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Coordination

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Overview

- **The basic analysis**
  - Set-valued features and distribution
  - Interaction with functional uncertainty
  - The representation of the conjunction
  - Non-distributive features
- **Expressing a rule schema by a macro**
- **Some complications**
  - spurious ambiguities
  - coordination of unlike categories, "non-constituent coordination"

The basic analysis – set-valued features

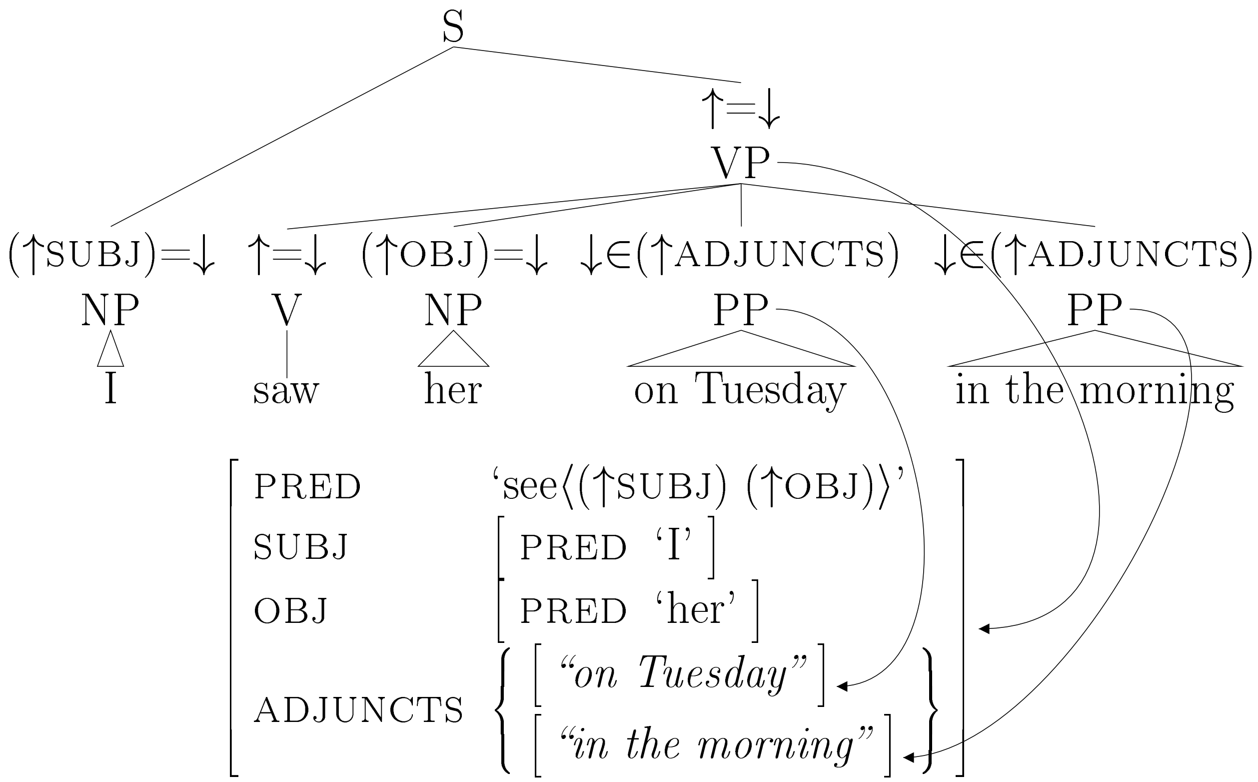
- Certain constructions do not obey the uniqueness conditions normally applying to grammatical functions and features

(1) a. I saw her.

b. I saw her on Tuesday.

c. I saw her on Tuesday in the morning.

(2)
$$\begin{array}{llll} \text{VP} \longrightarrow & \text{V} & \text{(NP)} & \text{PP*} \\ & \uparrow=\downarrow & (\uparrow\text{OBJ})=\downarrow & \downarrow\in(\uparrow\text{ADJUNCTS}) \end{array}$$



Set-valued features in coordination

- Likewise, the parts of coordination do not obey the uniqueness condition

(3) a. He saw Mary.
    b. He saw Mary and John.
    c. He saw Mary, Sue, and John.

⇒ f-structure representation: a set of f-structures

$$\begin{bmatrix} \text{PRED} & \text{`see}\langle(\uparrow\text{SUBJ})\ (\uparrow\text{OBJ})\rangle\text{'} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`I'} \end{bmatrix} \\ \text{OBJ} & \left\{ \begin{array}{l} \begin{bmatrix} \text{PRED} & \text{`Mary'} \end{bmatrix} \\ \begin{bmatrix} \text{PRED} & \text{`John'} \end{bmatrix} \end{array} \right\} \end{bmatrix}$$

Coordination rule

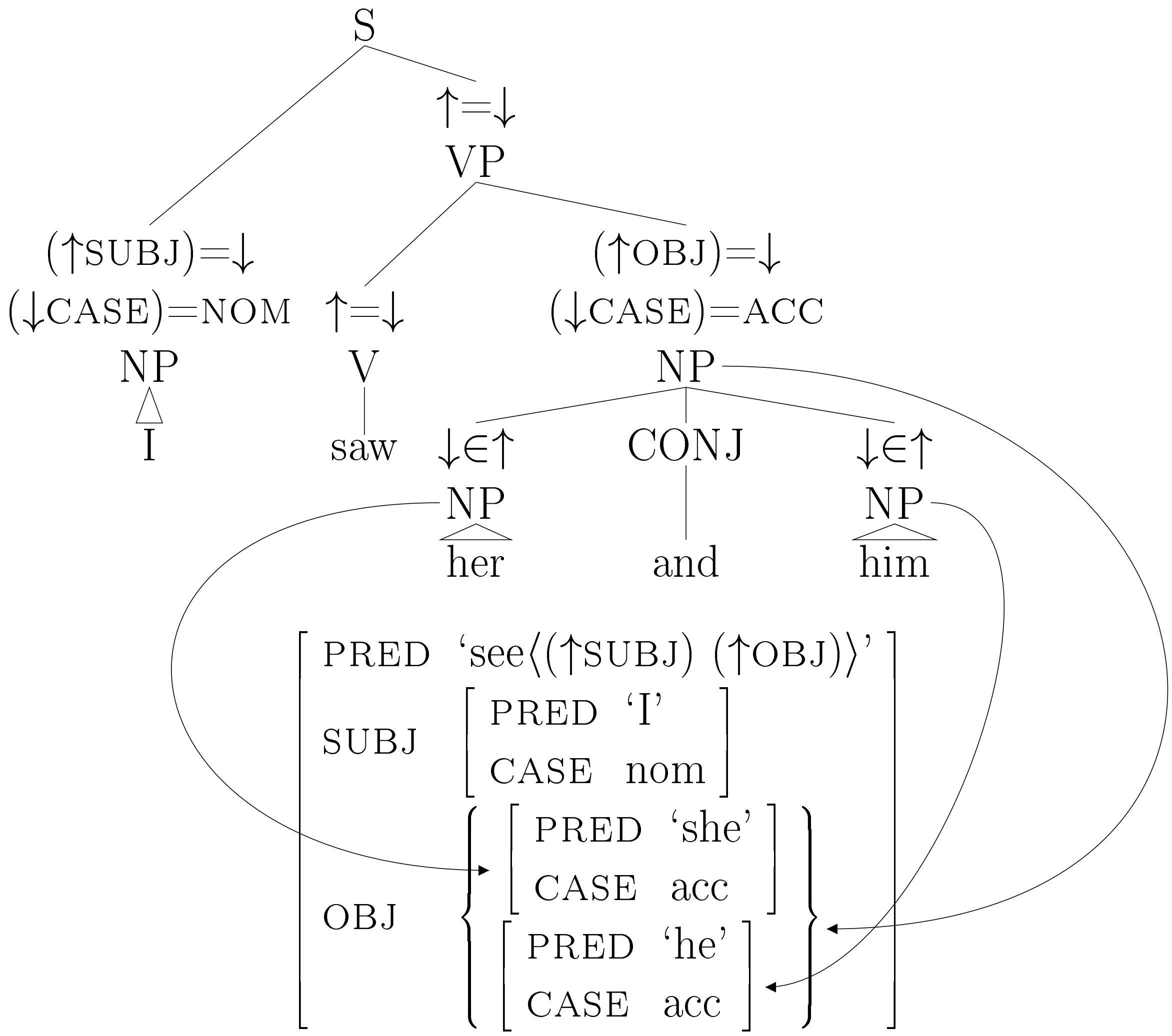
(4)
$$\begin{array}{lllll} \text{NP} & \longrightarrow & \text{NP} & \text{CONJ} & \text{NP} \\ & & \downarrow\in\uparrow & & \downarrow\in\uparrow \end{array}$$

Distribution in f-structures

- What about constraints on the f-structure set that are expressed "externally"?

(5) a. I saw her and him.

b. *I saw her and he.



Distribution in f-structures

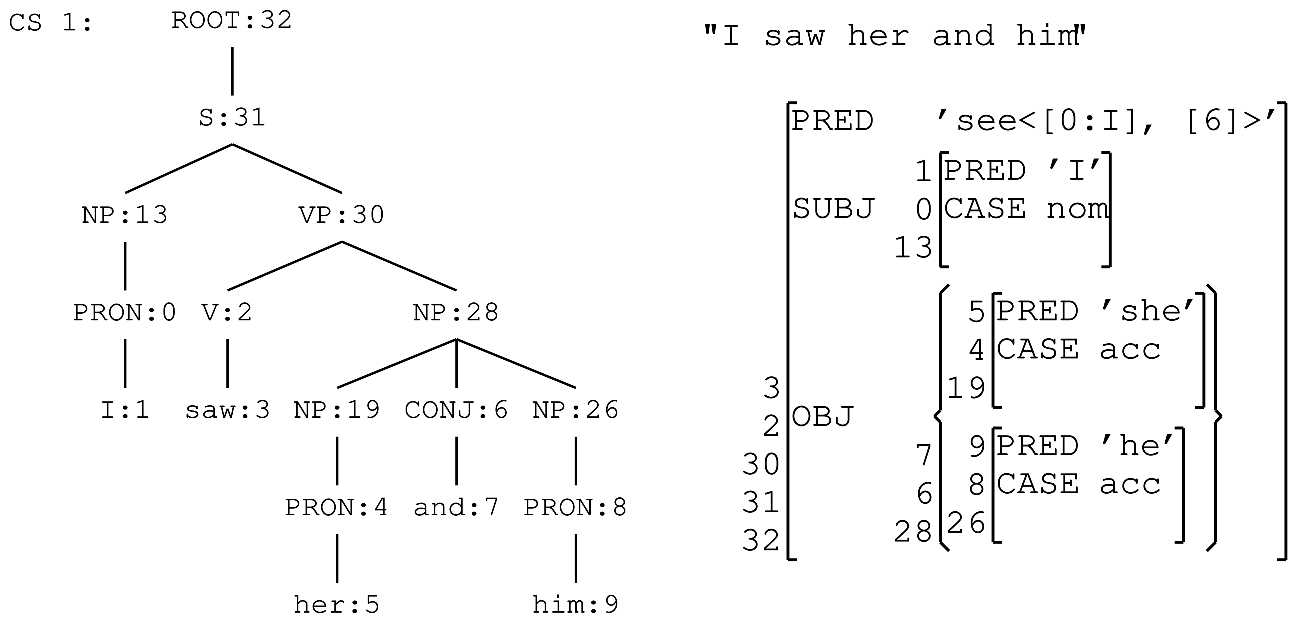
- Application expressions $(f\ a)$ of an f-structure f and an attribute a (e.g., $(\downarrow\textsc{case})$) are defined to also cover the situation where the f-structure is a set:
  - the application of a is **distributed** over all members of the set

(6) (Sells 1985, 187)

If some f-structure f is a set, then the value of an attribute a in f is v (that is, $(f\ a) = v$) iff for every $g \in f$, $(g\ a)$ includes the information in v.

- Given this definition, the constraints don't have to "know about" there being a set rather than a simple f-structure – they will work either way!

Distribution in f-structures

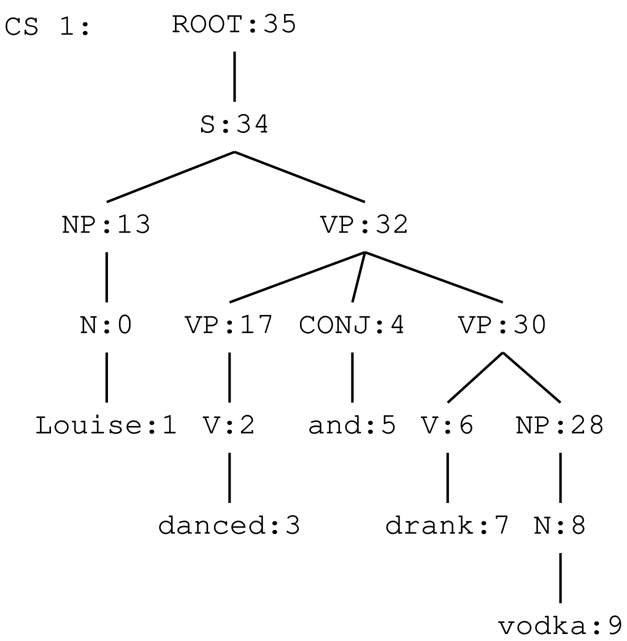



```
VP --> V NP: (^OBJ)=!
             (!CASE)=acc.

NP --> NP: ! $ ^;
       CONJ
       NP: ! $ ^.
```

Applying the definition of application expressions:
(f_{28} CASE)=acc, $f_{28} = \{f_{19}, f_{26}\}$
$\Rightarrow$ (f_{19} CASE)=acc,
and (f_{26} CASE)=acc

Distribution in f-structures

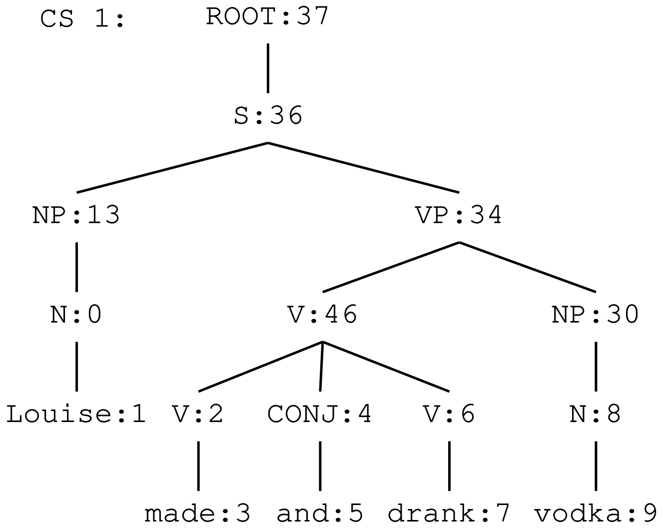
- Distribution also works for subcategorized grammatical functions, e.g., the subject, and the object
  - the occurrence of an NP outside the coordination satisfies the completeness condition of all coordinated verbs




```
"Louise danced and drank vodka"

      {  3 [PRED 'dance<[2-SUBJ]>'     ]                      }
      {  2 [SUBJ [PRED 'Louise']       ]                      }
      { 17 [     [CASE nom    ]        ]                      }
      {    [PRED  'drink<[6-SUBJ], [8:vodka]>'                ]}
      {    [SUBJ  [PRED 'Louise']                             ]}
   5  {    [      [CASE nom    ]                              ]}
   4  {    [                                                  ]}
  32  {  7 [       9[PRED 'vodka']                            ]}
  34  {  6 [OBJ    8[CASE acc    ]                            ]}
  35  { 30 [      28[            ]                            ]}

   1[PRED 'Louise']
   0[CASE nom    ]
  13[            ]
```

Distribution in f-structures

CS 1:



"Louise made and drank vodka"

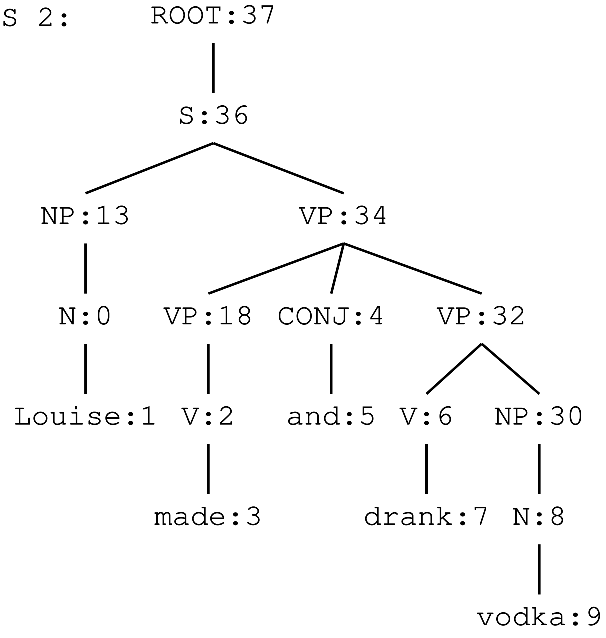
```
      { 3 [PRED 'make<[2-SUBJ], [2-OBJ]>'      ] }
      {   [OBJ  [PRED 'vodka'  ]               ] }
      {   [     [CASE acc      ]               ] }
      {   [SUBJ [PRED 'Louise' ]               ] }
      { 2 [     [CASE nom      ]               ] }
  5   {   [PRED 'drink<[6-SUBJ], [6-OBJ]>'     ] }
  4   {   [OBJ  [PRED 'vodka'  ]               ] }
  46  {   [     [CASE acc      ]               ] }
  34  {   [SUBJ [PRED 'Louise' ]               ] }
  36  { 7 [     [CASE nom      ]               ] }
  37  { 6 [                                    ] }
```

```
   1 [PRED 'Louise']
   0 [CASE nom     ]
  13 [             ]
```

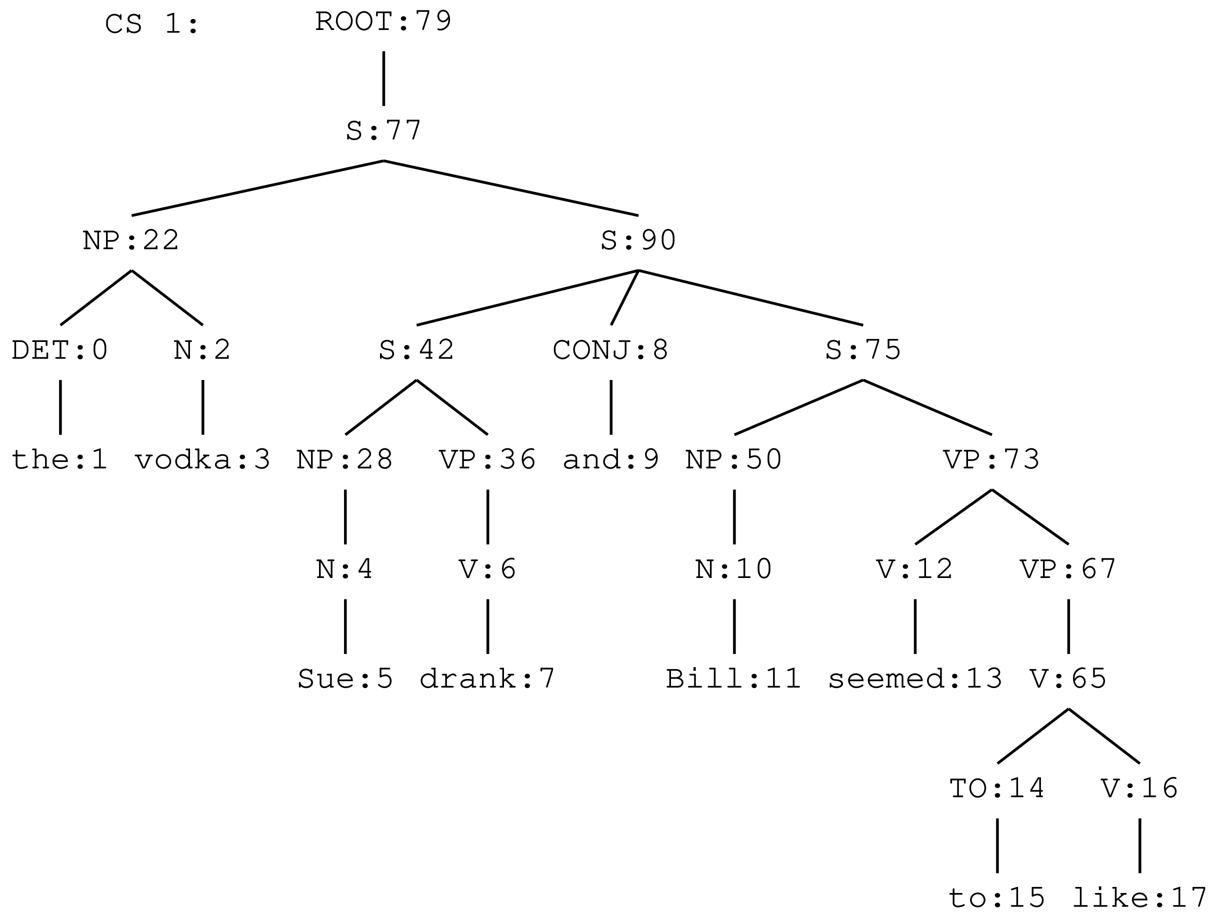
```
   9 [PRED 'vodka']
   8 [CASE acc    ]
  30 [            ]
```

No valid f-structure for the following c-structure analysis:

CS 2:



Interaction with functional uncertainty equations



Interaction with functional uncertainty equations

"the vodka Sue drank and Bill seemed to like"

```
 ┌   ┌PRED    'drink<[4:Sue], [6-OBJ]>'┐                            ┐
 │   │OBJ     ┌PRED 'vodka'┐             │                            │
 │   │        └SPEC def    ┘             │                            │
 │  7│TOPIC   [6-OBJ]                    │                            │
 │  6│      5┌PRED 'Sue'┐                │                            │
 │ 36│SUBJ  4│CASE nom  │                │                            │
 │ 42│     28└          ┘                │                            │
 │   └                                   ┘                            │
 │   ┌PRED     'seem<[14:like]>[10:Bill]'                            ┐│
 │   │TOPIC    ┌PRED 'vodka'┐                                        ││
 │   │         └SPEC def    ┘                                        ││
 │   │       11┌PRED 'Bill'┐                                         ││
 │   │SUBJ   10│CASE nom   │                                         ││
 │   │       50└           ┘                                         ││
 │   │       17┌PRED   'like<[10:Bill], [14-OBJ]>'┐                  ││
 │   │       16│OBJ    [14-OBJ]                   │                  ││
 9   │       15│SUBJ   [10:Bill]                  │                  ││
 8 13│XCOMP  14│                                  │                  ││
90 12│       65│                                  │                  ││
77 73│       67└                                  ┘                  ││
79 75└                                                               ┘┘

 3┌PRED 'vodka'┐
 2│SPEC def    │
 1│            │
 0│            │
22└            ┘
```

The representation of the conjunction

- How should the contribution of the conjunction be represented?

First attempt

(7) $\quad$ NP $\longrightarrow$ NP CONJ NP

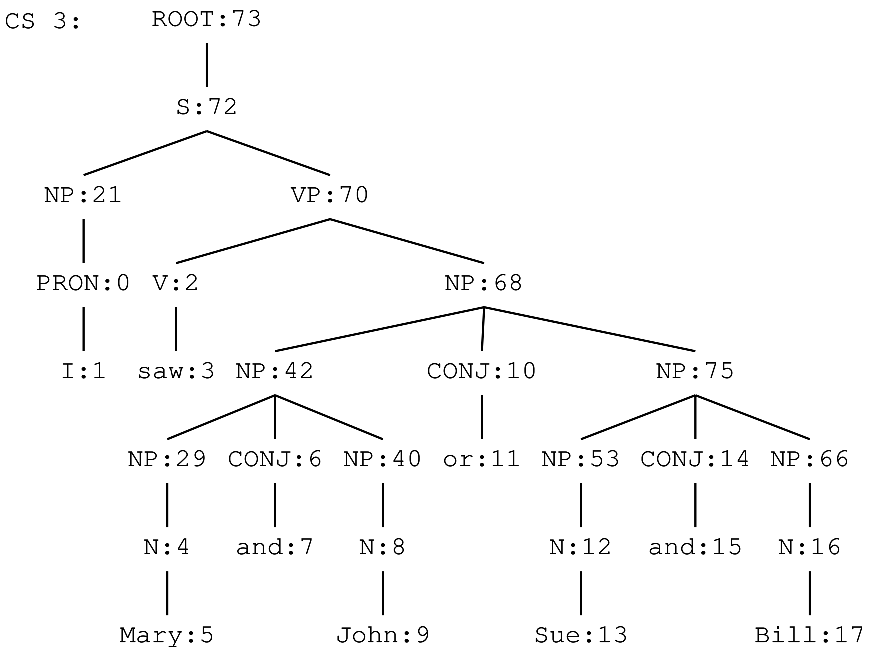
$$\begin{array}{lccc} \text{NP} \longrightarrow & \text{NP} & \text{CONJ} & \text{NP} \\ & \downarrow\in\uparrow & \uparrow=\downarrow & \downarrow\in\uparrow \end{array}$$

- contribution of the conjunction would be distributed across all conjuncts:

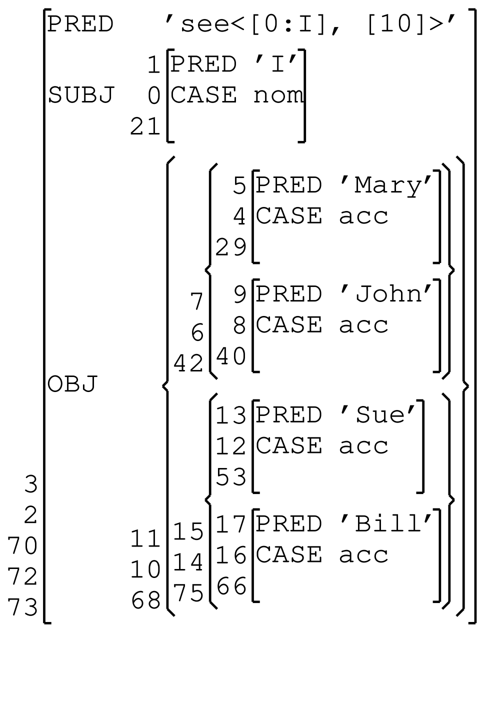
```
"I saw him and her"

     PRED   'see<[0:I], [6]>'
             1 PRED 'I'
     SUBJ    0 CASE nom
            13
                 5 PRED 'he'
                 4 CASE acc, CONJ-FORM and
  3             21
  2  OBJ
 36          7   9 PRED 'she'
 38          6   8 CASE acc, CONJ-FORM and
 39         34  32
```

- a feature clash would occur for nested coordinations

Nested coordination



"I saw Mary and John or Sue and Bill"

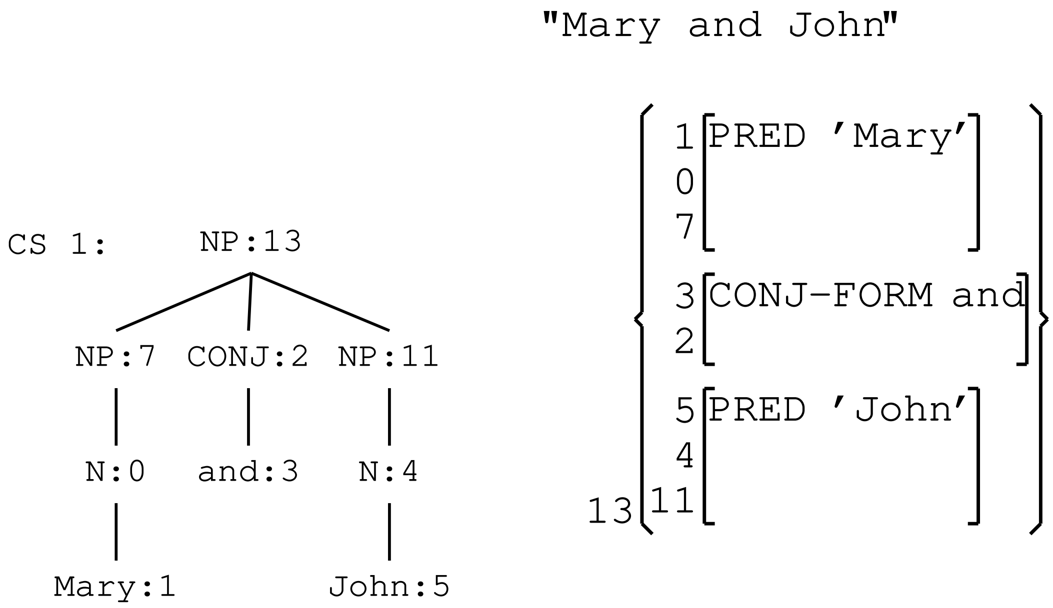


The representation of the conjunction

Second attempt

(8) $\quad \underset{}{\text{NP}} \longrightarrow \underset{\downarrow\in\uparrow}{\text{NP}} \quad \underset{\downarrow\in\uparrow}{\text{CONJ}} \quad \underset{\downarrow\in\uparrow}{\text{NP}}$

- for the conjunction, an extra element would be introduced to the set:



- counterintuitive
- this extra element will typically fail to satisfy the constraints that are imposed on all set elements from "external" sources (e.g., case, completeness, coherence etc.)

The representation of the conjunction

First solution (Kaplan and Maxwell 1995)

- No representation of the conjunction's contribution at the level of f-structure
  - representation at level of semantic structure instead

Second solution

- Define contribution of the conjunction (under CONJ-FORM) as non-distributive information:

  "I saw Mary and John"

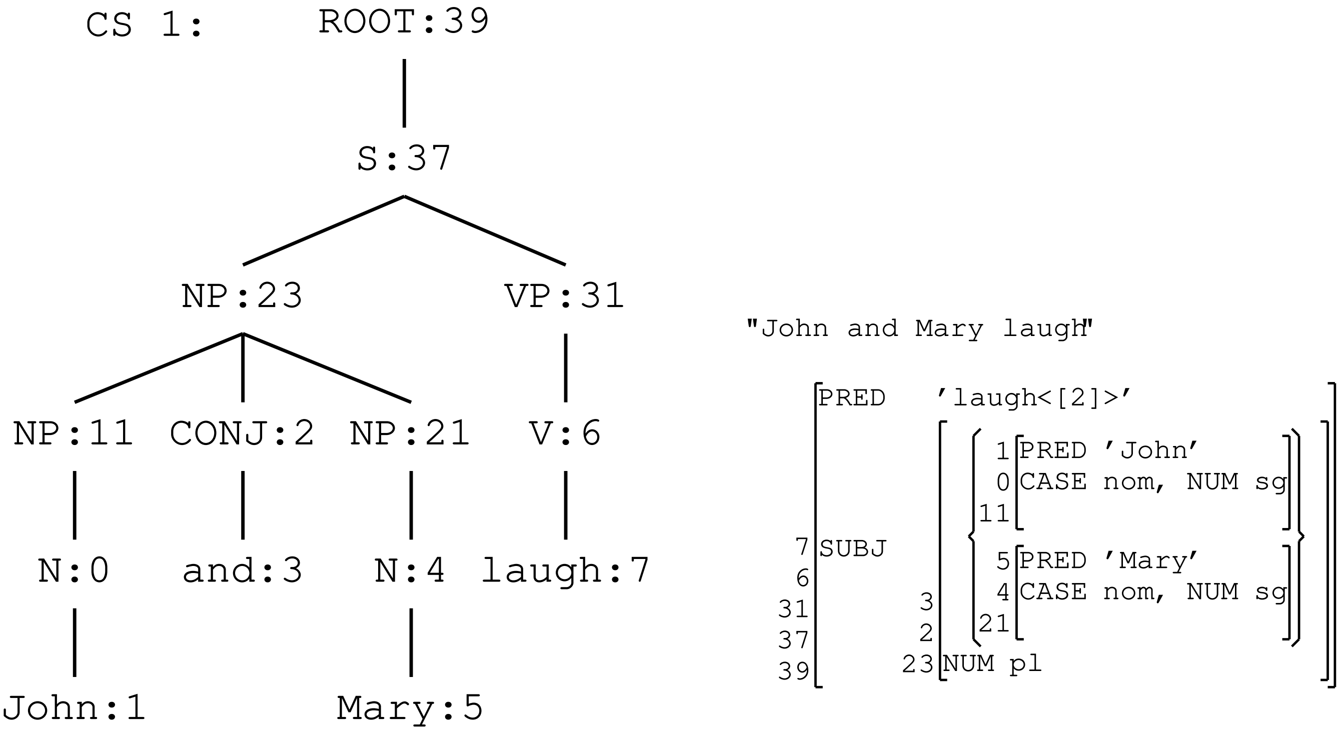
```
     PRED   'see<[0:I], [6]>'
          1 PRED 'I'
     SUBJ 0 CASE nom
         13
                 5 PRED 'Mary'
                 4 CASE acc
                21
  3  OBJ
  2              9 PRED 'John'
 36       7      8 CASE acc
 38       6     32
 39      34 CONJ-FORM and
```

- In XLE, the configuration section may contain a keyword `NONDISTRIBUTIVES`, followed by a list of features to be interpreted as non-distributive

Further usage of non-distributive features

- For some morphosyntactic properties, the status of a coordination may differ from the status of its individual parts:
  e.g., **NUM**ber in NP coordination

(9)
a. John laughs.
b. John and Mary laugh.



Expressing a rule schema by a macro

Explicit generalizations

- For (nearly) all categories, the coordination part in the rule follows the same scheme
- The generalization should be made explicit
  - modifications and extensions will then generalize to all instances automatically
- XLE provides a **macro mechanism**, which is similar to templates, but operates on the category language used on the right-hand side of rules

Example: PPs and pronominal adverbs in German (on .../thereon)

```
PP-ADJUNCTS = [{ PP:  !$(^ADJUNCT)   "auf ..."
               | P-ADV: !$(^ADJUNCT) "darauf" } ]*.

NP --> (DET) N @PP-ADJUNCTS.

VP --> V (NP: (^OBJ)=!;) @PP-ADJUNCTS.
```

Expressing a rule schema by a macro

A parametrized macro for coordination

Definition:

```
SCCOORD(_CAT) = "same category coordination."
                 _CAT: !$^;
                 CONJ
                 _CAT: !$^.
```

Usage:

```
NP --> { (DET) N
       | @(SCCOORD NP) }.


PP --> { P NP
       | @(SCCOORD PP) }.

S  --> { NP VP
       | @(SCCOORD S) }.
```

Effect:

```
NP --> { (DET) N
       | NP: !$^;
         CONJ
         NP: !$^ }.
```

Some complications of the coordination analysis

Spurious ambiguity

- The proposed coordination scheme has to be used on different projection levels to capture data like the following

(10) a. [the cousins]$_{\mathrm{NP}}$ and [a sister]$_{\mathrm{NP}}$

b. a [brilliant singer]$'_{\mathrm{N}}$ but [mediocre guitarist]$'_{\mathrm{N}}$

c. the numerous [friends]$_{\mathrm{N}}$ and [relatives]$_{\mathrm{N}}$ of Peter's

- This will result in three different c-structure readings for a coordination of bare NPs
  - all readings result in the same f-structure
    ⟶ spurious ambiguity

(11) a. N: [[[[cats] and [dogs]]]]

b. N': [[[[cats]] and [[dogs]]]]

c. NP: [[[[cats]]] and [[[dogs]]]]

Possible solutions (cf. Frank, King, Kuhn, and Maxwell 1998)

1. Preference scheme (Optimality Theory, cf. also Economy principles)
2. Constraining the rules appropriately

Some complications of the coordination analysis

Coordination of unlike categories

(cf. Sells 1985, 186)

(12) a. We consider him honest and a likely candidate for the next election.

b. Maria was asleep and causing a stoppage in the traffic.

- Can be accomodated for by making c-structure rule schema more general
  - such facts are predicted by the theory, since essentially, coordination is restricted on the level of f-structure rather than c-structure

"Non-constituent coordination"

(cf. Maxwell and Manning 1997)

(13) a. *Conjunction Reduction*
Bill gave the girls spades abd the boys recorders.

b. *Right-Node Raising*
Bill likes, and Joe is thought to like cigars from Cuba.

c. *Gapping*
Bill gave a rhino to Fred, and a camera to Marjorie.

d. *Ellipses*
Bill likes big cars, and Sally does too.

e. *Non-symmetric Coordination*
Bill went and took the test.

References

Frank, A., T. H. King, J. Kuhn, and J. Maxwell (1998). Optimality theory style constraint ranking in large-scale LFG grammars. In M. Butt and T. H. King (Eds.), *Proceedings of the Third LFG Conference*, CSLI Proceedings Online.

Kaplan, R. M. and J. T. Maxwell (1995). Constituent coordination in lexical-functional grammar. In M. Dalrymple, R. M. Kaplan, J. T. Maxwell, and A. Zaenen (Eds.), *Formal Issues in Lexical-Functional Grammar*. Stanford, CA: CSLI Publications. (Originally appeared in Proceedings of COLING-88, vol. 1 (Budapest, 1988), 303–305.).

Maxwell, J. and C. Manning (1997). A theory of non-constituent coordination based on finite-state rules. In M. Butt and T. H. King (Eds.), *On-line Proceedings of the First LFG Conference*, Grenoble.

Sells, P. (1985). *Lectures on Contemporary Syntactic Theories. An Introduction to Government-Binding Theory, Generalized Phrase Structure Grammar, and Lexical-Functional Grammar*. Number 3 in CSLI Lecture Notes. Stanford, CA: CSLI Publications.