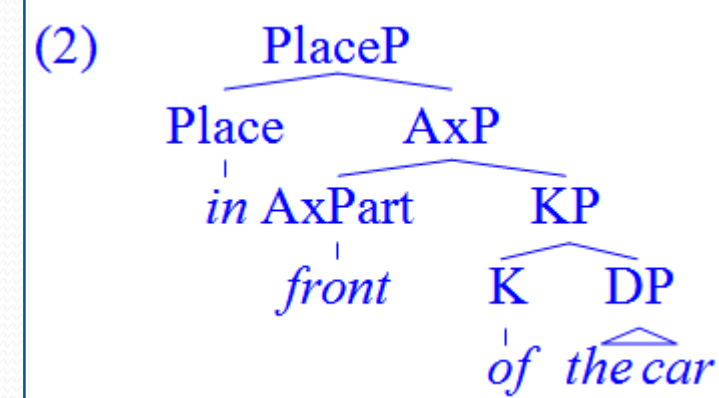# Axes to grind

Ora Matushansky[1,2]; Joost Zwarts[2]

[1] SFL (CNRS/U. Paris-8/UPL), [2]UiL OTS/Utrecht University

1. Axial complexes

Axial prepositional complexes are widespread cross-linguistically:

(1) a. El libro está **de-l-ante** **de la mesa**. *Spanish, Fábregas 2007*
   the book is from-the-front of the table
   The book is in front of the table.

   b. hu haya **mi-taxat** **la-bayit/ha-bayit**. *Hebrew, Botwinik-Rotem 2008a*
   he was from-bottom to.DEF-house/ DEF-house
   He was under the house.

   c. **S-pered-i** **ot dom-a** roslo derevo.
   down.from-front-LOC from house-GEN grew tree
   A tree grew in front of the house. *Russian, Mitrofanova and Minor 2013*

Svenonius 2006, 2010, etc.: axial elements (AxParts) are regarded as **purely functional**:

(2)
```
        PlaceP
       /      \
   Place       AxP
    in        /    \
          AxPart    KP
          front    /   \
                  K     DP
                  of  the car
```

Problems: AxParts seem to be nominal
  The projective component is disregarded
  Semantics and the connection to corresponding concrete parts is not established
  Functional elements (P, D inside the complex) are disregarded
  Cross-linguistic syntax of axial complexes is not the same

2. The lexical nature of AxParts

The majority of **axial elements are nominal**:

- They are historically derived from (body)part (*foot*) and axial (*top*) nouns
- They show **case morphology** consistent with the embedding context
- They have inherent **gender** reflected on the article (e.g., *au pied* vs. *à la tête*)
- Their meaning can be highly idiosyncratic (e.g., *on board* is only compatible with NPs denoting means of public transportation)
- They resemble **weak definites** in that the overt definite article alternates with zero (e.g., *at the foot of the bed*) and modification, pluralization, preposing, etc., are disallowed

Some AxParts are underlyingly adjectival (e.g., *to the left*)

3. The semantics and syntax of AxParts

In a number of languages **AxParts do not require an external proposition**:

(3) Maria a-mami **î-gûrû ri-a metha**. *Kîîtharaka, Muriungi 2006*
   1.Maria SM1-sleep 5-top 5-AS 9.table
   Maria is sleeping/lying on top of the table.

We propose that **AxPs can denote in the spatial domain**, defining *gûrû* 'top' as an AXIS:

(4) TOP $= \lambda x \in D_e . \lambda u \in D_v .$ START $(u) =$ CENTER (x) & END $(u) \in$ BOUNDARY (x) & UP (u)
   the primitives START, END, BOUNDARY, etc., are defined as in Zwarts and Winter 2000

The set of vectors starting at the center of the object, directed up and ending at its boundary
This representation works for both *gûrû* 'top' and the English *on*.

(5)
```
         NP
       /    \
   N_AXIS    PP
   î-gûrû   /   \
          P     DP
          ri-a metha
```
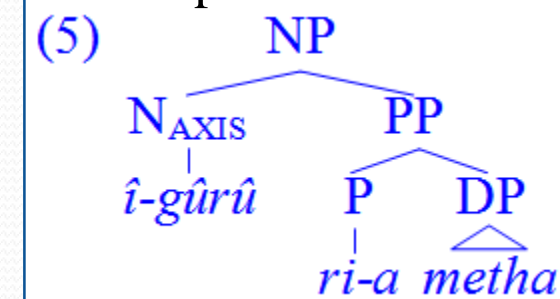
TOP (the-car)

Having defined the abstract axis, passing to the concrete material part of the object is easy by appealing to the maximal sum of individuals located at the relevant set of vectors:
(6) [[top]] $= \lambda x \in D_e . x = \sigma$ (LOC ˉ (TOP $_{AXIS}$ (x)))

The idea of an abstract axis is unavoidable.

3.1. The projective vs. topological dimension

Prepositions can be topological or projective (see Herskovits 1986):
(7)

house

on the house   over the house
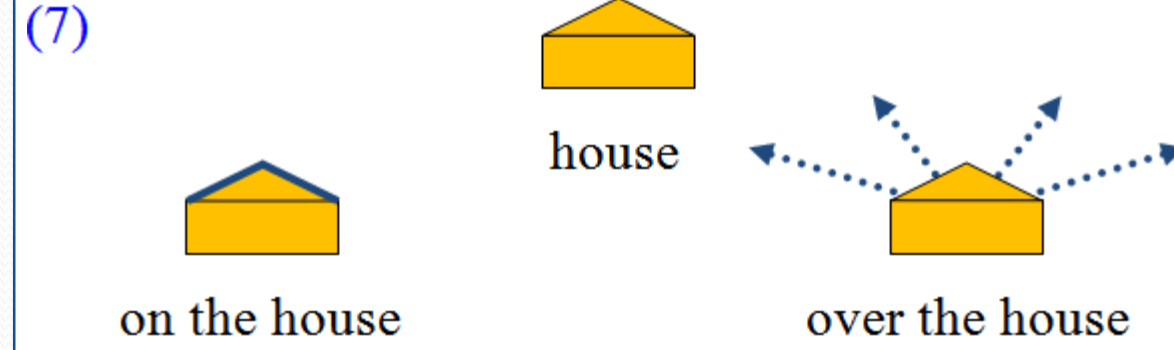
And the same is true for axial complexes

Topological:
aboard, about, amid, among, at the foot/head, beside, between, on board, on top…

Projective:
above, ahead, before, behind, below, beyond, beneath, in front, inside, outside, (to the) north/south/…, to the left/right …

What we need is a projective component:
(8) PROJECT $= \lambda f \in D_{\langle v, t \rangle} . \lambda u \in D_v . \exists w [f(w)$ & START $(u) =$ END (w) & DIR $(u) =$ DIR $(w)]$

PROJECT combines with an AXIS (GROUND) and returns the set of vectors starting from the relevant facet and directed outwards:
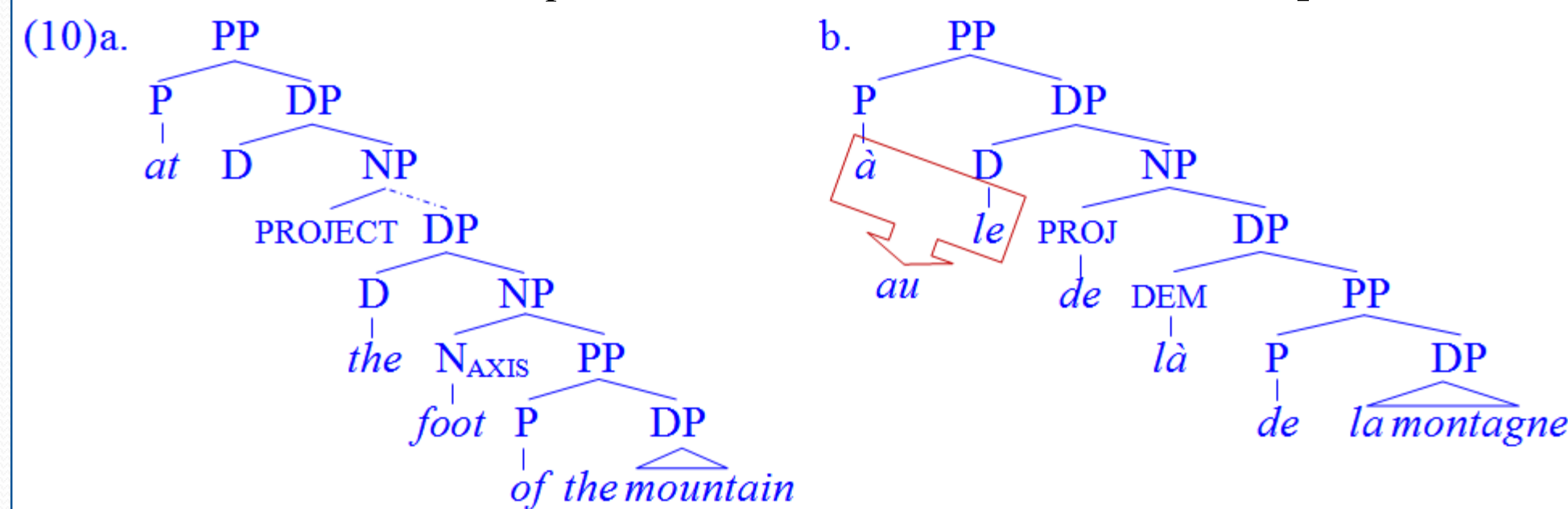(9)

PROJECT (TOP (house))
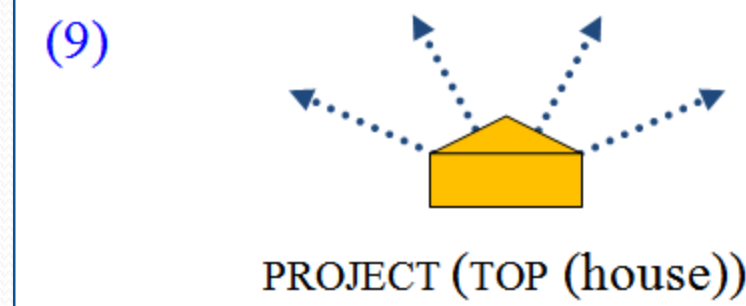
The presence of a PROJECT component is incompatible with Svenonius' unification

Evidence for PROJECT: **the outer source prepositions** in (1)

4. What does the definite article do?

What it doesn't do: it does not go away
If the AxPart is nominal, the presence of **the definite article entails uniqueness**

(10) a.
```
          PP
        /    \
       P      DP
       at    /   \
            D     NP
            PROJECT  DP
                   /    \
                  D      NP
                 the   N_AXIS   PP
                      foot     /   \
                              P     DP
                              of  the mountain
```

b.
```
          PP
        /    \
       P      DP
       à     /   \
            D      NP
            le   PROJ      DP
            au   de   DEM     PP
                     là     /   \
                           P     DP
                           de  la montagne
```

How can PROJECT (as defined above) apply to a DP (as in (10b))?
Answer: it can if the DP denotes **a spatial kind**

5. The weak definite connection

The lack of the article in *on top of* is not evidence for the functional status of *top*
(11) a. north of the mountain
   b. in front of the mountain
   c. at the foot of the mountain

All these are clearly projective (and therefore do not involve concrete material parts)

The item-specific presence of a definite article also characterizes **weak definites** (Ross 1996, Stvan 1998, 2007, Carlson and Sussman 2005, Aguilar Guevara and Zwarts 2010, 2013, Aguilar Guevara 2014, etc.):

(12) a. going to school/to the yeshiva
   b. play guitar/the piano

Proposal (Aguilar Guevara and Zwarts 2010, 2013, Aguilar Guevara 2014): kind-denotation

Intuition: a WD noun like *foot* can have spatial instantiations: as a set of vectors
PROJECT can the apply to this set

6. Summary

There is support for the cascading structure in (2), but with certain modifications

There is no support for the hypothesis that AxParts are functional

There is evidence for an additional functional component (PROJECT) in axial complexes

7. Putting axes in the lexicon

What does the English AxPart *top* mean?
   It cannot be (4), because then it would not require a preposition
   It must be kind-denoting (a weak definite)
   Thus: [[top]] = NOM ° TOP $_{AXIS}$

What does the English AxPart *front* mean?
   [[front]] = NOM ° PROJECT ° FRONT $_{AXIS}$

This is why the tree in (10a) is misleading for English
But justified for languages where PROJECT is instantiated as a separate term

8. Further semantic issues: the outer P

Story so far: AxParts have denotations based on spatial notions.
   The core meaning is spatial
   The presence of the definite article indicates kind-denotation
   Kinds need to be instantiated, and this is what P does

Hence two possible approaches to the outer P:
- the same semantics (instantiation of a spatial kind, INST) different realizations in function of the noun they combine with
- the prepositions have their normal semantics and the choice depends on how the axial noun is conceived of (e.g., *in the ground*: *ground* is not a container but the preposition in is used because *ground* has a privileged way of accessing it), cf. *at school* vs. *in yeshiva*
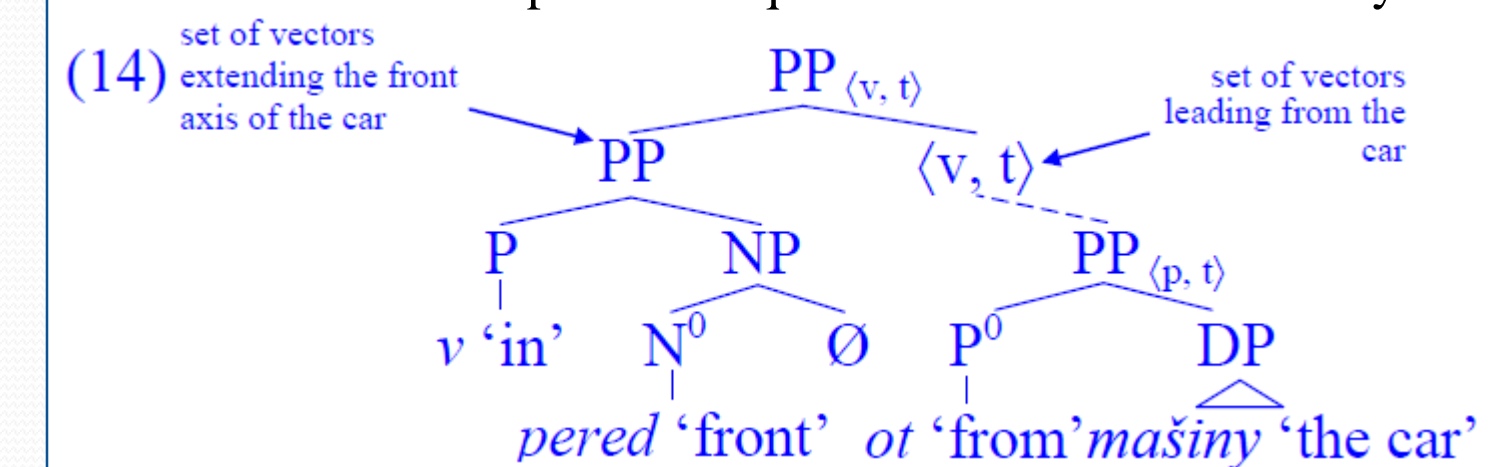
9. Bonus: Path-based axial complexes

Source-based axial complexes provide further evidence against simplistic unification and for the weak definite connection:

(13) a. Glotka raspoložena **v.pered.i** **ot zatyločnoj kosti**.
   gullet situated in.front.LOC from occipital bone
   The gullet is situated in front of [the main part of] the occipital bone.

   b. Postavim s.niz.u **ot ètogo pučka plastinku**.
   set.1PL down.from-bottom.GEN[II] from this bundle plate
   Let us set a plate under this bundle [of electrons].

The inner preposition is a dynamic one creating paths rather than places
- a transition from paths to places is necessary
- the composition requires a different constituency from (2)

(14)
set of vectors extending the front axis of the car
set of vectors leading from the car
```
                    PP_{⟨v, t⟩}
                   /           \
               PP              ⟨v, t⟩
              /    \          /
             PP                PP_{⟨p, t⟩}
            /   \              /    \
           P     NP          P[0]     DP
           v 'in' N[0]  Ø           /
                  pered 'front'  ot 'from'  mašiny 'the car'
```

The structure in (2) would combine an AxPart with a path or a location, from which it will be impossible to extract the source object (the ground), because loci do not have functions

It is always possible to disregard the functional items inside the axial complex

But then what are we in this business for?