Displacement as structural optimization: motivating roll-up movement

David P Medeiros (medeiros@email.arizona.edu), University of Arizona

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In this talk, I propose to view syntactic movement as a tree-balancing mechanism. Specifically, I propose that movement reduces the number of c-command/dominance relations in the resulting trees. The purely structural conditions governing movement on this view provide rich predictions about the configurations in which it may and may not occur. I propose an analysis of roll-up movement in these terms, which seems to align well with the facts of Malagasy.

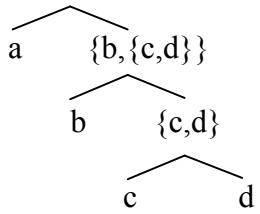
1. Introduction

I assume the following:

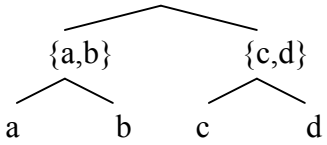
- Strict binary branching
- Antisymmetric linearization a la Kayne (1994)
- Movement leaving traces in interface forms (see below)

Trees with equivalent numbers of nodes may encode different numbers of c-command and containment (dominance) relations:

1) a. {a,{b,{c,d}}}



b. {{a,b},{c,d}}



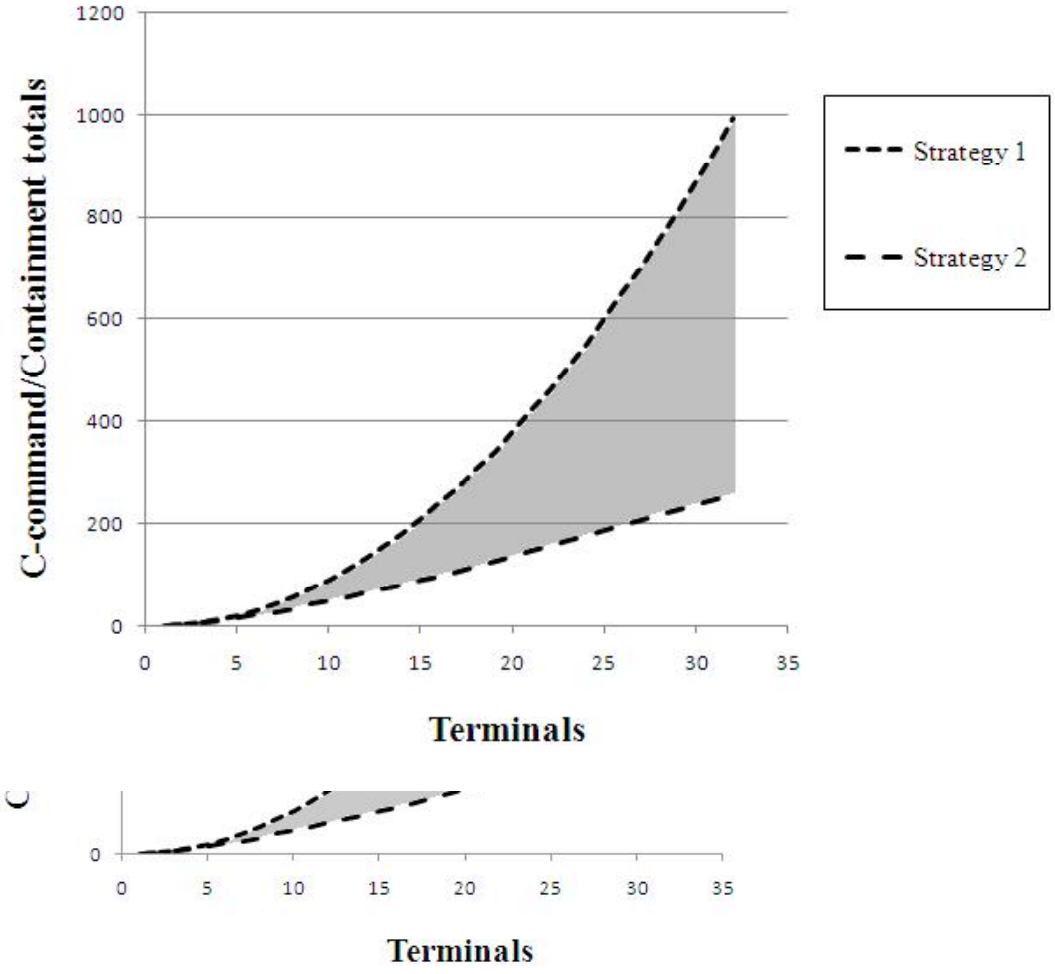
'Contains' relations: *read "x: y, z, w" as "**x contains** y, z, and w"*

{a,{b,{c,d}}}:	a,{b,{c,d}},b,{c,d},c,d	{{a,b}{c,d}}:	{a,b},a,b,{c,d},c,d
{b,{c,d}}:	b, {c,d}, c, d	{a,b}:	a,b
{c,d}:	c, d	{c,d}:	c,d
Σ = 12		Σ = 10	

C-command relations: *read "x: y, z, w" as "**x c-commands** y, z, and w"*

a:	{b,{c,d}},b,{c,d},c,d	{a,b}:	{c,d},c,d
{b,{c,d}}:	a	a:	b
b:	{c,d}, c, d	b:	a
{c,d}:	b	{c,d}:	{a,b}, a, b
c:	d	c:	d
d:	c	d:	c
Σ = 12		Σ = 10	

I use **CR** below to stand for *C*ontainment *R*elation or *C*-command *R*elation.

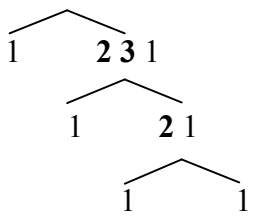


2. Why this matters.

cyclic phrasal stress assignment at PF,
agreement as search over post-movement configurations (Bobaljik 2009),
reading of (surface) scope,
linearization by LCA (Kayne 1994).

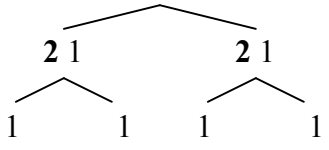
Consider an abstract case of phrasal stress assignment a la Chomsky & Halle (1968):

2) a. **2 3 4** 1



6 total stress adjustments

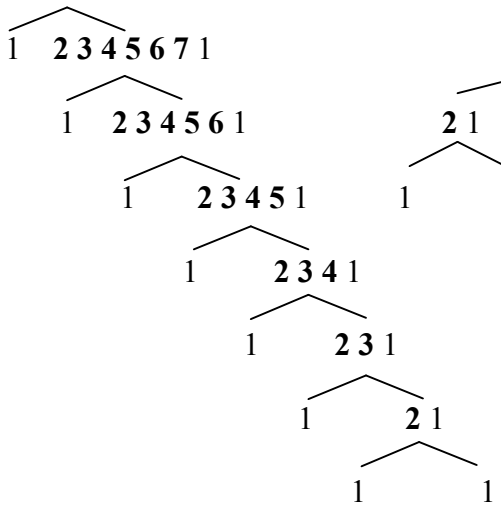
b. **3 2 3** 1



5 total stress adjustments

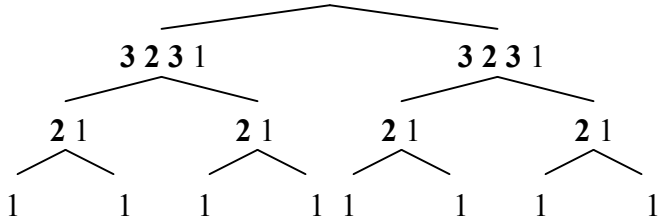
The difference is real, but hardly dramatic for such small pieces of structure. Let us examine how the totals diverge for larger trees:

3) a. **2 3 4 5 6 7 8** 1



28 total stress adjustments

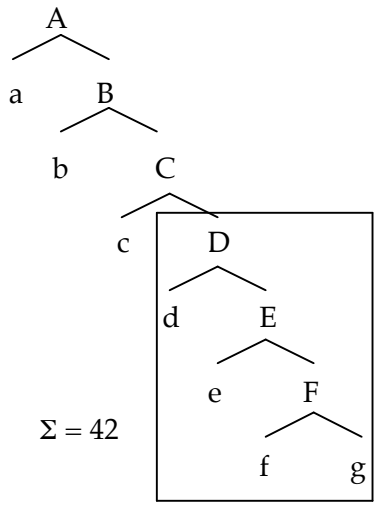
b. **4 3 4 2 4 3 4** 1



17 total stress adjustments

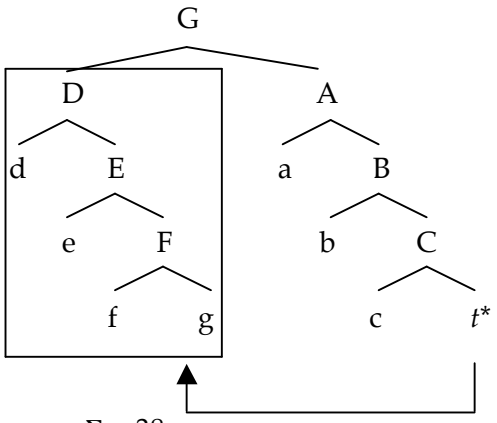
How movement can help: some "vertical" relations computed over interface forms, where movement effectively leaves a trace. The point is that the moved piece of structure behaves, with respect to certain processes, as though it is in its displaced position and not in its base position.

4) a.



Σ = 42

b.



Σ = 38

Some c-command-based phenomena are not like this, e.g. reconstruction:

5) [Which picture of herself] did Maria like t?
(anaphor is bound only in pre-move position)

"Although chains have been used to account for various processes involving scope and binding, particularly in the context of reconstruction, it is, to my knowledge, never the case that multiple occurrences of a given element are interpreted. The use of chains on the meaning side amounts to allowing different *portions* of an element to be interpreted in different positions as in reconstruction effects (e.g., the operator part of a wh-word is interpreted in SpecCP, but its restriction is interpreted in a lower, 'reconstructed' position…)" (Boeckx 2008:47)

For at least some c-command/containment-based computations, movement can improve the picture (reducing the total number of such relations effectively present):

Linearization: obviously, LCA-based linearization "reads" the c-command relations as they exist after (overt) movement. Insofar as movement reduces c-command totals, it should simplify the mapping from c-command relations to linear precedence.

Scope:

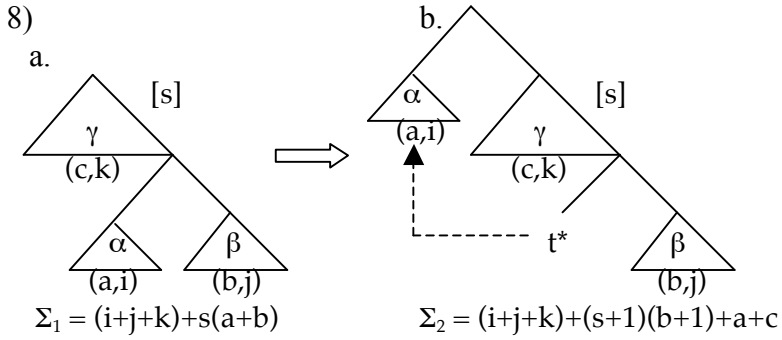
6) The target wasn't hit by many arrows. not > many
7) Many arrows didn't hit the target. many > not

According to Bobaljik (2008), agreement is computed over post-movement forms: "an NP need bear no relation to a verb other than satisfying morphological accessibility and locality in order to trigger agreement on that verb. This contrasts with the proposal in Chomsky (2001) under which agreement is a reflection of core-licensing (feature-checking) relations in the syntax." (Bobaljik 2008: 297)

The point: agreement is then another phenomenon which can be aided by a tree-balancing mechanism. Since movement (I claim) reduces the number and length of the vertical paths defined in the tree, it puts a tighter cap on the burden of the ubiquitous computations along such vertical paths.

3. The Fundamental Movement Condition

8)



$\Sigma_1 = (i+j+k)+s(a+b)$ $\Sigma_2 = (i+j+k)+(s+1)(b+1)+a+c$

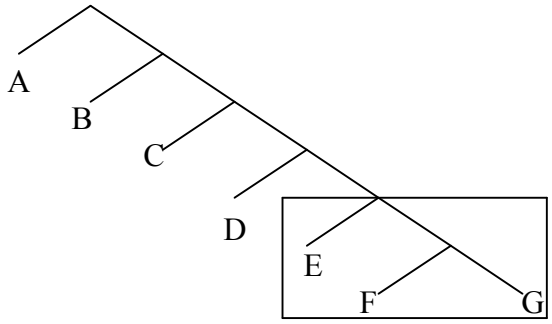
9) Fundamental Movement Condition (FMC): **Move α only if (a-1)(s-1) > b+c+2**

This is a *minimal* condition: at least this much must be true for movement to possibly be motivated in these terms.

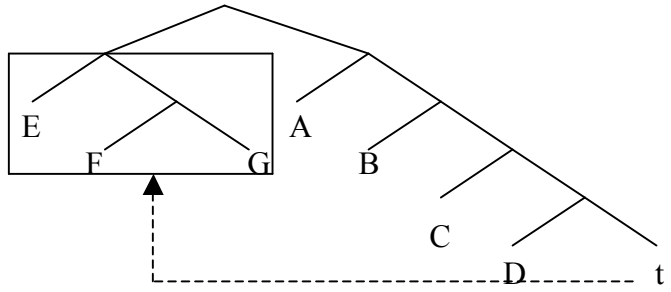
4. Prediction 1: Size Threshold

The factor a – the number of nodes in the moving category α – must be at least 5; moreover, the larger α is, the better it is to move it.

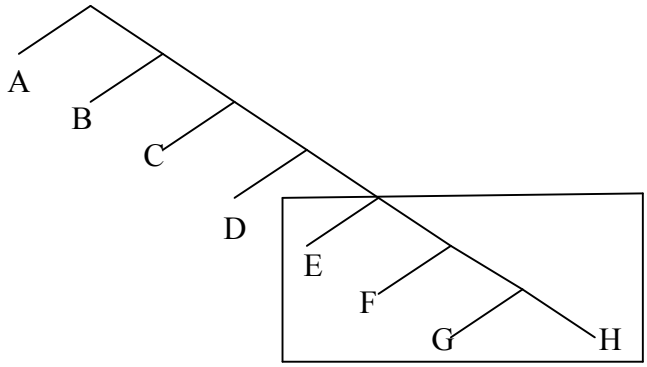
10) Before movement: CR sum = 42



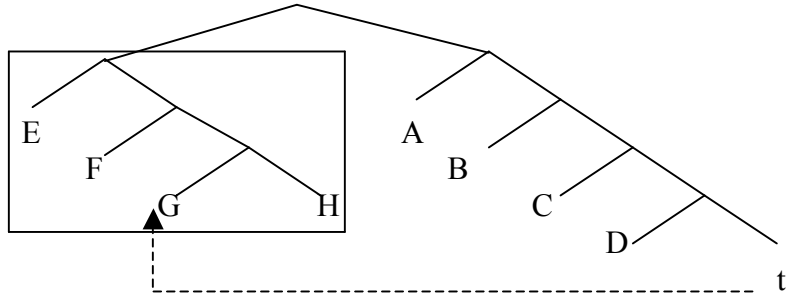
11) After movement: CR sum = 40



12) Before movement: CR sum = 56

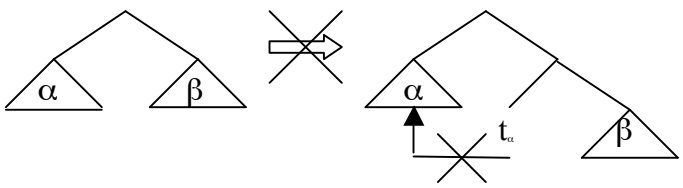


13) After movement: CR sum = 48

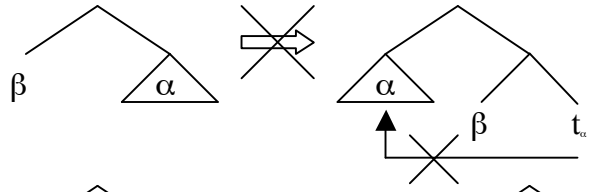


5. Prediction 2: Antilocality

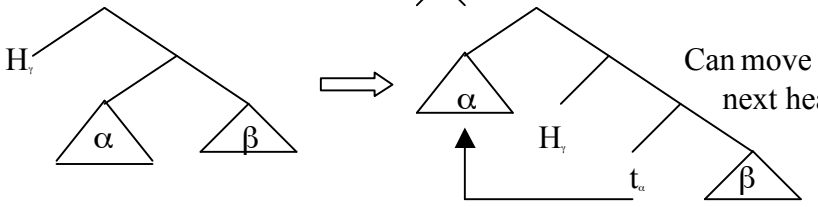
Anti-locality: the factor *s* must be at least 2.

14) 

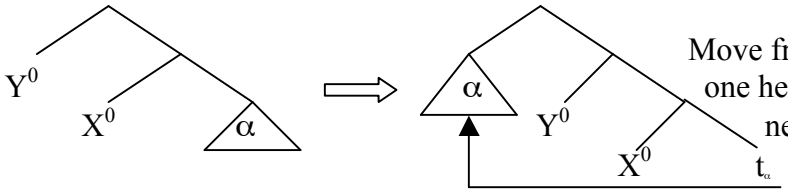
Daughters of the root should never move.

15) 

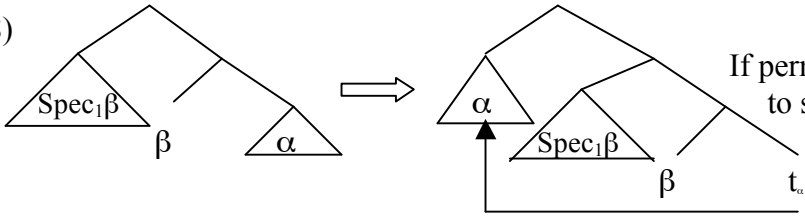
Rules out Comp-to-(first) Spec movement.

16) 

Can move to Spec of next head up.

17) 

Move from Comp of one head to Spec of next head up.

18) 

If permitted, may move to second Spec from Comp of same head.

6. Application: roll-up movement in Malagasy

Recent work postulates 'snowballing' or 'roll-up movement' underlying a cross-linguistically common pattern in which hierarchically continuous portions of a presumed universal base syntactic structure appear in the reverse of the expected linear order. Malagasy is one language displaying such a pattern (Rackowski 1996, Rackowski and Travis 2000, Pearson 2000, Svenonius 2007).

Although roll-up is implicated in head-final ordering generally (Kayne 1994), in Malagasy evidence for such movement comes from subtle facts about the relative ordering of adverbial modifiers: "While the order of preverbal adverbial elements in Malagasy conforms to Cinque's universal hierarchy, postverbal adverbials are in the mirror order."(Rackowski and Travis 2000: 120)

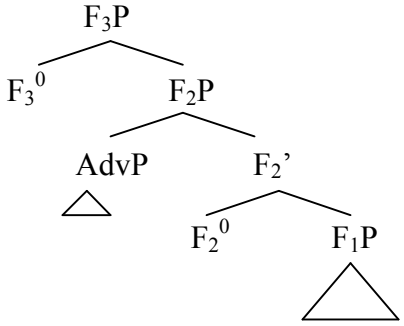
19) Tsy manasa lamba tsara intsony mihitsy Rakoto.
NEG PRES.AT.wash clothes well anymore at-all Rakoto
'Rakoto does not wash clothes well anymore at all.'
(Rackowski 1998: 18)

Let us suppose, with Cinque (2005), that roll-up movement proceeds in short, but not too-short steps – from the complement of one phrase to the specifier of the next. I follow Svenonius (2007) in labeling the alternating heads that do and do not induce movement as G and F, respectively. Then roll-up movement involves movement in a configuration like (20):

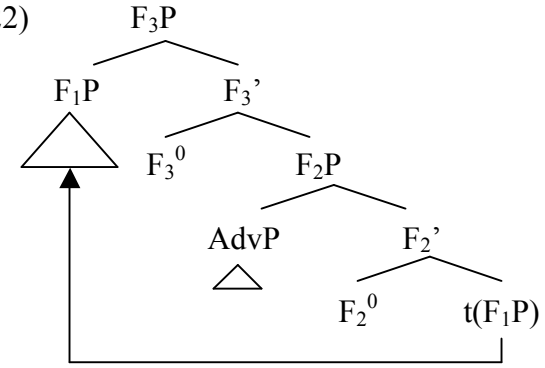
20) GP = [XP [G [(Adv)[F ~~XP~~]]]]]

Here, XP has undergone 'short' movement into a higher specifier; the pattern iterates, with the GP in (20) filling the role of the moving category XP at the next higher cycle. I depict this movement below: (21) is the pre-movement configuration, (22) is the result of applying this minimally anti-local form of movement.

21)



22)



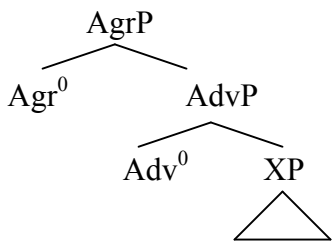
Let *a* represent the number of nodes in the moving α (F1P), and let *x* be the number of nodes in AdvP. Then movement in this configuration satisfies the FMC iff:

23) $2a > x + 9$

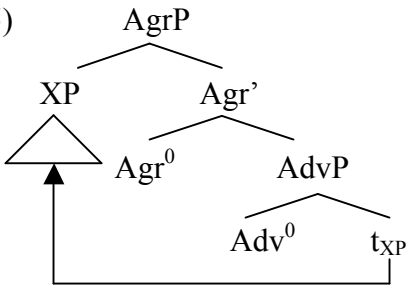
Rackowski and Travis (2000) point out that the post-verbal adverbials do not seem to allow modification by *tena* "very", unlike pre-verbal adverbials. They conclude from this

that those adverbs are heads rather than XPs in the specifiers of associated functional heads, as in the analysis of Cinque (1999). If so, the relevant configuration is (24/25):

24)



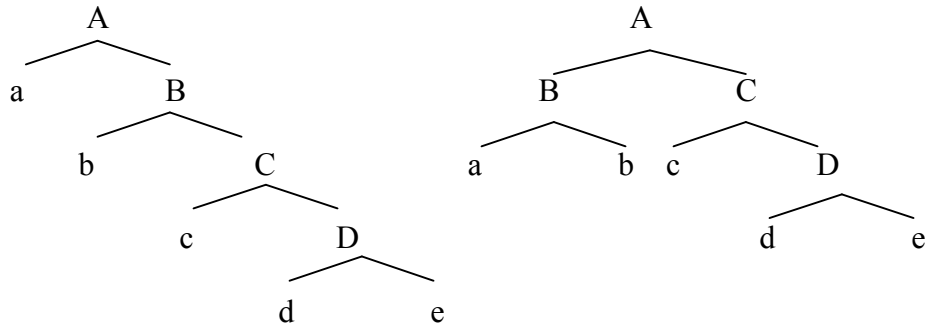
25)



26) a > 7

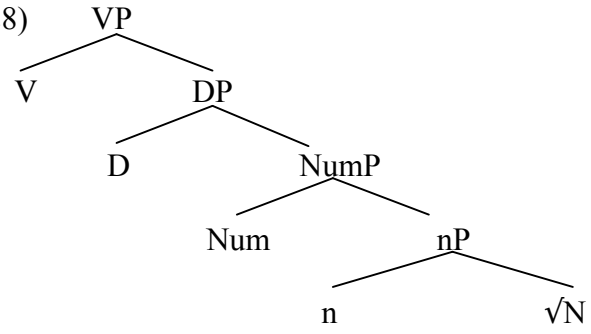
Applying the FMC [(a-1)(s-1) > b+c+2], b=1, c=3, s=2, we derive a > 7 as the relevant condition here (26). In other words, structures as small as the ones in (27), with 5 terminals (9 total nodes), are large enough to move in this configuration:

27)



This is quite modest. For example, if F1P is a VP containing a full DP object with determiner, number, and noun root plus little n, this is sufficient ($x = 9$):

28)



7. Analysis

The account here predicts a minimally antilocal form of roll-up movement. We arrive at a vision of such movement as a positive feedback loop of sorts, a decidedly natural phenomenon.

On an account where displacement is caused by lexical features, there is no immediate explanation for why these strictly reversed sequences should be observed (but see Svenonius 2007 for an attempt to implicate acquisition effects, and relevant discussion). Indeed, on the strictest interpretation, what is going on here is not movement of the complement of each head in the relevant portion of the structure into that head's specifier, as sometimes depicted: that violates Anti-locality (Abels 2003, Aboh 2004, Grohmann 2000), and Cinque's (1999) assertion that adverbs are prototypically specifiers of (usually null) heads.

Setting aside the possibility of multiple specifiers (thus adhering to the spirit of Kayne's original proposal), this forces us to conclude that roll-up movement involves portions of structure where *alternating* heads drive movement into their specifiers (these are Svenonius' G heads, Agr heads for Cinque).

An even more severe problem for a feature-based account of this fact is the frequent observation that some of the movements are actually *optional* in individual languages. For example, Rackowski (1998) points out that the most deeply embedded pair of adverbs in Malagasy may optionally appear in non-inverted order.

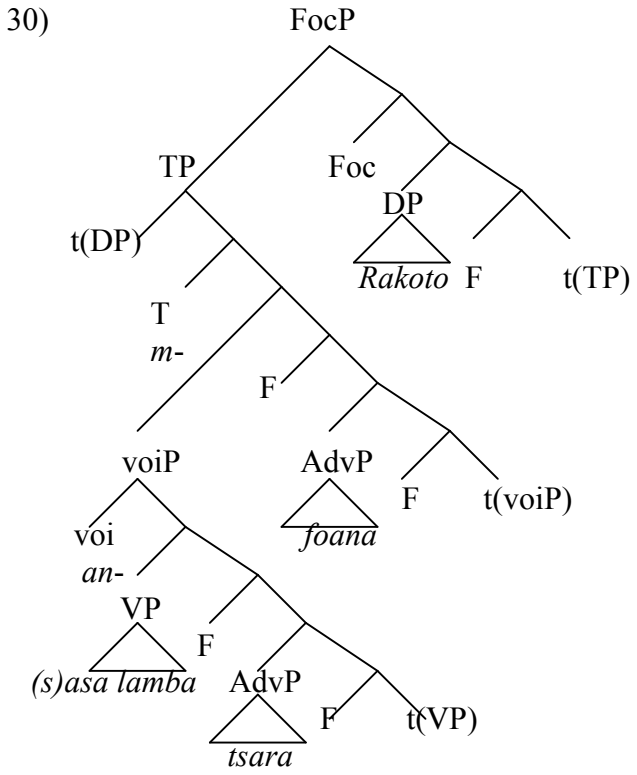
That makes a good deal of sense from the present perspective: the first step of roll-up movement (the one that would invert the deepest pair of adverbs) is the most weakly motivated. Moreover, once the first step of movement has occurred, each next step of movement faces the same structural configuration that allowed the first movement, and the "snowball" is driven to keep rolling ever more strongly.

The only thing that should derail the train, so to speak, is a cyclic opacity effect. It is interesting to note that in Malagasy the movement terminates somewhere around voice. In other words, the train stops in the near vicinity of the vP boundary. I predict that in both languages, close examination will reveal that the "snowball" is deposited in a specifier just below the phase head, where an appropriate version of phase impenetrability (PIC) (Chomsky 2000, 2001) may hide it from higher cycles. Conversely, if the snowball remains visible into the next cycle – by hypothesis, by landing in the phase edge (here, specifier of vP) – it ought to keep rolling, triggering inversion into the infl and C domains. cf. Japanese, with V+T+(Neg+)C verbal complexes.

Consider a typical example of such movement in Malagasy:

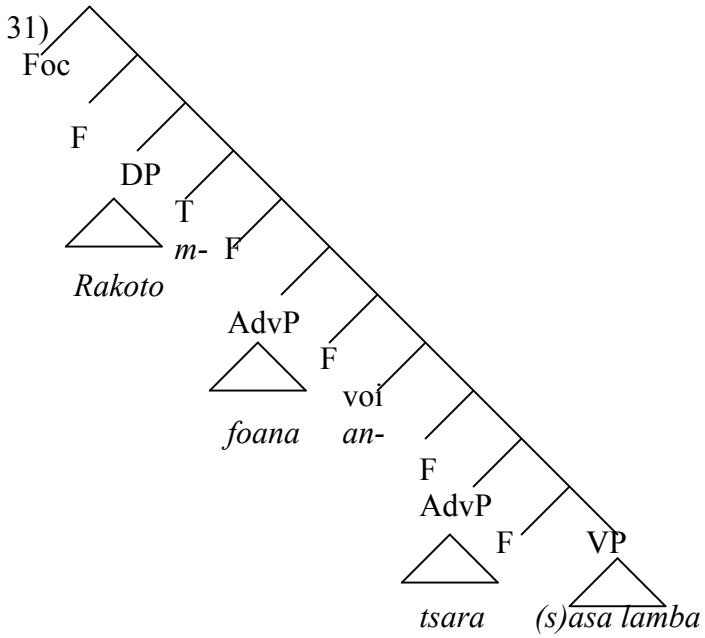
29) M- an- asa lamba tsara foana Rakoto
Pres-AT wash clothes well always Rakoto
"Rakoto always washes clothes well." (Svenonius 2006: 8)

30)



Compare (45), adapted from Svenonius, with the hypothetical structure (46) that would have resulted without this sequence of movements:

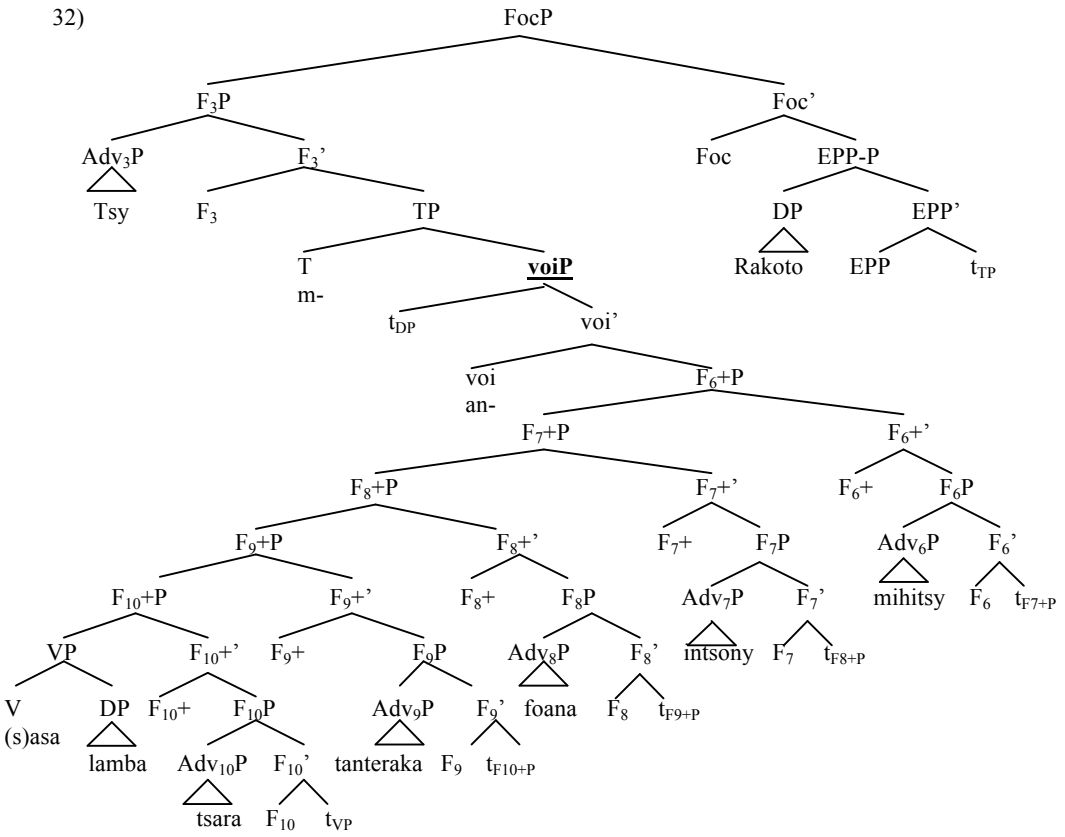
31)



Not only is the final configuration (45) globally less c-complex than the alternative without movement (46), but each *individual* movement satisfies the conditions

motivating movement locally as well. A tree with fuller adverb structure is provided below:

32)



Let A be the number of nodes in each adverb category, and D the number of nodes in the subject and object DPs (I assume, for tractability, that A and D are uniform). Then the number of c-command (or dominance) relations in the rolled-up voiP (including an unmoved subject in Spec, voiP) is (48):

33) [internal sums] + 35A + 9D + 238

The same structure without roll-up movement has (49) CRs:

34) [internal sums] + 50A + 19D + 273

Each term of the sum in (49) is greater than the equivalent term in (X) (the [internal sums] term tracks the number of CRs internal to the A and D categories; this is not affected by movement in any way). To get a feeling for the difference between these two, let us plug in some reasonable guesses for A and D. Suppose the adverb categories are of the form [Adv a], a lexical adverb root and a 'little a' category; then A is 3. If the DPs have modest internal complexity of the form [$_{DP}$ Det [$_{NumP}$ Num [$_{nP}$ n √]]], then D is 7, and the sum in (48) is 440, vs. 590 in (49) (34% more). If the DPs are more complex, along the lines proposed within cartographic work, the number of nodes in D could easily be, say, 21; if so, the sums work out to 566 in (48) and 856 in (49) (53% more).

If multiple specifiers are not permitted, it is moreover the most local configuration for movement. With multiple specifiers available, movement from complement to second specifier is sometimes motivated

Note also that displacement creates strictly more structure than would exist without movement (thus even more material to be c-commanded or contained as more structure is built, and more reason to keep snowballing). This directly predicts the outlines of the phenomenon of 'roll-up movement', which is so perplexing from a licensing-based view of syntactic movement.

Note that my tree differs from Svenonius who, following Rackowski, assumes a further movement carrying the voiceP above the phrase introducing the adverb *foana*. For my account to succeed, either this movement is incorrect (*foana* is below voice), or the voice morphology is not the lower phase head in Malagasy (some minimally higher silent head –little v?—is).

I speculate that the difference between roll-up movement and the more familiar successive-cyclic ('rolling stone', as Travis 2005 calls it) movement of categories in languages like English may reduce to a matter of derivational timing. Specifically, if displacement gets rolling early, so to speak, roll-up style movement is favored. If displacement does not occur until later in the derivation, successive-cyclic movement may be the preferred result (this makes particular sense if the successive-cyclically moving element ends up in the phase edge, where it remains visible in the next phase; certainly that is the case for wh-movement). It is also important to note that the two types of movement co-occur – Malagasy has a form of object movement as well as an EPP-like movement evacuating the subject from the vP, and Niuean, exhibiting roll-up in both DPs and clauses, moves subjects and objects high in the tree (Kahnemuyipour & Massam).

35) a. Tsy manasa **lamba** *mihitsy* ve Rakoto?
NEG PRES.AT.wash clothes at-all Q Rakoto

b. *Tsy manasa *mihitsy* **lamba** ve Rakoto?

c. Tsy manasa *mihitsy* **ny lamba** ve Rakoto?
NEG PRES.AT.wash at-all DET clothes Q Rakoto
'Does Rakoto not wash clothes at all?'
(Rackowski & Travis 2000: 120)

The lesson to be drawn here is that indefinite objects are obligatorily right-adjacent to the verb, while definites may be separated from the verb by adverbials. This looks very much like a form of Object Shift (interacting with roll-up movement). If that is correct, this is evidence for the interleaving of roll-up movement with a more familiar kind of movement, complicating the story.

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