Projections of P

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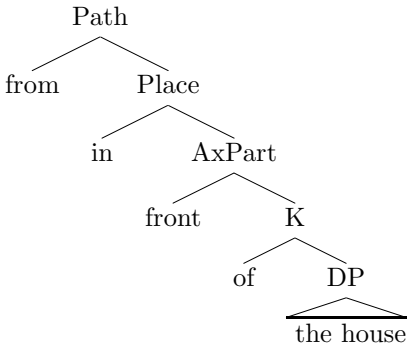
1 Introduction: The Extended projection of P

This is a paper about extended projections and the obligatoriness of individual functional projections in a fine-grained tree structure. It follows the general cartographic project in mapping distinct functional projections associated with different morphemes or phrasal modifiers (for example Cinque 1994; 1999; 2004, Zamparelli 2000, Julien 2002; 2005, Svenonius 2007; to appear a; for P see in particular Koopman 2000, den Dikken to appear, Svenonius 2006; to appear b, and various of the papers in this volume).

In Svenonius (to appear b), I investigate the meaning contributions of the different projections, an investigation which I have called the 'Anatomy' of P. The anatomy of P includes a wealth of spatial and non-spatial meanings, starting with the distinction between Path and Place (Jackendoff 1983) and including such features as the frame of reference (Levinson 1996) and the Axial structure of the Ground object (Svenonius 2006).

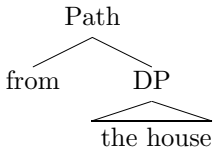
The end result is a large number of projections, for example a structure like (1) for *from in front of the house*.[1]

(1)

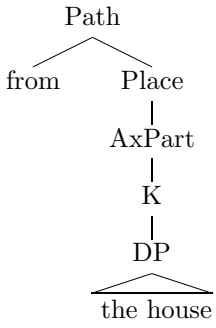


The question immediately arises whether such projections are present in every PP, or whether they are only present some of the time. For example, does the PP *from the house* have a structure more like that in (2a) or like that in (2b)?

(2) a.



b.



This is a much more general question, e.g. is there a T node in a sentence in which there is no overt morphology corresponding to tense, or is there a D node in a noun phrase with no overt morphology corresponding to a determiner? Ramchand and Svenonius (to appear) argue that there are T and D nodes in such cases, though we also suggest that there is room for cross-linguistic variation in the underlying presence of certain other features.

I will suggest here a model in which the elements which are not lexicalized necessarily make a "default" or maximally underspecified contribution. This has important consequences for various proposals concerning the lexicalization, government, and licensing of null elements.

2 Null elements

Research into restrictions on the distribution of NP-trace, $\overline{\text{A}}$-trace, *pro*, and PRO have led to various proposals invoking phonological emptiness as a syntactic property; for example the *Empty Category Principle* of Chomsky (1981:250) is a condition meant to hold of this entire class of phonologically null elements (though not necessarily all phonologically null elements).

Emonds' (1985:99) 'Limitation on Empty Nodes' and his (op cit p. 227) *Invisible Category Principle* go even further in connecting phonological non-overtness to specific conditions; the latter essentially states

that a functional head may remain empty if its complement or specifier bears a morphological reflex of a feature of that head.

Similarly, Koopman (1996) suggests that a projection cannot have a silent head and a silent specifier, and Kayne (2006) proposes that all and only material in the specifier of a phase head fails to be spelled out.

However, a strict modular separation between syntax and phonology would entail that syntax is insensitive to phonological non-overtness. The fact that LF movement is subject to many of the same restrictions as overt movement (Huang 1982) suggests that the restrictions on the distribution of trace are not connected to phonological overtness. Also, restrictions on *pro* are not clearly different from restrictions on specific classes of overt pronouns (e.g. weak pronouns, or clitics, also subject to cross-linguistic variation, as are the specific restrictions on *pro*). The conditions on PRO have never been satisfactorily reduced to the conditions on *pro* or trace anyway.

So it remains a viable alternative that there are no specific conditions on phonological non-overtness, apart from conditions of learnability and recoverability, and this is what I will assume below.

3 Measure expressions and Vector Spaces

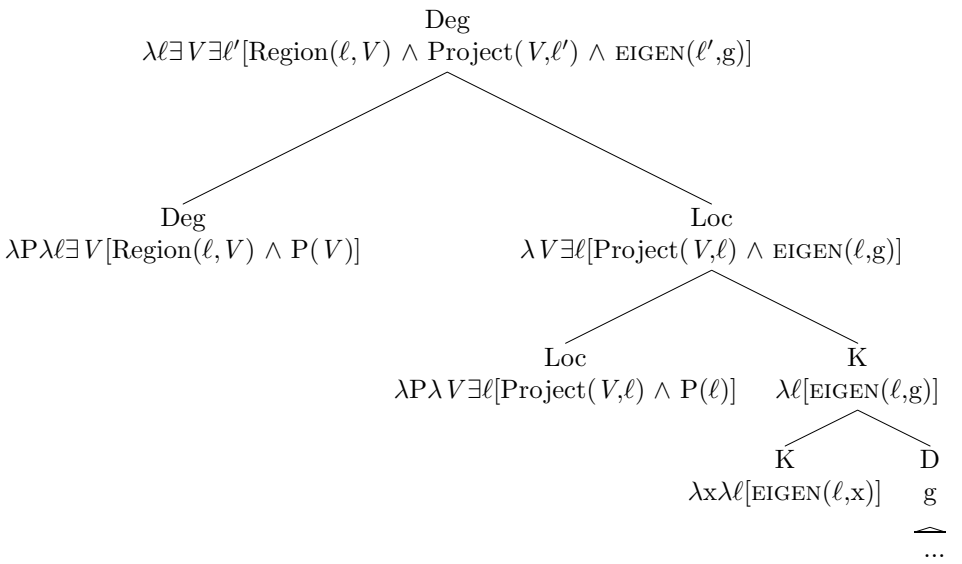
To establish some basic terminology, take the Figure to be the item located, and the Ground to be the reference object for the location of the Figure (Talmy 1978). Syntactically, the Ground-denoting DP is the complement of a preposition. Another useful notion in the formal analysis of locative expressions is that of REGION, which can be modeled as a contiguous set of points in space (Nam 1995, Kracht 2002; this volume). Wunderlich (1991) introduces the notion of EIGENPLACE, which we can take to be the region occupied by an object.[2]

A locative preposition like *behind* or *above*, at a first approximation, is a mapping from the eigenplace of the Ground to another region, hence a function from regions to regions. There are some important differences, however; as Kracht (this volume) points out, for example, the region which is the output of mapping is coordinated, in the sense that it is oriented in space, whereas the eigenplace is not; this will be discussed below.

Furthermore, the possibility of measure phrases (*ten inches under the desk*) and directional modifiers (*diagonally over the door*) shows that locative PPs have additional structure; Zwarts (1997) and Zwarts and Winter (2000) argue for a vector-based model for such PPs, since vectors have direction and length (see Kracht this volume for discussion).

They introduce a function from regions to vector spaces, which they call Loc, and another one from vector spaces to regions, which they dub Loc^-. In a tree representation, this would look something like the following, replacing their Loc^- with Deg for Degree (for typographical perspecuity and other reasons that will become clear below):

(3)



In the diagram in (3) I have dignified each type-shift with a label: K (for Kase) for the shift from objects to eigenplaces, and Zwarts and Winter's (2000) Loc for the shifts from regions to vector spaces, and Koopman's (2000) Deg for the one Zwarts and Winter proposed to shift vector spaces back into

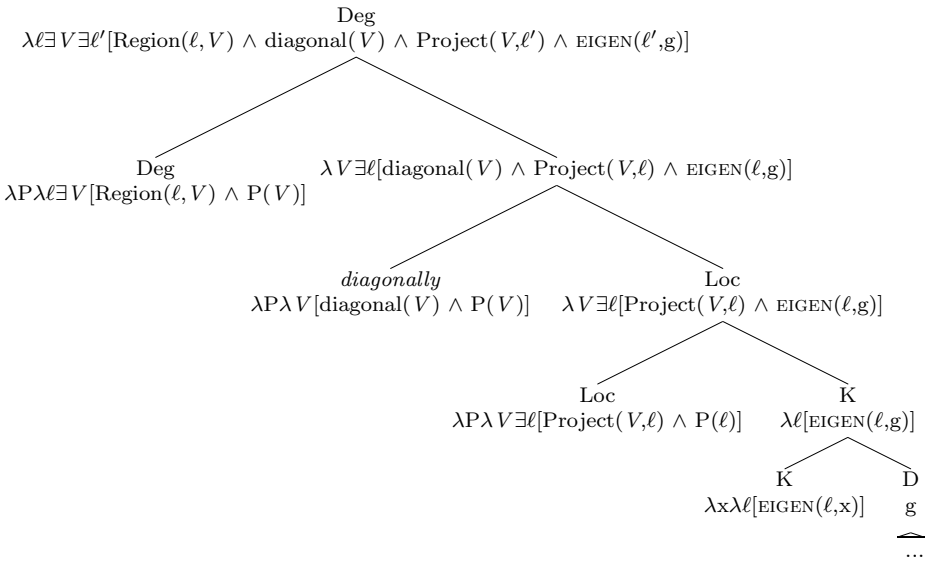
regions. The semantic notation is in a simple shorthand: ℓ is a variable over regions, and EIGEN is the relation of being the eigenplace of a thing; so if "g" is a house, then $\lambda\ell$[EIGEN(ℓ,g)] (the denotation of KP) is the region which is the eigenplace of the house, that is, the set of points that house occupies (the representations will be made more informative below, in a way that will also be more compatible with Kracht this volume).

V is a variable over vector spaces, and PROJECT is the relation of being a vector space projected from a region in a way specified by a particular preposition. For example, if the "Loc" head here is *behind*, and the KP is *the house*, then $\lambda V \exists \ell$[Project(V,ℓ) $\wedge$ EIGEN(ℓ,g)] in the tree (the denotation of LocP) is the set of vectors which are projected from the eigenplace of *the house* in the manner specified by *behind*; that is, backward-projecting vectors, or vectors projected from the back of the house.

Finally, Deg introduces the relation REGION, which simply gives the region which is picked out by the vector space denoted by its complement. In this case, the points which are pointed to by all the backward-pointing vectors coming off the eigenplace of the house.

A directional adverbial, then, can be a simple modifier of vector spaces, as suggested in the tree below (continuing to use 'Project' as a general label for whatever projective preposition is inserted).

(4)



Loc introduces vectors at a range of angles, and a directional adverb like *straight* or *diagonally* restricts the range. Similarly, a measure expression like *thirty feet* or *ten centimeters* picks out vectors of a certain length.

In (5a), for example, the lamppost is said to be behind the house, that is at the end of one or more vectors pointing more or less back from the house; the presence of the adverb *diagonally* further specifies that the vectors involved are diagonal ones, and finally the measure expression *three meters* specifies that the vectors in question are three meters long.

(5) a. The lamppost is three meters diagonally behind the house.
b. The crack is twenty centimeters straight below the window.

The order of measure phrases and directional adverbs is rigid.

(6) a. *The lamppost is diagonally three meters behind the house.
b. *The crack is straight twenty centimeters below the window.

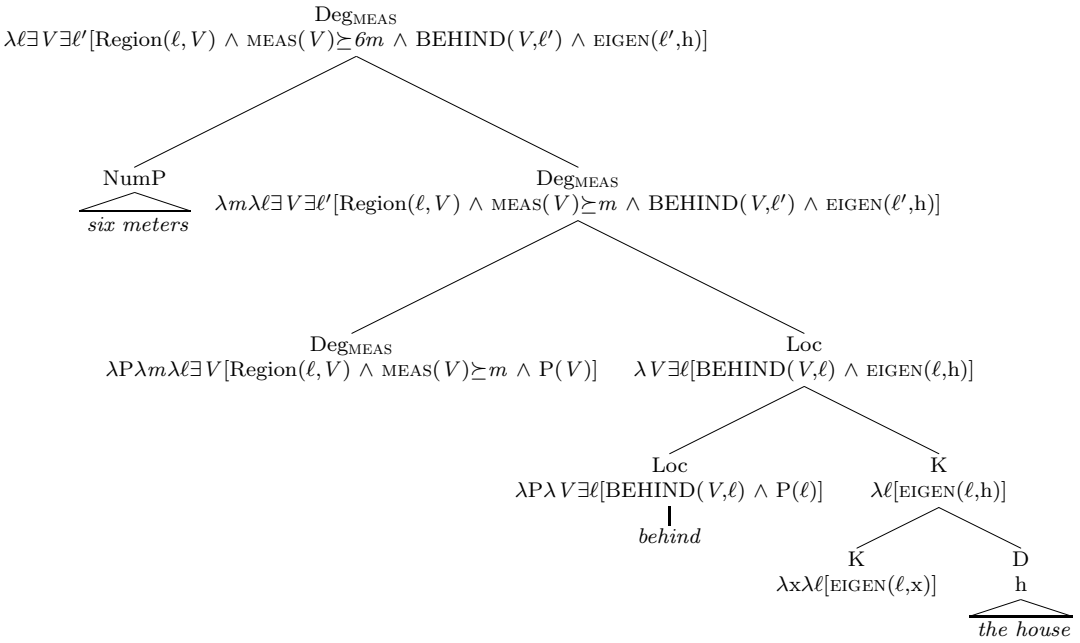
If measures and directional adverbs both modified vector spaces, then it would be unclear why they cannot be combined in either order. If, on the other hand, there is a functor which introduces measure expressions, and outputs a category different from the one with which directional adverbials combine, then the order would be rigid.[3] Suppose that functor is a variant of Deg; I will call the variant which introduces measure expressions Deg_{MEAS}.

Deg and Deg_{MEAS} can be seen as two different versions of the same category, as they both take a vector-space denoting complement and project a region-denoting maximal projection. The logical type of Deg_{MEAS} is given in (7), where m is a variable over measure expressions like *ten centimeters* and MEAS is a measurement function over vectors.

(7) $[\![\text{Deg}_{\text{MEAS}}]\!] = \lambda \text{P} \lambda m \lambda \ell \exists V[\text{Region}(\ell, V) \wedge \text{MEAS}(V) \succeq m \wedge \text{P}(V)]$

Thus, in the computation of the meaning of the expression *six meters behind the house*, only those vectors which are six meters in length are considered (or longer, subject to pragmatics). Each picks out a point which is *six meters behind the house*. In (8), I depict the Loc head as being filled by the preposition *behind*, and replace the general relation PROJECT with the specific instantiation of it, BEHIND. Here, h is a constant standing in for 'the house.'

(8)



It can be seen that the semantics proposed so far correctly predicts the possibility of combining directional adverbs and measure expressions, in the observed order.

Furthermore, it seems that the tree representations that I have provided work fairly well as syntactic representations; I take it as a working hypothesis that they are good approximations of the actual syntactic trees.

Thus, I will assume that there is a syntactic category Loc, which takes KP as a complement, and denotes a function from regions to vector spaces. Loc is the locus of the component of meaning that distinguishes different projective prepositions from each other (e.g. the difference between *behind* and *above*). There is another category Deg, which takes LocP as a complement, and denotes a function from vector spaces to regions. Deg is where vector length is specified, if it is specified.

Cartographic studies suggest that certain aspects of meaning are consistently localized at particular heights in a functional sequence; thus, given that vector length is specified in Deg, it is not expected that vector length will also be specifiable at other heights in the extended projection of P.

4 Immeasurable prepositions: *Beside* and *next to*

Measure phrases are incompatible with *beside* and *next to*. A ladder can be one meter from the house, and simultaneously be *beside the house* or *next to the house*, but one cannot grammatically utter (9b). Similarly for (10).

(9) a. The ladder is beside the house, one meter away.
b. *The ladder is one meter beside the house.

(10) a. The ladder is next to the house, just six inches away from it.
b. *The ladder is six inches next to the house.

It is clear that the badness of the measure phrase cannot be due to conceptual or world-knowledge factors, given that these distances are fully compatible with the notions expressed by these prepositions. Instead, it seems that a syntactic solution is called for.

One possibility would be that these prepositions simply do not denote vector spaces; this would make it impossible for Deg_{MEAS} to combine with them, on the assumptions outlined here. Instead, these prepositions could be functions from eigenplaces to 'beside' or 'next to' regions, without vector semantics.

However, for at least some speakers, direction-specifying adverbs like *diagonally* and *straight* are compatible with *beside* and *next to*.

(11) a. There is a tree diagonally beside the house.
b. The post office is diagonally next to the convenience store.

Some speakers reject these sentences. Therefore, I add a couple of examples found on the internet, long enough to provide some natural context.

(12) a. Always look to both sides, using mirrors & looking **straight beside** & over your shoulder, to where you intend to move & always indicate your intentions before you change lanes.
b. There is no more corrosive an atmosphere than a fertiliser plant especially with our location **straight beside** the Brisbane River on one side and a creek on the other we are pretty well surrounded by water sea water and close to the mouth of the river also.
c. in the three cases the runner arrived before the ball but was just unable to get around the third baseman due to the way 3rd was blocking the bag, he was crouched **diagonally beside** the bag on the baseline about 1 foot infront of the bag.
d. I got a DIRECT view of the stage, minus the fact that there were 2 tall gentlemen in front of us, and **diagonally beside** me, which blocked me a little.

I have discounted numerous examples of the following sort:

(13) a. She lies still, her arms **straight beside** her.
b. I heard that if you take 2 mirrors and place them **diagonally beside** eachother like this: /\ And then look into it, that is how people see you.

In these cases, straight or diagonal orientation might be being predicated of the Figure argument (arms in (13a), mirrors in (13b)). This is not the same as picking out straight or diagonal exemplars of a 'beside' space, which is what is happening in (12). It seems that examples like those in (12) can best be modeled by assuming that *beside* does project a vector space to the sides of the ground, normally consisting like other vector spaces of vectors at a variety of angles. Then *straight beside* is restricted to the vectors projecting perpendicular to the Ground, while *diagonally beside* is restricted to oblique vectors, at least for those speakers who find the examples in (12) grammatical.

Similar examples can be found for *next to*.

(14) a. As soon as a track tile is placed horizontally or vertically (NOT diagonally) next to one of these buildings, then a stop sign is placed on top of that tile.
b. Click each of the four corners, then each of the "off" lights diagonally next to each corner.
c. Now the million dollar question, why did they put the key "Q" just diagonally next to "1" on the keyboard when they know how critical could it be when managing Unix servers remotely ;-)

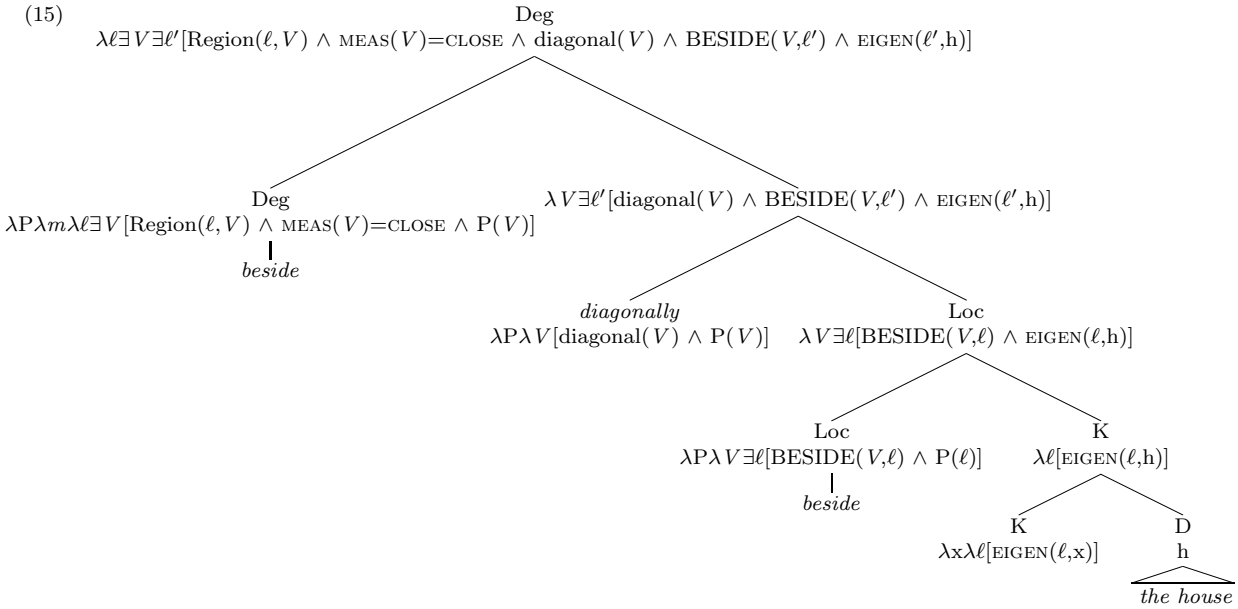
I conclude, then, that *beside* projects a vector space, for some speakers (as does *next to*, but I will illustrate with *beside* here).[4] For some reason, however, that vector space cannot be overtly measured.

It does seem that *beside* implies proximity, or nearness. For example, if two houses are very far apart then the one is not *beside* the other. As already noted, if this were simply a conventional or encyclopedic association, there should be no incompatibility with measure phrases expressing short distances, such as *one meter* (which is short relative to houses).

I propose, therefore, that the closeness component of the meaning of *beside* is syntactically represented. In other words, *beside* spells out or lexicalizes both Loc (it specifies that vectors are projected from the sides of the Ground DP) and Deg (it specifies that the vectors are short). This prevents the head Deg_{MEAS} from being inserted together with *beside*.

Directional adverbials like *diagonally* are compatible with closeness and are not dependent on the specific meaning of the Place head Deg_{MEAS}. Therefore, they are correctly predicted to be compatible with *beside*, as long as the Loc head projects a vector space. This is depicted in tree form in (15).

(15)



I have drawn the word *beside* under both the Deg node and the Loc node, because there are values under both nodes which are lexicalized by *beside*; thus, the lexical item *beside* must check features both in Loc and in Deg. The locality of such checking appears to be similar to that of head movement (cf. Svenonius 1994), though other implementations are of course possible. Since *beside* does not precede direction adverbs like *diagonally*, the head-movement in question is either covert or is obscured by other movement.

If the assumptions made above are on the right track, then they constitute an argument against 'bundling' Deg and Loc in the syntax, even when the two are lexicalized by a single preposition like *beside*. In order for an adverb like *diagonally* to attach, there must be a projection corresponding to the level of vector spaces, as depicted above.

5 Comparison to Decomposition in *v*P

There is a well-known argument for decomposition in the verb phrase which has a partly similar character to the one I have sketched for decomposition in the adpositional domain. Here I briefly sketch the argument for the sake of comparison to the current situation.

von Stechow (1995; 1996) argues (following up on older arguments by McCawley 1971 and others) that the differences in interpretation between examples like (16a) and (16b) motivate a syntactic decomposition of the verb into component parts (of the sort articulated by Kratzer 1996).

(16) a. weil Fritz das Fenster wieder öffnete
because Fritz the window again opened
'because Fritz opened the window again' (repetitive or restitutive)

b. weil Fritz wieder das Fenster öffnete
because Fritz again the window opened
'because Fritz again opened the window' (repetitive only)

The definite DP in German leaves the verb phrase, so that when *wieder* precedes it as in (16b), it is clearly also external to the verb phrase, and scopes over both arguments. Hence, only the repetitive reading is available (the one which presupposes that Fritz has opened the window before). On the other hand, in (16a), the adverb could either be attached outside the verb phrase, as before, or to a subpart of it — in which case the reading is restitutive (which presupposes only that the window has been in a closed state before).

Alternatives have been proposed; for example Jäger and Blutner (2000) present various counterarguments to von Stechow's analysis, including notably the following sentence.

(17) A Delaware settled in New Jersey again.

As they point out, this could be true in the following scenario: The Delaware Indians had always been in New Jersey until they were forced out, 200 years ago, and relocated to Oklahoma. Then, recently, a

Delaware who grew up in Oklahoma settled in New Jersey. This is not a repetitive reading, because the Delaware in the scenario has never settled in New Jersey before; it is a restitutive reading, one in which the state restored is that of Delaware Indians living in New Jersey.

Jäger and Blutner provide an account in which *wieder* is lexically ambiguous, one variant being repetitive and the other restitutive. Both attach at the same height, but one asserts that there is a resultant state which is being restored.

As pointed out by von Stechow (2003), the account does not account for the sensitivity of the different readings to different word orders (cf. (16)). Furthermore, the account overgenerates, as it implies that the restitutive version of *wieder* should combine with any causative verb with an indefinite subject. For example, von Stechow suggests a scenario in which everyone is born with a disease (as in the film *The Omega Man*); the question is then whether a sentence like (18) has a restitutive reading, in which the state restored is that of there being a healthy person.

(18) Jetzt hat sich wieder jemand geheilt.
now has RFX *again somebody cured*
'Now someone has cured himself again'

Apparently, sentences like this do not have restitutive readings, in English or in German, so there is something interestingly different about (17). Von Stechow suggests that (17) has a non-agentive use, in which case the indefinite can originate lower than the low attachment site of *wieder*, giving the right result, namely that the restitutive reading includes the existential quantifier; von Stechow sketches the essence of this solution as in (19).

(19) $\text{BECOME}_e(\text{again } \exists x[\text{Delaware}(x) \ \& \ x \text{ live in NJ}])$

See von Stechow (2003) for responses to Jäger and Blutner's other challenges. In sum, then, the argument from *wieder* seems to go through, and it seems that verb phrases consist of more syntactic projections than they have morphemes to head them — a verb like *öffnen* might consist of two or three syntactic parts (CAUSE-BECOME-OPEN) even apart from tense or an infinitival ending, and these parts are active for the attachment of adverbial modifiers.

Thus, the situation I outlined above for P should not be surprising: there are multiple parts to a preposition like *beside*, and these parts are available for adverbial modification. It is tempting to equate the two parts with the two morphemes *be-* and *-side*, especially given the prepositions *inside, outside*, and *alongside*. However, the restricted measurement meaning is not present in *between*, *behind*, or *beneath*, so it is not straightforward to identify *be-* with the specifics of the Deg component of the meaning of *beside*. Instead, I suggest below, there may be a different decomposition for *beside*.

6 AxParts

I have elsewhere (Svenonius 2006) argued for a further decomposition of the projection called Loc in §3 into two subcomponents, which can be called Place and AxPart. AxPart, a formal adaptation of Jackendoff's (1996) term *axial part*, is a category manifested in very many languages by a set of about five to fifteen words with meanings like 'front,' 'back,' 'top,' 'bottom,' 'side,' 'interior,' 'vicinity,' and so on (for examples, see the Persian, Hebrew, Japanese, and Spanish locative expressions in Pantcheva (this volume), Botwinik-Rotem (this volume), Tomioka (this volume), and Tortora (this volume), respectively).

Such parts can be identified either on the basis of intrinsic properties of the Ground object itself (for example people, houses, and cars have conventional fronts and backs and sides), or on the basis of what is known as 'relative' frame of reference (for example when the 'front' of an object is the part facing the observer, for English, or the part facing away from the observer, for Hausa, as described by Hill 1974; cf. also Herskovits 1986, Levinson 2003).

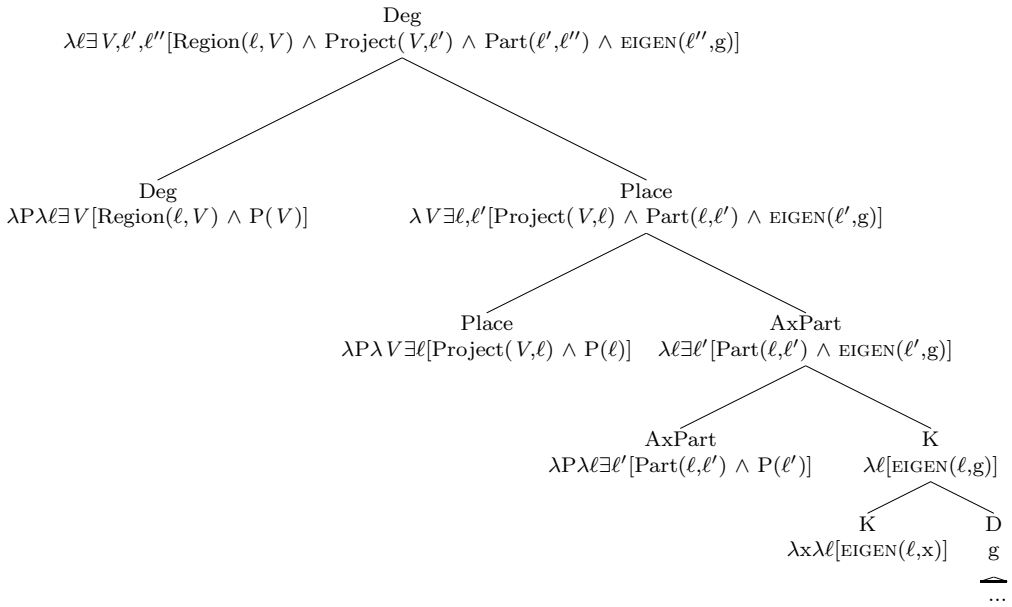
In the discussion in §3, I characterized Loc as a class of functions which projected vectors in particular ways with respect to an eigenplace (e.g. backward-projecting vectors for *behind*, upward-projecting vectors for *above*). In a decomposition of Loc, I suggest, AxPart is a function from eigenplaces to regions which are normally subparts of those eigenplaces such as front, back, top, side, interior, or exterior. Place, then, is a function which identifies spaces on the basis of those subparts. As discussed by Kracht (this volume), AxPart is the level at which a coordinate frame is fixed.

This means that Place (Kracht's (this volume) P_{stat}) can simply project vectors 'away' from the denotation of the AxPart phrase, the coordinate system having been established at the AxPart level. Other spatial relations such as containment, attachment, and so on might be alternative expressions of

Place (cf. the analyses in Pantcheva this volume, Botwinik-Rotem this volume); compare English *in front of* and *on top of*; see also Svenonius (2006).

The decomposition is sketched in (20), where 'Project' is retained from §3 as the label for the relation introducing vectors, and PART is introduced as the label for the axial part relation.

(20)



Many languages which lexicalize AxPart using what are variously called relational words, relational nouns, component part terms, and so on, combine them with a generalized locative adposition or affix. This analysis provides an explicit semantics for each of the morphologically realized components. It may be directly compared to the highly compatible proposal of Botwinik-Rotem (this volume), where my Place corresponds approximately to her P_{loc}, and my AxPart serves roughly the function of her X; an important difference is that I am abstracting away from the introduction of the Figure argument, which is the chief motivation for the nominal projection (her *Place*) which she postulates below X.[5]

6.1 Overt and covert Place

Languages vary concerning how many overt morphemes are involved in expressing projective space. An example of a language which lexicalizes both Place and AxPart is Japanese, in which the postposition/case suffix *-ni* can form a locative expression from an ordinary DP (Sadakane and Koizumi 1995), as illustrated in (21a); it also appears on AxPart words such as *mae* 'front,' *ushiro* 'behind,' *yoko* 'side,' and so on, as illustrated in (21b) (both examples from Takamine 2006).

(21) a. Taro-ga isu-ni suwatta
T-NOM *chair*-LOC *sat*
'Taro sat on the chair'

b. Mary-ga Taro-no mae-ni suwatteiru
M-NOM *T*-GEN *front*-LOC *sit*
'Mary is sitting in front of Taro'

In both cases, *-ni* can be taken to occupy the Place node. If it is to have a consistent meaning in the two cases, then (21a) may be vague, with the specific part of the chair being sat on being contextually determined; I will suggest below that there is a null AxPart projection in similar cases (again compatible with Botwinik-Rotem's analysis of Hebrew in this volume).[6]

In other constructions, the Place node is not overtly realized. For example, in the variety of Zapotec studied by Lillehaugen (2006), AxPart terms (which Lillehaugen terms Component Part Locatives) appear with no supporting locative adposition, as illustrated in (22) (from Lillehaugen 2006:197–198).

(22) a. Mnnààa' zuu dehts co'ch.
woman stand behind car
'The woman is standing behind the car'

b. Mnnààa' zuu cwe'eh co'ch.
woman stand beside car

'The woman is standing beside the car'

Lillehaugen provides extensive argumentation that phrases like *dehts co'ch* and *cwe'eh co'ch* have the distribution of PPs. Thus, we can postulate a null Place head in Zapotec, corresponding to the overt *-ni* of the Japanese examples.

In most languages, AxPart terms may make use of either intrinsic or relative frames of reference, depending on various factors including the nature of the Ground. Lillehaugen reports that in Zapotec, relative reference is only possible if the ground is inanimate; thus, (22a), like its English translation, can either mean that the woman is in a space projected from the car's conventional back end, or that the woman is in a space projected from the side of the car which is away from the observer (or from the perspective chosen). In contrast, (23) is only natural with intrinsic reference, because the Ground is animate.

(23) Bìinny zuu dehts mì'iny.
person stand behind child
'The person is standing behind the child'

In other languages, some AxParts may appear with overt Place heads while others might not. For example, Yukatek Maya as described by Bohnemeyer and Stolz (2006) employs a set of relational nouns to express spatial relations, and most of them require a locative preposition *ti'*, which I gloss here 'at'; it shows an agreement marker, here 3 for third person (parse and gloss otherwise simplified from Bohnemeyer and Stolz 2006:286).

(24) Te'l kulukal u pèek'il t-u pàach le naho'
there sits 3 dog at-3 back the house
'There the dog is sitting outside the house'

Bohnemeyer and Stolz (2006) observe that a small number of Yukatek spatial terms do not require *ti'*, namely *àanal* 'bottom, underside,' *iknal* 'proximity,' and *óok'ol* 'top.' The latter is illustrated in (25), from Bohnemeyer and Stolz (2006:285), again with simplified parse and gloss.

(25) Le ch'íich'o' túun xíiknal y-óok'ol le che'o'
the bird PROG *fly 3-top the tree*
'The bird is flying above the tree' (e.g. circling, not directed motion)

Such expressions can be taken to lexicalize both AxPart and Place, as a lexical characteristic, just as English *beside* was found in §4 to lexicalize Deg as well as Loc (where Loc is now decomposed into AxPart and Place).

This means that the American English expression *in back of* and the apparently monomorphemic Zapotec *dehts* 'behind' might have exactly the same structure, i.e. Place over AxPart over K. In the next subsection, I provide one additional argument that there is an AxPart projection present even with simple-looking spatial adpositions (and by extension this will imply that Place is present as a separate projection in PPs with AxParts, like the ones in Zapotec).

6.2 Binding

The argument is based on the analysis by Rooryck and Vanden Wyngaerd (2007) of the fact that locative expressions allow an alternation between anaphoric and pronominal complements, under certain conditions. Some examples are given in (26)–(28), based on similar examples in Rooryck and Vanden Wyngaerd (2007) (see also Botwinik-Rotem this volume).

(26) a. Karen talked about herself/*her.
b. Karen looked about herself/her.

(27) a. Miranda relies on herself/*her.
b. Miranda pulled the blanket over herself/her.

(28) a. Samantha has confidence in herself/*her.
b. Samantha has it in herself/her to become a great musician.

In each pair, the non-locative example requires an anaphor, while the locative example allows a pronominal complement, even with coreference. It is often assumed that this is because locative PPs can be attached relatively high, and escape the binding domain, but there is no evidence that the locative PPs in (26)–(28)

are attached outside the VP. For example, VP-fronting and VP-ellipsis tests suggest that these PPs are an integral part of the VP, as illustrated below.

(29) a. I said Karen would look about her, and look about her she did.
b. *I said Karen would look about her, and look she did about her.

(30) a. Pull the blanket over her though she did, Miranda still felt cold.
b. *Pull the blanket though she did over her, Miranda still felt cold.

(31) a. Samantha has it in her to become a great musician, and you might too.
b. *Samantha has it in her to become a great musician, and you might in you to become a great mathematician.

Rooryck and Vanden Wyngaerd offer a novel explanation for the binding facts. They note (citing earlier work) that the choice between anaphor and pronoun correlates at least partly with perspective.

(32) a. They placed their guns, as they looked at it, in front of themselves/*them.
b. They placed their guns, as I looked at it, in front of *themselves/them.

The contrast may not be as sharp as Rooryck and Vanden Wyngaerd indicate it, but it certainly goes in this direction.

Rooryck and Vanden Wyngaerd adopt the AxPart analysis of locative PPs proposed in Svenonius (2006), and propose that the frame of reference is manifested in the syntax by binding. A discourse-based perspective is achieved by coindexing the AxPart with a deictic center, which Rooryck and Vanden Wyngaerd locate in an Evidentiality projection at the top level of the clause. In the intrinsic frame of reference, on the other hand, AxPart is coindexed with the Ground object, acquiring its orientation. This is sketched in (33), closely following Rooryck and Vanden Wyngaerd (2007).

(33) a. $[_{\text{Evid}}$ **Sp** The suitcase is $[_{\text{Place}}$ be- $[_{\text{AxPart}}$ hind$_i$ $[_{\text{DP}}$ the car$]_i$ $]]]$
b. $[_{\text{Evid}}$ **Sp**$_i$ The suitcase is $[_{\text{Place}}$ be- $[_{\text{AxPart}}$ hind$_i$ $[_{\text{DP}}$ the tree $]]]]$

For an object with an intrinsic front and back, such as a car, it is natural to coindex AxPart with the Ground, in which case *behind the car* means in the space projected from the car's back end. The other option is to bind AxPart with a higher, discourse-based perspective, which Rooryck and Vanden Wyngaerd represent as **Sp**, for 'speaker.' This is the most natural option for an object without any intrinsic front and back, such as a tree. In this case, *behind the tree* means in the space projected from the part of the tree which is turned away from the perspective chosen.

The binding facts are then explained, if pronouns like *him* do not provide axes suitable for establishing the intrinsic frame of reference, while complex anaphors like *himself* do. In order for a pronoun to be used, a relative frame of reference has to be chosen. This is sketched in (34).

(34) a. $[_{\text{Evid}}$ **Sp** They$_i$ placed the guns $[_{\text{Place}}$ in $[_{\text{AxPart}}$ front$_i$ of $[_{\text{DP}}$ themselves$]_i$ $]]]$
b. $[_{\text{Evid}}$ **Sp**$_i$ They$_j$ placed the guns $[_{\text{Place}}$ in $[_{\text{AxPart}}$ front$_i$ of $[_{\text{DP}}$ them $]_j$ $]]]$

The fact that the non-locative examples in (26)–(28) lack the additional binding possibility suggests that they lack AxParts.[7]

Possibly, the intrinsic reference should actually involve coindexation between AxPart and N, rather than between AxPart and DP; in any case, it has been argued that binding cannot involve subparts of words (cf. Williams 2007). Suppose that we interpret this to mean that coindexation can only be with syntactically represented constituents. This would mean that the binding in question could only occur when AxPart is present in the syntax as a distinct projection; since the two frames of reference are both available in locative PPs even when there are not two morphemes, as seen in (26)–(28) above, this suggests that AxPart projects in locative PPs in general, not just in explicit collocations like *in front of* and *on top of*.

Note that Rooryck and Vanden Wyngaerd's analysis neatly provides a place for the two parts of *beside*: *side* is clearly an AxPart, with a consistent meaning in *inside*, *outside*, and *alongside*, and *be-* has a consistently projective meaning in *beside*, *behind*, *beneath*, and perhaps also *between*. This is already implicit in their representations on which (33) is based.

7 Conclusion

I have assumed a strict distinction between encyclopedic or conceptual-intentional information associated with lexical entries on the one hand, and syntactico-semantic information which bears on the well-formedness of syntactic structures on the other. This means that all prepositions with the same syntactic characteristics have the same syntactic representation. Given that **one meter beside the house* is plausible and coherent, but nonetheless ungrammatical, it must be ruled out by syntax. This leads to the postulation of a syntactically represented distance component in the meaning of the word *beside*, which precludes the attachment of a measure phrase. This entails that measure phrases are not simply freely adjoined to the category projected by Ps like *beside*, but rather are introduced syntactically by an instantiation of the syntactic category (which I called Deg) which represents the additional meaning component distinguishing *beside* from *behind*.

Since *behind* and *beside* otherwise show every sign of belonging to the same category, I concluded that there must be a null Deg head (or a set of them) which combines regularly with *behind*, and all other locative expressions that allow measure phrases. This is compatible with the position taken by Cinque (1999), that all functional heads which are present in a given language are always present in an extended projection, even if they are not overtly lexicalized by any phonologically pronounced material. Vague, default interpretations can be assumed to be available when no lexical material is inserted to specify otherwise.

Similarly, I presented an argument that AxPart is present as a distinct syntactic component in all locative PPs, building on the proposal of Rooryck and Vanden Wyngaerd (2007) to analyze frames of reference in terms of binding. If binding is a relation between syntactic constituents, as they assume, then even PPs headed by simple adpositions like *in* appear to have an AxPart component, like the one which is overt in *inside* or *in front of*.

It has been quite widely assumed that there is a T node in sentences like *John sat*, without the verb occupying T, and I pointed out some of the specific reasons for believing that verbs are even more complex than that. I believe that other null projections in the PP can also be motivated (I have assumed a K projection here, without discussing it in any detail). Arguments of this kind are not new; Bennett (1975:21–25) presented arguments that Path (his d-exs, 'directional expressions') must be distinguished from Place (his l-ex, 'locative expression') in the syntax, and that both are present in directed motion sentences like *Trevor went behind the door* or *The bridegroom has arrived at the church*, even though there is no overt Path head in either.

I have not directly addressed the question of whether the same categories are present in all languages (see Sigurðsson 2004 for discussion of the difference between presence and overtness). There are plausible claims in the literature for differences among languages that might very well be characterizable in terms of the systematic absence of one category or another. The aspectual projection proposed by Tortora (this volume), for example, might conceivably be present in Italian and Spanish but absent from some other languages, though its semantic contribution is fairly subtle and it is difficult to be sure at this point whether it is an obligatory component of locative expressions cross-linguistically or not.

Pederson et al. (1998) and Levinson and Wilkins (2006) argue that there are languages in which the relative frame of reference is systematically absent.[8] In my terms, these languages might lack an AxPart projection, or lack any way to lexicalize it.

Munro (2000) and Lillehaugen and Munro (2006; 2007) argue that Chickasaw systematically lacks expressions with the external distribution of adjunct PPs, though there are expressions that look very much like projections of AxPart (for example as the complements of positional verbs, and in locative expressions introduced by applicatives). Possibly, then, Chickasaw would be a language in which there is no lexical expression of Place.

The syntax of measurement has not been adequately investigated, but anectodal evidence suggests that there are languages with no way to add measure expressions to PPs. Possibly, some subset of such languages would lack the Deg projection altogether. Such languages would have to have other ways to introduce locative expressions, like Chickasaw does.

An important projection above Deg is Path. Ever since Talmy (1978) (see also Talmy 1985; 2000), there has been a great deal of work investigating the possibility that some language lack Path heads. This is an intense area of ongoing research, but as of this moment it does seem plausible that the difference that Talmy observed between Spanish on the one hand and English on the other could be stated in terms of a functional head that Spanish lacks and English has.

Furthermore, it appears from comparing Hebrew as described by Botwinik-Rotem (this volume), or Japanese as described by Tomioka (this volume), or Persian as described by Pantcheva (this volume)

to each other, or to English, that the possibilities for combining PPs with other categories varies from language to language. This might be due to differing properties of functional heads relatively high in the extended projection of P, or of heads in the extended projection of the categories modified.

If these suggestions turn out to be correct, then a substantial component of cross-linguistic variation might be in the presence or absence either of the functional heads themselves, or of the means to 'license' them (the distinction is a subtle one) — as has been suggested many times, in one form or another.

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Notes

[1]In this paper I abstract away from the question of where the Figure argument (the theme of motion) is introduced; see Botwinik-Rotem (this volume) for discussion. I also abstract away from the more general question of how the PP is integrated into the structure that it modifies; see Tomioka (this volume) for discussion.

[2]Compare Kracht's (this volume) *loc′*, and see his formalization for a way to take the dimension of time into consideration.

[3]Dominique Sportiche has pointed out to me that a vector space has certain mathematical properties, such as closure under addition, which may be relevant here. A set of diagonal vectors, or of straight vectors, could still have these properties; but a set of vectors of a certain length could not. So if directional adverbials are functions on vector spaces, then this would explain why they cannot combine outside a measure expression. On the model proposed here, this is formally encoded, if Loc is taken to consistently denote a vector space, and if that property is what both Deg and the directional adverbials seek to combine with.

[4]If some speakers have a non-vector-based lexical entry for *beside*, it is possible that speakers may also differ with respect to *beside* and *next to*, for instance having a vector-based semantics for the one but not for the other.

[5]Also note that the analysis here is compatible with the proposal of Terzi (2004; to appear) that Greek locative expressions are phrases in the specifier of X, my AxPart (see also Botwinik-Rotem and Terzi to appear). Both Botwinik-Rotem and Terzi also argue that certain nominal characteristics of the AxPart constructions motivate the presence of an N node. The N node is also more extensively argued for in Pantcheva's (this volume) analysis of Persian, which is also interestingly different from the present proposal in that the node which I label AxPart here corresponds to a complex there, consisting of AxPart modifying the null N (PLACE). It remains to be seen to what extent all these analyses can be unified completely or whether they reflect differences among the different languages investigated (Botwinik-Rotem and Terzi to appear explicitly explores the difference between Hebrew and Greek).

[6]I am simplifying slightly here, in abstracting away from the question of how the PP combines the the larger structure in which it is embedded. In non-selected contexts, Japanese locative expressions may be marked with *-de* (Naoko Tomioka, personal communication).

(35) a. Taro-ga beddo-de neta.
T-NOM *bed*-LOC *slept*
'Taro slept in the bed'
b. Taro-ga beddo-no ue-de neta.
T-NOM *bed*-GEN *top*-LOC *slept*
'Taro slept on the bed'

This suggests that *-de* must function both as Place and also as a connector to the VP, as discussed in Tomioka (this volume).

[7]Botwinik-Rotem (this volume) notes other differences between locative and non-locative PPs in Hebrew, which indicate additional differences between the two types of PP, at least in that language.

[8]See also the critique in Li and Gleitman (2002) and the response in Levinson et al. (2002).