9) and (8),

(8) ?? (I met) the person who it was that Marilyn suspected.

(9) ?? (Mary ate) what it was that Fred cooked.

Bresnan and Mchombo's information structure explanation

The cleft NP and the question phrase in the first example set both have FOCUS functions, so that none of the principles for discourse functions are violated:

(10) a.   [It was John   [that   Marilyn suspected ⎯   ]].
                    FOCUS   TOPIC   OBJ

      b.   [who   it was ⎯   [that   Marilyn suspected ⎯   ]].
              FOCUS   FOCUS   TOPIC   OBJ

In the relative clauses in the second example set, the trace of the cleft NP is FOCUS, whereas the relativized cleft NP is TOPIC. This violates the principle that the same constituent cannot be both focus and topic at the same clause level:

      c. ??? [the person [who   it was ⎯   [that   Marilyn suspected ⎯   ]].
                    TOPIC   FOCUS   TOPIC   OBJ

Linking discourse functions to phrase structure positions

- King (1995) examines word order and the encoding of topic and focus in Russian.

- She argues that certain phrase structure positions license discourse functions.

- Annotations on the c-structure are used for the syntactic encoding of discourse functions, mapping a constituent to a grammatical and a discourse function.
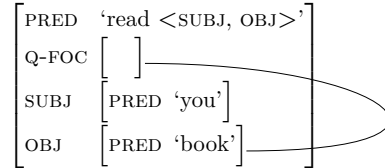
An example for the approach of King (1995)

The c-structure rule in (11) captures that in Russian li-questions the constituent preceding the li is the focus of the yes-no question.

(11) CP → XP C'
   ($\uparrow$Q-FOC) = $\downarrow$ $\uparrow = \downarrow$
   ($\uparrow$XCOMP*GF)=$\downarrow$

(12) Knigu li ty pročitala?
   book Q you read

   'Was it a book that you read?'

$$\begin{bmatrix} \text{PRED} & \text{'read} <\text{SUBJ, OBJ}>\text{'} \\ \text{Q-FOC} & [\quad] \\ \text{SUBJ} & [\text{PRED 'you'}] \\ \text{OBJ} & [\text{PRED 'book'}] \end{bmatrix}$$
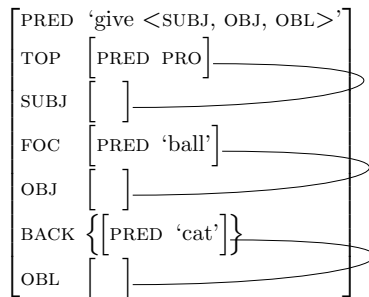
Adding BACKGROUND to the setup

Butt and King (1996) capture the correlation between word order and discourse functions in Urdu and Turkish. Just like King (1995) they associate certain c-structure positions with particular discourse functions, but they explicitly include the BACKGROUND:

(13)
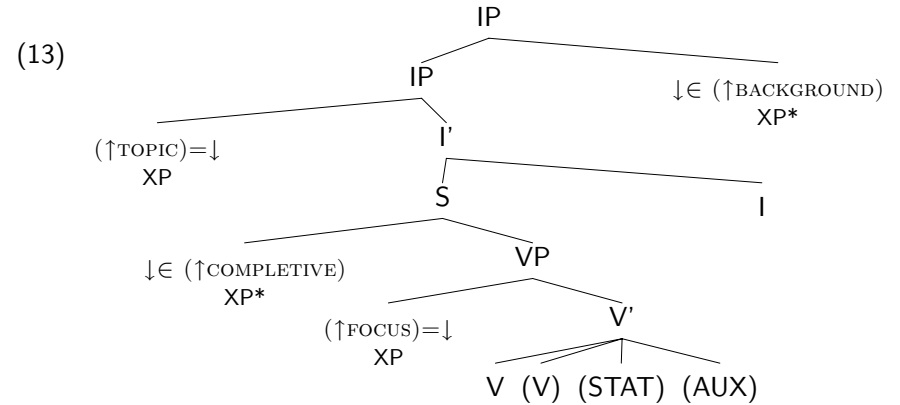
An example for the approach of Butt and King (1996)

(14) yok, [Funda'nın top-un-u]$_F$ ver-me-m [kedi-ye]$_{Back}$
   no Funda-Gen ball-Poss3-Acc give-Neg-1Sg cat-Dat

   'No, (I) won't give Funda's ball to the cat. (Turkish)'

$$\begin{bmatrix} \text{PRED} & \text{'give} <\text{SUBJ, OBJ, OBL}>\text{'} \\ \text{TOP} & [\text{PRED PRO}] \\ \text{SUBJ} & [\quad] \\ \text{FOC} & [\text{PRED 'ball'}] \\ \text{OBJ} & [\quad] \\ \text{BACK} & \{[\text{PRED 'cat'}]\} \\ \text{OBL} & [\quad] \end{bmatrix}$$

Problems with grammaticized discourse functions (King 1997)

The approach cannot adequately handle discourse functions assigned to f-structure heads:

- Discourse information is encoded in the f-structure, obtained through c-structure annotations.

- The f-structure of a head is generally specified to be identical to that of its mother ($\uparrow = \downarrow$).

- When assigning a discourse function to f-structure heads, one thus cannot distinguish between different levels of the head projection; e.g., one cannot express that only the lexical head is the focus.

- King (1997) illustrates the problem with two examples:

  1. contrastive focus on verbs
  2. focus projection resulting in new-information focus of the VP

Example problem 1: Contrastive focus

- Contrastive focus picks out one element as prominent new information.
- In many languages, contrastive focus is encoded intonationally, as for example shown in example (15) with a pitch accent on *read*.

  (15) Q: Did she write a book?

  A: (No,) she READ a book.

- Two possible annotations in the c-structure to mark contrastive focus, namely the annotation of the verb *read* with

  - $\downarrow \in (\uparrow \text{FOC})$ or with
  - $(\downarrow \text{PRED}) \in (\uparrow \text{FOC})$

- Both possibilities will result in a focus that not only contains the verb itself, but also the two arguments *she* and *book*.

Example problem 2: Focus projection

- When a word receives a pitch accent signaling focus (16), frequently the focus projects up to a larger constituent (17), possibly the entire clause (18).

  (16)   She read a BOOK.

  (17) Q: What did she do?

  A: She ⟦read a BOOK.⟧$_F$

  (18) Q: What happened?

  A: ⟦She read a BOOK.⟧$_F$

- How can one capture the VP focus (17)? There are two possible annotations:

  I. Annotation of the verbal projection in the c-structure with $\downarrow \in (\uparrow \text{FOC})$

  II. Annotation of all the nodes contained in the focus with $(\downarrow \text{PRED}) \in (\uparrow \text{FOC})$

- In both cases, the subject of the sentences is incorrectly included in VP focus.

Illustration of the two possibilities and resulting f-structures
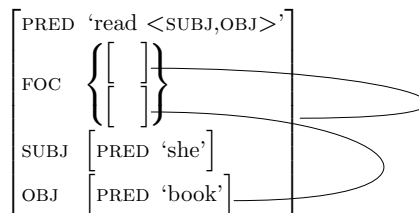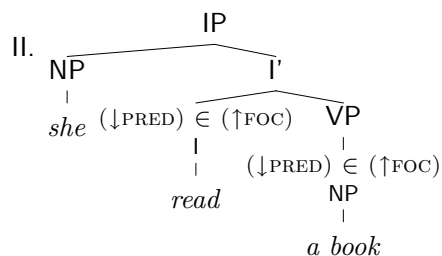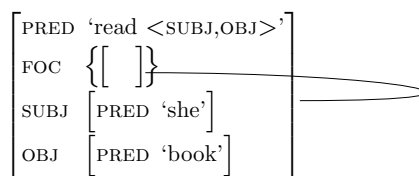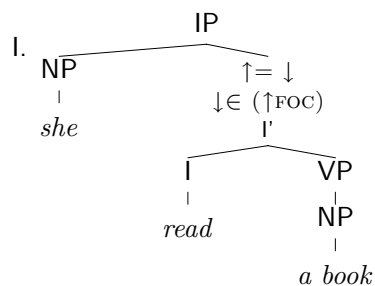
Towards a solution to the problems

King (1997) suggest a solution to the problem with grammaticized discourse functions involving two steps:

- positioning of an information structure projection distinct from the f-structure

- removing the argument structure of the predicate in order for the i-structure to be able to refer to just the core meaning of a predicate

Information structure as an independent projection

phonetic string
|
c-structure
/   \
f-structure   i-structure
\   /
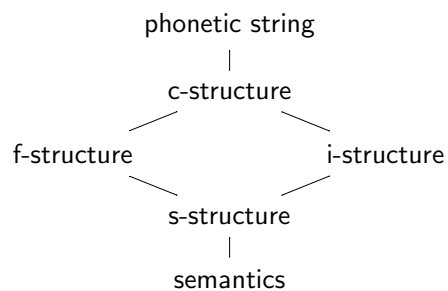s-structure
|
semantics

- The c-structure is augmented with annotations mapping to i(nformation)-structure features.

  For Russian, King (1997) defines special c-structure annotations assigning values to the i-structure features FOCUS and TOPIC.

- The setup envisaged by King (1997) includes a s(emantic)-structure mediating between f- and i-structure; but it is not further discussed.

- To ensure completeness of the i-structure, all PREDs which are not assigned a discourse function are designated as BACKGROUND.

Making the core meaning of a predicated available

- Instead of focusing the entire PRED value, which includes the argument structure, it must be possible to focus only the core meaning, i.e., the functor of the PRED.

- Following Kaplan and Maxwell (1986), this functor is introduced under the path PRED FN, as illustrated in (19) for the verb *read*.

  (19) PRED   'read$<$SUBJ,OBJ$>$'
       PRED FN 'read'

- In the setup of King (1997), the i-structure features thus are assigned values based on the f-structure PRED FN values.

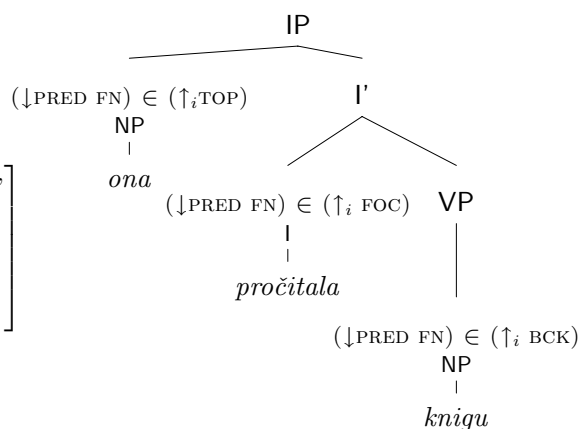## A contrastive focus example from Russian (King 1997)

(20) a. Ona PROCITALA knigu.
         she read   book
         'She READ the book.'

   b. F-structure

   $$\begin{bmatrix} \text{PRED} & \text{'read} \langle \text{SUBJ,OBJ} \rangle\text{'} \\ \text{PRED FN} & \text{'read'} \\ \text{SUBJ} & [\text{PRED 'she'}] \\ \text{OBJ} & [\text{PRED 'book'}] \end{bmatrix}$$

   c. I-structure

   $$\begin{bmatrix} \text{TOP} & \{\text{'she'}\} \\ \text{FOC} & \{\text{'read'}\} \\ \text{BCK} & \{\text{'book'}\} \end{bmatrix}$$

IP
/   \
$(\downarrow\text{PRED FN}) \in (\uparrow_i\text{TOP})$ I'
NP
|
ona
$(\downarrow\text{PRED FN}) \in (\uparrow_i \text{FOC})$ VP
I
|
pročitala
$(\downarrow\text{PRED FN}) \in (\uparrow_i \text{BCK})$
NP
|
knigu

A focus projection example from Russian (King 1997)

(21) a. Ona [procitala knigu]$_F$
         she   read   book

   b. I-structure

   $$\begin{bmatrix} \text{TOP} & \{\text{'she'}\} \\ \text{FOC} & \left\{\begin{array}{c}\text{'read'} \\ \text{'book'}\end{array}\right\} \end{bmatrix}$$

IP
/   \
$(\downarrow\text{PRED FN}) \in (\uparrow_i \text{TOP})$ $\uparrow = \downarrow$
NP   I'
|
ona
$(\downarrow\text{PRED FN}) \in (\uparrow_i \text{FOC})$ VP
I
|
pročitala
$(\downarrow\text{PRED FN}) \in (\uparrow_i \text{FOC})$
NP
|
knigu
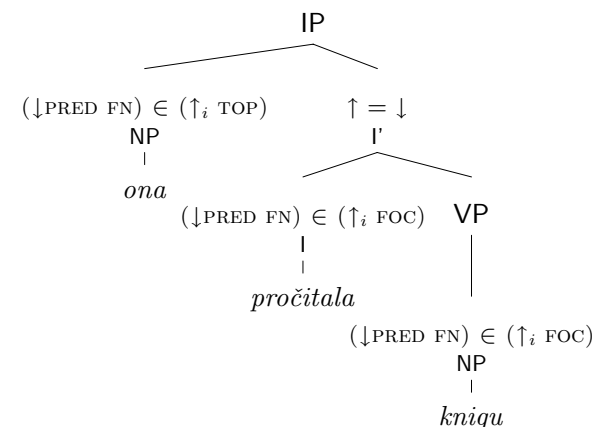
Note: FOC is a set of atomic (i.e, not complex) f-structure terms. How would multiple focus constructions be represented?

A related approach to Hindi/Urdu (Butt and King 2000)

Butt and King (2000) build on Butt and King (1996), but follow King (1997) in encoding the discourse function within i-structure (instead of f-structure).

(22) [naadyaa]$_T$ (to) [abhii]$_{CI}$ [Tofii]$_{CI}$ [bazaar=se]$_F$ xariid rahii t^{h}ii
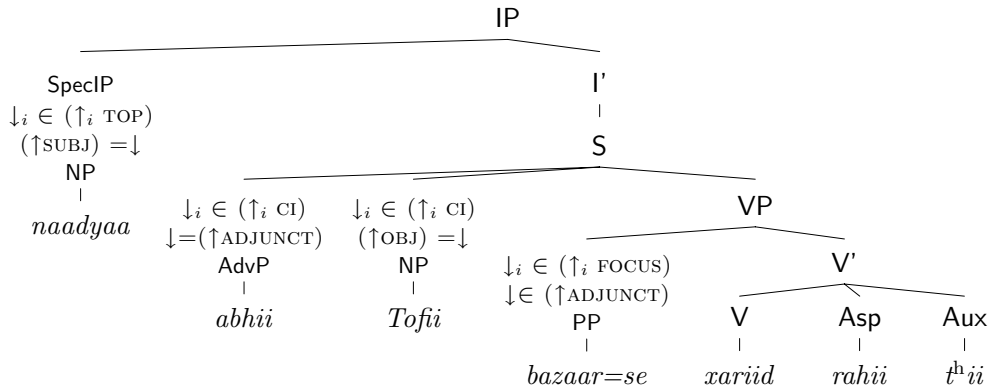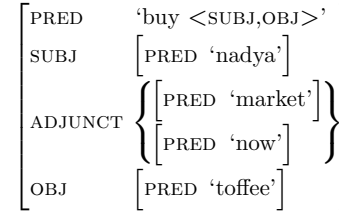   Nadya   indeed just now toffee market=from buy Stat be

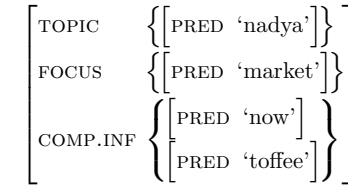'Nadya was just buying toffee at the market.'

```
                                   IP
              _____/    \
             /                         I'
        SpecIP                         |
   ↓_i ∈ (↑_i TOP)                     S
   (↑SUBJ) =↓            _____/  _____
        NP              /           |                \
        |          ↓_i ∈ (↑_i CI)  ↓_i ∈ (↑_i CI)    VP
     naadyaa      ↓=(↑ADJUNCT)     (↑OBJ) =↓      __/  \__
                     AdvP             NP         /        V'
                      |               |     ↓_i ∈ (↑_i FOCUS)  __/ | \__
                    abhii            Tofii   ↓∈ (↑ADJUNCT)     V   Asp  Aux
                                              PP              |    |    |
                                              |            xariid rahii t^hii
                                          bazaar=se
```
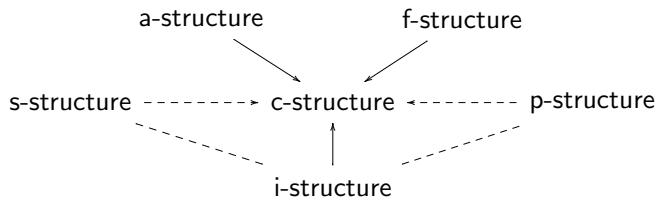

F- and I-structures of the example

Functional structure:

$$
\begin{bmatrix}
\text{PRED} & \text{'buy <SUBJ,OBJ>'} \\
\text{SUBJ} & \begin{bmatrix} \text{PRED 'nadya'} \end{bmatrix} \\
\text{ADJUNCT} & \left\{ \begin{bmatrix} \text{PRED 'market'} \end{bmatrix} \atop \begin{bmatrix} \text{PRED 'now'} \end{bmatrix} \right\} \\
\text{OBJ} & \begin{bmatrix} \text{PRED 'toffee'} \end{bmatrix}
\end{bmatrix}
$$

Information-structure:

$$
\begin{bmatrix}
\text{TOPIC} & \left\{ \begin{bmatrix} \text{PRED 'nadya'} \end{bmatrix} \right\} \\
\text{FOCUS} & \left\{ \begin{bmatrix} \text{PRED 'market'} \end{bmatrix} \right\} \\
\text{COMP.INF} & \left\{ \begin{bmatrix} \text{PRED 'now'} \end{bmatrix} \atop \begin{bmatrix} \text{PRED 'toffee'} \end{bmatrix} \right\}
\end{bmatrix}
$$

NEW and PROM as discourse features in the i-structure

Choi (1999) proposes another architecture that includes an information structure and a prosodic structure in addition to the f-structure and c-structure:

```
   a-structure          f-structure
         \                  /
          ↘                ↙
s-structure ----→ c-structure ←---- p-structure
         ↘          ↑          ↙
                 i-structure
```

- The a-structure and the f-structure pass the syntactic information to the c-structure, while the i-structure passes along discourse-pragmatic information.

- This i-structure is constrained by information from the s- and the p-structure.

I-structure and its encoding through NEW and PROM

- Vallduví (1992) assumes a division of the information structure into *focus* and *ground*. *ground* is further divided into *link* and *tail*, where elements that are in the *link* are more prominent than elements that are in the *tail*.

- Choi (1999) assumes a similar division for *focus*: *focus* is divided into *contrastive focus* and *completive focus*, where contrastive focus has the additional property of being "more prominent".

- Choi (1999) represents these four distinctions through two primitives: NEW and PROM

	+New	−New
+Prom	contrastive focus	topic
−Prom	completive focus	tail

Information feature assignment

An all focus sentence is assigned [+NEW] and [−PROM].

(23) a. What happened yesterday?
      b. [Mary bought a book]$_{+N,-P}$

If the VP represents new information, the entire VP is assigned [+NEW, −PROM].

(24) a. What did Mary do?
      b. [She]$_{-N,-P}$ [bought a book]$_{+N,-P}$

Each component of the sentence can bear a distinct feature assignment:

(25) a. What about Mary? What did she buy?
      b. [Mary]$_{-N,+P}$ [bought]$_{-N,-P}$ [a book]$_{+N,-P}$.

Information feature assignment (cont.)

If the object alone represents new information, it receives the feature assignment [+NEW,−PROM].

(26) a. What did Mary buy?
      b. [She bought]$_{-N,-P}$ [a book]$_{+N,-P}$.

Choi (1999) notes a second, spurious possibility for assigning [−NEW] to the rest of the sentence:

(27) c. [She]$_{-N,-P}$ [bought]$_{-N,-P}$ [a book]$_{+N,-P}$.

Information structuring constraints assumed by Choi (1999)

(28) Scrambling of Ground elements:
     a. Ground elements, both topic and tail, can scramble.
     b. Topic scrambles more easily than tail.

(29) Scrambling of focus elements
     a. Completive focus cannot scramble.
     b. Contrastive focus can scramble.

(30) Information structuring constraints
     a. NEW: [−NEW] should precede [+NEW].
     b. PROM: [+PROM] should precede [−PROM].

(31) Ranking: PROM >> NEW

Relating information and prosody (Choi 1999)

(32) Prosodic Constraints (prosodic-struc/info-struc correspondence):
     a. [+Ń]: Put a high pitch accent on [+NEW].
     b. ∗X́: Do not place any pitch accent.

- Focused elements have high pitch accents or prosodic prominence, while topic and tail do not.

- The second constraint is an "economy" constraint (in terms of optimality theory), and is in conflict with the [+Ń] constraint.

- This conflict is resolved by ranking the two constraints: [+Ń] >> ∗X́.

Limits of Choi's view of information and prosody

- As Choi (1999) notes herself, this view of sentential prosody presented is quite limited, e.g., it only applies under the assumption that each word of a sentence is an independent information unit and thus bears an individual feature assignment.

- Related to this, it only applies to narrow focus cases. In order to account for focus projection as illustrated in (33), significantly more complex correspondence constraints between p-structure and i-structure are needed.

(33) a. Mary bought ⟦a BOOK⟧$_{+New}$.
      b. Mary ⟦bought a BOOK⟧$_{+New}$.
      c. ⟦Mary bought a BOOK⟧$_{+New}$.

An Example for Choi's approach: Scrambling in German

It has been observed (Lenerz 1977), that in German a focused NP cannot scramble, as illustrated in (34). Example (34b) is correctly ruled out by Choi since she requires -NEW material to precede +NEW material (cf. the constraint in 30a).

(34) Was hat Hans dem Schüler gegeben?
      'What did Hans give the student?'

    a. Ich glaube, daß Hans$_{-N,-P}$ dem Schüler$_{-N,-P}$ das BUCH$_{+N,-P}$
          I   believe that Hans   the student   the book
          gegeben hat.
          given   has

    b. * Ich glaube, daß Hans$_{-N,-P}$ das BUCH$_{+N,-P}$ dem Schüler$_{-N,-P}$
          I   believe that Hans   the book   the student
          gegeben hat.
          given   has

    'I believe that Hans gave the student the book.'

Summary

- We saw two kinds of approaches for encoding information structure in LFG:

  i. grammaticized discourse features focus and topic within the f-structure
  ii. information structure as a module separate from c- and f-structure

- There are several open issues:

  - The relation between information structure and semantic structure needs to be spelled out.
  - A more thorough analysis of the interaction between prosody (i.e., pitch accents) and information structure is needed.
  - A wider range of phenomena, in particular focus projection and multiple foci, remain to be considered.

References

Bresnan, Joan and Sam A. Mchombo (1987). Topic, pronoun, and agreement in Chichewa. *Language* 63(4), 741–782. Reprinted in (Iida et al. 1987, pp. 1–59).

Butt, Miriam and Tracy Holloway King (1996). Structural Topic and Focus without Movement. In *Proceedings of the First Annual LFG Conference*. Stanford: CSLI Publications. http://cslipublications.stanford.edu/LFG/1/butt.ps.

Butt, Miriam and Tracy Holloway King (2000). Null Elements in Discourse Structure. In Karumuri Venkata Subbarao (ed.), *Papers from the NULLS Seminar*. Delhi: Motilal Banarasidas. http://ling.uni-konstanz.de/pages/home/butt/nulls97.ps.

Chafe, Wallace (1976). Givenness, contrastiveness, definiteness, subjects, topics, and point of view. In Charles N. Li (ed.), *Subject and topic*, New York: Academic Press, pp. 27–55.

Choi, Hye-Won (1999). *Optimizing Structure in Context: Scrambling and Information Structure*. Stanford: CSLI Publications.

Iida, Masayo, Steven Wechsler and Draga Zec (eds.) (1987). *Working Papers in Grammatical Theory and Discourse Structure: Interactions of Morphology, Syntax, and Discourse*. CSLI Lecture Notes. Stanford: CSLI Publications.

Kaplan, Ronald M. and Joan Bresnan (1995). Lexical-Functional Grammar: A Formal System for Grammatical Representations. In Mary Dalrymple, Ronald M. Kaplan, III Maxwell, John t. and Annie Zaenen (eds.), *Formal issues in Lexical-Functional Grammar*, Stanford, CA: CSLI Publications, pp. 29–130.

Kaplan, Ronald M. and III Maxwell, John T. (1986). *LFG grammar writer's workbench*. Tech. rep., Xerox PARC, Palo Alto, CA. ftp://ftp.parc.xerox.com/pub/lfg/lfgmanual.ps.

King, Tracy Holloway (1995). *Configuring Topic and Focus in Russian*. Stanford: CSLI Publications. (Revised version of 1993 Linguistics Department, Stanford University disseration).

King, Tracy Holloway (1997). Focus Domains and Information Structure. In *Proceedings of the LFG '97 Conference*. Stanford: CSLI Publications. http://csli-publications.stanford.edu/LFG/2/king/king-lfg97.ps.

Lenerz, Jürgen (1977). *Zur Abfolge nominaler Satzglieder im Deutschen*. Tübingen: Gunter Narr Verlag.

Vallduví, Enric (1992). *The Informational Component*. New York, NY: Garland.