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The Structure of Length

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*On ne découvre pas de terre nouvelle sans consentir
à perdre de vue, d'abord et longtemps, tout rivage.
("One doesn't discover new lands without consenting
to lose sight of the shore for a very long time.")*
— André Gide

Contents

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Preface

When I started working on this dissertation, I did not expect that the word "structure" in the (then preliminary) working title would take on *such* prime importance. Initially, my main goal was to give an analysis of Estonian over-length within the framework of Government Phonology. In the course of time and many discussions with Jonathan Kaye and Reinhard Bachmaier on theoretical aspects of Government Phonology, it turned out that certain properties which had formerly been assumed to be melodic should rather be encoded structurally. Such a shift in perspective made many complex and most interesting interactions with length transparent.

One of those properties that was wrongly assumed to be melodic was the element **H**. **H** was used to distinguish *e. g.* an English *d* (as in *bid*) from an English *t* (as in *bit*). This difference is understood as a melodic one in basically *all* current phonological theories. Evidence from English, however, makes it clear that such a view cannot be upheld. As I shall argue, **H** is not an element, but rather a particular structural configuration.

Another property that used to be treated as melodic is the element **ʔ**, responsible for stopness. As has already proposed by Jensen (1994), there is a fair amount of evidence showing that that element, too, ought to be replaced by structure. What distinguishes, say, a *p* from an *f*, then, is not their internal melodic makeup, but rather structural properties.

Yet another element that literally seemed to scream out that it has structural properties is the element **A**. In the course of this dissertation we will see that **A**, though not really structural itself, has a clear effect on structure.

In other words, the perspective shifted away from melody and more and more towards structural issues. Obviously, this also had a big impact on the representation of length. It became clear that a large-scale revision of the theory of constituent structure was inevitable. While this meant throwing

out huge parts of the framework I was working in and while it literally felt as if the theoretical ground under my feet gave way, it made one thing quite clear: Estonian overlength is far from being a "rare phenomenon". In fact, it can even be found in languages like English. This was of course a welcome result. One of the basic assumptions of the general framework of Government Phonology is that cross-linguistic variation is highly restricted. That Estonian and English should become largely identical is therefore a strong argument of the fundamental correctness of that approach to phonology.

However, as reassuring as this insight was, it could not be incorporated within standard GP's theory of constituent structure. What this called for was a complete overhaul of the theory, an enterprise I am going to undertake in this dissertation.

This dissertation is organised as follows: In chapter 1 the main reasons for shifting the attention from melody to structure will be presented. I will discuss the particular problems with the element **H** and the Non-Arbitrariness Principle. I argue that the element **H** be replaced by a structural configuration. In addition to that I review a proposal by Jensen (1994) to the effect that the element **ʔ** be reinterpreted as a structural property as well. The advantages of both moves will be discussed, but at the same time we will see that they are difficult to implement in standard Government Phonology.

In chapter 2 I illustrate some further shortcomings that Standard GP suffers from. After that, I outline the basics of a new model that is to replace the standard model of constituent structure. We will discuss the basic axioms of that new model and see how they apply in the internal structure of onsets. We will arrive at a structural representation of the properties formerly associated with **H** and **ʔ**.

Chapter 3 elaborates on the basics presented in the previous chapter. We will discuss simple phonological domains and the interactions that hold within them. There will be three types of domains that will be of interest to us, and those three types of domains will help us understand the distribution of length.

In chapter 4 we take our model beyond English and apply it to Estonian. Due to its allegedly outstanding system of length, Estonian is often assumed to be radically different from languages like English. As our new model of constituent structure will show, however, those differences are nothing but an optical illusion. As a matter of fact, Estonian is to a great extent nearly identical to English.

Chapter 5 takes a closer look at the role of morphology, a factor that previous analyses of Estonian generally disregarded, but which is crucial for an understanding of length. We will see that analytic morphology is the one area where Estonian and English differ in crucial ways. This will also lead over to a brief discussion of how the model presented in this dissertation can be applied to Italian.

Finally, in chapter 6 we will discuss how clusters can be implemented in the model advocated here. We will discuss the most important cases from English and Estonian and see that the parallels between the two languages continue. We will be concerned with the distribution of length within the clusters as well as with questions of phonotactics.

Chapter 1

From melody to structure

In this thesis a large-scale revision of standard Government Phonology (GP) is proposed, and it is thus necessary to discuss the reasons that first led up to such a change. This chapter presents some of the problems standard GP faces; those problems pertain to both element theory and the theory of constituent structure.

These days there are a number of competing versions of element theory around: my starting point is the particular version used in what is commonly referred to as standard GP. Section 1.1 provides a general discussion of the set of elements employed in standard GP and the problems of over-generation. Section 1.2 illustrates a particular problem with the element **H** and the Non-Arbitrariness Principle. I argue that the element **H** be replaced by a structural configuration, which, however, runs into problems with the theory of constituent structure that standard GP uses. In section 1.3 I review a proposal by Jensen (1994) to the effect that the element **ʔ** be eliminated from the set of elements and reinterpreted as a structural property as well. The advantages of such a move will be discussed, but at the same time we will see that once again it is difficult to implement in standard GP. The problems get even worse once the configuration replacing **H** and the configuration replacing **ʔ** are combined. I propose that the standard model of constituent structure be done away with and outline the basics of a new model that is to replace it.

1.1 Elements, phonological expressions and over-generation

In contrast to many other phonological theories, which employ phonetically based binary features to encode melodic properties, GP makes use of mono-valent cognitive units, so-called **elements**.[1] The set of elements currently employed in Standard GP, *e. g.* by Kaye (2000), is given in (1); examples of where each element occurs will be given in a moment.

(1)   The set of elements E:

E = {**A**, **I**, **U**, **H**, **L**, **?**}

While each one of those elements is interpretable by itself (*i. e.* there is no under-specification or default fill-in of melodic information of any kind), elements can in turn be combined with other elements to form compound expressions. Elements occur in so-called **phonological expressions** (PE's), which is the technical notion underlying the sounds of the world's languages. The definition of the notion of PE is given in (2), following Kaye (2000: 2).

(2)   A phonological expression is an ordered pair of a head H and a (set of) operators O: $(\mathbf{O}, \mathbf{H})$, such that

    a. O ⊆ E (O possibly empty)

    b. H ∈ E (possibly the identity element)

    c. H ∉ O

The head of a PE is written to the right and underlined by convention: Thus, $(\{\mathbf{I}, \mathbf{A}\}\underline{\mathbf{U}})$ has **U** as its head and **I** and **A** as its operators, $(\{\mathbf{I}\}\_)$ has an operator **I** but no head (it is headless), while $(\{\}\_)$ has neither head nor operator. The chart in (3) shows what the individual elements represent and where they can be found. The ultimate interpretation of a PE depends on whether it is associated to a nuclear position (a position dominated by a nucleus node) or a non-nuclear position.

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[1]   Privative melodic units are not unique to GP, however, but are also employed in Dependency Phonology (Anderson & Ewen 1987) and Particle Phonology (Schane 1984).

(3)

element	PE	nuclear position	non-nuclear position
A	$(\{\mathbf{A}\}\_)$	b<u>a</u>t	<u>r</u>ight
I	$(\{\mathbf{I}\}\_)$	b<u>i</u>t	<u>y</u>oung
U	$(\{\mathbf{U}\}\_)$	p<u>u</u>t	<u>w</u>est
	$(\{\}\underline{\mathbf{U}})$	r<u>u</u>de	<u>v</u>est
H	$(\{\mathbf{H}\}\underline{\mathbf{U}})$	high-toned ú	<u>f</u>ind
L	$(\{\mathbf{A}\}\underline{\mathbf{L}})$	nasal ã	
	$(\{\mathbf{L},\boldsymbol{?}\}\underline{\mathbf{A}})$		<u>n</u>ight
	$(\{\boldsymbol{?},\mathbf{A}\}\underline{\mathbf{L}})$		French <u>d</u>eux 'two'
?	$(\{\boldsymbol{?}\}\_)$	*	<u>g</u>o

Notice the gap (indicated by a '*') in the case of the element **?**, to so-called "stop element": **?** is universally barred from the nuclear position, an issue we will discuss in more detail in section 1.3.

Elements define natural classes, in that any set of PE's can always be divided into a subset that contains a certain element and the complement subset which does not contain the element in question. For example, in the discussion of New York City English in section 1.2, we will be dealing with the set of PE's containing **H** as opposed to its complement set, *i. e.* all the PE's not containing **H**.

The number of elements has not always been as low as today. In the very beginning of GP (Kaye, Lowenstamm & Vergnaud 1985, 1990), the ten elements **A**, **I**, **U**, **H**, **L**, **N** (nasality), **ATR**, **h** (noise/release), **R** (coronality) and **?** were employed, which led to a serious over-generation of PEs.[2] A formula for calculating the total number of PEs is given in (4), where n represents the number of elements in use.

(4) $2^{n-1} \times (n+2)$

Using the formula in (4), the following chart illustrates the dramatic over-generation that a theory with too high a number of elements brings with it.

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[2] In earlier versions of the theory, each element had a certain charm value (positive, negative or neutral) which restricted both the possibilities of elements to combine with each other (elements of like charm could not combine) as well as the distribution of PEs (a negatively charmed PE could not be dominated by a nucleus). Charm is only of historical interest these days and therefore disregarded here.

Substituting n by 10, the number of elements in earlier models of element theory, we generate $10 \times 2^{10-1} + 2^{10} = 6144$ PEs, which of course is way beyond the number of PE's that natural languages employ. PEs only encode what is *phonologically relevant*, and current estimates are that the number of expressions needed will be well below 100. Any theory generating more than that is certainly wrong.

(5)

NUMBER OF ELEMENTS	EXPRESSIONS GENERATED
10	6144
6	256
5	112
4	48

For example, Southern British English has only six PE's that can be dominated by a non-branching nucleus (giving us a short vowel), and eight PE's that can be dominated by a branching nucleus (for long vowels).

(6)   short vowels

$(\{\}\_)$ *but* $(\{\mathbf{A}\}\_)$ *pat* $(\{\mathbf{A},\mathbf{I}\}\_)$ *pet*

$(\{\mathbf{I}\}\_)$ *pit* $(\{\mathbf{A},\mathbf{U}\}\_)$ *pot*

$(\{\mathbf{U}\}\_)$ *put*

long vowels

$(\{\}\_)$ *fur* $(\{\}\underline{\mathbf{A}})$ *far* $(\{\mathbf{A}\}\underline{\mathbf{I}})$ *bait*

$(\{\}\underline{\mathbf{I}})$ *beat* $(\{\mathbf{I}\}\underline{\mathbf{A}})$ *bear*

$(\{\}\underline{\mathbf{U}})$ *boot* $(\{\mathbf{A}\}\underline{\mathbf{U}})$ *boat*

$(\{\mathbf{U}\}\underline{\mathbf{A}})$ *bought*

In other words, Southern British English exploits a grand total of 13 PE's for nuclei,[3] a miniscule fraction of the phonological objects a theory with ten elements would provide. And as if to add insult to injury, the inventories of PE's we find across languages are to a large extent very similar to each other. That is, we cannot even hope that all the PE's *not* found in English

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[3] The expression $(\{\}\_)$ occurs twice in (6).

could be found in other languages, thus somehow justifying a high number of expressions. As the chart in (7) shows, the set of PE's we find in the tonic position in Standard Central Catalan is virtually identical to the one that underlies long vowels in Southern British English; the only difference is the lack of ({}_) in Catalan.

(7)   Standard Central Catalan
     ({}**A**) a *sac* 'sack'   ({**A**}**I**) e *cec* 'blind'
     ({}**I**) i *ric* 'I laugh'   ({**I**}**A**) ɛ *sec* 'dry'
     ({}**U**) u *suc* 'juice'   ({**A**}**U**) o *sóc* 'I am'
                              ({**U**}**A**) ɔ *soc* 'log'

Furthermore, the seven-vowel system illustrated in (7) is of course not unique to a certain variety of Catalan, but is the same we also find in Standard Italian. In other words, the margins of variation are not very wide. Certain patterns and inventories are repeated time and again, and therefore any theory that predicts the existence of a large number of PE's must be treated with suspicion. Trivially, the smaller the number of elements, the better a theory fares with respect to over-generation.

Earlier versions of element theory certainly provided too large a number of PE's a language could choose from, *e. g.* for the nuclear position, but this was not the only defect they suffered from. As a matter of fact, a substantial portion of the 6144 expressions generated by a ten-element system would not be 'eligible' for the nuclear position, since some of the elements, *viz.* **R**, **h** and **ʔ**, could only occur in non-nuclear positions. All expressions containing them could therefore not be associated to nuclear positions. This certainly reduces over-generation, at least to some extent, but only at the cost of creating an even bigger problem: Why should certain elements such as **U** and **I** be allowed to freely occur in both nuclear and non-nuclear positions, while **R**, **h** and **ʔ** were restricted to non-nuclear positions and **ATR** to nuclear positions? Harris & Lindsey (1995) distinguish between "elements for vowels" and "elements for consonants", where their notions of vowels and consonants are short-hand for "position dominated by a nucleus" and "position not dominated by a nucleus", respectively. But the distinction between nuclear and non-nuclear positions is part of the theory of constituent structure and should not have to be recapitulated in the theory of elements.

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Elements should not have to be sub-divided according to where they can associate. The null hypothesis would certainly be that any element can occur in any position. The mere existence of asymmetries in the distribution of individual elements show that the particular choice of elements is burdened with some unwanted redundancy. Such asymmetries as well as the problem of over-generation led to a large-scale revision of element theory in the course of time. The system we have today, *i. e.* the one with the six elements in (1), is the result of various simplifications and unifications in the set of elements. **N** and (old) **L** have been merged into (new) **L** (Ploch 1999), **R** and (old) **A** have been merged into (new) **A** (Broadbent 1991), **h** and (old) **H** have been merged into (new) **H** and **ATR** is now expressed as headedness (Charette 1994). What was left over was a set of six elements, **A**, **I**, **U**, **H**, **L** and **ʔ**. The mergers that have been proposed not only restrict the expressive power of element theory, generating a total of 256 PE's as compared to 6144, but also to give a better empirical match with existing phonological processes.

This happy reduction of elements came to a screeching halt when arriving at the element **ʔ**. Unfortunately, the remaining set of six elements was still somehow heterogeneous: While the elements **A**, **I**, **U**, **H** and **L** could associate freely to any kind of constituent, **ʔ** was the odd one out in that it was the only survivor from the original set which was still limited to non-nuclear positions, as we have already seen. In a brave attempt to remedy this situation, Jensen (1994) set out to eliminate the offender. Eliminating **ʔ** would not only restrict the expressive power of the theory, but also leave us with a more balanced set of elements, where each and every element can in principle associate to any position. This is the issue we will turn to in section 1.3.

Before that, however, we will discuss the element **H**, which might come as a surprise given what we just said: **H** is inconspicuous in that it can attach to both nuclear and non-nuclear positions: in nuclei it gives us a high tone, in non-nuclear positions it encodes differences like the one between English *d* and *t*, the latter of which contains **H**; *i. e.* it represents the property traditionally referred to as "voicelessness". However, treating **H** as an element on a par with, say **I** and **U**, does not allow us to express a certain generalisation that can be made about many varieties of English (and other languages). In order to investigate this particular problem, we now turn to the English spoken in New York City.

1.2   New York City English

The particular phenomenon we will have a look at is often referred to as "lengthening before voiced consonants" (Belasco 1953, 1958: Chen 1970: Delattre 1962: Denes 1955: Hoffman 1958: House 1961: House & Fairbanks 1953: Maddieson 1997: Peterson & Lehiste 1960: Zimmermann & Sapon 1958).[4] This phenomenon can be seen in pairs like *bid* and *bit*, where the nuclear expression in *bid* is much longer than the one in *bit*. The distribution of length is dependent on the kind of onset that follows the nucleus. The phenomenon is by no means restricted to New York City (NYC) English, but can be found in many other varieties of English as well. However, there are certain details about NYC English that make it particularly interesting for us.

1.2.1   The basic pattern

The chart in (8) gives some examples of the distribution of length in NYC English. On the left side we have words where the final onset adds extra length to the preceding nucleus, and on the right side those where it does not.

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[4] The term lengthening suggests that there is some process going on; in order to use a more neutral, non-derivational term, I will just talk about the distribution of length.

(8)

EXTRA LENGTH		FINAL ONSET	NO EXTRA LENGTH		FINAL ONSET
bid	bɪːd	$(\{\textbf{ʔ}\}\underline{\textbf{A}})$	*bit*	bɪt	$(\{\textbf{H},\textbf{ʔ}\}\underline{\textbf{A}})$
bead	biːːd	$(\{\textbf{ʔ}\}\underline{\textbf{A}})$	*beat*	biːt	$(\{\textbf{H},\textbf{ʔ}\}\underline{\textbf{A}})$
big	bɪːg	$(\{\textbf{ʔ}\}\_)$	*sick*	sɪk	$(\{\textbf{H},\textbf{ʔ}\}\_)$
league	liːːg	$(\{\textbf{ʔ}\}\_)$	*beak*	biːk	$(\{\textbf{H},\textbf{ʔ}\}\_)$
rib	rɪːb	$(\{\textbf{ʔ}\}\underline{\textbf{U}})$	*rip*	rɪp	$(\{\textbf{H},\textbf{ʔ}\}\underline{\textbf{U}})$
lube	luːːb	$(\{\textbf{ʔ}\}\underline{\textbf{U}})$	*loop*	luːp	$(\{\textbf{H},\textbf{ʔ}\}\underline{\textbf{U}})$
bin	bɪːn	$(\{\textbf{L},\textbf{ʔ}\}\underline{\textbf{A}})$	—		
bean	biːːn	$(\{\textbf{L},\textbf{ʔ}\}\underline{\textbf{A}})$	—		
dim	dɪːm	$(\{\textbf{L},\textbf{ʔ}\}\underline{\textbf{U}})$	—		
deem	diːːm	$(\{\textbf{L},\textbf{ʔ}\}\underline{\textbf{U}})$	—		
bill	bɪːl	$(\{\textbf{A}\}\underline{\textbf{ʔ}})$	—		
peel	piːːl	$(\{\textbf{A}\}\underline{\textbf{ʔ}})$	—		
live	lɪːv	$(\{\}\underline{\textbf{U}})$	*stiff*	stɪf	$(\{\textbf{H}\}\underline{\textbf{U}})$
leave	liːːv	$(\{\}\underline{\textbf{U}})$	*leaf*	liːf	$(\{\textbf{H}\}\underline{\textbf{U}})$
his	hɪːz	$(\{\}\underline{\textbf{A}})$	*hiss*	hɪs	$(\{\textbf{H}\}\underline{\textbf{A}})$
(to) use	juːːz	$(\{\}\underline{\textbf{A}})$	*(a) use*	juːs	$(\{\textbf{H}\}\underline{\textbf{A}})$

(8) illustrates several issues. The nucleus in a word like *bid* bɪːd is clearly longer than the one in *bit* bɪt. The same effect can be observed with lexically long nuclei, as the pair *bead/beat* biːːd/biːt serves to show: The nucleus is lexically long in both words, but before *d* we have additional length. Note furthermore that also a qualitative difference exists between *bid* and *bit* on the one hand and *bead* and *beat* on the other. In the former set we find a lax ɪ, which is assumed to be $(\{\textbf{I}\}\_)$, in the latter set we have tense i, *i. e.* $(\{\}\underline{\textbf{I}})$. In other words, we have four different objects altogether that need to be represented in some way: short and long nuclei without extra length (*bit*, *beat*) and short and long nuclei with length (*bid*, *bead*).[5]

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[5] It is often assumed that this is "phonetic only" and a "physiological necessity" (Chen 1970) and that it therefore does not have to be taken into account in phonology. In the course of this dissertation we will see that there are several contexts where this alleged "physiological necessity" does not take place, thus making clear that what we are dealing with is truely phonological, and not just a "phonetic effect". For arguments against the phenomenon under discussion being automatic and non-phonological even from a phonetician's point of view, *cf.* Maddieson (1997).

As can also be seen from (8), this additional length is of course not only found before d, but also before b, g, v etc. As far as length is concerned, *rib* is to *rip* what *bid* is to *bit*. Likewise, *leave* and *leaf* are entirely parallel to *bead* and *beat*.

How can we formally characterise the two sets in (8), *i. e.* the set of onset allowing for extra length *vs.* those that do not? A quick look at the internal composition of the PE's that underly the final onsets makes clear what the responsible factor is: Any PE without **H** allows for extra length of the preceding nucleus, while PE's containing the element **H** do not: The d in *bid* contains no **H**, its PE is simply $(\{\textbf{ʔ}\}\underline{\textbf{A}})$, and as a result we get extra length; the t in *bit* on the other hand contains **H**, it is $(\{\textbf{H},\textbf{ʔ}\}\underline{\textbf{A}})$, and no extra length is to be found. The same holds for all the other final onsets in (8). We can state a principle like the following.

(9) **NYC Lengthening**
     Lengthening ensues if the vowel is not immediately followed by a PE containing **H**.

In other words, a formal characterisation is fairly easy. All we have to know is whether an onset contains **H** or not.[6] The crucial question of course now is: *Why* does **H** play such a crucial role in the distribution of length? Why should it be special? This will be the issue we turn to now.

1.2.2   In search of a non-arbitrary explanation

It has become clear that **H** is the crucial factor in the distribution of additional length in NYC English. (9) is a fair statement of the facts in that it correctly captures the environment where additional length is to be found, but of course it is nothing more than a description of what is going on. We might have reached the level of observational adequacy, but certainly not of descriptive, let alone explanatory adequacy: Crucially, why would the the presence or absence of **H**, *i. e.* a melodic property, have an influence on length, which is encoded by the number of skeletal points a given PE is associated to?[7] Melody and structure are independent of each other, so we should expect

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[6] Additional conditions will be discussed in the course of the following chapters. Those conditions are irrelevant to my point here.

that one has no influence on the other. Put differently, the distribution of length as stated in (9) fails to meet the Non-Arbitrariness Principle. In order to make this point crystal-clear, let us quickly have a look at this principle and the notion of non-arbitrariness.

The Non-Arbitrariness Principle is at the very core of GP, it is a formal requirement that any phonological process has to adhere to. Non-Arbitrariness demands that there be a direct relationship between a phonological process and the environment it takes place in, *i. e.* there is always a local trigger. As a short example, taken from Kaye, Lowenstamm & Vergnaud (1990: 194–195), consider a process whereby a high tone following a low tone is turned into a rising tone, *i. e.* the sequence low–high changes into low–rising. Such a process is non-arbitrary in that there is a clear connection between the target of the process and the phonological environment. In GP, such a process can be modelled in a straightforward way: the rising tone is created by spreading the low tone to the same slot the high tone is already linked to, *cf.* (10a). Compare this to the characterisation of the very same process in terms of an SPE-like rule in (10b), which does not meet this requirement of non-arbitrariness: nothing in the general rule format A → B / C __ D prevents that A, B, C and D are replaced by whichever features we care to employ (10c–d).

(10)   a.   L   H   L   H

         | | ╲   │

         ×   ×   ×   ×

        b.   H → LH / L __

        c. * H → HL / L __

        d. * H → LH / __ L

(10b) simply states that a high tone is turned into a rising one if it follows a low tone. The structural change SC (H → LH) has nothing to do with the structural description SD (L __). Both SC and SD refer to an L, but the

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[7] We shall see in section 2.3.2.4 that conceiving of PE's as being linked to slots is problematic itself. This has no bearing on the issue under discussion here.

L in sc is independent of the L in sd. Nothing connects the trigger (the environment) with the process.

Our statement about **H** in (9) fares no better than any of the rules in (10b–d). There is no connection between the phonological process (distribution of length) and its environment (following PE must not contain **H**). Let us have a look at that in detail. No previous account has been given for length in NYC English within standard GP and accordingly, the representations assumed for the words *give* and *whiff* would look as in (11), where no additional length is indicated. The nuclei in *give* as well as in *whiff* used to be represented in identical fashion, *i.e.* as a non-branching nucleus dominated by a non-branching rhyme.

(11) a. *give* (standard GP)   b. *whiff* (standard GP)

$$
\begin{array}{cccc}
O_1 & R_1 & O_2 & R_2 \\
| & | & | & | \\
 & N_1 & & N_2 \\
 & | & | & | \\
\times_1 & \times_2 & \times_3 & \times_4 \\
| & | & | & \\
g & \text{\scriptsize I} & v & \\
 & | & & \\
 & (\{\}\underline{U}) & &
\end{array}
\qquad
\begin{array}{cccc}
O_1 & R_1 & O_2 & R_2 \\
| & | & | & | \\
 & N_1 & & N_2 \\
 & | & | & | \\
\times_1 & \times_2 & \times_3 & \times_4 \\
| & | & | & \\
w & \text{\scriptsize I} & f & \\
 & | & & \\
 & (\{\mathbf{H}\}\underline{U}) & &
\end{array}
$$
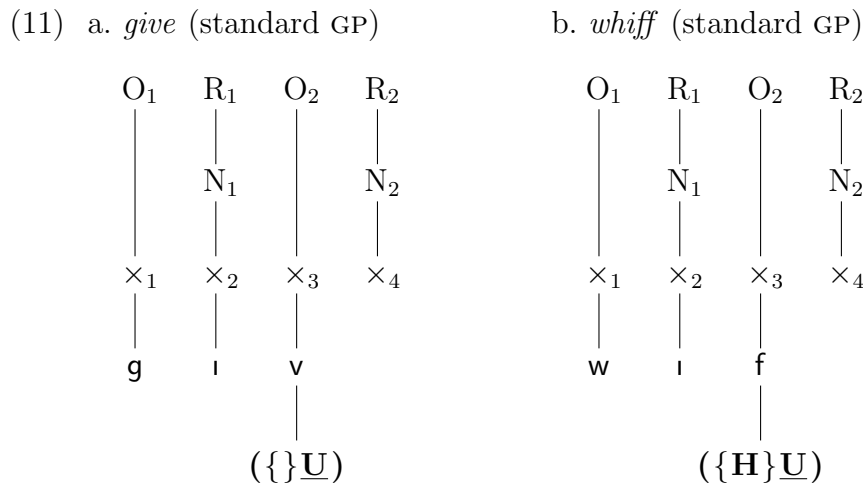
What kind of an analysis could we propose within standard GP? The structure in (11a) does not show the additional length of the nucleus that is due to the *v*. What we would have to assume in order to express this additional length is that representations as in (11) "grow a point" *iff* the following PE contains no **H**. Of the two structures above, only (11a) fulfills this requirement and we would end up with the following two representations, where the additional point in the representation for *give* is boxed.[8]

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[8] I leave that newly created point unassociated for the time being. Precisely where it is associated (be it the nucleus, the rhyme, or even the following onset) is not our concern at the moment.

(12) a. *give* (standard GP) b. *whiff* (standard GP)

```
O₁    R₁        O₂    R₂          O₁    R₁    O₂    R₂
|     |         |     |           |     |     |     |
      N₁              N₂                N₁          N₂
      |               |                 |           |
×₁    ×₂  ⌷×₃⌷  ×₄    ×₅          ×₁    ×₂    ×₃    ×₄
|     |         |                 |     |     |
g     ɪ         v                 w     ɪ     f
                |
              ({}U̱)              ({H}U̱)
```
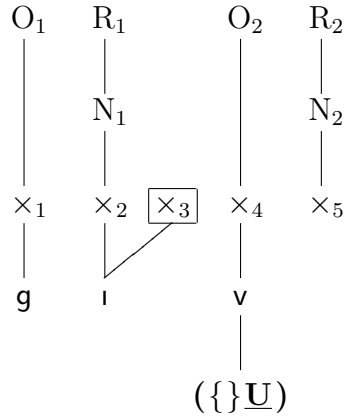
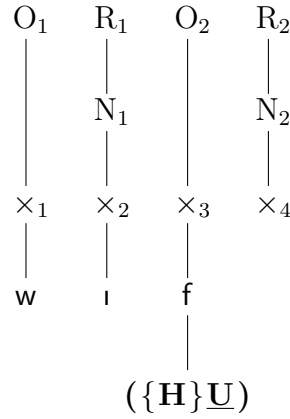While this allows for representing the ɪː in *give*, the process we have just described ("growing a point" ×₃ in (12a)) is a blatant violation of the Non-Arbitrariness Principle. The proposal in (12a) could not possibly be correct. There is no connection whatsoever between the absence of **H** and this emergence of an additional point. **H** is a melodic property, while the extra skeletal slot ×₃ is a structural property. One has nothing to do with the other.

The structures in (12) thus fail to meet basic requirements of GP. In addition to that, even if we did allow for a violation of the Non-Arbitrariness and said that the absence of **H** mysteriously creates an extra point, we would still have no answer to our crucial question: What is special about **H**? *Why* does its absence allow us to grow a point and cause length? If length is sensitive to **H**, why should it not also be sensitive to other elements, *e. g.* **I** or **U**? Our central question remains unanswered. That **H** has a key role to play in length as stated in (9) is a true description of what goes on, but at the same time it reveals a major defect in our theory, which is incapable of expressing a phonological event in a non-arbitrary way: There is no connection between **H** and the lack of extra length.

What is the way out of this dilemma? We have assumed so far that a melodic property (**H**) has an influence on a structural property (length), which gets us into trouble by violating non-arbitrariness, as melody cannot have an effect on structure. In order for a trigger to have an effect on structure, it would have to be structural itself. If, instead of a melodic property like

H, we found some structural property that all the PE's which were believed to contain **H** (or, alternatively, the complement set) share, a non-arbitrary solution would be within our reach. If we can argue that all PE's that we thought contain **H** are associated to a particular structure, then it is clear that it must be the structure that is responsible for the lack of extra length, and not a melodic property.[9]

Once such a structural property is found, **H** could be removed from the set of elements of course, as it would be highly redundant to have both a particular structure and a melodic prime encode the same property. What we need is a language that makes it crystal clear what this structural property is. In our search for such a language we will have to move on to Italian.

1.2.3 Parallels between English and Italian

Let us now see whether there are similar phenomena in other languages, which can serve as a model for our analysis of NYC English. A particularly clear example of the distribution of length comes from Italian—a case that everyone considers purely structural.[10] In other words, a structural phenomenon (distribution of length) is triggered by structural properties. Melody has no role to play whatsoever. A closer look at this particular phenomenon will give us some insight into the kind of solution we will also want for NYC English. However, as we shall see in section 1.2.4, the structures of Italian cannot be adapted to English without violating yet further principles of standard GP. What this means is that standard GP is incapable of expressing the NYC facts in a non-arbitrary way. The purpose of the present section is thus to illustrate that length phenomena can be treated in a structural way, but that such an analysis squares poorly with the theory of constituent structure in standard GP.

(13) gives two pairs of Italian words that illustrate a certain trade-off relationship.

---

[9] This idea is of course not new. For a recent claim along similar lines in West Germanic *cf.* van Oostendorp (2003).

[10] For valuable discussion *cf.* Bertinetto (1981): Chierchia (1986): Nespor & Vogel (1986).

(13)   a.   b.
        fato   'faːto   'fate'   *fatto*   'fatːo   'done'
        casa   'kaːza   'house'   *cassa*   'kasːa   'till'

(13a) shows words with a simpleton onset between two nuclei; the nuclei preceding that onset, *i. e.* the *a*'s of *f<u>a</u>to* and *c<u>a</u>sa* come out as long. In (13b) we have a geminate and the preceding nucleus is short. The (first) *a* in *fatto* or *cassa* is clearly shorter than in *fato* or *casa*. In other words, either the nucleus is long (*fato*, *casa*), or the following onset is (*fatto*, *cassa*). There is a total amount of room that must be taken up, and it can be taken up either by the nucleus or the onset.
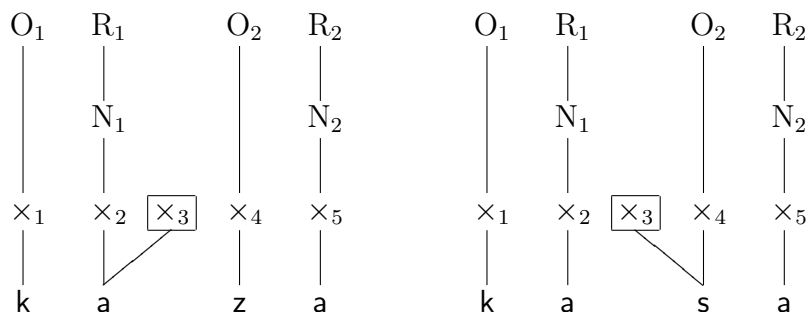
The phenomenon in (13) is commonly referred to as tonic lengthening, *i. e.* as lengthening under stress, but that is too crude a characterisation: It is correct that all long vowels in Italian are stressed, but the reverse is *not* true: Not every stressed nucleus is automatically long, *cf.* the words *città* 'city' or *mùsica* 'music' (stress being indicated by a grave accent `), where the stressed nucleus is not long. Long nuclei are only to be found in penultimate position, and only if the nucleus is not followed by a geminate or a cluster, as we saw in (13).

The details of where and when length occurs are irrelevant to us here, what we are interested in now is the structural properties of this trade-off relationship and whether it can help us understand the facts from NYC English. (14) illustrates this trade-off for the words *casa* 'kaːza 'house' and *cassa* 'kasːa 'till'. The point $\times_3$ is not linked to any constituent node, an issue we will come back to in a moment. What (14) is intended to show is that this point $\times_3$ can either be taken up by the nucleus as in *casa* (14a) or by the onset as in *cassa* (14b). The point cannot be taken up by both at the same time, but on the other hand it *has* to be taken up by one or the other. This gives us the trade-off we observe.

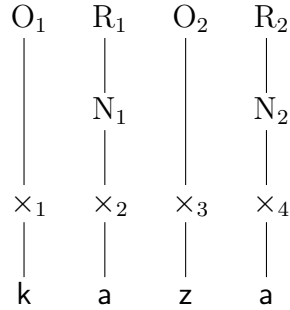(14) a. *casa* 'kaːza 'house'   b. *cassa* 'kasːa 'till'

$$
\begin{array}{cccc}
\text{O}_1 & \text{R}_1 & \text{O}_2 & \text{R}_2 \\
 & \text{N}_1 & & \text{N}_2 \\
\times_1 & \times_2\ \boxed{\times_3}\ \times_4 & & \times_5 \\
\text{k} & \text{a}\quad \text{z} & & \text{a}
\end{array}
\qquad
\begin{array}{cccc}
\text{O}_1 & \text{R}_1 & \text{O}_2 & \text{R}_2 \\
 & \text{N}_1 & & \text{N}_2 \\
\times_1 & \times_2\ \boxed{\times_3}\ \times_4 & & \times_5 \\
\text{k} & \text{a}\quad \text{s} & & \text{a}
\end{array}
$$

The intervocalic sː in *cassa* is simply the longer version of the z in *casa*. We also observe a qualitative difference between sː and z, but, as *fato* 'faːto 'fate' *vs. fatto* 'fatːo 'done' in (13) served to show, no such qualitative difference is required. What counts is the length of the nuclei and the onsets.

What is crucial now is that the representations in (14) allow for a non-arbitrary explanation of the lengthening of the vowel in *casa*. The z in *casa* takes up just one point ($\times_4$); since $\times_3$ has to be filled by something, the preceding a will have to occupy it. The result is *casa* 'kaːza. Contrast this to the long sː in *cassa*, which takes up both $\times_3$ and $\times_4$. The point $\times_3$ is taken care of by the onset and, as a consequence, the preceding a is short.
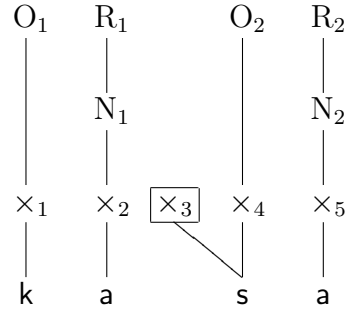
Another important fact about Italian is that the distribution of length is completely independent of melodic considerations. What is important is how many points a given PE is assigned to. The particular melody of that PE (*i. e.* which elements it contains) has no role to play: the first *a* in *casa* is long, just like the first *e* in *mele* 'mɛːle 'honey' or the *u* in *luna* 'luːna 'moon'. Likewise, the PE preceding the long sː in *cassa* will be short just like the one preceding the long fː in *buffo* 'bufːo 'funny MASC.'. Everything revolves around a purely structural issue, *viz.* the number of points a PE is associated to.

While all this is well and fine, there is one issue that the structures in (14) leave unanswered. The lexical representations of *casa* 'kaːza and *cassa* 'kasːa are usually only assumed to contain the geminate *ss* in *cassa*, but not the long vowel in *casa*. The representations given in (14) are generally assumed to be the result of the application of phonology. That is, the representations contained in the lexicon would look like this.

(15) a. *casa* 'kaːza 'house'   b. *cassa* 'kasːa 'till'

	O_1	R_1	O_2	R_2		O_1	R_1		O_2	R_2
		N_1		N_2			N_1			N_2
	$\times_1$	$\times_2$	$\times_3$	$\times_4$		$\times_1$	$\times_2$	$\boxed{\times_3}$	$\times_4$	$\times_5$
	k	a	z	a		k	a		s	a

Crucially, (15a) does not contain any point where the length of the nucleus could be expressed, as a comparison with (14a) makes clear. In other words, we still have no answer to the question *why* the structure of *casa* would grow a point. Where does the point $\times_3$ in (14a) come from? Why does it have to be there, why can we not simply get 'kaza as the realisation of *casa*, *i. e.* with the a staying short? This (still) mysterious appearance of the point responsible for length in *casa* is an important issue we will have to come back to later in the discussion. For the time being, however, let us concentrate on the insight that with structures as under (14) a non-arbitrary account of the trade-off relation between nucleus and onset becomes possible. We might not know yet where the point $\times_3$ in (14a) comes from, but we have seen that it allows for the distribution of length to be expressed in an insightful way. And importantly, unlike in NYC English before, no reference to melody was necessary. Italian relies purely on structure.

Certainly, we would want to able to say something similar about NYC English. The crucial difference between Italian and English is that for English we seem to be forced to make reference to melody: a nucleus gets additional length unless **H** follows. A structural property, *viz.* how many points are available for a certain PE, is dependent on a melodic property, the element **H**. This, as we have seen, runs afoul of the Non-Arbitrariness Principle. Obviously, there must be a mistake then somewhere in our reasoning. Let us go through our assumptions again. We had assumed that **H**, the crucial factor in the distribution of length in NYC English, is melodic. In Italian we saw that length can only refer to structural properties, *i. e.* whether a certain point is taken up by the PE dominated by the nucleus or by the PE dominated by the onset. Treating **H** as a melodic property like any other element is the

very source of our problems in NYC English. **H** seemed to have an effect on structure, which is not what we expect of an element. The obvious conclusion to draw from this then must be that **H** *cannot* be melodic, *i. e.* it cannot be an element. If **H** has an effect on structure, then it certainly must be treated as structural *itself*, *i. e.* a kind of length. That is, instead of saying that a given PE contains or does not contain **H**, we should be saying that a PE which up to now has been assumed to contain **H** is really the longer version of the corresponding PE without that **H**. For example, in the discussion of give ɡɪːv and *whiff* wɪf above, we assumed that a *v* and an *f* in NYC English are only different in that the latter contains **H**, while the former does not: *v* was assumed to be ({}U̲) and *f* ({**H**}U̲). This was the only difference that set the two apart and that difference was melodic in nature. Their structure was identical, *i. e.* they both occupied only one point. Once we understand that we ought to model NYC English after Italian, what we want to say is that an English *f* is a longer version of an English *v*. That is, there is no melodic difference, but only a difference in length. Melodically, *v* and *f* are identical, they are both ({}U̲). The same would hold for pairs like *hiss* hɪs and *his* hɪːz, where *s* is the longer version of *z*, or *bit* bɪt and *bid* bɪːd, where *t* is the longer version of *d*.

Let us call this claim the **fortis/lenis hypothesis**. It states that there is no element **H**; the work that **H** used to do for us is taken over by a structural configuration.[11]

---

[11] The proposal that the distinction between voiceless and neutral consonants is expressed in the structure, *i. e.* as length, instead of melodically, is not new, of course, but has a long tradition in the analysis of many languages, *cf. e. g.* Bloomfield (1956) for Eastern Ojibwa, Sherzer (1970) for Cuna or van Oostendorp (2003) for Dutch (fricatives). The notion of *virtual geminates*, as proposed in *e. g.* Larsen (1994) and Lowenstamm (1996) for Danish or Ségéral & Scheer (2001) for Cologne German and Somali, is similar to the present proposal, though not completely identical.

(16) **Fortis/lenis hypothesis:**
     The element **H** is to be replaced by length: Any PE that formerly
     contained the element **H** is associated to an additional position.

old (with **H**):   new (without **H**):
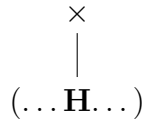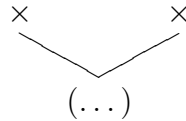
$$\times \qquad\qquad\qquad \times \qquad\qquad \times$$
$$| \qquad\qquad\qquad\qquad \diagdown\quad\diagup$$
$$(\ldots\mathbf{H}\ldots) \qquad\qquad\qquad (\ldots)$$

Where $(\ldots\mathbf{H}\ldots)$ denotes a PE containing **H** and $(\ldots)$ the PE that
remains once **H** has been removed.

If **H** can be expressed as length, it will become superfluous as a melodic
property and can accordingly be eliminated from the set of elements.[12] At
this point we are down to five elements: **A**, **I**, **U** and **L**, which can in prin-
ciple associate to any point, as well as **?**, which is restricted to non-nuclear
positions and, exactly because of that unwanted property, the odd one out
(to which we proceed in section 1.3). We might also want to say that we have
four elements (**A**, **I**, **U**, **L**) and a problem case (**?**).

In order for this change in theoretical perspective to be reflected in the
discussion, I will employ the terms **fortis** and **lenis** from now on. A non-
nuclear expression is said to be fortis if its PE formerly contained **H** and is
now re-interpreted as being associated to two points as per (16). A lenis onset
is an onset whose PE never contained **H**; under the fortis/lenis hypothesis its
melody is associated to only one point.[13]

Let us compare the Italian and the English structures now. (17a) repeats
the structure of Italian *cassa* ˈkasːa 'till' from (14b) and compares it to the
structure of NYC English *whiff* (17b). In order to focus the attention on the
part that really matters, I will only represent the relevant structures from

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[12] Obviously, once **H** is gone as a melodic prime, high tone in nuclei will also have to be
expressed structurally.

[13] The exact wording about the melody being "associated to only one point" will become
crucial in section 1.2.4, where we will see that lenis onsets have the same number
of points as fortis onsets, but that their melody is associated to one point less. The
difference is not in the number of points, but in the number of associations. For the
time being such an (apparent) hair-splitting is rather meaningless.

now on, *i.e.* the long/short nucleus and whatever follows it. This way we do not have to worry whether the initial onset is fortis or lenis, as this is irrelevant to the present discussion.[14]

(17) a. Italian *cassa* 'kasːa 'till'   b. NYC English *whiff* wɪf

$$
\begin{array}{cccc}
\text{R}_1 & \text{O}_2 & \text{R}_2 & \\
| & | & | & \\
\text{N}_1 & & \text{N}_2 & \\
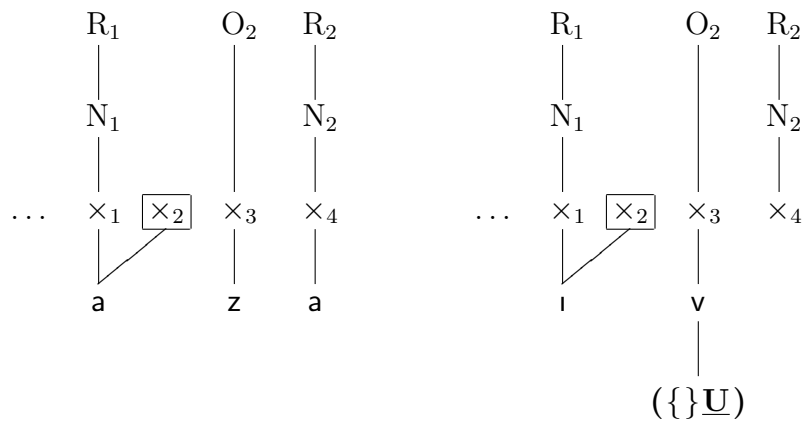| & | & | & \\
\ldots \quad \times_1 \quad \boxed{\times_2} & \times_3 & \times_4 & \\
| & | & | & \\
\text{a} & \text{s} & \text{a} &
\end{array}
\qquad
\begin{array}{cccc}
\text{R}_1 & \text{O}_2 & \text{R}_2 & \\
| & | & | & \\
\text{N}_1 & & \text{N}_2 & \\
| & | & | & \\
\ldots \quad \times_1 \quad \boxed{\times_2} & \times_3 & \times_4 & \\
| & | & | & \\
\text{ɪ} & \text{f} & & \\
& | & & \\
& (\{\}\underline{\text{U}})
\end{array}
$$
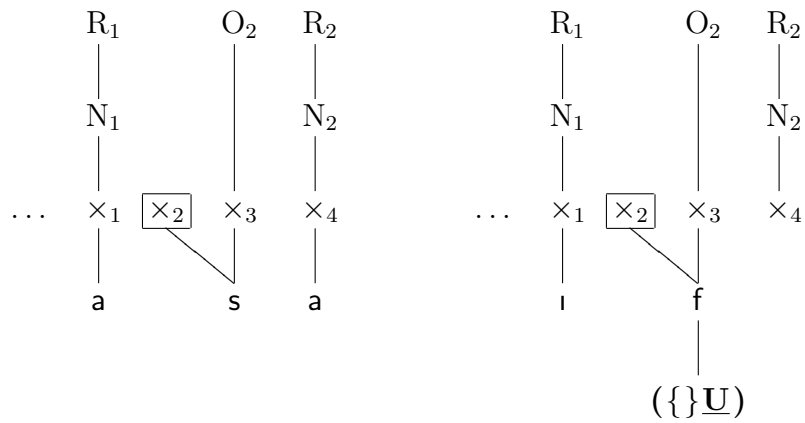
Now, the picture is not complete until we have compared the Italian word *casa* 'kaːza 'house' with NYC English *give* gɪːv. Those two structures are contrasted in (18), where (18a) is a repetition of (14a).

(18) a. Italian *casa* 'kaːza 'house'   b. NYC English *give* gɪːv

$$
\begin{array}{cccc}
\text{R}_1 & \text{O}_2 & \text{R}_2 & \\
| & | & | & \\
\text{N}_1 & & \text{N}_2 & \\
| & | & | & \\
\ldots \quad \times_1 \quad \boxed{\times_2} & \times_3 & \times_4 & \\
| & | & | & \\
\text{a} & \text{z} & \text{a} &
\end{array}
\qquad
\begin{array}{cccc}
\text{R}_1 & \text{O}_2 & \text{R}_2 & \\
| & | & | & \\
\text{N}_1 & & \text{N}_2 & \\
| & | & | & \\
\ldots \quad \times_1 \quad \boxed{\times_2} & \times_3 & \times_4 & \\
| & | & | & \\
\text{ɪ} & \text{v} & & \\
& | & & \\
& (\{\}\underline{\text{U}})
\end{array}
$$

---

[14] A detailed discussion of the word-initial position is given in section 3.4.

At this point, NYC English and Italian merge. In terms of constituent structure and the number of skeletal slots, Italian *cassa* is identical to NYC English *whiff*, while *casa* is the same as *give*. Note in particular that the PE underlying the final fricative in *whiff* and *give* is the same, *viz.* $(\{\}\underline{U})$. Whether we are dealing with an *f* or a *v* only depends on how many points that PE is associated to, which is the consequence of the fortis/lenis hypothesis in (16).

With the structures of English being identical to those of Italian, the lengthening phenomenon we had observed for NYC English falls out. Again, like in Italian, we observe a trade-off. There is a total amount of positions that have to be divided up between the nuclear PE and the following non-nuclear PE: either the nuclear PE takes up more room, or the non-nuclear PE. In the case of *whiff* (17b), the point $\times_2$ is taken up by the final *f*; the fact that $(\{\}\underline{U})$ is associated to both $\times_2$ *and* $\times_3$, *i. e.* that it is long, makes sure that we get a fortis *f*, not a lenis *v*. Since $\times_2$ is taken up by the final *f*, it cannot be taken up by the preceding nuclear expression at the same time. This is quite different in *give* (18b). Here, $(\{\}\underline{U})$ only takes up $\times_3$, which gives us a lenis *v*, and $\times_2$ is taken up by the preceding nuclear PE. That is, the nuclear expression in *give* extends over two positions, $\times_1$ and $\times_2$, which gives us the length we observe. The problematic interaction between melody and structure has been replaced by a purely structural relationship. We are moving towards a theory where reference to melody is no longer necessary.

Let us sum up what we have seen in this section. We discussed length in Italian and saw that it is in no way dependent on melody, which is exactly the state of affairs we wanted to attain for NYC English, too. By reinterpreting the difference between so-called voiceless and neutral consonants, which had been assumed to be distinguished by the element **H**, as a structural difference, the representations of Italian and English became virtually identical. We introduced the fortis/lenis hypothesis in (16) and showed that all the PE's that were assumed to contain **H** could be interpreted as long, *i. e.* as involving two skeletal slots. This effectively allowed us to remove **H** from the set of elements.

While all this is certainly encouraging, our work is not done yet. We have not yet established a satisfying connection between trigger and process in accordance with the Non-Arbitrariness Principle. That is, we have seen that the notion of trade-off helps us to understand NYC English, but we still do not know where the point $\times_2$ in *give* (18b), nor $\times_2$ in the Italian example in

(18a), would come from. Why does it have to present? We know that $\times_2$ in *whiff* (17b) has to be present in order to give us a fortis *f*, but what is the role of $\times_2$ in *give*? The same question had already come up in the discussion of Italian before, and it is now time that we take up this issue. This also brings us to the question which constituent the point $\times_2$ in (14), (17) and (18) is associated to. Those issues will be the topic of the next section.

1.2.4   Fortis/lenis and constituent structure

Let us start with the question which constituent $\times_2$ is associated to. (19) repeats the structures of the English words *whiff* and *give* shown in (17b) and (18b).
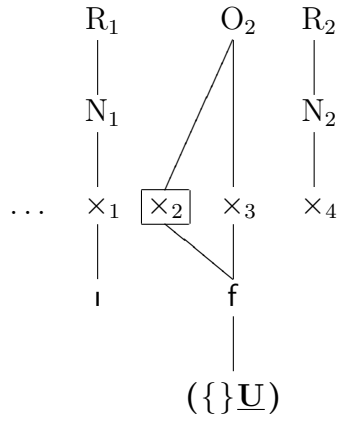
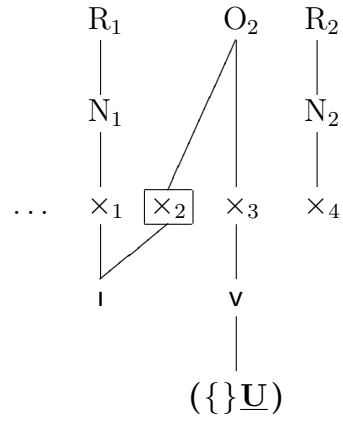(19)   a. *whiff* wɪf   b. *give* gɪːv
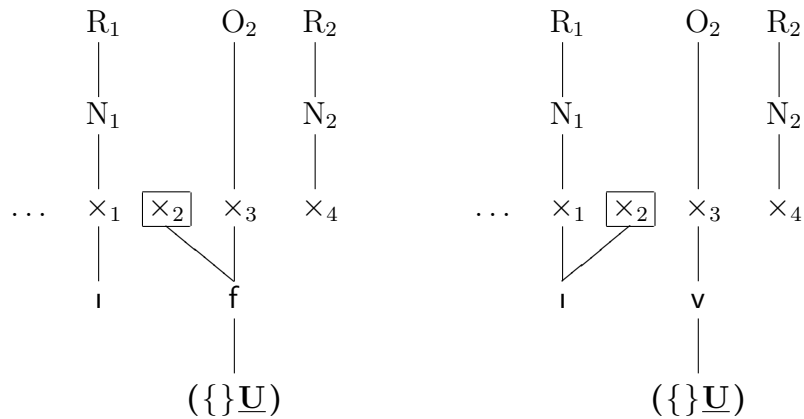
So far we have left the point $\times_2$ unassociated. Which constituent is $\times_2$ associated to? In principle, there are three candidates: it could be associated to O_2 or to N_1, or to R_1. All three possibilities are given for both words in (20).
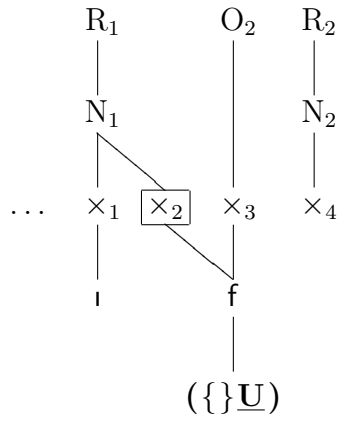
(20) a. *whiff* wɪf

R_1   O_2   R_2

R_1 O_2 R_2

N_1 N_2

... $\times_1$ $\boxed{\times_2}$ $\times_3$ $\times_4$

ɪ   f

$(\{\}\underline{U})$

b. *give* gɪːv

R_1 O_2 R_2

N_1 N_2

... $\times_1$ $\boxed{\times_2}$ $\times_3$ $\times_4$

ɪ   v

$(\{\}\underline{U})$

c. *whiff* wɪf

R_1 O_2 R_2

N_1 N_2

... $\times_1$ $\boxed{\times_2}$ $\times_3$ $\times_4$

ɪ   f

$(\{\}\underline{U})$

d. *give* gɪːv

R_1 O_2 R_2

N_1 N_2

... $\times_1$ $\boxed{\times_2}$ $\times_3$ $\times_4$

ɪ   v

$(\{\}\underline{U})$

e. *whiff* wɪf   f. *give* gɪːv

$$R_1 \qquad O_2 \quad R_2 \qquad\qquad R_1 \qquad O_2 \quad R_2$$

$$N_1 \qquad\qquad N_2 \qquad\qquad N_1 \qquad\qquad N_2$$

$$\ldots \quad \times_1 \;\boxed{\times_2}\; \times_3 \quad \times_4 \qquad \ldots \quad \times_1 \;\boxed{\times_2}\; \times_3 \quad \times_4$$

ɪ　　　　f　　　　　　　ɪ　　　　v

$$(\{\}\underline{\mathbf{U}}) \qquad\qquad\qquad (\{\}\underline{\mathbf{U}})$$
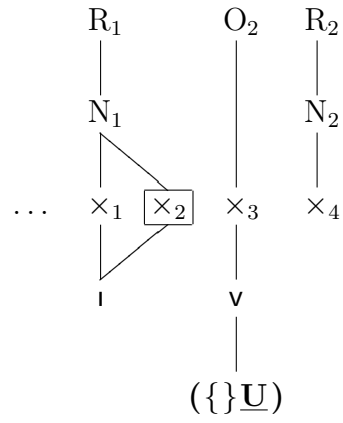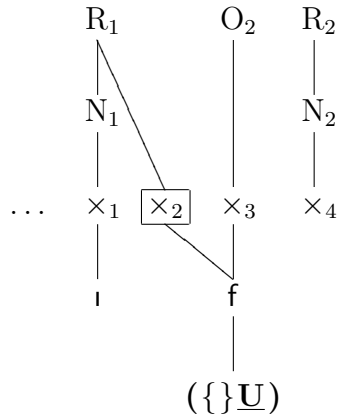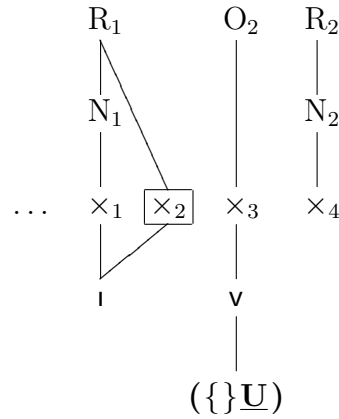
The representations that are normally used in the analysis of such trade-off phenomena are (20e–f), *cf.* Johnsen (1990) for the analysis of Norwegian. Johnsen claims that a lexically long nucleus is to be represented as a branching nucleus, while a nucleus involved in a trade-off relationship with the following onset is to be represented as a branching rhyme. All other structures except for (20e–f) are somewhat problematic. (20a) is excluded since no melodic material may be shared within branching onsets (Kaye, Lowenstamm & Vergnaud 1990: 212). (20b) would be the first case where material from a nucleus is shared with the head of a branching onset: branching onset are head-initial governing domains, *i. e.* $\times_2$ is the head and governs $\times_3$. No such structure has ever been proposed, and as a matter of fact it is doubtful that it could exist. (20c) is in a sense the mirror image of (20b), in that it would be the first case where a geminate is associated to the complement of a branching nucleus and a following onset. This also violates the Minimality Condition proposed in Charette (1989). (20d) is excluded since a headless expression like ɪ ($\{\mathbf{I}\}\_$) cannot be the head of a branching nucleus. In other words, (20e–f) seem to be the only structures that are well-formed and we should assume that those are the correct structures underlying *whiff* and *give*, respectively.

What this suggests is that a fortis f is spread across two constituents ($\times_2$ is dominated by the rhyme and $\times_3$ by the following onset) and that a lenis v occupies just one point ($\times_3$, dominated by an onset). This lenis v requires a preceding rhymal point ($\times_2$) where the length of the preceding nuclear PE

can be expressed. Recall that so far we have no explanation as to why the point $\times_2$ would even have to be there in the word *give*.

The claim I want to make is different. What I want to argue is that the point $\times_2$ in (20e–f) could not be where it is standardly assumed, *i. e.* under the rhyme, but rather that it is part of the onset, both in lenis and fortis onsets. A more detailed discussion of the theory of constituent structure I propose in this dissertation will be given in the following chapters, but let us have a quick look at the representation of a fortis f and a lenis v right away.[15]
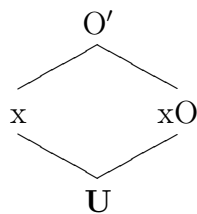
(21) a. fortis f: b. lenis v:
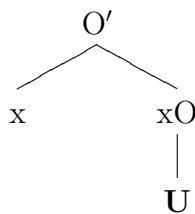
Several things have to be said about (21). Both the 'x' and the 'xO' are skeletal points. They are different in kind, though: xO, a so-called onset head, is the head of the structure, while x is the complement. The head xO is to the right of its complement and projects to a higher level, giving us the O$'$, *i. e.* a constituent of the type onset. The most important aspect of (21) is that both a fortis onset and its lenis counterpart have exactly the same number of points, *viz.* two in the representation of v/f in (21). What distinguishes a v from an f, then, is the number of points the PE is associated to, *not* the number of points present. That is, an f is the longer version of a v, but only in terms of how much room is taken up by the specific melody, not by how much room there is in total. The f has its melody **U** extending over both points, while in v the same **U** takes up the rightmost point only.

What this means is that every lenis onset comes with an "unused" skeletal point, *i. e.* one that is not taken up by any melody.[16] This automatically gives

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[15] In the new structures I only indicate the elements, but not complete PE's. Also, in (21) the elements are shown as being *associated* to skeletal points, which, as I will show, cannot be correct. I use association lines here for expository reasons only. We will come back to both issues in chapter 2.

us the effects with respect to length that we have observed. Assume that the empty point of a lenis onset, *e. g.* $\times_1$ in (21b) always has to be occupied by some melody. Obviously, if the melody of the onset itself does not make use of it (because if it did we would be dealing with a fortis onset, not a lenis one), then it follows that the preceding nucleus has to take care of that point and take it up. Thus, in a word like *give*, the nucleus will have to be long and we get gɪːv. We finally have an answer to our question, *viz.* where does the point come from where length is expressed in *give*. It is part and parcel of the lenis onset. Extra length does not come out of nothing, but it comes with the lenis onset. This idea is illustrated in (22), where xN represents a nuclear head to be discussed in chapter 2. For the time being it is enough to know that it represents the nucleus.

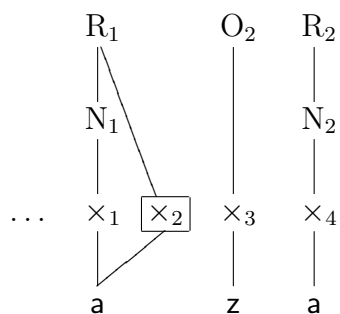(22)   a. *whiff* (relevant part)   b. *give* (relevant part)
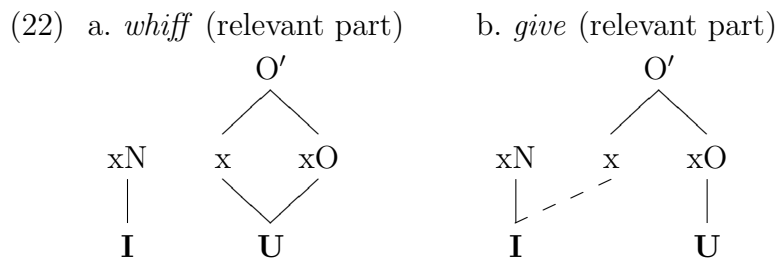
However, as we said above, this is not how standard GP sees it. Standard GP uses the structures in (20e–f). What we will have to do now is a kind of *reductio ad absurdum*: We need to demonstrate that the fortis/lenis hypothesis does not square with the standard theory of GP. In order to show that the standard theory has to be wrong, we will assume that it is right after all (and that my claim in (21) was wrong) and see what problems we run into. This method will demonstrate that the structures employing branching rhymes face insurmountable difficulties and that a new way of representing fortis/lenis onset, such as under (21), is required.

Let us go through this step by step now. (23) compares the representations of Italian *casa* and *cassa* with those of NYC English *give* and *whiff*, assuming that all four have a branching rhyme. This is essentially a repetition of (17)
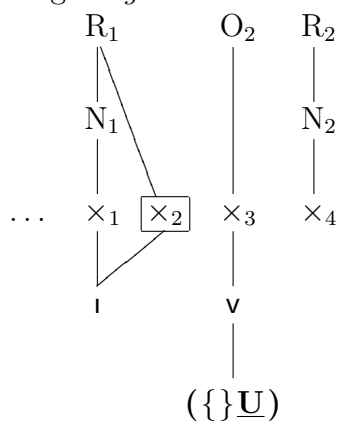
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[16]   Again, in chapter 2 we will see that this reference to melody being attached to particular positions or not being attached to a position is actually incorrect. For our present purposes, this is irrelevant.

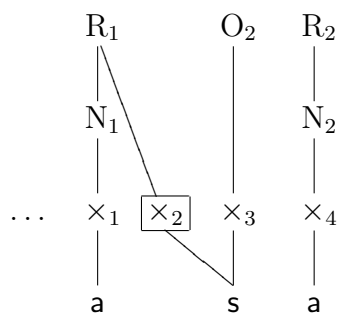and (18), except that the association line between $\times_2$ and the preceding rhyme has been added in.
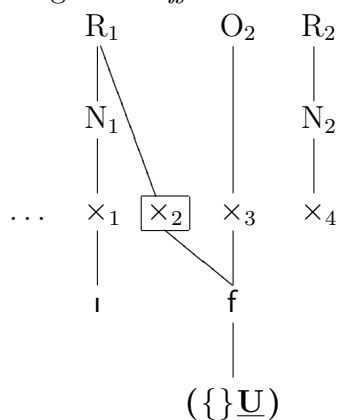
(23) a. Italian *casa*

$$R_1 \qquad O_2 \quad R_2$$

$$N_1 \qquad\qquad N_2$$

$$\ldots \quad \times_1 \;\boxed{\times_2}\; \times_3 \quad \times_4$$

$$a \qquad z \quad a$$

b. English *give*

$$R_1 \qquad O_2 \quad R_2$$

$$N_1 \qquad\qquad N_2$$

$$\ldots \quad \times_1 \;\boxed{\times_2}\; \times_3 \quad \times_4$$

$$ɪ \qquad v$$

$$(\{\}\underline{U})$$

c. Italian *cassa*

$$R_1 \qquad O_2 \quad R_2$$

$$N_1 \qquad\qquad N_2$$

$$\ldots \quad \times_1 \;\boxed{\times_2}\; \times_3 \quad \times_4$$

$$a \qquad s \quad a$$

d. English *whiff*

$$R_1 \qquad O_2 \quad R_2$$

$$N_1 \qquad\qquad N_2$$

$$\ldots \quad \times_1 \;\boxed{\times_2}\; \times_3 \quad \times_4$$

$$ɪ \qquad f$$

$$(\{\}\underline{U})$$

All the structures in (23) are well-formed. The only difference between *casa* in (23a) and *give* in (23b) as well as *cassa* in (23c) and *whiff* in (23d) is that in Italian the last nucleus is filled, while in the English words given it is empty. In all four cases, the point $\times_2$ is associated to the rhyme. This point is used by the nuclear PE in (23a–b) and by the fortis onset in (23c–d).

While the structures in (23) are fine for Italian, we run into serious problems in English once we extend our analysis to words like *leave* and *leaf*. Both words contain a lexically long nucleus and the *v* in *leave* provides extra

room, *i. e.* we have liːːv *vs.* liːf. A lexically long nucleus in English is assumed to be a branching nucleus, *i. e.* both *leave* and *leaf* have to contain branching nuclei. But if that is correct, where do we have room to express the extra length in *leave*, or the fortis *f* in *leaf*? In addition to the branching nucleus we would need a branching rhyme in both cases, which violates the Binarity Theorem, as the rhyme would dominate three positions. The illicit structures that *leave* and *leaf* seem to require are given in (24).

(24) a. *leave* (illicit)   b. *leaf* (illicit)

$$
\begin{array}{ll}
\text{a. } R_1 \quad O_2 \quad R_2 & \text{b. } R_1 \quad O_2 \quad R_2 \\
\quad N_1 \quad\quad N_2 & \quad N_1 \quad\quad N_2 \\
\dots \; \times_1 \; \times_2 \; \boxed{\times_3} \; \times_4 \; \times_5 & \dots \; \times_1 \; \times_2 \; \boxed{\times_3} \; \times_4 \; \times_5 \\
\quad\quad\quad i \quad\quad\quad v & \quad\quad\quad i \quad\quad\quad f
\end{array}
$$
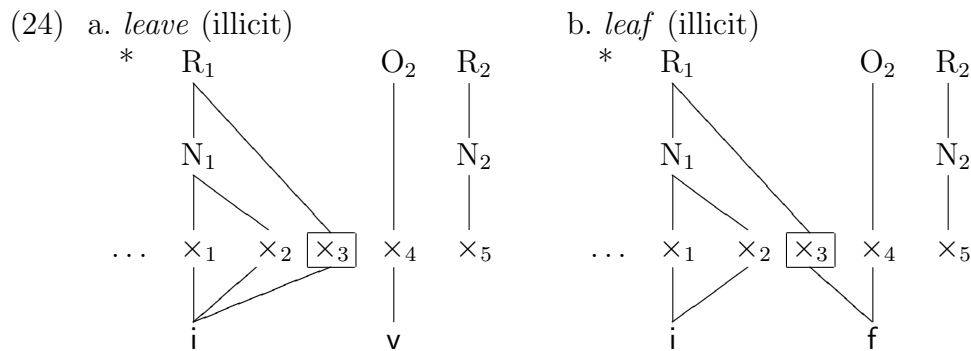
Both structures in (24) are excluded. There is no way to incorporate the fortis/lenis hypothesis introduced in (16) within the standard theory of constituent structure. The three skeletal slots we want to assign the nuclear PE in *leave* to cannot be dominated by the rhyme, and nor can the long iː and the 'first half' of the *f* in *leaf*. The standard theory fails. The point $\times_3$ cannot be dominated by the rhyme.[17] Rather it has to be part of the following onset, as proposed in (21).

The Binarity Theorem is itself derived from the principles of strict locality (governor and governee must be strictly adjacent) and strict directionality (within a constituent the leftmost point is the head), *cf.* Kaye, Lowenstamm & Vergnaud (1990: 199). From those two principles it follows that the structures in (24) are illicit: $\times_1$ is the leftmost point of the constituent R_1, *i. e.* it is the head and must govern everything within the same constituent. However, $\times_3$ is not strictly adjacent to its governor $\times_1$, therefore $\times_3$ cannot be governed and the structure is ungrammatical. Of course, one might be tempted

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[17] In section 1.3.4 we will discuss an alternative possibility, *viz.* that fortis consonants be represented as onset-onset structures. As we shall see there, such an approach fails as well.

to simply relax those two principles (and therefore the Binarity Theorem) and declare the structures in (24) grammatical.[18] The Binarity Theorem in its current incarnation states that no constituent may dominate more than two skeletal slots *ever*, *i. e.* it is not relevant whether the skeletal points are immediately dominated by the constituent in question or not. Neither rhyme in (24) dominates three slots *immediately*, but in total they do dominate three. What (24) seems to require is that strict locality be restated. What we would need is a principle where all that matters is whether constituents immediately dominate more than two daughters or not. Under such a redefinition, both structures in (24) become grammatical, as no constituent dominates more than two two daughters, *i. e.* branches more than twice. However, all this is saying is that the standard theory as we know it has to be redefined, for which still further evidence will be provided in this chapter. Any redefinition of basic principles is not a "solution", but only an admission of defeat. Furthermore, even if we declared (24) grammatical, we would still have no reason for the additional point $\times_3$ coming with the lenis *v*. Clearly, a solution such as the one under (21), where the extra point comes with the lenis consonant, is to be preferred.

Summing up: We have seen that replacing **H** by length (the fortis/lenis hypothesis) makes the seemingly arbitrary distribution of length in NYC English a good deal less arbitrary. However, as became clear in the last section, there is no way to incorporate this shift from melody to structure in the existing theory of constituent structure, which suggests that constituent structure as we know it has to be modified. One first step towards such a modification has already been presented: Both fortis and lenis onsets (*e. g. f* and *v*) were treated as branching onsets, *i. e.* contained two skeletal points. The difference between fortis and lenis was then whether both points would be taken up by melody or only the rightmost point. This allowed for a straightforward explanation of distribution of length to be observed in words like *give*. This branching onset structure was one tiny fragment of a full-fledged theory of constituent structure to be elaborated in the following chapters. What we will turn to now is the elimination of **ʔ**. All the examples of fortis and lenis onsets we have discussed so far only involved fricatives, and the reason for that will become clear in the following section.

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[18] Harris (1994: 67ff) proposes such as relaxation for words with 'super-heavy rhymes' as in *moist*, *count* or *fiend*, which also seem to require structures as in (24b).

1.3 Jensen's (1994) configuration hypothesis

In this section I will discuss a proposal by Jensen (1994) to the effect that **ʔ** is to be replaced by a particular structural configuration. The difference between, say, a p and an f or a b and a v is not to be expressed with the melodic prime **ʔ**, but rather structurally. Jensen is only concerned with the element **ʔ** and treats **H** as an element like all the others. Accordingly, when discussing Jensen's proposal (section 1.3.1) and the problems associated with it (section 1.3.3), I will pretend that **H** is still a member of the set of elements. In section 1.3.4, however, I will discuss the consequences of abandoning both **ʔ** and **H**, *i. e.* how the insights from section 1.2 and Jensen's proposal can be combined. The immediate advantages of such a move are obvious: If we succeed in eliminating both **ʔ** and **H**, our set of remaining elements is down to four. We are left with **A**, **I**, **U** and **L**, generating a grand total of $2^{4-1} \times (4+2) = 48$ expressions, *cf.* the formula in (4). The expressive power of element theory is more restrained than ever before.[19] Let us first see what would be necessary to get rid of **ʔ**, though.

1.3.1 The proposal

Crucial evidence for Jensen's (1994) proposal that **ʔ** be abolished as a melodic prime comes from the West-Atlantic language Pulaar (Anderson 1976: Diallo 2000: Skousen 1972: Sylla 1982), where the element **ʔ** seems to play an important role. Close inspection of the facts, however, reveals that the melodic property **ʔ** ought to be replaced by a structural configuration.

Pulaar has a large number of noun classes, each of which has a characteristic suffix. Due to their semantic function, noun classes can be roughly divided in classes for humans, non-humans, diminutives and augmentatives (Sylla 1982: 29ff); each of those four groups in turn comprises a number of noun classes. A particular noun class can have a very specialised semantic meaning, but does not have to. The singular and plural of a particular word are in different noun classes: the word ba:fal 'door' has a plural ba:fe 'doors'; those two words belong to different (non-human) noun-classes.

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[19] Of course, by simply replacing elements with more structure we cannot hope to curb over-generation altogether. With bigger structures we have an increased number of possibilities where melody can associate to, which partly makes up for eliminating elements. In section 2.3.3 we will discuss ways to restrict this.

There are at least two areas where Pulaar makes a clear distinction between the set of PE's containing **ʔ** and the complement set of those without. The first issue concerns geminates: only PE's containing **ʔ** can occur as geminates, those without cannot. That is, we get long plosives, affricates, nasals or *l*, all of which contain **ʔ**, but no long fricatives or glides. Every geminate must contain the element **ʔ**, and every PE containing **ʔ** can occur as a geminate. Evidence such as this can been brought to the fore as an argument for the element **ʔ**, as it exactly defines the natural class that gemination is sensitive to. With this in mind, let us now consider the words in (25a).

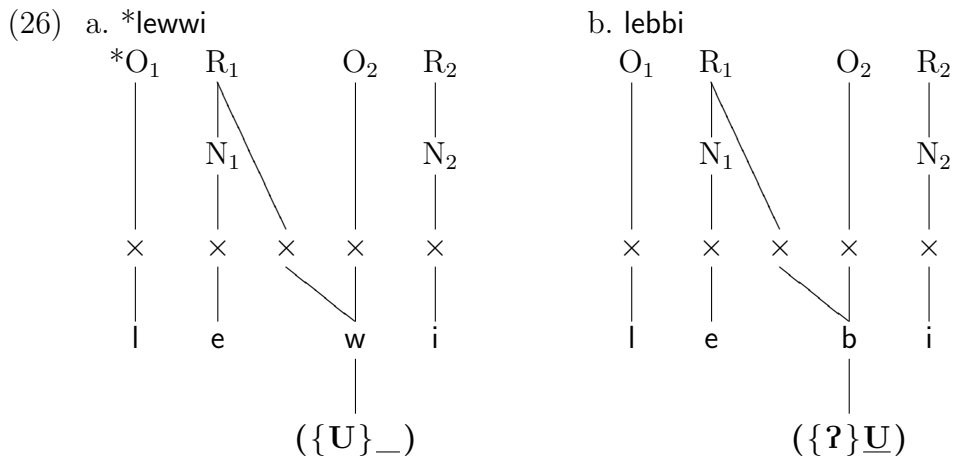(25) a. lewru   lebbi   'month ∼ months'
          nofru   noppi   'ear ∼ ears'
          lefol   leppi   'pennant ∼ pennants'
          kɔsam   kɔtʃːɛ   'milk' ∼ (pl.)
          etc.

      b. **Correspondences**
          w   b   f   p
          ∅   g   h   k
          r   d   s   tʃ

Let us take the word lewru 'month': lew is the stem and -ru the suffix marking the particular noun class. The stem-final w has an underlying PE that does not contain **ʔ**: w is simply $(\{U\}\_\_)$ and therefore, as we have said before, it could never occur as a geminate. The plural corresponding to lewru is lebbi. The marker of the noun class we see in the plural is -Ci, where C means that it is a copy of the preceding consonant. That is, the stem lew plus the suffix -Ci gives us lebbi, and not *lewwi. This is not only true of *ww: as (25a) shows we also get pp instead of *ff etc., *cf.* the correspondences in (25b). A geminate *ww is disallowed, the geminate *bb we find in its place contains the element **ʔ**, as required in Pulaar. The question is of course: where does this **ʔ** come from? Once we geminate a w, we seem to get a **ʔ** for free. Instead of (26a) we get (26b).

(26)   a. *lewwi   b. lebbi

$*O_1$ R_1 O_2 R_2 O_1 R_1 O_2 R_2

              N_1 N_2 N_1 N_2

×   ×   ×   ×   ×   ×   ×   ×   ×   ×

l   e   w   i   l   e   b   i

($\{U\}\_$)   ($\{\textbf{ʔ}\}\underline{U}$)

Internal geminates are not the only case where an **ʔ** seems to emerge out of nothing. We find an identical phenomenon at the beginning of the base. Consider the following words, taken from Jensen (1994: 71) (transcription adapted) and Sylla (1982).

(27)

WEAK	STRONG	GLOSS
waː^{n}du	baːɗi	'monkey ∼ monkeys'
waːre	bahel	'beard ∼ little beard'
fɛrlo	pɛrle	'hill ∼ hills'
hinɛrɛ	kine	'nose ∼ noses'
reːdu	deːɗi	'stomach ∼ stomachs'
saːre	tʃaʔe	'town ∼ towns'
baːfal	baːfe	'door ∼ doors'
dewal	deweːdʒe	'big woman ∼ big women'
palel	palon	'little field ∼ little fields'
nofru	noppi	'ear ∼ ears'
lekki	leɗɗe	'tree ∼ trees'

This is the second area where Pulaar makes a clear distinction between PE's containing **ʔ** and those without. Each row in (27) shows a particular base occurring in two different noun classes. From the point of view of the phonological make-up, we can divide those noun classes into two groups, *viz.* a weak group (the first row in (27)) and a strong group (the second row in (27)). The weak group is characterised by the fact that *any* consonant

can occur at the beginning of the base, *i. e.* glides, fricatives, nasals, plosives etc. There are no restrictions whatsoever. In the strong group, on the other hand, we only find base-initial consonants containing the element **ʔ**, *i. e.* plosives, affricates, nasals and *l*. Consonants with PE's not containing **ʔ** are categorically banned from the strong class.

Let us look at one row in detail. We find the word **waːre** 'beard' and a corresponding diminutive **bahel** 'little beard'. Both words are in different noun classes and accordingly, we get a different suffix. In addition to the different class markers, though, we observe an alternation at the beginning of the morphological base. The noun class of **bahel** belongs to the strong group, and accordingly, an initial **w** (as in **waːre**) will not do, we need a **b**. A **w** simply contains **U**, a **b** contains **U** and **ʔ**. Again, it is as if we got a **ʔ** for free and the question is: where does the **ʔ** come from?

Both in the discussion of internal geminates and in the cases of initial mutations we saw a **w** alternating with a **b**. This parallel between geminates and initial mutations is not restricted to **w** ∼ **b**, however. Closer comparison of the words (25a) and (27) reveals that the same (seemingly melodic) alternations occurring in (25a) can also be found in (27) and vice versa: **w** alternates with **b**, **f** with **p**, **s** with **tʃ** etc. The set of alternations is completely identical, *cf.* the chart in (25b). What sets the two phenomena (geminates and initial mutations) apart, is that with the initial mutations we get simpleton stops/affricates, while with the internal geminates we get—of course—geminates. In both cases, the alternation can be characterised by an addition of the element **ʔ**, which begs the question of where that **ʔ** comes from.

In the case of the geminates one could assume that the element **ʔ** in some sense "comes with" the coda-onset structure. In (26) we saw that such structures could only be occupied by PE's containing **ʔ**; it is as if that particular structure "added" a **ʔ**. Once a PE is associated to a coda-onset structure, a **ʔ** will be present by necessity. What if this were generally true, and, more importantly, what if the reverse were true as well? That is, assume that not only will a coda-onset structure guarantee the presence of **ʔ**, but that, conversely, also every PE containing **ʔ** would be associated to a coda-onset structure. If this reasoning is correct and if **ʔ** is indeed a property associated with coda-onset structures, we must assume that that also holds for the initial mutations. In a pair like **waːre** 'beard' and **bahel** 'little beard' we must assume that the initial **b** of **bahel** occurs in a coda-onset structure, while the initial **w** of **waːre** is an onset without a preceding coda. The difference between a

weak w and a strong b correlates with noun classes, *i. e.* it is morphologically conditioned. That is, the particular noun class that bahel is in not only has a suffix, but also a rhymal *prefix*. What is special about the initial mutations and what sets them apart from the internal geminates is that we never get to hear the "first half" of the geminate. Both, however, involve a coda-onset structure.

That ʔ is connected with coda-onset structures is exactly the conclusion Jensen draws. In fact, he goes one step further: If ʔ only occurs in coda-onset structures and coda-onset structures always imply ʔ, then we have one property, stopness, expressed by two means, *viz.* melodically and structurally. One of them is clearly superfluous. This allows us to get rid of the element ʔ, which has been problematic all along, *cf.* the discussion in section 1.1. Stopness is not a melodic prime, but rather the *interpretation* a PE receives when it is dominated by an onset point that governs a preceding coda. The formal definition is given in (28).

(28)   A PE α receives stop-interpretation *iff* it is associated to an onset in a strictly local, head-final governing relationship (a coda-onset configuration).
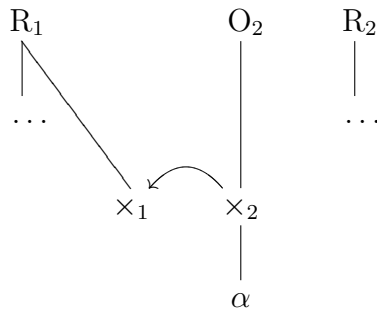

Whether the rhymal point $\times_1$ also dominates melody is immaterial for the stop interpretation.[20] This also allows us to distinguish between the initial simpleton stops in the strong group of Pulaar nouns, *e. g.* in bahel 'little beard', as opposed to the internal geminates in words like lebbi 'months'. In

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[20] Jensen (1994) also discusses prenasalised stops which would have a structure as in (28) with $\times_1$ dominating the element **L**, which is responsible for nasality.

a geminate (internal position), the melody would have to spread from $\times_2$ to $\times_1$, while in simpleton stops (initial position) it is only associated to $\times_2$.

In order to make this clearer, let us give the representation of the initial consonant in the Pulaar words waːre and bahel. The w in waːre does not receive stop interpretation, so it must not be associated to an onset governing a preceding rhymal point. It is simply dominated by an onset, with nothing preceding. This is given in (29a). The b in bahel, on the other hand, receives stop interpretation. We have to conclude that it occurs in a coda-onset structure as given in (29b).
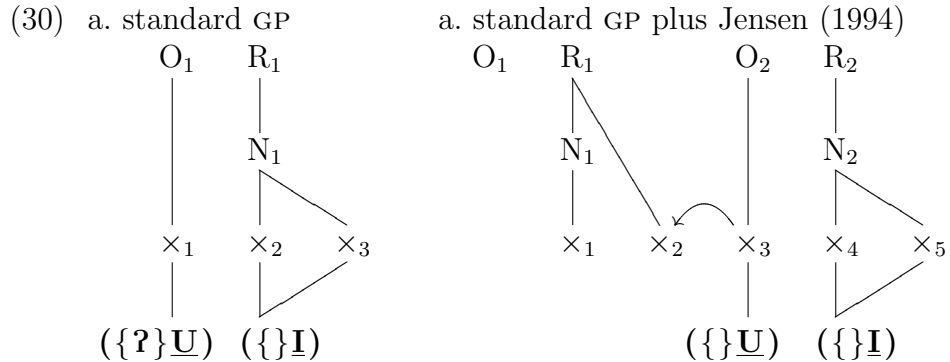
(29) a. w in waːre   b. b in bahel
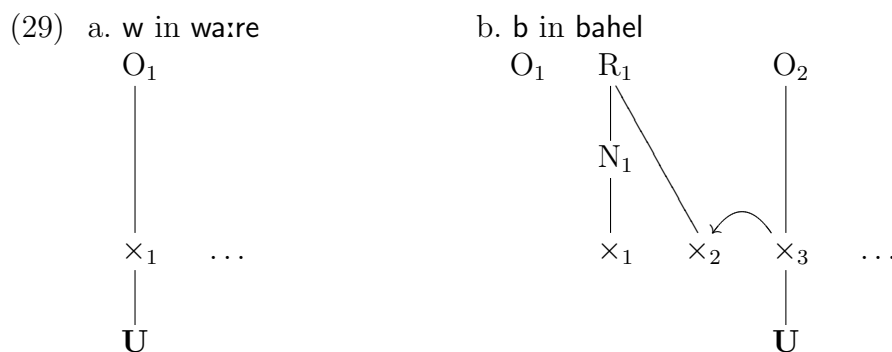
Jensen's proposal is of course not restricted to Pulaar. Once **ʔ** is removed from the set of elements, it is clear that the structure in (28) is not peculiar to that language, but rather the universal representation of stops—any PE that was assumed to contain **ʔ** will have to be reinterpreted as a coda-onset configuration, in any language.[21, 22] Compare the following two representations for the English word *bee*, where (30a) gives the standard representation

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[21] Jensen (1994: 75ff) also shows that alternations like the ones in Pulaar are not restricted to that particular language, but can be found in very similar fashion in (the distantly related language) Sesotho and even in a completely unrelated language like (Munster) Irish. The 'classical' initial mutations of Irish can be analysed along similar lines as the alternations in Pulaar.

[22] This effectively means that there cannot be a parameter for whether a language has branching rhymes or not (Kaye 1989: 54ff) in standard GP. Since all languages have stops and since stops always involve a coda-onset configuration, all languages must have rhymes. Variation rather lies in that certain languages allow for the rhymal position to be filled (like in English), while others do not.

following Kaye, Lowenstamm & Vergnaud (1990), while (30b) shows the representation according to Jensen's proposal.

(30) a. standard GP   a. standard GP plus Jensen (1994)

$$O_1 \quad R_1 \qquad\qquad O_1 \quad R_1 \qquad\qquad O_2 \quad R_2$$

$$N_1 \qquad\qquad\qquad N_1 \qquad\qquad\qquad N_2$$

$$\times_1 \quad \times_2 \quad \times_3 \qquad\qquad \times_1 \quad \times_2 \quad \times_3 \quad \times_4 \quad \times_5$$

$$(\{\mathbf{?}\}\underline{U}) \quad (\{\}\underline{I}) \qquad\qquad (\{\}\underline{U}) \quad (\{\}\underline{I})$$

In (30b) $\times_3$ governs the preceding rhymal point $\times_2$ and thus, the PE ($\{\}\underline{U}$) associated to $\times_3$ will receive a stop interpretation. This gives us the b in *bee*.

1.3.2 Advantages of Jensen's proposal

Let us now note a number of advantages that Jensen's proposal has. Stopness is not seen as a melodic property, but rather involves a structural relationship holding between two points. Such a change in perspective helps us understand a particularly weird property the element **?** was burdened with, *viz.* the fact that **?** never seemed to spread. There seem to be no cases of "stopness assimilation", where **?** would have to spread from one position to another.[23] In a model employing **?** as an element, this comes somewhat as a surprise: If other elements can spread (*e. g.* in clusters, in harmony etc.), why would **?** be any different? Once **?** is done away with and replaced by a structural configuration, we get an immediate and satisfactory answer to our question: Stopness is an interpretational property given to a particular configuration between two points, and obviously configurations cannot spread. They hold between two particular positions. The structural approach has solved an awkward problem with respect to the weird properties of **?**. In addition to that,

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[23] For the same point *cf.* Golston & Hulst (1999), who also represent stopness as a structural configuration, albeit in a very different model of constituent structure.

and that is the second advantage of Jensen's account, it becomes clear why
ʔ was limited to non-nuclear positions. This asymmetry falls out once we
assume that it is really a coda-onset structure. Since both the coda (*i. e.*
the post-nuclear rhymal complement) and the onset are different from the
nucleus, it is obvious why ʔ could not occur in nuclei.

Another advantage of Jensen's proposal has been mentioned a number
of times: Once ʔ is removed from the set of elements, we obtain a system
where melody and structure are completely independent of each other. All
the remaining elements are free to associate to both nuclear or non-nuclear
positions. Just by looking at the PEs in a representation, there is no telling
which one of them associates to nuclear positions, and which ones to non-
nuclear positions. Furthermore, any reduction in the set of elements leads of
course to a curtailment of the generative power of element theory, as a quick
look at the chart in (5) shows.

Yet another appealing feature of Jensen's proposal is the fact that "man-
ner" is entirely a matter of structure now. The only properties that are en-
coded by the melodic primes relate to the "place of articulation".[24] While
of course nothing *requires* that the phonological world be divided that way
(after all, "manner" and "place of articulation" refer to categories relating
to *articulation* and nothing truely phonological here), it is still an interesting
and aesthetically pleasing result.

1.3.3   Consequences of Jensen's proposal

Jensen's proposal is highly attractive for several reasons, as we saw in sec-
tion 1.3.2. However, it is fraught with problems that seem hard to overcome in
the theory of constituent structure that standard GP uses. Jensen is of course
well aware of that. As he himself already points out (Jensen 1994: 71), "par-
ticular areas of existing supra-skeletal theory [. . .] require 'tweaking'"—where
"tweaking" is quite an understatement, it seems. Let us turn to this issue
now and see where we run into problems. Jensen does not explicitly discuss
the examples presented in this section, but it is clear from his article that he
is aware of the problems. (In a follow-up article (Jensen 1995) he proposes a
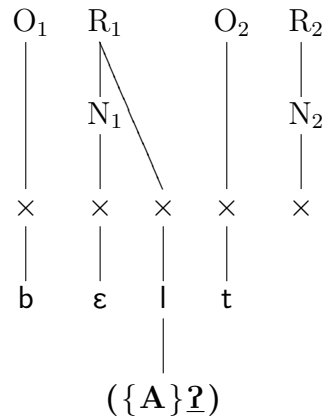radically modified version of constituent structure to accomodate the change

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[24] For similar proposals, *i. e.* that stopness is a structural property, *cf.* Golston & Hulst
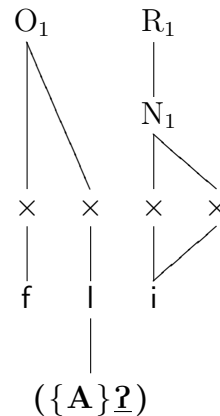   (1999) and Szigetvári (2002).

from **ʔ** being melodic to it being expressed structurally. I will not adopt the model presented in (Jensen 1995), however, since it does not allow me to incorporate the fortis/lenis hypothesis in (16). In Jensen's (1995) model, it is a definitional property of stops that they always involve two points, while fricatives always involve one point. This makes it impossible to encode the difference between *e. g.* v and f as structural.)

There are several issues that make it difficult to integrate the proposal in Jensen (1994) into standard GP. Firstly, while it is certainly true that the element **ʔ** was banned from nuclear positions, it could occur in *different* kinds of non-nuclear positions, *e. g.* in rhymal complements as in words like *belt*, *self*, *helmet*, *bend*, *lamp*, *apt*, *act*, etc. (31a) or the complements of branching onsets in *flee*, *play*, *clock*, etc. (31b).

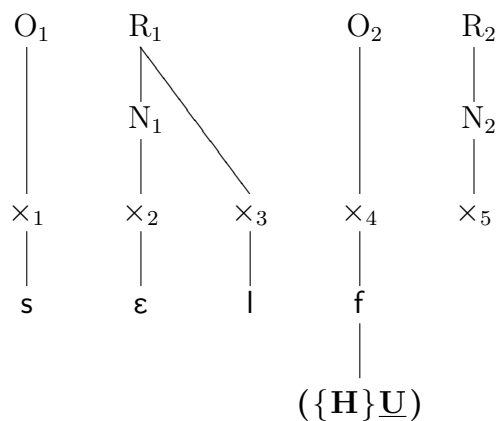(31) a. *belt* in standard GP   b. *flee* in standard GP

$$O_1 \quad R_1 \qquad O_2 \quad R_2 \qquad\qquad O_1 \qquad R_1$$

$$N_1 \qquad\qquad N_2 \qquad\qquad\qquad N_1$$

$$\times \quad \times \quad \times \quad \times \quad \times \qquad\qquad \times \quad \times \quad \times \quad \times$$

$$b \quad \varepsilon \quad l \quad t \qquad\qquad\qquad f \quad l \quad i$$

$$(\{A\}\underline{\textbf{ʔ}}) \qquad\qquad\qquad\qquad (\{A\}\underline{\textbf{ʔ}})$$

In other words, if it is the case that **ʔ** can be "synthesised" (to use Jensen's wording) by being in the governing position of a coda-onset relationship, then the *l* in *belt* or *fly* would have to be exactly in such a position, but it is not, as the representations in (31) show. It is in a complement position in both cases. Since a given ×-slot cannot be dominated by two different configurations at the same time, it would follow that laterals and nasals (both classes containing **ʔ** in the standard theory) should not be allowed to occur in complement positions, which is of course incorrect. We would either be forced to say that (i) liquids and nasals do not contain **ʔ**, or (ii) that there are in fact two sets for each class: a set of liquids with **ʔ** and

one without, and a set of nasals with **ʔ** and one without, or that (iii) the representations in (31) cannot be correct. Part of the evidence for **ʔ** in nasals and stops came of course from Pulaar itself, *i. e.* it was the very evidence that suggested that **ʔ** be replaced by a structural configuration. Option (i) is out. Option (ii) begs the question of what the evidence for such an assumption is. The only reason we would have to posit two such sets would be our desire to make Jensen's proposal work. This is clearly not satisfactory. We are left with option (iii): the representations given in (31) must be wrong. If they are wrong, however, what *is* the correct representation? Clearly the theory of constituent structure will need a major overhaul to cope with this problem.

The second problem the standard theory faces is basically the reverse of the first one: Not every onset involved in a coda-onset relationship is a stop in the standard theory, *cf.* words like *self*, *cur̲v̲e*, *fil̲t̲h̲* etc.

(32) *self* in standard GP

$$
\begin{array}{cccccc}
O_1 & R_1 & & O_2 & R_2 \\
| & | \diagdown & & | & | \\
 & N_1 & & & N_2 \\
 & | & \diagdown & & | \\
\times_1 & \times_2 & \times_3 & \times_4 & \times_5 \\
| & | & | & | & \\
\text{s} & \varepsilon & \text{l} & \text{f} & \\
 & & & | & \\
 & & (\{\mathbf{H}\}\underline{\mathbf{U}}) & &
\end{array}
$$

If **ʔ** is to be replaced by a coda-onset configuration, the structure given in (32) cannot be the one assigned to words like *self*. The slot $\times_4$ governs the preceding rhymal point $\times_3$ and accordingly, any PE associated to $\times_4$ must receive stop interpretation and could not come out as a fricative like f: instead, we would get a p.

A third problem is how we could get a long nuclear PE before stops as in a word like *weed*. If a stop like d requires a coda-onset configuration, the preceding rhyme will have to be branching, *cf.* (28). Since the Binarity

Theorem precludes branching nuclei within branching rhymes, we should not get long vowels before stops. The illicit representation is depicted in (33).

(33) $*O_1$ R_1 O_2 R_2

                N_1 N_2

       ×   ×   ×   ×   ×   ×

       w   i   d
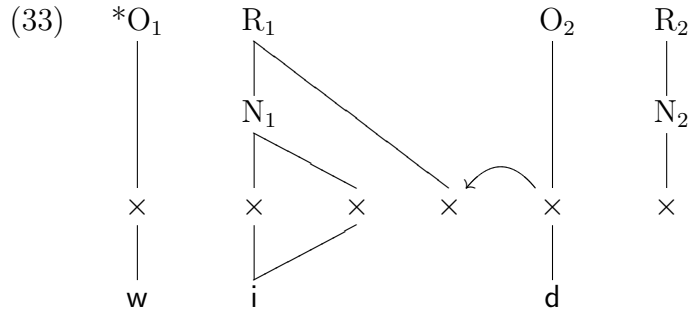
English *weed* or *cube* should therefore be excluded, which is of course incorrect.

1.3.4   Abandoning ʔ and H

As the discussion in section 1.3.3 showed, making Jensen's proposal work with the theory of constituent structure that standard GP uses is not without problems. Coda-onset configurations would be required in places where the standard theory cannot provide them.

As the reader will already be able to anticipate, the problems would get even worse if we tried to combine Jensen's insights with the fortis/lenis hypothesis from section 1.2 within standard GP. While getting rid of **ʔ** alone is demanding enough, abandoning both **ʔ** and **H** at the same time seems like a real challenge. In section 1.2.4 I argued that the model of constituent structure used in standard GP runs into problems with incorporating the fortis/lenis hypothesis, as it requires rhymes where the standard theory cannot provide them. In other words, the problematic area is basically the same both for Jensen's proposal *and* the fortis/lenis hypothesis: we always seem to need rhymes where we cannot have them.

In this section I want to show where Jensen's proposal is incompatible with representing fortis consonants as coda-onset structures. This provides additional arguments that the standard theory of constituent structure is badly in need of an overhaul. We have to bear in mind, however, that this

incompatibility is not the only reason why we would want to redo constituent structure. We have already found *independent* arguments showing that both treating fortis consonants as coda-onset structures (1.2.4) *as well as* ascribing stop interpretation (1.3.3) to coda-onset structures is quite problematic.

In order to illustrate the central problem, let us go back to NYC English *give* and *whiff*. We have seen that the nucleus is long before *v*, but not before *f*. Another pair, *bid* and *bit*, works exactly the same way, *i. e.* we get a long nucleus before the lenis *d* (bɪːd), but not before the fortis *t* (bɪt). Since *bid* behaves like *give* and *bit* like *whiff*, we would want them to have reasonably similar structures to capture that parallel. In section 1.2.4 we said that the standard theory, trying to incorporate the fortis/lenis hypothesis, would have to represent *give* and *whiff* with branching rhymes. We should then expect that *bid* and *bit* have the same structure. (34) gives the relevant part of the representation.

(34) a. English *bid*   b. English *bit*
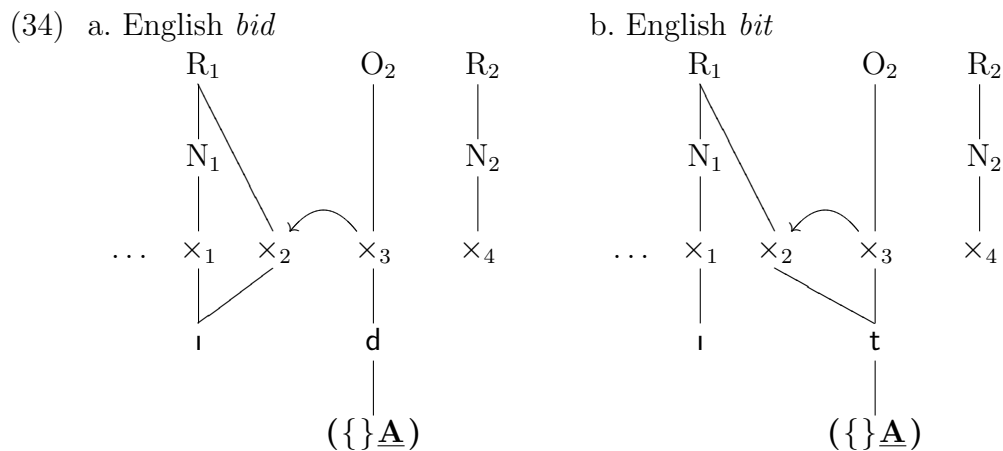
With the structures in (34) we are doing fine both for the fortis/lenis hypothesis and Jensen's proposal. The *d* and the *t* are melodically identical, they are ({}**A**). This PE is associated to $\times_3$ (a point dominated by an onset), which governs the preceding rhymal point $\times_2$, and accordingly receives stop interpretation. The final *t* in (34b) is fortis, as it is associated to two points, while the *d* in (34a) is lenis. Note in particular that $\times_2$ gives us stop interpretation and a site where the extra length of the preceding nucleus can be expressed at the same time. That is, all we need for stop interpretation is an onset ($\times_3$) governing a preceding rhymal point ($\times_2$). The fact that the

melody of the *d*, *i. e.* $(\{\}\underline{\mathbf{A}})$, is only associated to the onset, and not to the rhymal point as well, is completely irrelevant. So far everything is alright.

The problem comes with words like *whiff*. The phonological behaviour of *whiff* is identical to that of *bit* as regards length. The onset consonant in both words is fortis and the preceding nucleus is short. If we give *bit* a structure as in (34b), *i. e.* a geminate consisting of an onset and a preceding rhymal point, we should expect that *whiff* is the same in that crucial respect: if their behaviour is identical, their structure should be identical. The final fortis *f* should also be a coda-onset structure. We should simply be able to take the structure in (34b) and replace the melody of *bit* with that of *whiff*. This is shown in (35).
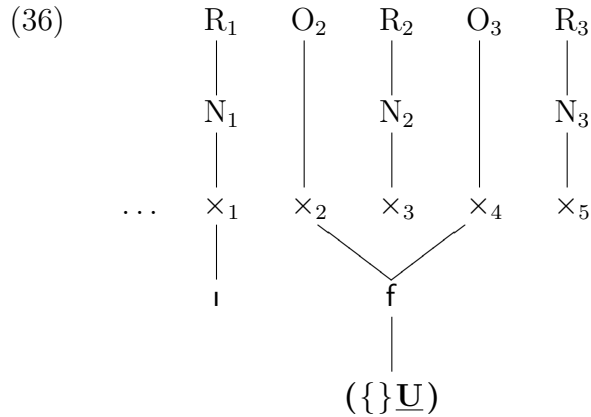
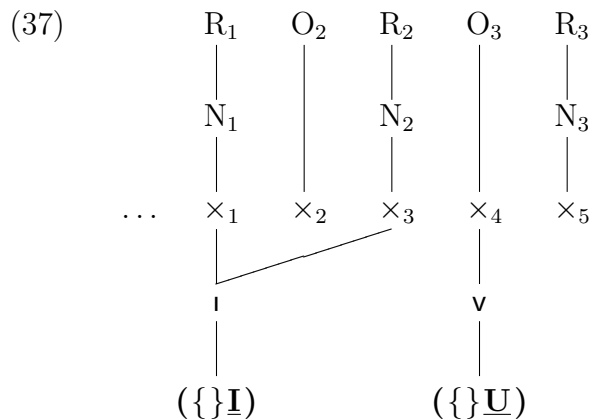(35) An attempt at NYC English *whiff*, failing miserably
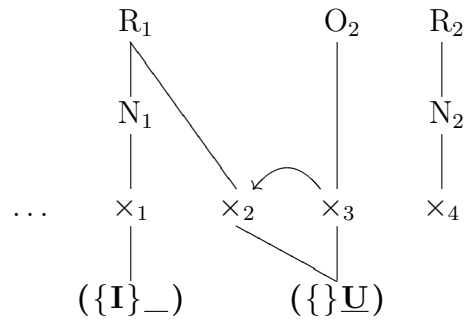
Note that there is nothing wrong with the structure in (35) with respect to standard GP. It is perfectly well-formed. The only problem is: it cannot possibly be the representation of *whiff*, of course. Given the definition of stop interpretation in (28), any such structure with a coda-onset configuration would come out as a stop. The representation in (35) is certainly grammatical, but it is the representation of the word *whip*, not of *whiff*. We cannot claim that (28) is the representation of *whiff*, as this runs afoul of the stop interpretation. In other words, while the fortis/lenis hypothesis would require *f* to be associated to a coda-onset structure (we want it to pair up with *bit*), (28) precludes it. We are clearly in a dilemma.

Would the standard theory provide us with an alternative representation for *whiff* that makes sure that the fricative comes out as a fricative, but fortis

at the same time? In the sections 1.2.3 and 1.2.4 we only considered coda-onset structures as candidates for fortis interpretation. Assume for the sake of the argument that the fortis f in *whiff* was really an onset-onset structure as in (36).

(36)

$$
\begin{array}{ccccc}
R_1 & O_2 & R_2 & O_3 & R_3 \\
| & | & | & | & | \\
N_1 & & N_2 & & N_3 \\
| & | & | & | & | \\
\times_1 & \times_2 & \times_3 & \times_4 & \times_5 \\
| & & & & \\
\text{I} & & \text{f} & & \\
& & | & & \\
& & (\{\}\underline{U}) & &
\end{array}
$$

This representation does not run afoul of (28), *i. e.* the final consonant comes out as an f and not as a stop. Neither onset that f is associated to governs a preceding rhymal point. The PE $(\{\}\underline{U})$ is linked to two positions and we could assume that this gives us the fortis interpretation. However, if (36) is the representation of *whiff*, then what is the structure underlying its "counterpart" *give*? What we want to express is a trade-off phenomenon: the less room is taken up by a lenis onset (the *v*), the more can be taken up by the preceding nucleus. Accordingly, the representation of *give* ought to look like this.

(37)

$$
\begin{array}{ccccc}
R_1 & O_2 & R_2 & O_3 & R_3 \\
| & | & | & | & | \\
N_1 & & N_2 & & N_3 \\
| & | & | & | & | \\
\times_1 & \times_2 & \times_3 & \times_4 & \times_5 \\
| & & & | & \\
\text{I} & & & \text{v} & \\
| & & & | & \\
(\{\}\underline{I}) & & & (\{\}\underline{U}) &
\end{array}
$$

The point $\times_3$ provides the room necessary to express the long ɪː in *give*. However, there is no reason why $O_2\,R_2$ (and with it $\times_2\,\times_3$) should be present at all. If a simpleton onset is interpreted as lenis, then why does it need a preceding, empty OR-pair? Where does the pair $O_2\,R_2$ come from, and why would it only occur before lenis onsets?[25]

In other words, no matter which route we choose in standard GP, we always run into problems. Both Jensen's proposal and the fortis/lenis hypothesis are promising, but cannot be implemented in the theory of constituent structure that standard GP uses. That this should be so is not surprising: Element theory and the theory of constituent structure are delicately balanced, and changes in one are likely to affect the other. The problems we faced are the natural consequence of trying to fit changes in theoretical thinking into a tightly constructed framework that was not designed to handle much tinkering around in the first place. What this means is that we will have to build a new model of constituent structure, one where both **H** and **ʔ** can be expressed as structural properties, but where those two structural properties are independent of each other. This will be our task in chapter 2.

1.4   Summary

In this chapter I have discussed three issues: Firstly, we saw that the set of elements employed in standard GP still generates too big a number of phonological expressions. Secondly, we discussed length in NYC English and showed that it seemed to depend on the element **H**, thus violating the Non-Arbitrariness Principle. We argued that **H** has to be be replaced by a structural configuration, but saw at the same time that such a change ran into problems with the standard theory of constituent structure. We had a first look at the new theory of constituent structure advocated in this study and saw how it could avoid the problems the old theory faced. Thirdly, I review a proposal by Jensen (1994) showing that the element **ʔ** be reinterpreted as a structural property. While this move promised certain advantages, it was hard to implement in the theory of constituent structure that standard GP employs. A large-scale revision of the theory of constituent structure became an even more pressing task.

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[25] This is of course identical to the problem we discussed in section 1.2.3.

Chapter 2

The winds of change

In the previous chapter I argued that the standard theory of GP was in need of a major revision. Inevitable changes in element theory, *viz.* the abolishment of **ʔ** and **H**, proved virtually impossible to implement, given GP's assumptions about constituent structure. However, does this really mean that we have to go through the trouble and take standard GP apart and construct a radically new model of constituent structure? In the first two sections of this chapter I am going to show that there are further issues which point in exactly the same direction, *i. e.* that such a major change in the model is unavoidable and that standard GP as we know it has to go. Standard GP also runs into problems in areas which have nothing to do with the fortis/lenis hypothesis or with Jensen's proposal. This makes a general overhaul even more desirable. Ideally, the model we are going to present here should not only allow us to get rid of **H** and **ʔ** once and for all, but also solve other problems the old theory could not deal with.

In section 2.1 we will discuss certain problems with the notion of complexity and conclude that it cannot be adopted in the new theory. Section 2.2 discusses problems with super-heavy rhymes, which also escape a satisfactory explanation in the standard theory. In section 2.3 we leave standard GP behind us and move on to construct a new phonological model. I will lay out the basics of this new model where the problems discussed in the last chapter and the first two sections of this chapter will eventually find a solution.

2.1 Problems with complexity

The notion of **complexity** refers to the number of elements a PE is made up of. In standard GP, complexity played a pivotal role and fulfilled two functions: (i) it could capture possible lenition trajectories and (ii) impose substantive constraints on governing relationships. As for (i), the internal structure of an English-type t, which was assumed to be $(\{\mathbf{H}, \mathbf{?}\}\underline{\mathbf{A}})$ in standard GP, only allowed for certain lenition outcomes. Assuming that lenition involves the loss of melodic material (Harris & Kaye 1990: Harris 1990, 1994, 1997, 1999: Ségéral & Scheer 1999: Szigetvári 1999), we could observe *e.g.* the loss of **H** and **A**, leaving only **?**, as in the London pronunciation of *city* as *ci?y*. Alternatively, if **H** and **?** are lost, we will arrive at the NYC pronunciation as *ciɾy*.

The property in (ii) was expressed in the **Complexity Condition** (Harris 1990: Kaye, Lowenstamm & Vergnaud 1990: Kaye 2000):

(1) An expression x may govern an expression y if $N_x > N_y$
     (where N = the number of elements in the expression).

Let us have a quick look at an example to make this point clear. (2a) gives the representation of the French word *parti* 'party', (2b) the one of *patrie* 'native country', both within standard GP, *cf.* Kaye, Lowenstamm & Vergnaud (1990): Charette (1991) for discussion. Arrows indicate government relationships.

(2) a. *parti* 'party'   b. *patrie* 'native country'

55
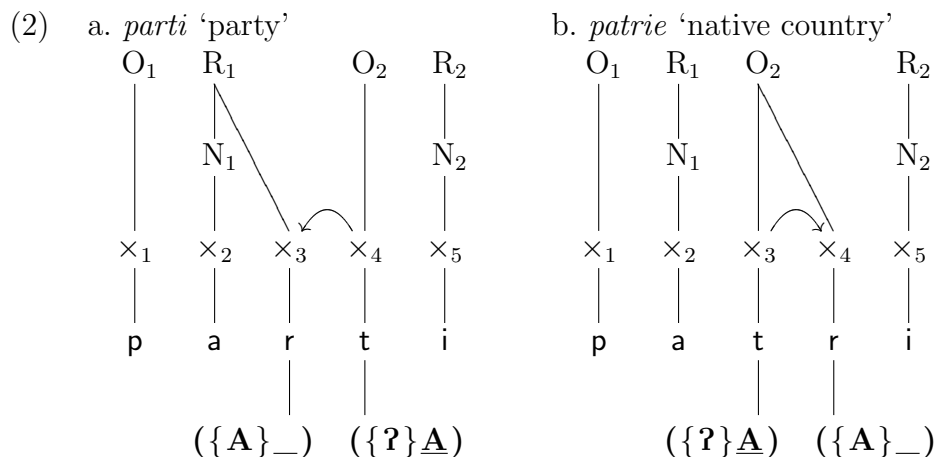
French r $(\{\mathbf{A}\}\_)$ is less complex than French t $(\{\mathbf{?}\}\underline{\mathbf{A}})$,[1] which means that the point dominating $(\{\mathbf{?}\}\underline{\mathbf{A}})$ can govern the point that dominates the PE $(\{\mathbf{A}\}\_)$, but not vice versa. Accordingly, rt would have to be a coda-onset structure (2a), while tr would be a branching onset (2b).

However, there were a fair number of cases where complexity failed to explain why a certain governing relationship could or could not hold. A very clear demonstration of the problem can be given with branching onsets.

(3)   a.

b.
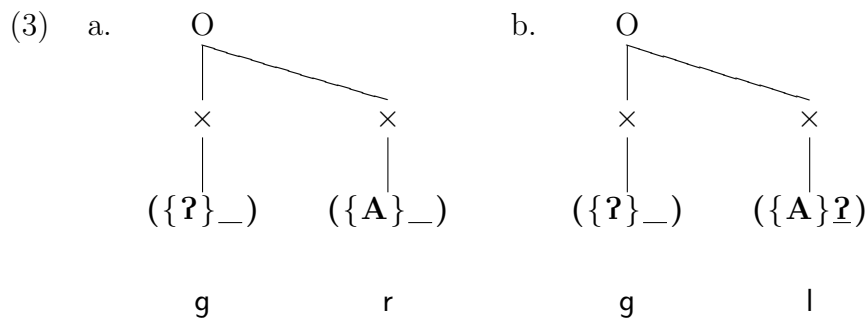
(3a) comes out as gr, *e. g.* in English *grass*, (3b) as gl as in English *glass*. In (3a) we have situation where governor and governee are of equal complexity and where $\mathbf{A}$ is in the recessive position (although here it is in the recessive position of a branching onset, not a branching nucleus). Both PE's are headless. It is completely unclear why it is the PE $(\{\mathbf{?}\}\_)$ that can govern the PE $(\{\mathbf{A}\}\_)$, since both are equal in complexity. We should expect that the two can be flipped around to yield *rg as a branching onset, but *rg as a branching onset has never been found. In other words, the Complexity Condition is of no help with a structure like this. Things seem to get even worse when we turn our attention to (3b). The complexity of the expressions involved is not even equal, rather the governee is more complex than its governor. A situation like that should be excluded under *any* formulation of the Complexity Condition, yet a branching onset like gl is commonly found. Any principle responsible for accounting for why gr and gl are good branching onsets, while *rg and *lg are not, is like a slap in the face for the Complexity Condition.

---

[1]   French has $\mathbf{L}$-voicing: The t in *parti*/*patrie* equals an English d, *i. e.* both were assumed to be $(\{\mathbf{?}\}\underline{\mathbf{A}})$, while French d as in *deux* 'two' was assumed to be $(\{\mathbf{L}, \mathbf{?}\}\underline{\mathbf{A}})$, *i. e.* it has $\mathbf{L}$-voicing. English stops do not contain $\mathbf{L}$.

Further examples where complexity runs into problems could be enumerated, but the case of branching onsets is sufficient. Another more general issue revolves around the delicate balance between complexity and the number of elements present in the system. This also has a bearing on the model to be developed in the present dissertation, and not just standard GP. Trivially, the Complexity Condition is easier to satisfy in a model with more elements than in one with fewer. In a system with ten elements, say, it is fairly easy to have PE's with a rather high complexity and the appropriate complexity differential between governer and governee will be easy to achieve. In a model with only four elements (**A**, **I**, **U** and **L**), like the one we are about to propose in what follows, the situation is quite different. The combinatorial possibilities are far more limited. Since the maximally possible complexity of an expression equals the number of elements employed in the theory, the complexity of expressions will reduce once the number of elements is reduced. The number of PE's with equal complexity will grow, making clear that the Complexity Condition is dubious and should not be carried over into the new model. For example, recall the discussion of *parti/patrie*, where French *t* was assumed to be ({**ʔ**}**A̲**), and *r* ({**A**}__) in the standard theory. In the calculation of the respective complexity, **ʔ** was of course counted in in standard GP. Obviously, once **ʔ** is removed from the set of elements, as in our new theory, both a French *t* and *r* will be *melodically* equal, and thus of equal complexity: all they contain is the element **A**. However, the two will be quite different in terms of structure. What this suggests is that structural properties are likely successors of complexity. A further factor will be the element **A**, as I discuss in chapter 6. However, since **A** seems to be structural itself (as we shall see in due course), we are justified in saying that structure is indeed the only crucial factor.

2.2 Superheavy rhymes

Superheavy rhymes are the second problematic area in standard GP that I want to mention here. In English words like *fiend*, *weird* or *taste* we have a long vowel followed by a cluster that would qualify as a well-formed coda-onset cluster. The crucial condition for having such structures is that both members of the cluster contain the element **A**.[2]
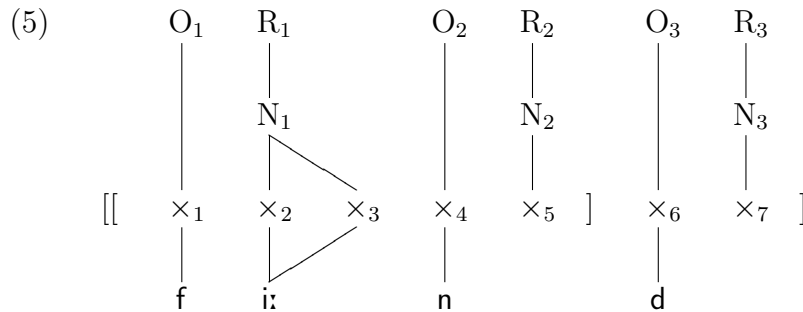
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[2] An exception to this is the Southern British pronunciation of words like *clasp*, *ask*

In the standard theory, the common assumption for English is that long vowels are branching nuclei and clusters like *nd* coda-onset structures. In a word like *fiend* we would then have a structure where both nucleus and rhyme branch (a superheavy rhyme), which violates the Binarity Theorem. Such an illicit structure is given in (4).

(4) *O$_1$ R$_1$ O$_2$ R$_2$

              N$_1$ N$_2$

      $\times_1$ $\times_2$ $\times_3$ $\times_4$ $\times_5$ $\times_6$
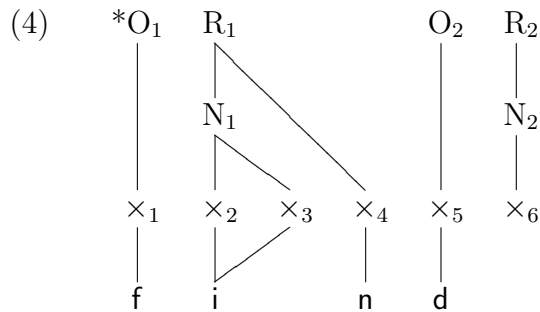
       f   i   n   d

Either we choose to live with a violation of the Binarity Theorem, as Harris (1994: 67ff) does, or we find an alternative representation. One alternative has been suggested by Jonathan Kaye (*p. c.*), who proposed that words like *fiend* be treated as cases of dummy morphology, *i. e.* [[*fien*] *d*].

(5)   O$_1$ R$_1$ O$_2$ R$_2$ O$_3$ R$_3$

                N$_1$ N$_2$ N$_3$

      [[$\times_1$ $\times_2$ $\times_3$ $\times_4$ $\times_5$] $\times_6$ $\times_7$]

            f   iː   n   d

This would automatically explain why the empty nucleus between *n* and *d* is licensed: it is in domain-final position in the inner domain and therefore p-licensed by parameter. Kaye justifies the introduction of dummy morphology by drawing a parallel with existing analytic morphology in English: suffixes

---

or *draft* as klɑːsp, ɑːsk and drɑːft, where only one member of the cluster contains **A**. However, such words always contain the vowel *a*, which itself is nothing but ({}**A̱**).

with no realised nucleus always have to contain **A**, *e. g.* the past tense suffix *-ed*, the plural suffix *-s*, the superlative suffix *-st* and the suffix for forming ordinal numbers, *-th*. Words like *fiend*, so the claim, simply "mimic" this pattern. Note that this tells us why the final consonant of the cluster has to contain **A** (because that is what English suffixes with only one consonant look like), but it *only* tells us about the final consonant. If indeed we are dealing with dummy morphology, we should expect that no (or only few) restrictions between the final two consonants hold, *cf.* past tense forms like [[*seem*] *ed*] with a sequence md. If *seemed* is is fine, why is *fiemd not? What special property does **A** have that its presence is required in both members of the cluster? How come that **A**, a seemingly melodic property, has such an impact on structure?

In addition to those unresolved questions, the dummy morphology analysis (as any other alternative that has been proposed) fails to explain the pattern shown in (6).

(6)

	lenis	fortis	melody in standard GP
a.	*fiend*	*	$(\{\}\underline{\mathbf{I}})$
b.	*wound*	*	$(\{\}\underline{\mathbf{U}})$
c.	*	*taint*, *paint*, *saint*, etc.	$(\{\mathbf{A}\}\underline{\mathbf{I}})$
d.	*	*don't*, *won't*, *wont*	$(\{\mathbf{A}\}\underline{\mathbf{U}})$
e.	*	*taunt*, *haunt*, *daunt*, etc.	$(\{\mathbf{U}\}\underline{\mathbf{A}})$
f.	*command*, *demand*, *remand* etc.	*aunt*, *chant*, *grant* etc.	$(\{\}\underline{\mathbf{A}})$
g.	*round*, *bound*, *sound* etc.	*count*, *mount*, *amount* etc.	$(\{\}\underline{\mathbf{A}}) + (\{\mathbf{U}\}\_)$
h.	*kind*, *find*, *mind* etc.	*pint*	$(\{\}\underline{\mathbf{A}}) + (\{\mathbf{I}\}\_)$
i.	*	*joint*, *point*, *disappoint* etc.	$(\{\mathbf{U}\}\underline{\mathbf{A}}) + (\{\mathbf{I}\}\_)$

(6) reveals a strikingly regular interaction between the melody of the nucleus and whether the following cluster is *nd* or *nt*. That is, while there are words like *taint* teːnt or *paint* peːnt, there is none like **taind* teːnd or **paint* peːnd. Likewise, we find *fiend* fiːnd or *wound* wuːnd, but no **fient* fiːnt or *wount* wuːnt. The pattern is as follows: After PE's without **A** (6a–b) we only find *nd*, after PE's with **A** and some other element (6c–e) only *nt*, and after PE's with only **A** (6f) we find both *nd* or *nt*. In words with diphthongs (6g–i) the first member of the diphthong is relevant: if the first member contains only **A**, both *nd* or *nt* are possible (6g–h), but if it contains **A** and some other element (6i), only *nt* is possible.

What this means, of course, is that dummy morphology or any alterna-

tive analysis expressible in standard GP will not do. There are no means to capture the interaction between the melody of the nucleus and whether the following cluster is *nd* or *nt* (*i. e.* with a lenis *d* or a fortis *t*). The two properties involved are considered completely unrelated in standard GP: for the melody of the nucleus, **A** is the relevant ingredient, while t/d were characterised by the presence or absence of **H** in the standard theory. **A** and **H** are independent elements and have nothing to do with each other. Given the conspicuous symmetry and exceptionlessness of the pattern in (6), however, it can hardly be accidental.

In the previous chapter I suggested that the difference between *d* and *t* is not a melodic one, but structural. In chapters 4 and 6 we will see evidence that also the element **A** must be seen as having structural properties—at least to some extent. While I will not present a detailed analysis of the facts in (6) in this dissertation, it is clear that in an approach where both the fortis/lenis distinction and **A** are treated structurally we stand a realistic chance of capturing the phonotactic patterns in an insightful way. Instead of two unrelated melodic properties we now have two structural properties interacting with each other: the fortis/lenis structure on the one hand and the structure due to **A** on the other.[3]

2.3   A new proposal

It is now about time to move on to the theory of constituent structure that is to replace that of standard GP. I have already given some previews in the last chapter, but a detailed discussion has been postponed until now. In this section we will discuss the basic ingredients and building blocks of the new theory, which will then serve as the basis for further discussion in the chapters to follow.

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[3] The patterns get more complex once other clusters besides *nd*/*nt* are brought in. For example, English *rt* can only be preceded by a long nucleus if that nucleus contains **A**, hence **weirt* wiːrt but *weird* wiːrd. All this just adds to the pressure to abandon standard GP.

2.3.1 Elements

In chapter 1 we discussed the advantages of getting rid of the elements **H** and **ʔ** and replacing them by structural configurations. If we succeed in constructing a model of phonological constituents where the former elements **H** and **ʔ** find satisfactory expression in the structure, they can of course be removed from the set of elements, as it would be completely redundant to encode them both melodically and structurally. We are then down to four melodic primes, as given in (7).

(7) **The new set of elements E**
     E = { **A**, **I**, **U**, **L** }

As we shall see in due course, there are certain properties that single out **A** and **L** and make them look very different from the other two elements, **I** and **U**. There are certain indications that at least **A** has to be given structural properties.
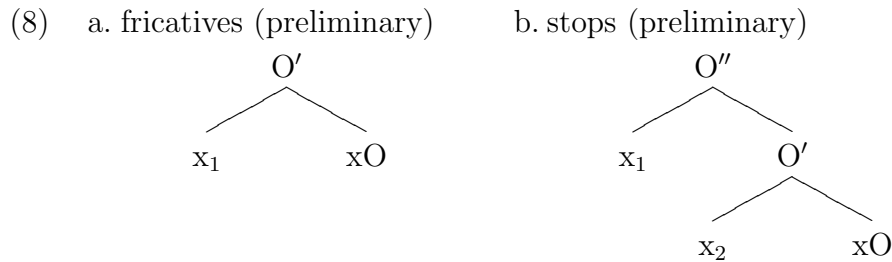
Counter to previous models, elements must not be understand as objects that are *associated* to certain points, but rather as properties a certain point is *annotated* for. This important distinction will become clear in the course of the present section.

2.3.2 Structure: the basics

2.3.2.1 Single- and double-layered structures

What is the shopping list for our structures, what do we want them to be able to express? In the discussion of the fortis/lenis hypothesis it became clear that fricatives need to be given two points. In the case of fortis fricatives, both points are occupied. Lenis fricatives on the other hand leave one point unused. Jensen's proposal requires that stops have one point more than fricatives, *i. e.* three all together. This extra point is completely independent of the fortis/lenis distinction, *i. e.* there are four types of objects we want to represent: fortis and lenis fricatives (English *f* and *v*) as well as fortis and lenis stops (English *p* and *b*). This independence can be guaranteed in a model employing two independent layers of structure. One layer will enable us to

express the difference between fortis and lenis consonants, the second layer will give us stops. What do those two layers look like? Let us concentrate on one aspect first, *viz.* the difference between fricatives and stops, and go through their properties step by step. Fricatives and stops respectively will have structures as follows. (For the start we abstract away from melody, to which we return in section 2.3.2.2.)

(8)   a. fricatives (preliminary)   b. stops (preliminary)

```
         O′                              O″
        /  \                            /  \
      x₁    xO                        x₁    O′
                                           /  \
                                         x₂    xO
```

This first representation is intended to show several things. Firstly, we have annotated x-slots. In the structures in (8) we see slots annotated as an onset head ('xO') and others are simply unannotated ('x'). This differs from standard GP, where x-slots of the skeleton were neutral and unannotated. The purpose they would fulfill was a function of which constituent node they were attached to: A given slot would have to be dominated by a nucleus, onset or rhyme. In our theory here, this function is directly encoded in the skeletal slots.[4]

(8) only showed xO's and x's, but there is yet a third type, xN (the nuclear head), for which we will see examples later on. Those three (x, xO, xN) form the set of **terminal nodes**.

(9)   **The set of terminals T:**
       T = {x, xO, xN}

Two of the terminals, xO and xN, are special in that they are heads.

---

[4] In this respect, the model advocated here is similar to CV models, *cf.* Larsen (1994): Lowenstamm (1996): Scheer (2004), where the C's and the V's are timing units and at the same time give categorial information.

(10) **The set of heads H:**
      H = {xO, xN}

An xN corresponds roughly to a nuclear position in standard GP, while an xO corresponds to a non-nuclear position.

In a representation, the terminals are linearly ordered, *e. g.* in (8b) x_1 comes before x_2, while x_2 comes before xO.[5]

The second issue illustrated in (8) is **projection**. A projection, like in syntax, groups objects together. Heads as defined in (10) (or projections thereof) can **merge** with other points as their **complements**, in the "normal" case unannotated x's, and project to a higher level. For example, in (8a) the head xO takes the x to its left as its complement and projects to the next level, O′. This projection O′ groups xO (a head) and x (the complement) together. A complement is then simply defined as the member of a merge operation which does *not* project. In (8a) that is x. The projection O′ is a **non-terminal**. As a cover term for terminals and non-terminals (*i. e.* projections) I will use the term **node**, as is customary. In (8a) there are three nodes, *viz.* x, xO and O′.

The merge operation is recursive and does not have to stop after the first level, but can in fact go up further, as we see in the case of stops (8b).[6] Here, the projection of xO, O′, takes another x-slot as a complement and projects again to O″. The highest projection of a given head will be called **maximal projection**, as in syntax. In (8a) O′ is the maximal projection (it is the highest projection of the head xO), while in (8b) O″ is the maximal projection.

This leads over to the third issue illustrated in (8): fricatives have a **one-layered structure**, stops a **two-layered structure**. Any such one-layered structure will be interpreted as a fricative, while the two-layered structure will be interpreted as a stop. (This includes nasals and *l*, as we shall see in section 2.3.3.) The distinction between fricatives and stops is entirely structural, and no longer a matter of melody. A melodic property such as the element ʔ is superfluous. Stops have two layers, fricatives only one. Everything that refers to the so-called "manner of articulation" is expressed structurally.[7]

---

[5] But *cf.* the discussion on directionality in section 3.2.2.

[6] I postpone the discussion of how far up projections can go until chapter 3.

The notion of projection raises the question of whether nodes can project without taking other nodes as their complement, *i. e.* whether there is unary branching as in (11).

(11)   O′
         |
        xO

This runs counter to the idea that projection is the result of grouping objects together and forming a unit. If there are no two nodes to be merged and subsumed under one common label, there is no reason to project.[8] Thus, the model we are proposing adopts the formal requirement that there are only complete binary trees (in the sense of graph theory): every non-terminal node dominates exactly two daughters. Such a formal ban on unary branching of course reduces the expressive power of the theory. We can capture it in the principle of Structure Minimality.

(12) **Structure Minimality**
     A unary branching node is reduced to its daughter.

     α'
      |
      |
     α $\rightarrow$ α

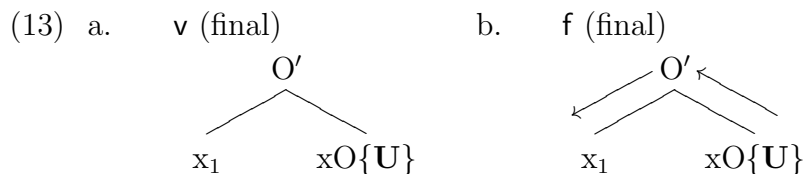If at any point a structure as on the left side of (12) arises, the tree will be pruned accordingly.

---

[7] For another proposal where manner of articulation distinctions are expressed structurally *cf.* Golston & Hulst (1999), which, however, is different from the model presented here in crucial aspects.

[8] This of course is very much in the spirit of the Minimalist Programme in syntax (Chomsky 1995b) and comes very close to the notion of "bare phrase structure" (Chomsky 1995a).

2.3.2.2 Melody and m-command

The structures in (8) only gave the general template of single- and double-layered structures, but we have not said anything about melody or the difference between fortis and lenis so far. Let us start with v and f as at the end of the NYC English words *give* and *whiff*. As we have seen, v allows for extra length of the nuclear expression preceding it, f does not. Both are identical melodically in that both only contain the element **U**. Both are one-layered structures. That is, both in terms of melody and in terms of the number of nodes involved, v and f are identical. What sets them apart? The respective representations are given in (13).

(13)   a.   v (final)   b.   f (final)

$$\text{O}' \qquad\qquad\qquad\qquad \text{O}'$$

$$x_1 \qquad xO\{\mathbf{U}\} \qquad\qquad x_1 \qquad xO\{\mathbf{U}\}$$

Again, (13) illustrates several things. Firstly, in both structures the head xO is simply annotated with the melody **U**, *i. e.* this **U** will contribute to the ultimate interpretation.[9] Note that there are *deliberately* no association lines, for reasons to be explained in detail later on.

A further comment on the notion of annotation is necessary at this point. So far we have used the term at two different occasions. On the one hand, we have said that there are slots annotated as onset heads (xO) or as nuclear heads (xN) as opposed to unannotated slots (x's). That is, a given slot can be annotated for categorial information, *i. e.* whether it is of the type onset (O) or nucleus (N). On the other hand, we have said that a position can be annotated with melody, *i. e.* an element. This can be termed melodic annotation. What this means is that there is only one kind of terminal that

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[9] Annotation with elements will be indicated with curly brackets throughout this dissertation: xO{**U**} is an xO annotated with **U**, xN{**U**,**I**} an xN annotated with **U** and **I**. A full-fledged theory of phonological expressions within the current framework still needs to be worked out, or rather it remains to be seen to what extent notions like head and operator will play a role. For my purposes here I will just indicate the (unordered set of) elements a position is annotated for, without going into any further details.

is unannotated, *viz.* a bare x without any melody, while every other kind of slot counts as annotated, be it categorial and/or melodic annotation.

(14)   Only unannotated slot: x

          Examples of annotation: xO, xN, xO{**U**}, x{**I**}, x{**A**, **U**} . . .

The difference between categorial and melodic annotation will not play a role in the following text. What is of importance to us is (i) whether a point has no annotation (x) or some annotation (everything else), and (ii) whether it is a head (xO or xN, with or without melodic annotation) or not (x, with or without melodic annotation).

Let us now come to the second issue illustrated in (13). In (13b) we see a special relationship holding between the head xO and its complement x_1, which we call **melodic command** or **m-command** for short. In an f, the head xO m-commands its complement x_1, which is symbolised by the arrows. Note that in the case of a v (13a) no such m-command relationship holds: xO and x_1 are merged under the projection O′, but xO does not m-command x_1. That is, just because two nodes have been merged does not automatically mean that an m-command relationship must hold between the two nodes. Merge is independent of m-command.

A formal definition of m-command, which I adopt as a primitive relation in the theory, is given in (15).[10]

---

[10] While (15) imposes tight restrictions on possible m-command relationships, it might have to be subject to further refinement. Ideally, we want to restrict it even more, *e. g.* in its scope: None of the statements in (15) say anything about how far apart from each other m-commander and m-commandee can be. We will come back to this issue in chapter 6.

(15) **Melodic command (m-command)**

    a. M-command is a binary relationship between two terminals, an m-commander and an m-commandee.

    b. Only heads (xN, xO) can be m-commanders.

    c. Only non-heads (unannotated x's) can be m-commandees.

    d. An m-commandee can be m-commanded only once, but an m-commander can m-command several times.

   e. An m-commanded point receives the same interpretation as its m-commander.

(15a–c) make sure that in a structure as in (13b) xO can m-command x_1 but not vice versa. According to (15d) an m-commanded point can have only one m-commander, *i. e.* it can be m-commanded only once. An m-commander, on the other hand, can m-command several m-commandees. We will see a large number of examples for this throughout the entire dissertation. Last but not least, (15e) defines the *meaning* of m-command. A relationship of m-command takes over all the functions that association lines had, *i. e.* it indicates which points are interpreted with the same melody. Of course, this raises the issue of why we do not simply use association lines? This question will be answered in a moment, but let us first have a look at m-command in the structures in (13). In (13b), xO m-commands x_1, *i. e.* both x_1 and xO are interpreted in the same way. This gives us a fortis f. In (13a), on the other hand, there is no m-command relationship and accordingly, only the head xO is interpreted as containing **U**. The point x_1 is part of the projection O′, but in the absence of an m-command relationship between xO and x_1 this point x_1 does not receive the same interpretation as its head xO. The outcome of this is a lenis v. In other words, m-command gives us the difference between fortis and lenis objects (among other things, as we shall see): m-command makes sure that m-commander and m-commandee are interpreted in the same way. In an f, both m-commander and m-commandee are interpreted alike, while in v there is no m-command relationship. Being a one-layered structure has nothing to do with the fortis/lenis distinction. The structural make-up and m-command are independent of each other.

How does that help us in understanding the length difference in the nucleic expression of *give* as opposed to the one in *whiff*? As I have already hinted at in the last chapter, the length we get in *give* is due to that one point x_1 that is not m-commanded by the head xO: since it is not m-commanded by xO, it is free to be m-commanded by the preceding nuclear head.[11] This allows for a simple explanation of the length facts: either the nucleus is longer *or* the following onset. The following representation gives a close-up of the crucial sequence. The reason why the nucleus can take a following onset as a complement will be discussed in detail in chapter 3. What is of interest to us here is the unannotated point x_1: either it is m-commanded by the nuclear head xN or by the onset head xO.

(16) a. *give* (relevant detail)
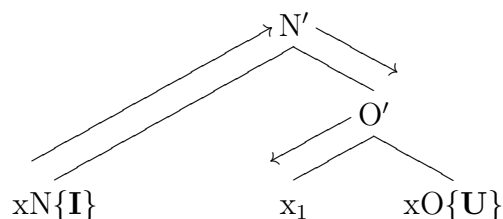
(16) b. *whiff* (relevant detail)
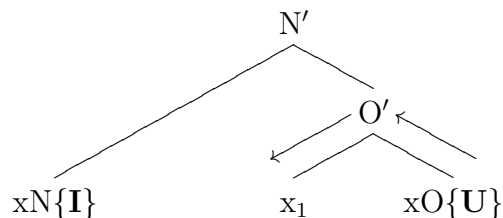

The nucleus preceding the onset is simply an xN labelled with the element **I**. In the case of f in (16b), the unannotated point x_1 is already m-commanded by its head, xO. We get a short ɪ in *whiff*. In (16a), on the other hand, x_1 is not m-commanded by its head xO, but rather by xN, as a result of which we get a long ɪː in *give*. In other words, the very fabric that fricatives are made of—a structure with two points—predicts that there is an interpretation of

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[11] In fact, as we shall see in the next section, it will *have* to be m-commanded by the preceding nuclear head in this context.

length. We finally have a non-arbitrary account of the distribution of length in English.

Let us now move on to the stops. The respective representations of a lenis b and a fortis p are given in (17).

(17) a. lenis b (final)   b. fortis p (final)
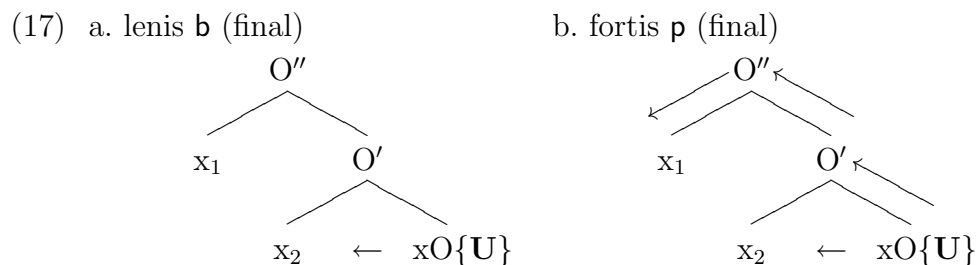
Again, both are melodically identical: their head is labelled for the element **U**. Also, since both are stops, they will both have a two-layered structure. The only difference between the lenis b and the fortis p is m-command. In a lenis b (17a) xO does not m-command any other point.[12] In a fortis p (17b), on the other hand, xO m-commands x_1. This is thus entirely parallel to one-layered structures like v and f: In a fortis f the onset head xO m-commands the highest unannotated x, in a lenis v it does not. This is summed up in (18).

(18)   fortis: xO m-commands highest unannotated x
                    two points involved

       lenis: xO does *not* m-command highest unannotated x
   only one point involved

The notion of m-command allows us to express which points belong together. The definition in (18) also allows us to understand the distinction between fortis and lenis as one of length: A fortis structure is longer than a lenis structure in the sense that in a fortis structure an xO m-commands exactly one point (and this point is the highest unannotated x) while in a lenis

---

[12] We will come to the meaning of the arrow between xO and x_2 in both structures in (17) in section 2.3.2.3. It does *not* represent an m-command relationship.

structure the xO does not m-command any other point. A fortis structure "involves" two points, a lenis structure only one.

The fact that in **b** (17a) x_1 is not m-commanded by the head xO means that it is free to be m-commanded by the preceding nuclear head. In a **p** (17b), on the other hand, the point x_1 is m-commanded by the head xO. This gives us a fortis **p** and at the same makes sure that the point x_1 could not be m-commanded by the preceding nucleus. The representations in (19) illustrate this idea with the pair *rib/rip*.[13]

(19)   a. *rib* (relevant sequence)
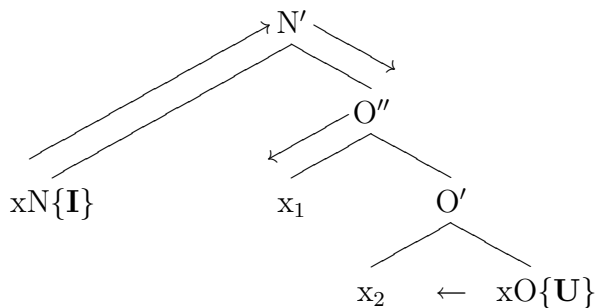
b. *rip* (relevant sequence)
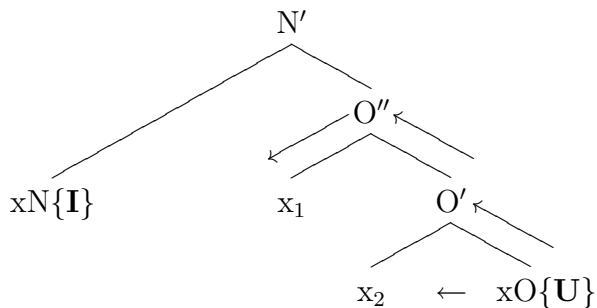
In fact, nothing much has to be said about those two forms as they are quite parallel to our earlier analysis of *give* and *whiff*. The reason for why the nucleic expression is longer in *rib* than in *rip* becomes obvious. In (19a),

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[13] As already said before, we will return to the issue of why a nucleus, xN in (19), can take the projection of an onset, O″ in (19), as its complement once the higher level structure has been introduced in chapter 3.

x_1 is not m-commanded by xO and therefore has to be taken care of by the preceding xN. In (19b), on the other hand, x_1 is already m-commanded by xO, giving us a fortis stop.

As we have seen, the difference between a fortis p and a lenis b is simply due to whether the point x_1 in structures like (19) is m-commanded by xO or not. What about x_2, however? In all the two-layered structures we have seen so far, there was simply a little arrow between the head and its complement. We are now going to turn to what this arrow means.
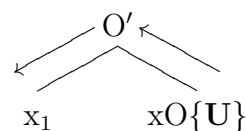
2.3.2.3 Potential m-commanders and control

(20) repeats the four onsets we have talked about so far: a lenis v (20a), a fortis f (20b), a lenis b (20c) and a fortis p (20d).
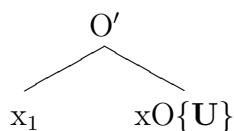
(20) a. lenis v   b. fortis f
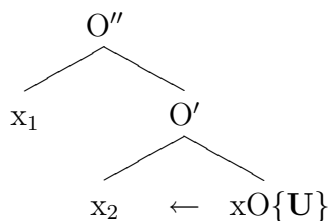
  c. lenis b   d. fortis p
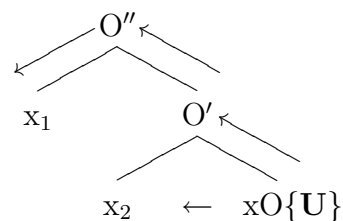
A fortis onset was defined as a structure where the highest complement, *i. e.* the daughter of the maximal projection, is m-commanded by xO. In all cases above, that highest complement is x_1. In (20b, d), x_1 is m-commanded by xO, and therefore the structure counts as fortis. In (20a, c), on the other hand, x_1 is not m-commanded by xO, and we get a lenis onset. The basic ingredients of the internal structure of onsets that we have identified so far are given in (21).

(21) fricative: one-layered structure

      stop: two-layered structure

      fortis/lenis: m-command of highest unannotated x

In English, it is of course an idiosyncratic property whether an onset is fortis or lenis. That the word *rib* ends in a lenis *b*, while *rip* ends in a fortis *p* cannot be predicted.[14] For English then, it is a lexical property whether the highest complement of one of the structures in (20) is m-commanded by xO or not.
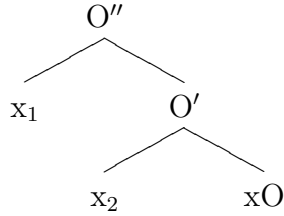
Let us now turn to the lower complements in the case of two-layered structures (20c–d), where "lower complement" refers to the complement which is not a daughter of the maximal projection. That lower complement is x_2 in both cases. (Obviously, one-layered structures only have one complement and no such distinction between a complement that is a daughter of the maximal projection and another complement that is not a daughter of the maximal projection can be made. The only complement that one-layered structures have will always be a daughter of the maximal projection.) In (20c–d) xO does not m-command x_2. The question now is: Could there be m-command between xO and x_2 *in principle*? That is, can we find structures like (20c–d), with an additional m-command relationship between xO and x_2? The answer to that, I claim, is no: xO cannot m-command x_2 in the double-layered structures given in (20c–d). Obviously, this needs justification and we have to discuss the reason why xO cannot m-command x_2.

We can approach this in the following way: Let us assume that there *could* be m-command between xO and x_2, contrary to what I am claiming. We have already seen that the terminal x_1 is either m-commanded by xO (which gives us a fortis stop), or it is not (giving us a lenis stop). Under the assumption that xO can m-command x_2, we should expect that the same freedom exists with respect to x_2 as with respect to x_1: either x_2 is m-commanded by xO, or it is not. This would give us a total of $2 \times 2 = 4$ different types, depending on (i) whether the higher complement is m-commanded by xO and (ii) whether the lower complement is m-commanded by xO. Those four possibilities are illustrated in (22).
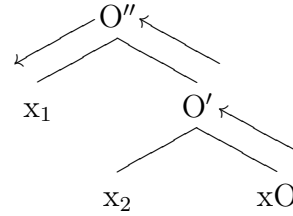
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[14] In chapter 4 we will talk about Estonian, where the distribution of fortis/lenis onsets can be predicted to a large degree from the structures they occur in.
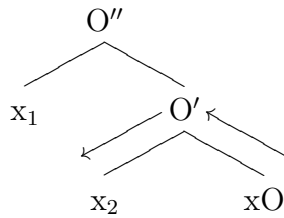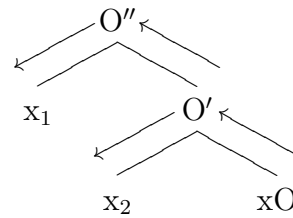
(22) a.

$$O''$$
$$x_1 \quad O'$$
$$x_2 \quad xO$$

b.

$$O''$$
$$x_1 \quad O'$$
$$x_2 \quad xO$$

c.

$$O''$$
$$x_1 \quad O'$$
$$x_2 \quad xO$$

d.

$$O''$$
$$x_1 \quad O'$$
$$x_2 \quad xO$$

In (22a) xO does not m-command any complements. In (22b) xO only m-commands the higher complement, x_1. In (22c) we have an xO that m-commands x_2 but not x_1, and in (22d) m-commands both x_1 and x_2. We have four formally different objects. However, those four different objects do not seem to correspond to anything in the real world. English, for example, makes a difference between fortis and lenis stops, *i. e. two* different types, but (22) provides us with *four* possibilities, more than we need.[15]

If (22) provides us with more structures than we need, *i. e.* four instead of just two, then obviously we will have to find a restriction. There are two possibilities open to us at this point. The first possibility is to say that in a two-layered structure the head xO *always* has to m-command the lower complement x_2. Under this assumption a situation as in (22a–b), where x_2 is not m-commanded by xO, would be impossible. Only two possibilities, *i. e.* (22c–d), would be licit. Those two are repeated here as (23).

(23) Obligatory m-command of the lowest complement x_2?

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[15] In chapters 4 and 5 we will talk about geminates in languages like Estonian and Italian, and we will see that their representation is different from anything in (22), so we cannot exploit the superfluous structures to represent geminates, either.

a.   b.

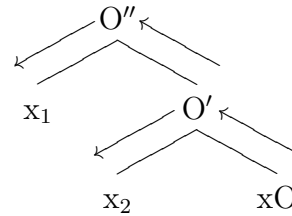O″   O″
x₁   O′   x₁   O′
      x₂   xO   x₂   xO

$$\text{a.} \qquad O'' \qquad\qquad \text{b.} \qquad O''$$
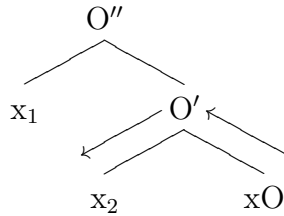
However, if a certain relationship *always* has to be there, it is completely redundant. An obligatory m-command relationship between x_2 and xO does not get us anywhere. Furthermore, such obligatory m-command also complicates our notion of m-command as an expression of length, as mentioned on p. 70. Recall the representation of lenis v and fortis f given in (20a–b) and repeated here as (24).

(24) a. lenis v   b. fortis f

O′   O′
x₁   xO{U}   x₁   xO{U}
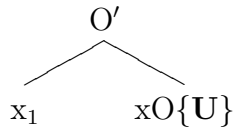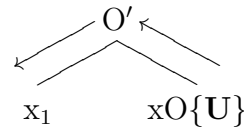
A fortis f (24b) involves the two points x_1 and xO, related by m-command. A lenis v, on the other hand, only involves one point, the head xO. In this sense, a lenis object is smaller than a fortis object. What does this mean for double-layered structures? Under the assumption we made above, *viz.* that the lowest complement in double-layered structures always has to be m-commanded, we are forced to say that fortis stop as in (23b) would involve three points (xO, x_1 and x_2, all of them related by m-command), while a lenis stop (23a) would only involve two points (xO and x_2, related by m-command). In other words, we would be forced to say that a *lenis* b involves the same number of points (*viz.* two) as does a *fortis* f, which seems wrong. We have seen evidence in chapter 1 that stops are *structurally bigger* than fricatives, *i. e.* they consist of more terminals and are double-layered. However, there is no reason to assume that stops are *inherently longer* than fricatives, *i. e.* that more points are m-commanded by the head of the structure. Yet this is exactly what (23) suggests—an undesirable result.

What all this suggests is that the lowest complement in a double-layered structure is *never* m-commanded by its head. Going back to our four possibilities in (22), we are left with only the two in (22a–b), repeated here as (25). (22c–d), where xO m-commands x_2, are thus universally excluded. (We will see in a moment why the structures in (25) are still in need of further refinement.)

(25) a. lenis (to be refined)   b. fortis (to be refined)
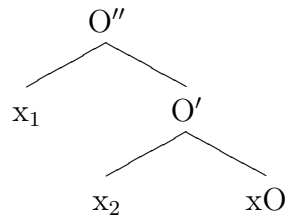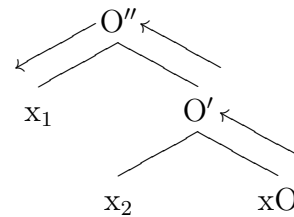
This gives us a perfect parallel between one- and two-layered structures (for the one-layered structures *cf.* (24)): in fortis structures, m-command relates exactly two points, *viz.* the head xO and the highest complement. In lenis structures, the head xO does not m-command any other point (and therefore it does of course not m-command the highest complement). This holds true for both the single-layered structures in (24) and the double-layered structures in (25). The calculation of length (in terms of the number of points involved) is the same both in single-layered and double-layered structures.

At this point we have to ask *why* the lowest complement in a double-layered onset-projection cannot be m-commanded? In order to answer that questions, we will have to look at the conditions under which unannotated x's can occur. So far we have simply said that a head (xO or xN) or a projection thereof takes an x as a complement and projects. However, this is not all there is to say. What I would like to propose is the following.

(26) **Licensing of x's:**

Every unannotated x must be licensed by exactly one licenser.

Unannotated x's have a requirement to fulfill: they must be licensed. That is, for every unannotated x we have to find exactly one licenser. This shifts

our attention to what a possible licenser is. One licensing mechanism that we have already talked about is m-command.

(27) An m-commanded point counts as licensed.

An x that is m-commanded is licensed by this m-command relationship. In a fortis onset, the head xO will m-command its highest complement and therefore license it. What does this imply for double-layered structures? We have seen before that the *lower* complement is not m-commanded by the head xO, *cf.* x_2 in (25). However, since the lower complement is an unannotated x, it will have to be licensed. If the point is not m-commanded, then what is it licensed by? What I would like to propose is that there is a relationship of **control** (which we have not talked about yet) between xO and the lowest complement.
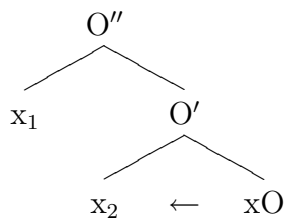
(28)   a. **Control:**

An unannotated x in a non-maximal onset projection must be controlled by its xO.

b. **Licensing mechanisms:**

m-command, control.

Control is a licensing mechanism, *i. e.* a controlled point counts as licensed. As stated in (28a), control is unique to the non-maximal onset projection.

(29) **Control:**

O″

x_1 O′

x_2 ←   xO

Control is an obligatory relationship between xO and x_2. It never occurs elsewhere, *i. e.* never between xO and x_1 or within nuclear projections. Since (26) requires that every unannotated x must be licensed by *exactly* one licenser and since (28a) requires that x_2 in (28) must be controlled by xO (a licensing mechanism), it follows that x_2 cannot be m-commanded by xO. This is exactly the result we want. However, this must not betray the fact that at this point control is nothing but a stipulation. It might well turn out that this obligatory control relationship between the onset head and the lowest complement is one of the defining characteristics of onsets. Further research will have to show what its exact nature is.

The requirement on licensing makes a very welcome prediction. In order to see this, let us have yet another look at the representations of lenis and fortis onsets that we have employed so far. (30) repeats the structures of a lenis **b** and a fortis **p**, respectively.
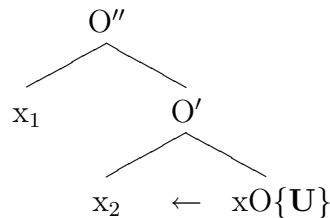
(30) a. lenis **b**   b. fortis **p**
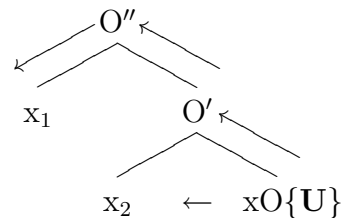
The point x_2 is an unannotated point and (28) requires that it must be controlled. Control is a licensing mechanism, so the condition that every unannotated point be licensed is fulfilled. We have dealt with x_2 and can move on to x_1. In (30b) xO controls x_2 and m-commands x_1. All points are licensed and nothing else has to be said. In the representation in (30a) on the other hand, x_1 is not m-commanded by xO. What does this mean for us? If xO does not m-command x_1, x_1 will have to be licensed some other way. For example, we will have to find another m-commander that could take care of x_1. Where could we find such an m-commander? The answer is simple: the preceding nucleus will be the licenser. The structures in (30) are only fragments which are to be integrated in larger structures.[16] So let us look at

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[16] The exact details of this will be discussed in the following chapter.

a **b/p** at the end of a word. We have already talked about the representation of the words *rib/rip* in (19), repeated here as (31).

(31)   a. *rib* (relevant sequence)
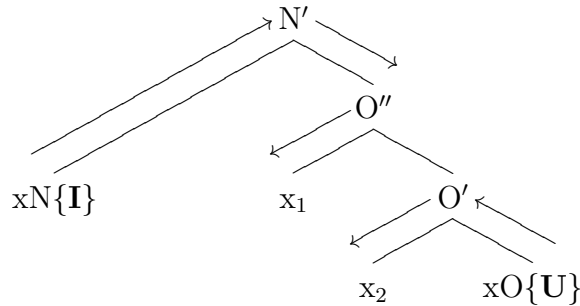
    b. *rip* (relevant sequence)
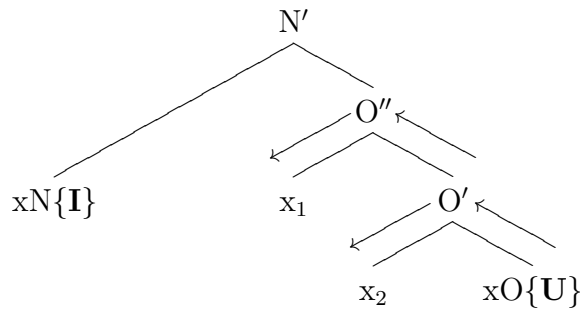
In (31a), the nuclear head xN m-commands x_1, which is therefore licensed. That is, the condition in (26) automatically predicts that we will find a longer nuclear expression before lenis onsets than before fortis onsets. Since in (31a) x_1 is not m-commanded by xO, another m-commander has to be found. The head xN takes over this role and m-commands x_1, therefore licensing it. In (31b) x_1 is already m-commanded by xO. Since every unannotated point has to be licensed exactly once, we predict that x_1 cannot be m-commanded a second time by xN. This gives us the difference between *rib* ɹiːb and *rip* ɹɪp. In other words, the principles we have established so far predict the correct distribution of length.

Notice that the condition in (26) makes the correct predictions not only for double-layered structures, but of course also for single-layered structures.

A quick look at the relevant part of the representation of the word *give* (16a), repeated here as (32), verifies this.

(32) *give* (repeated)
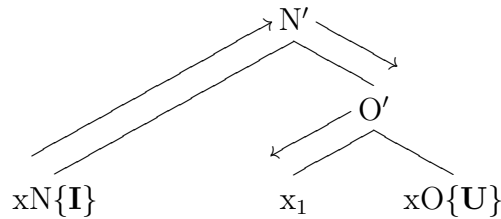
In a word like *give*, x_1, the complement of xO, is not m-commanded by xO. The point x_1 is a daughter of the maximal projection O′ and thus not controlled by xO, either. Accordingly, if every unannotated x must be licensed, xN will have to step into the breach and act as an m-commander, as a result of which we get a long ɪː. The condition in (26) thus functions as a well-formedness condition on phonological representations, and at the same time helps us explain the distribution of length.[17]

We have now seen m-command in use several times. One question raised very early in the discussion has not received an answer yet: Why do we use labelling and m-command to indicate which positions are to be interpreted with a certain melody instead of the more traditional association lines? We will turn to this issue now.

2.3.2.4   Association lines *vs.* m-command

Recall the representations of a lenis v and a fortis f as given in (13) and repeated here for the sake of convenience.

(33) a.   lenis v   b.   fortis f

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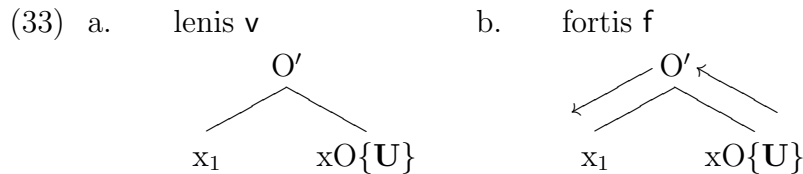
[17] Cases where there is no potential m-commander preceding a lenis onset will be discussed in section 3.4, where we shall see that there are still other means to license an unannotated x.

The heads (the xO's) are labelled with melody, an **U**, and m-command indicates whether x_1 is to be interpreted with the same melody as its m-commander or not. If there is no m-command relationship, we get a lenis v, if there is one, the result will be a fortis f.

Why do we label positions with melody and say that a particular relationship, m-command, can hold between them? Why can we not use association lines to do all this? That is, why don't our representations look as in (34)?

(34) An *illicit* attempt at using association lines in the present model

a. lenis v:

        O′
    ╱   ╲
x   xO
           |
         U

b. fortis f:

        O′
    ╱   ╲
x   xO
  ╲   ╱
    U
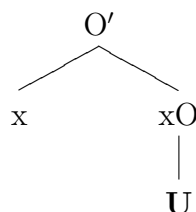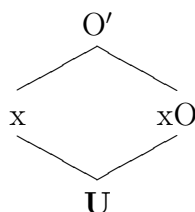
In (34a), the **U** would be linked to the head xO only, giving us a lenis v; in (34b) the **U** is linked to both positions, which yields a fortis f. It seems as if association lines could express exactly the same things that labelling and m-command can. In fact, they cannot. As I shall show, any such attempt to use association lines as in (34) is hopelessly flawed. (34) could not possibly be correct, as association lines are completely incompatible with the present model.[18]

In fact, the proof for this can be given quite easily. Association lines obviously require some melody that can be associated with certain positions. In the structures in (34), we used the melody **U** and linked it to certain positions. In the case of multiple association, as in (34b), this melody would

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[18] Note also that once multiple association is allowed for, as in (34b), we are no longer dealing with tree structures in the sense of graph theory. A tree is defined as a graph where any two nodes are connected by exactly one path. (34b) is therefore not a tree, since it is not true that any two objects in the representation are connected by exactly one path. In fact, *every* object is connected to every other object by more than one path: O′ is connected to **U** both via x and via xO, xO is connected to x both via O′ and via **U**, **U** is connected to xO both directly and via x and O′ etc.

also serve to indicate which positions belong together. Double association would indicate that both points are to be interpreted with the melody **U**. Now, to illustrate the fundamental flaw in this, let us go back to standard GP for a moment and take a PE like $(\{\textbf{?}, \textbf{H}\}\_)$, which was assumed to represent a fortis **k**, and compare it to a lenis **g**, which was assumed to be $(\{\textbf{?}\}\_)$. The lesson we learnt from chapter 1 was that there *are no* elements **H** and **?**. The properties they encoded could not be melodic, as we discussed in detail. But if we take the PE's used for **k** and **g** in standard GP, $(\{\textbf{?}, \textbf{H}\}\_)$ and $(\{\textbf{?}\}\_)$ respectively, and take away **H** and **?**, all we are left with is—nothing. There is simply no melody left. As far as the melodic make-up of **k** and **g** is concerned then, they are identical: neither of them contains any melodic primes, *i.e.* elements.

Crucially, if there is no melody left, we have nothing that we could *associate* to points. The use of association lines was unproblematic in a model like standard GP, with a sufficient number of elements. The richer the theory of melody, the easier it is to use association lines. In earlier models, PE's would be quite complex (as discussed in section 1.1) and in most cases there was always at least one element in the PE, which could then be associated to one or more positions. With the number of elements dropping to four, this task becomes more difficult, and at times even impossible. By doing away with **?** and **H**, the old PE's $(\{\textbf{?}, \textbf{H}\}\_)$, $(\{\textbf{?}\}\_)$ or $(\{\textbf{H}\}\_)$ and the like will be reduced to nothing, and the properties formerly encoded by **H** and **?** are now expressed by structure.

What this means is that association lines cannot be used in the present model. A notion like m-command becomes unavoidable, and this in fact is a welcome development since it makes our theory conceptually cleaner. Purely structural relationships between points (m-command) can, and actually must be expressed without any reference to melody. That is, m-command does not care about and is completely independent of whether a point is labelled with melody or not; m-command simply indicates which points are to be interpreted in the same way. Melody has neither any influence on structure, nor on relationships holding between certain points of that structure (such as m-command). There is a clear divide between the two levels.[19]

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[19] In section 4.2.2 we will discuss the nature of the element **A**, which repeatedly seems to violate that divide and exert an influence on structure. What the behaviour of **A** seems to indicate is that **A**, too, will have to be treated as a structural property, and not as an element.

The fundamental problem with association lines and the superiority of m-command becomes even more obvious when we look at pairs of an empty nucleus and an empty onset. Like onset heads, xN's can be devoid of melody as well, *e. g.* in the English word *lump* lʌmp, where the ʌ is simply the realisation of an empty nucleus. Consider now pairs as the ones given in (35a), *e. g. dug* and *duck*. Assuming that both ʌ (the vowel in the two words) is devoid of any melody and velars like g and k as well, how can we distinguish the two members of the pairs (*e. g. dug vs. duck*)? What we want to express is that the distribution of length between the nucleus and the final onset in *dug* is the same as in *bid*, while *duck* parallels *bit*. Since there is no melody left (in the relevant nucleus-onset sequence) that could be associated to the terminals, association lines would fail to show this relationship. In terms of *structure and melody*, both *dug* and *duck* have an identical representation, as given in (35b).

(35) a. *bug* *buck*
          dug *duck*
          mug *muck*
          plug *pluck*
          rug *ruck*

b. The structure of *dug* and *duck*, minus m-command
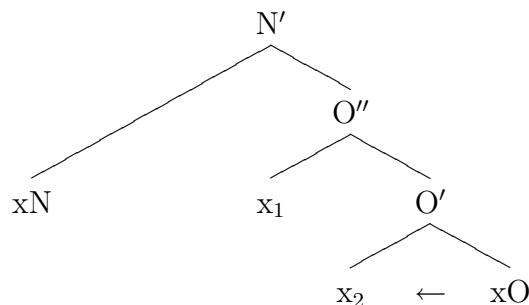
The structural fragment in (35b) will underlie any of the words in (35a). From a structural point of view, *dug* and *duck* cannot be told apart. Melody will not help us, either, since there *is* no melody. The task of indexing which points belong together and are to be interpreted in the same way has to

be carried out in some other way. (35b) has to be supplemented with m-command relationships as given in (36).

(36)   a. *dug* dʌːg (relevant sequence)

$$N'$$
$$xN \qquad O''$$
$$x_1 \qquad O'$$
$$x_2 \quad \leftarrow \quad xO$$
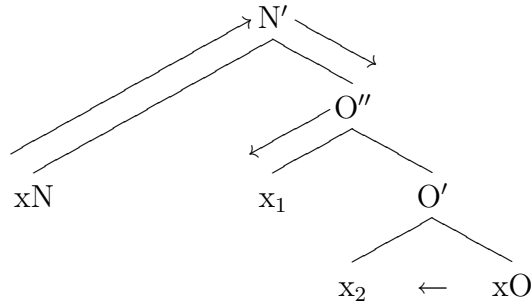
    b. *duck* dʌk (relevant sequence)

$$N'$$
$$xN \qquad O''$$
$$x_1 \qquad O'$$
$$x_2 \quad \leftarrow \quad xO$$
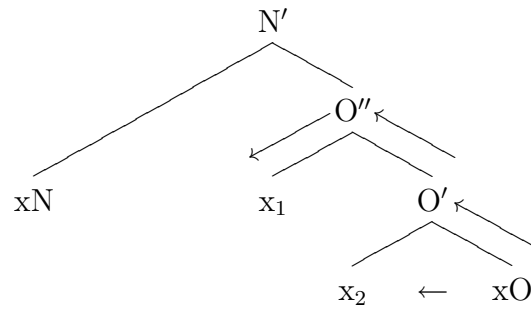
In (36a), the relevant sequence of *dug* dʌːg, xO does not m-command any other point, which gives us a lenis g. The point x_1 is m-commanded by xN, giving us a long ʌː. In (36b), which represents part of the word *duck* dʌk, xO m-commands x_1, as a result of which the entire onset projection O″ comes out as a fortis k. Since the point x_1 is m-commanded by xO, it cannot be m-commanded by xN any more, which gives us a short ʌ. Notice that we can tell the two forms in (36) apart by the m-command relationships holding between xN/xO and x_1. No reference to melody is necessary; in fact no reference to melody is *possible*, since there is no melody.

Let us conclude our discussion of m-command here. Its importance has been amply demonstrated. So far we have only talked about a certain type of single- and double-layered onset projections. It is now time to extend our repertoire a little and move on to other classes of onset structures.

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2.3.3 Nasals and *l*

What is the structure of nasals and *l*? Are they similar to something we have seen before? The answer is "yes": their behaviour clearly indicates that we are dealing with (i) two-layered structures (*i. e.* stops) which (at least in English) are (ii) lenis. There is one peculiarity which makes nasals and *l* slightly different from the stops we have seen before, but before we discuss that particular property, let us review the evidence for (i) and (ii).

Firstly, recall the discussion of Pulaar in section 1.3.1. While initial glides and fricatives could only occur in what we called the weak group (the group of noun classes that allowed for *any* consonant initially), nasals and *l* could occur in the strong group, which only allowed for base-initial stops. Thus, nasals and *l* have to be stops themselves, otherwise they could not occur in the strong group.[20]

The second kind of evidence is the length pattern in New York English which suggests that nasals and *l* are lenis configurations: The nuclear expression in *bin* is of the same length as the one in *bid*, and the one in *bean* equals the one in *bead*. Put differently, nasals and *l* must include an unannotated slot that is free for m-command from the preceding nucleus.

While the stop-like behaviour of nasals and *l* seems to be universal, their lenis behaviour might not be (but rather a contingent fact about English and many other languages). Cyran (1997) discusses an interesting case from Munster Irish, where tense and lax sonorants are to be distinguished. Their difference in behaviour is quite telling: while the lax series allows for lengthening of preceding nuclei, the tense series does not. Irish, unlike English, seems to allow for sonorants that are fortis, *i. e.* where the unannotated slot dominated by the maximal projection cannot be m-commanded by the preceding nucleus. Cyran's tense and lax sonorants should then rather be termed fortis and lenis, in accordance with the model developed so far.

Now, if both an English *l* and an English *d* are lenis, if both are stops and the only melodic prime they contain is **A**, how can they be kept apart? (37) gives the structures of a lenis **d** and a fortis **t**.

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[20] The insight that liquids and nasals behave like stops is of course not new, but can already be found in SPE (Chomsky & Halle 1968).

(37) a. lenis d   b. fortis t

$$O''$$
$$x_1 \qquad O'$$
$$x_2 \quad \leftarrow \quad xO\{\mathbf{A}\}$$

$$O''$$
$$x_1 \qquad O'$$
$$x_2 \quad \leftarrow \quad xO\{\mathbf{A}\}$$
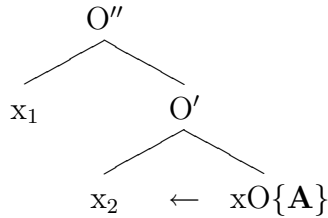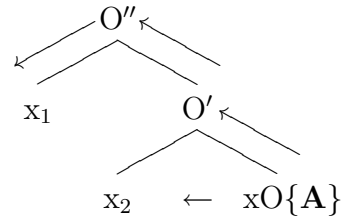
An *l* should be similar to the lenis d in (37a), but of course still different. One promising way to represent an *l* would be to take advantage of the bigger structures we are working with. Since *l* behaves like a stop, it will have a two-layered structure with three terminals altogether. In that respect it is similar to a d. What if in an *l* the element **A** was not sitting in the head xO (as in a *d* or *t*), but rather in the complement of the head xO? This idea is illustrated in (38).

(38) The structure of l

$$O''$$
$$x_1 \qquad O'$$
$$x_2\{\mathbf{A}\} \qquad xO$$
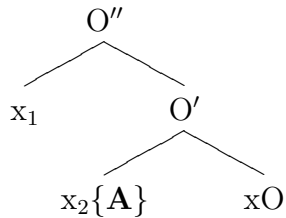
This is indeed the structure I want to propose for (a lenis) *l*. The node x_2 is labelled for **A**. Since x_2 is annotated and therefore licensed, no control relationship between xO and x_2 is necessary. Furthermore, the onset head xO does not m-command x_1, *i. e.* the structure is lenis. Note, however, that there is nothing in the structure in (38) that would prevent xO from m-commanding x_1, *i. e.* we should also expect to find languages with fortis *l*'s. As we have said above, this is borne out by the facts: Irish is a language where such fortis *l*'s seem to exist.

Nasals will have a similar structure. In (39) I give the representation of (lenis) m, n and ŋ.[21]

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[21] The structure given for ŋ is the one we find as the first member in a cluster like English *sink*. It is not the structure of what we find at the end of *sing*, since what is usually transcribed as ŋ at the end of *sing* behaves like a cluster.

(39) a. **m**   b. **n**   c. **ŋ**

$$
\begin{array}{ccc}
\text{O}'' & \text{O}'' & \text{O}'' \\
\diagup\diagdown & \diagup\diagdown & \diagup\diagdown \\
x_1 \quad \text{O}' & x_1 \quad \text{O}' & x_1 \quad \text{O}' \\
\quad\ \diagup\diagdown & \quad\ \diagup\diagdown & \quad\ \diagup\diagdown \\
x_2\{\mathbf{L}\}\ \ x\text{O}\{\mathbf{U}\} & x_2\{\mathbf{L}\}\ \ x\text{O}\{\mathbf{A}\} & x_2\{\mathbf{L}\}\ \ x\text{O}
\end{array}
$$
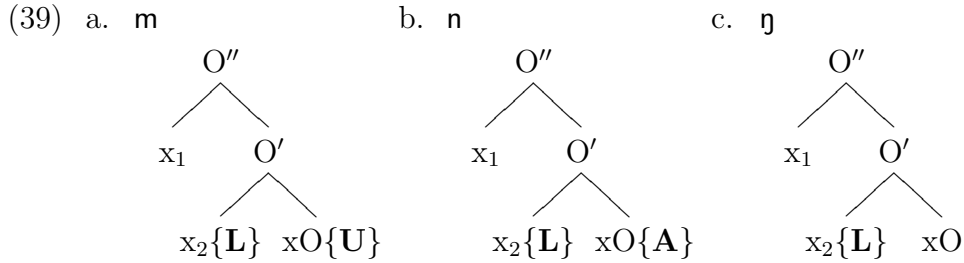
The ingredient responsible for nasality, $\mathbf{L}$, sits in the complement position x_2. The other elements (if any) are in the head position $x\text{O}$. Again, there is no control relationship between x_2 and $x\text{O}$, since x_2 is annotated. The highest complement, x_1, is not m-commanded by $x\text{O}$, *i. e.* all the structures in (39) are lenis.

The structures in (38–39) are the first instances where we find melody in a non-head position. Under which conditions can melody occur in non-head positions? What are the consequences of allowing for melody in other positions than heads? In section 1.1 we argued that the element calculus of standard GP still suffered from overgeneration and that a model with only four elements would fare better than one with six. Note, however, that while it is true that the model presented here makes do with fewer elements, its structures are much more complex than the ones employed in standard GP. If we now allow for melody to occur in different positions, this seriously undermines our attempts to curb overgeneration. If we allow for an element ε to occur in non-head positions, then we can generate three different double-layered onset projections with that element alone, *cf.* (40).

(40) a.   b.   c.

$$
\begin{array}{ccc}
\text{O}'' & \text{O}'' & \text{O}'' \\
\diagup\diagdown & \diagup\diagdown & \diagup\diagdown \\
x_1 \quad \text{O}' & x_1 \quad \text{O}' & x_1\{\varepsilon\} \quad \text{O}' \\
\quad\ \diagup\diagdown & \quad\ \diagup\diagdown & \quad\ \diagup\diagdown \\
x_2\ \ x\text{O}\{\varepsilon\} & x_2\{\varepsilon\}\ \ x\text{O} & x_2\ \ x\text{O}
\end{array}
$$
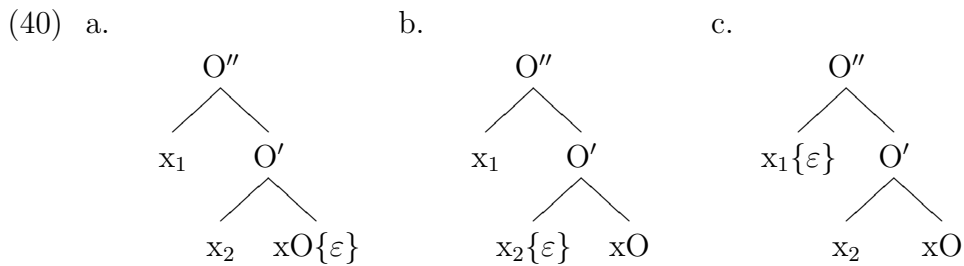
That is, there are three objects with two layers and the element ε, another three with two layers and the element ζ, a total of $3 \times 3 = 9$ as soon as we

take double-layered structures and *two* elements etc. How can we avoid such overgeneration?

A reasonable claim to make is that melody is restricted to head positions (*i. e.* xO's and xN's), which would allow for (40a), but exclude (40b) and (40c). This reduces the expressive power of the theory by a great deal. But under such a restriction it becomes impossible to tell *l* and *d* apart. We have evidence that both are two-layered structures and that both are lenis—the only possibility left to distinguish them is the position of the element **A**. What this means is that we will have to allow for melody in non-head positions, but we will have to be careful not to create a system that overgenerates wildly.

Let us have another look at our structures in (38) and (39). The elements that occur outside the head positions are **A** and **L**. Now, there is good reason to assume that **A**, and to some extent also **L**, are quite different from the other two elements, **I** and **U**. We have already seen evidence for the special properties of **A** in the discussion of superheavy rhymes in section 2.2 and will discuss some more in section 4.2.2. One area where both **A** and **L** display special behaviour is in clusters (to be discussed in chapter 6). All clusters in English have to contain **A** somewhere *or* their first member has to be a nasal (*i. e.* contain **L**). For example, we find *rt* (where both *r* and *t* contain **A**), *pt* (where the *t* contains **A**), *lk* (with **A** in the *l*) or *mp* (where the first member is a nasal, *i. e.* contains **L**), but there is no **fk* or **kp*, since neither member of the cluster contains **A** and the first member is not a nasal.

Further evidence that singles out **A** and **L** comes from French. Ploch (1995) proposes that in French all nasal nuclear PE's (characterised by the element **L**) have to contain **A**. Ploch argues that there is no "special affinity" between **L** and **A** to the extent that **L** would require the presence of **A**. Rather, all nasal nuclear PE's have to be associated to branching nuclei (in the sense of standard GP), and every branching nucleus in French has to contain **A**. Crucially, this latter condition that a branching nucleus must contain **A** is due to independent reasons, and has nothing to do with nasality. The connection between the two elements **A** and **L** is therefore indirect. But even if **L** and **A** occur in branching nuclei for independent reasons, it is still surprising that it is exactly those two (and not any other random pick of two elements) that have to fulfill such a condition.

Let us apply this knowledge to our problem of overgeneration. In order to restrict the expressive power of the theory, I would like to propose the

conditions in (41).[22]

(41)   a. Non-heads can only be annotated with **A** or **L**.

           b. Non-heads can only be annotated with melody *iff* they are not dominated by a maximal projection.

(41a) expresses the special status of **A** and **L**. The condition in (41b) restricts the possibilities of where melody can occur: it excludes a structure as in (40c), while allowing for the representations we proposed for l (38) and the nasals (39).

Structures like the ones in (38) and (39), where a non-head is annotated with melody, will be referred to as **AL-constructions** in this dissertation. The name will remind us of the special nature of **A** and **L**, *i. e.* that they are the only elements that can occur in non-head positions.

(42) **AL-construction:**

      A projection where **A** or **L** occurs in a non-head position is called AL-construction.

The structure of AL-constructions gives rise to some speculations. In the structure of l (38) the only melody in the whole onset projection is found in a non-head position, while the head itself is empty. The same holds for the representation of ŋ in (39c). The fact that the head is empty in both of those structures, while a complement position is annotated with melody, seems like an open invitation to fill some melody into the head. AL-constructions like the one of l (38) or ŋ (39c) can be considered somewhat instable; we should expect that the head be filled in by something. This reasoning might answer two questions: (i) Why do most languages have different kinds of nasals (and often also different kinds of *l*'s)? (ii) Why is there homorganicity in clusters where the first member is a nasal? If the head position is empty and there is a tendency to fill it in, both questions might be answered at the same time.

---

[22] For the time being, (41) is still a stipulation. I am confident that further research into the nature of **A** and **L** will allow us to derive the conditions in (41) from more general principles.

Languages tend to display a series of nasals, like the three in (39a–c), in order to fill the head position. In an m (39a) or an n (39b), the head position is filled by melody, *i. e.* the elements **U** and **A**, respectively. Likewise, if AL-constructions tend towards having their head filled, it does not come as a asurprise that we observe homorganicity in clusters like in *lamp* (**lanp*) etc. Furthermore, if AL-structures with melodically empty heads are somewhat instable, we should also expect that they might "combust" in the course of time. One such case might be the development towards modern Catalan, where l has generally turned into ʎ, *e. g.* in the words *llengua* ʎ'eŋgwə 'tongue, language' or *lloc* ʎɔk 'place'.
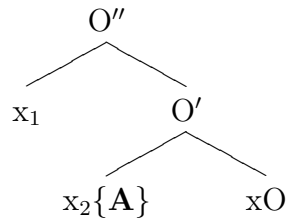
(43) a. l   b. ʎ
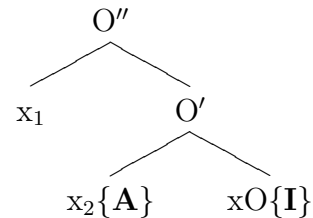
Let us now take those AL-constructions, plug them into a larger structure and see how we fare for length. (44) gives the relevant sequence of a word like NYC English *bin* bɪːn.

(44) NYC English *bin* bɪːn (relevant sequence)
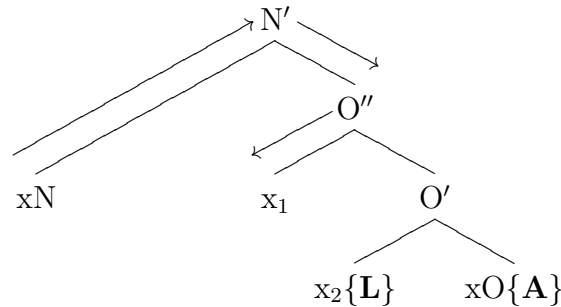
Since NYC English *n*'s are lenis, the terminal x_1 has to be m-commanded by the preceding nuclear head xN. Accordingly, we get a long ɪː in *bin* bɪːn. The same holds true of words like *bill* or *swim*.

This closes our discussion of AL-constructions for the moment, but we will come back to them and their properties in sections 4.2.1 and 4.2.3.

2.3.4   Non-projecting structures

What is left is the discussion of objects such as w, j, r and ɣ. What is their underlying structure? So far we have dealt with two-layered and one-layered structures. The only remaining option we have not exploited yet are simple, non-projecting xO's, without any complements. This offers us a possibility to represent w, j, r and ɣ as given in (45).[23]

(45) a.   b.   c.   d.

    xO{**U**}   xO{**I**}   xO{**A**}   xO

       w   j   r   ɣ

    Notice that with the exception of r, none of them can occur in post-vocalic position in English.[24] Testing for whether w and j would allow for extra length before them is thus impossible, at least in English. Likewise, r has a habit of disappearing in post-vocalic position. Evidence from Estonian (to be discussed in section 4.2.2) shows clearly, however, that r does provide extra room that can be m-commanded by a preceding nucleus. We will then have to deal with how this is possible, given that its structure seems to be a simple xO. That is, if an r has a structure as in (45c), it does not come with an "unused" x-slot that could be used for m-command from a preceding nucleus, unlike lenis onsets such as d or l. The representation in (45c) will have to be slightly modified, since the behaviour of r gives us a crucial clue about the nature of **A**.

2.4   Summary

In the first two sections of this chapter we have have discussed further evidence that showed some fundamental problems standard GP encountered,

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[23]   An empty xO surfaces as ɣ unless it is p-licensed. For further details on p-licensing within the present framework *cf.* sections 3.2.2, 3.3.2 and 3.3.3.

[24]   The ɣ is completely absent from English, but occurs in certain Turkish dialects as realisation of an empty, unlicensed xO.

viz. problems with complexity (2.1) and problems with super-heavy rhymes (2.2). In section 2.3 we moved on to the basics of a new phonological model. We discussed the structure of different classes of consonants, showed that association lines have to be replaced by m-command and demonstrated how m-command would give us the difference between fortis and lenis consonants. What we have not seen so far is the structure of entire words, however, but only of fragments. We will now have to ask the question how the structures discussed in this chapter can be combined into larger structures to give us the representation of entire words. This is the issue we will turn to in the next chapter.

Chapter 3

Higher level structure

In the previous chapter the basics of a new theory of constituent structure were presented. With the exception of some fragmentary representations, *e. g.* in (16) on p. 69 or (19) on p. 71, we have only talked about the internal structure of individual consonants so far. However, it is clear that they have to be integrated in some higher order structure that encompasses the entire phonological domain. For example, as we saw in words like NYC English *bid*, the vowel *i* and the final *d* interact closely: the vowel takes up the unused space that comes with the lenis *d*, which gives us a long ɪː. This close interaction suggests that the sequence ɪːd in *bid* bɪːd forms a unit of some kind where this interaction can take place.

In this chapter we will look at very simple domains, *e. g.* the structure of words like *bid*, *Libby* or *bee*. (More complex structures will be discussed at a later point.) Before we can construct structures for those words as a whole, however, we will need some further details about their behaviour. Section 3.1 is intended to do exactly that and gives some more information on length phenomena in NYC English. In section 3.2 we will discuss how the levels of projection can be restricted and what that means for higher level structures. Section 3.3 presents three different kinds of domains that will figure prominently in the chapters to follow. The last two sections, 3.4 and 3.5, discuss certain problems associated with lenis configurations.

3.1 Further conditions on NYC length

So far we have only talked about words like *bid* or *bit* and *give* or *whiff* and the nature of the final consonant that either gives rise to length (if it is lenis) or fails to do so (if it is fortis). Note that in all those words that particular consonant always followed the stressed position. (Obviously, since it follows the only nucleus in the domain that is realised.) Furthermore, the consonant is always in final position, never followed by any other realised nucleus. Let us have a look at these two factors (stress and following realised nuclei) in detail now. The questions we have to ask are the follong ones: (i) Do unstressed nuclei behave like stressed nuclei with regard to length? (ii) Do all stressed nuclei behave alike, regardless of whether another realised nucleus follows or not? To make the second question more precise, we will concentrate on cases where that other realised nucleus following the domain head is not stressed.

The answer to the first question (do stressed and unstressed nuclei behave alike?) is negative, as the following example shows. In (1) we see a pair where d/t follow an unstressed nucleus.

(1)   *wicked*   wˈɪkəd   *wicket*   wˈɪkət

The unstressed vowel preceding a lenis d (in *wicked*) comes out as identical to the unstressed vowel preceding a fortis t (in *wicket*). This is quite different from the pair *bid*/*bit*, where the length of the vowels is clearly different. Our theory will have to say something about this.

The answer to the second question raised above (do all stressed nuclei behave alike, no matter if another realised nucleus follows or not?) is negative as well. (2) contrasts monosyllables and similar bisyllabic words to demonstrate the difference.

(2)   a.   b.
        rub   rʌːb   *rubber*   ˈrʌbə
        rib   rɪːb   *Libby*   ˈlɪbi
        men   meːn   *many*   ˈmeni
        big   bɪːg   *bigot*   ˈbɪgət
        laid   leːːd   *lady*   ˈleːdi
        leave   liːːv   *beaver*   ˈbiːvə
        league   liːːg   *beleager* bəˈliːgə

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Compare the words *big* and *bigot*. Stress is on the *i* in both words. There is a clear difference between *big* bɪːg (long ɪː) and *bigot* 'bɪgət (short ɪ). In fact, the stressed *i* in 'bɪgət is no longer or shorter than the stressed *i* in the word *wicket* 'wɪkət, where the stressed nucleus is followed by a fortis k. In other words, any difference fortis and lenis becomes completely irrelevant in this context as regards the length of the preceding nucleus. Of course, this does not mean that the distinction between short and long is lost altogether. The nucleus in *bigot* is short, while the nucleus in *lady* is long. What unites those two words is that there is no *additional* length due to the lenis consonant following, as comparison with *big* or *laid* shows. The stressed nucleus in *big* is longer than the one in *bigot*, and the one in *laid* is longer than the one in *lady*.[1]

What is the crucial factor between *big* and *bigot*? It must be the fact that in *bigot* a further realised nucleus follows the lenis *g*, *viz.* the unstressed vowel ə. In other words, a structural difference has to be responsible for the different behaviour of the *i* in *big* and *bigot*, respectively. In the last chapter we saw that a lenis *g* comes with an unused x-slot, and in words like *big* that unused x-slot was responsible for length. In *bigot* this unused x-slot of the *g* seems to be inaccessible to the preceding nucleus. Our theory of higher level structure will have to take that into account, too.

3.2   Higher level structure

So far we have only considered onset heads and their projections as individual objects. We have only seen fragments of the higher level structure up to now. We will now come to a more detailed discussion of higher level structure. This higher-level structure conforms to the the same principles we have applied so far: a given node takes another node as its complement (it merges) and projects.

The general concept that drives the construction at this higher level is the Licensing Principle, which I retain from standard GP (Kaye 1990a).

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[1]   So far we have not seen the representation of a long nucleus as in *laid*. We will come to that issue in a moment.

(3)   **Licensing Principle**
       All phonological positions save one must be licensed within a do-
       main. The unlicensed position is the head of this domain.

   In the context of the present framework this means that every domain
will be one unified tree and the root of that tree will be a projection of the
domain head. That is, the highest projection of the domain head dominates
all other positions in the domain. We shall see examples of this soon. (4)
gives the definition of the notion 'phonological domain'.

(4)   **Phonological domain**
       Every phonological domain is a unified tree. The domain consists
       of everything that is dominated by the root node.

   All instances of merging must be understood as licensing relationships,
as set out in (5).

(5)   In a configuration where a node α merges with a node β and projects
       to α', the head of β, H_β, counts as licensed.
       $H_\beta \in H$.

   Where the set H was defined as {xN, xO} in (10) on p. 64.

   To illustrate this, we can take one of the fragments we have already worked
with, *e. g.* (16b) from p. 69, repeated here as (6).

(6)   *whiff* (relevant detail)
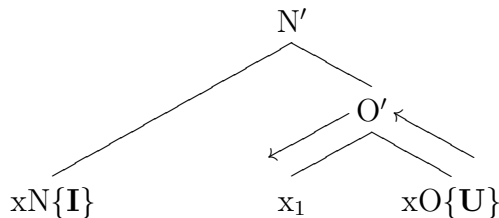
In (6) we have a situation where xN takes O′ as its complement and projects to N′. As a result of this merging operation, the head of O′, *i. e.* xO, is licensed. Note in this context that O′ is itself the result of a merge, consisting of a head xO and the complement x. However, since merge only licenses the *head* of a complement, and since x is not a member of the set of heads, it does not count as licensed as a result of the merge operation. What licenses x in (6) is the m-command relationship holding between xO and x. In the course of this chapter we will see yet another way of how an unannotated x can be licensed.

Our theory contains two types of heads, *viz.* xO's and xN's. Both of them can merge with complements and project. In order to understand higher level structure, we will have to understand what well-formedness conditions hold within those projections of xO's and xN's. We will start with the properties of onset projections, as they are simpler, and then see to what extent nuclear projections are similar or where they differ from onset projections.

3.2.1 Onset projections

The biggest kind of onset we have seen so far was a two-layered structure, illustrated with a fortis p in (7).

(7)   fortis p

$$
\begin{array}{c}
O'' \\
\diagdown \\
x_1 \qquad O' \\
\diagdown \\
x_2 \quad \leftarrow \quad xO\{\mathbf{U}\}
\end{array}
$$
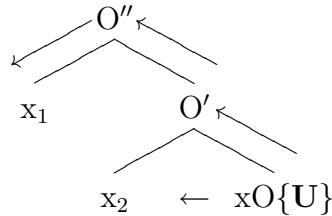
In fact, I want to claim that a two-layered structure is the actual maximum an onset head xO can project to. There are no three-layered structures as in (8).

(8)   An *illicit* three-layered structure

*   O‴
       /   \
     x₁   O″
            /   \
          x₂   O′
                 /   \
               x₃   xO
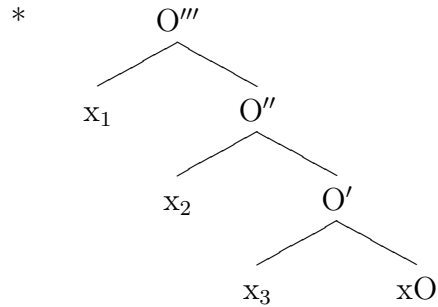
Two-layered structures are the maximal onset structures we ever seem to find in natural language. The empirical record does not require anything bigger, such as the three-layered structure in (8). Excluding three-layered structures also cuts back the generative power of our theory, of course.

How can this restriction be formalised? I propose the following condition.

(9)   **Maximal onset projection**
       The highest projection of an onset head xO can contain at the most one non-maximal projection.

This of course restricts the projection of the onset to an upper limit of two layers. In a stop structure as in (7) we have a maximal projection (O″) and one non-maximal projection (O′). (7) conforms to (9) and is grammatical. The illicit structure in (8) violates (9) in that it contains more than one non-maximal projection: Both O″ and O′ are non-maximal, O‴ is the maximal projection. (8) is thus successfully excluded by (9).

One-layered structures do of course not pose any problems. Due to their being one-layered, they could not possibly violate (9). (10) gives the structure of a fortis f.

(10)   fortis f

          O′
       /   \
     x₁   xO{**U**}
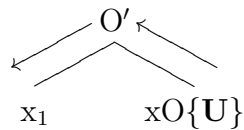
(10) only contains a maximal projection (O′), but no non-maximal projection and therefore cannot run afoul of (9). The same will be true of non-projecting structures, *i. e.* simple xO's. (11) repeats the structure of a w.

(11) xO{**U**}

Since there is not a single projection, (11) will not run into difficulties with (9).

3.2.2 Nuclear projections

Above we said that every tree, *i. e.* every phonological domain, will be a projection of the domain head. The domain head is a nucleus. If the highest projection of that nucleus has to dominate all other points in the domain, we can already foresee that a limitation to maximally two projections of nuclear heads will not do. Since a given projection can only group two nodes together, quite a number of projections will be needed to group all the nodes in a domain together, in particular when we are talking about longer domains.

This problem notwithstanding, let us have a look at the following structure.

(12) **Projections of the nucleus**
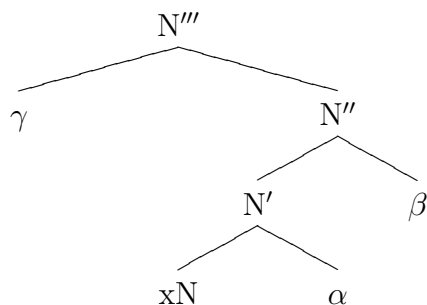
$$\alpha \in \{x, O\}, \beta \in \{x, O, N\}, \gamma \in \{O\}$$

The structure in (12) represents a basic building block that we will see time and again. It shows the three levels of projection that any nucleus can in principle expand into—"in principle", since, as we shall see, there are language-specific restrictions as to when a nuclear head can or must expand to a certain level. In other words, an xN can project up to N‴ and merge with α, β and γ along the way, but it does not necessarily have to: it might not project at all, or it might only project once or twice. N‴ is simply the highest level that any nucleus can project to; the only exception to this upper limit, as we will see in section 3.3.2, is the domain head, which can project to even higher levels (*i. e.* N⁗, N⁗′ etc.).

For the moment, however, we will restrict ourselves to the structure with maximally three levels, as given in (12). This structure can be characterised as follows.

(13)   a. A nuclear head xN can (but does not have to) take a complement to its right.

   b. The first projection N′ can (but does not have to) take a complement to its right.

   c. The projection above the highest projection with a complement to the right can (but does not have to) take a complement to its left.

Note the different position of the complements. In the case of onset projections, the complements were always to the left, while in the structure in (12) only the highest complement is to the left, the ones below are to the right. One remark on directionality is in order here. In graph theory, a tree is a graph in which any two nodes are connected by exactly one path.

(14) a.   b.   c.
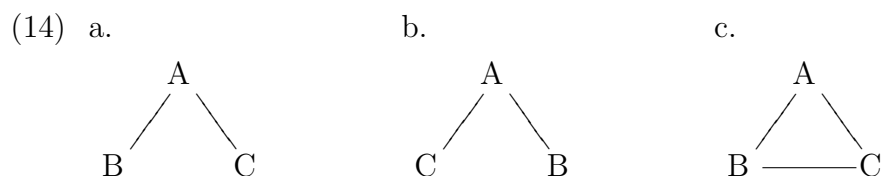
Let us look at (14a) first. There is exactly one path connecting B and C, and that path goes via A. Contrast this to (14c), which is not a tree. For any

two nodes it is true that there are two paths connecting them. (14b), on the other hand, *is* a tree, and crucially it is the *same* tree as (14a). (14a) and (14b) are identical: The ordering of B and C is irrelevant, *i.e.* there is no ordering relationship between the two. In fact there could not be any such ordering relationship, because that would mean there has to be a directed branch between B and C indicating that order, and as soon as we add a branch between B and C (no matter if it is directed or not), we are no longer dealing with a tree, *cf.* (14c). That is, there can only be dominance, but no precedence.[2]

What does this mean for phonology? Above we refered to nodes to the right of the nuclear head as opposed to nodes to the left. Ideally, such reference to the left/right side or to preceding/following nodes should be superfluous in a model employing hierarchical structure. Any kind of linearisation, *i.e.* directionality, should be derivable from the hierarchical structure.[3] That is, ultimately we are striving for a model where linearisation can be read off the hierarchy directly and unambiguously. Since I can only present the basics of a new model of constituent structure here, I will leave the issue of directionality at that. Further research will have to show whether or to what extent reference to linear ordering is indeed superfluous.

Let us come back to the structures predicted by (13) and go through them systematically. We will first have a look at γ, *i.e.* the node preceding the nuclear head. As stated in (12), γ can only stand for a node of the type O.[4] A node of the type N can merge with a preceding O, but does not have to. We can have nuclei with preceding onsets (15a) and nuclei without (15b).[5]

---

[2] Or alternatively, only precedence, but no dominance, *cf.* Prinzhorn, Vergnaud & Zubizarreta (2005) for such a view. Government and Binding syntax had both dominance and precedence, *cf. e.g.* Haegeman (1994).

[3] One of the first to express such an understanding for syntax was Kayne (1994). For a proposal that Kayne's model should also be applied to (standard) GP *cf.* Wiltschko (1994).

[4] A node of the type O is an onset head or a projection thereof. Likewise, a node of the type N is a nuclear head or a projection thereof.

[5] Recall that N simply stands for a nuclear head or a projection thereof, *e.g.* the N in (15a–b) can stand for xN, N' or N'', but of course not for any higher projection, as that would exceed the limit given in (13).

(15) a.   b.
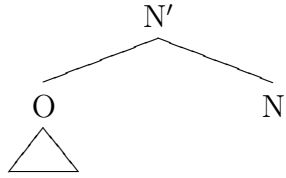
```
              N′
            /    \
          O        N
         /\                                         N
        /__\
```

Clear evidence that such a distinction is necessary comes from French.

(16)   a. *le mot* ləmo 'the word'

    b. *l'eau* lo 'the water'

    c. *le haut commissaire* ləo... 'the high commissioner'

The final nucleus of the definite article (irrespective of gender) is realised if the following word begins with an audible onset, *e. g. mot* mo 'word' (16a). If the following word does not begin with an audible onset, two possibilities exist: with certain words the final nucleus of the definite article is not realised, *e. g. eau* o 'water' (16b), with certain others it is realised, *e. g. haut* o 'high' (16c). The type illustrated in (16c) begins with what is usually referred to as *h aspiré*. As regards the behaviour of the article, (16c) behaves like (16a). The representation of the three words is given in (17).[6]

(17) a. *mot* mo 'word'   b. *eau* o 'water'   c. *haut* o 'high'

```
              N′                                                    N′
            /    \                                                /    \
         O″        xN                      xN              xO        xN
        /  \      {A, U}                 {A, U}                      {A, U}
      x₁     O′
            /  \
          x₂    xO
         {L}   {U}
```

---
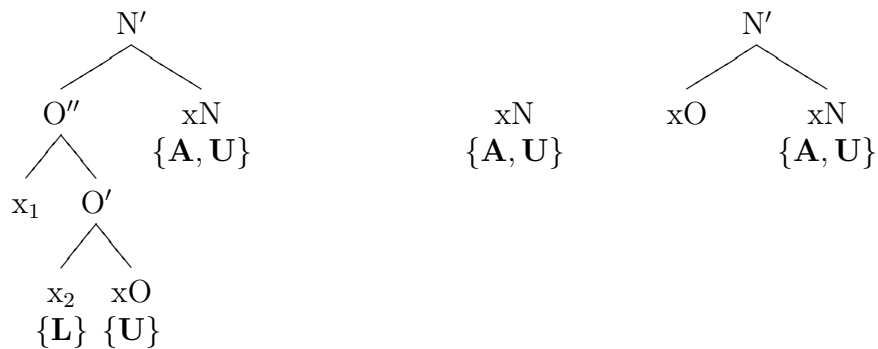
[6] The o of mo/o/o is given as a simple xN annotated with $\{A, U\}$. There is some evidence that the nucleus might actually be long, *cf.* Rizzolo (2002). This means that xN would m-command a complement x. That issue is irrelevant here, what is of importance is whether there is an initial onset or not.

From the structures in (17) it is clear why *haut* o 'high' (17c) patterns with *mot* mo 'word' (17a). Both words begin with an onset, while *eau* o 'water' (17b) does not begin with an onset. (17a) and (17c) are crucially different from (17b). The internal structure of the onset, *i. e.* whether it is a double-layered structure (17a) or a non-projecting xO (17c), is not important; what matters is whether there is an onset or not.[7, 8]

So far we have only talked about the position indicated with γ in (12), *i. e.* the one preceding the nucleus. We have seen that it can be present or absent. Let us now come to α and β. The conditions on α and β in (13) give us the three possibilities in (18). In order to simplify the discussion I will assume in the following examples that the position γ is present, *i. e.* that the nucleus merges with an onset to its left. One has to bear in mind, however, that the presence or absence of γ is completely independent of the presence or absence of α or β. All the structures in (18a–c) could also exist *without* an onset to the left of the nucleus.

(18)   a. Neither xN nor N′ takes a complement to the right
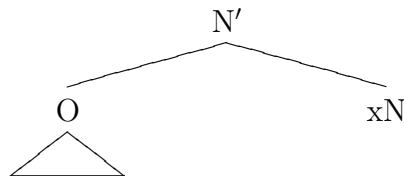
        b. Only xN takes a complement to the right

---

[7] In section 2.3.4 we said that an empty, non-projecting xO is realised as ɣ. In (17c) we have an empty, non-projecting xO that remains unrealised. I assume that this difference in realisation must have to do with whether the xO is p-licensed or not, *cf.* Charette (2003).

[8] In standard GP *haut* was assumed to begin with an onset dominating a skeletal slot, while *eau* was assumed to begin with an onset that does not dominate a point, *cf. e. g.* Charette (2003). Such a distinction is of course inexpressible in the model presented here: Categorial properties (onset *vs.* nucleus) are encoded by annotations (an xO is an x annotated with O). Since those annotations are only attributes ascribed to a given point, *i. e.* since they do not exist on their own, it follows that there could not be such thing as an onset without a point. An onset without a point would require a categorial annotation O without any point that could be annotated, which is nonsensical.

```
            N″
         ╱      ╲
       O          N′
      ╱─╲        ╱    ╲
     ╱───╲     xN      β
```
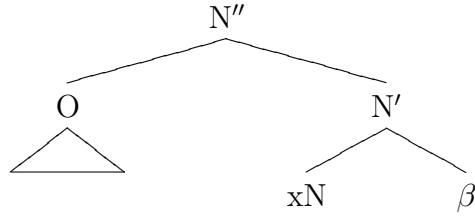
c. Both xN and N′ take a complement to the right


```
               N‴
            ╱       ╲
          O           N″
         ╱─╲        ╱    ╲
        ╱───╲     N′      β
                ╱    ╲
              xN      α
```
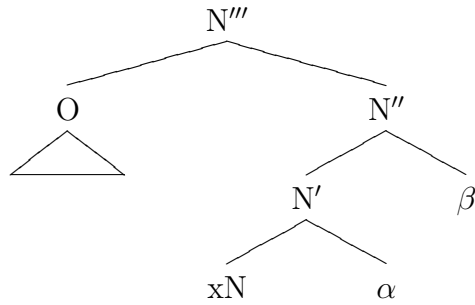
The complements were indicated with α and β, where the highest complement to the right is always β. That is, if there is only one complement to the right, as in (18b), it will be of type β. For α we can substitute an unannotated x or a node of the type O. For β we can substitute an unannotated x, a node of the type O or another N.[9] In this and the following two chapters we will only discuss cases where α is an unannotated x-slot. The case where α is of the type O will be discussed in chapter 6.[10]

Note in particular that β can stand for another N, *i. e.* a nuclear head or a projection thereof. That is, a nucleus can take another N as a complement. This complement N can in turn take yet another N as a complement etc. (Each of those nuclei will conform to the schematic structure of nuclear projections as given in (12), *i. e.* each nucleus in the structure can take one

---

[9] Recall that a "node of the type O" is an xO or a projection thereof. However, of all *non*-projecting xO's we only seem to find xO{**A**} in this position.

[10] Reference to two different sets of complements is certainly not very elegant, even more so since α is a subset of β. One could remedy this by assuming a general set of complements $\gamma \in \{x, O, N\}$ and stipulate that the N always has to be highest complement to the right.

complement to the left and up to two to the right.) This gives us an iterative dependency of nuclei as illustrated in (19). In order to emphasise the individual nuclei (and their projections) that the tree is made up off, each nuclear projection in (19) is boxed.[11]

(19) An illustration of a nuclear projection (N_2'') containing a nuclear projection (N_4'') containing a nuclear projection (N_6')
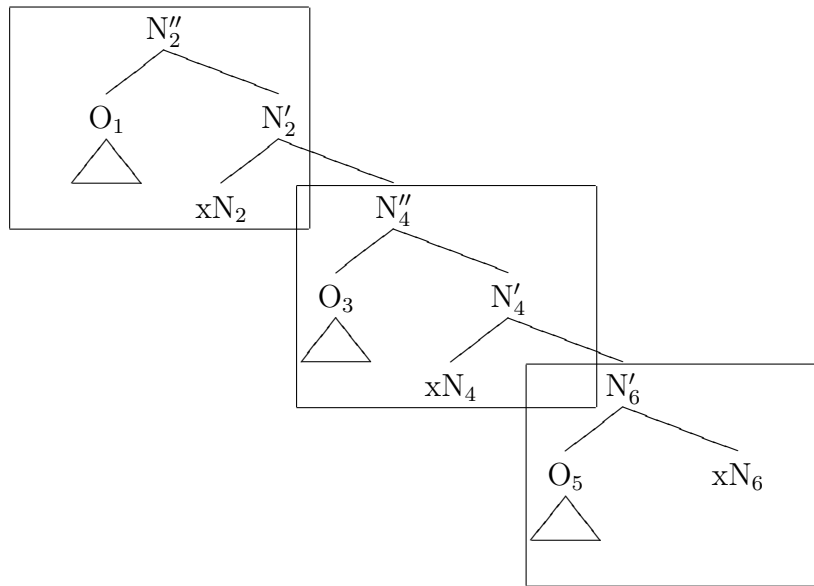
The nuclear head xN_2 takes another node of the type N, N_4'', as its complement. In turn, the nuclear head of that node N_4'', *i. e.* xN_4, takes yet another N, *viz.* N_6', as its complement. N_6' is a projection of xN_6, which does not take any complement to the right. The string ends. However, if xN_6 took a complement to its right, an even longer string could be created etc.

Let us now concentrate on the number of projections that a nuclear head can expand into. We notice a certain, but definitely not a complete, parallel

---

[11] In standard GP onset-rhyme pairs were numbered pairwise ($O_1\,R_1\,O_2\,R_2\,O_3\,R_3$ etc.), while terminals (*i. e.* skeletal slots) were numbered continuously ($\times_1\,\times_2\,\times_3$ etc.), if they were numbered at all. In the framework presented here, terminals and abbreviated nodes are always numbered continuously (and not pairwise) and this numbering is carried over into the projections. This explains why we have O_1, xN_2, O_3 etc in (19).

to onset projections here. We stated for onset projections that the most complex structure we could find was a double-layered one. A somewhat similar restriction on the number of projections holds in the case of nuclear projections: If N$'$ takes a complement to its right, then the next projection of N$'$, *i. e.* N$''$, cannot take a projection to the right any more. Instead, it can only take one complement to its left. That is, a nuclear head can project *at most twice* before it can take a complement to the left. For onset projections, arriving at the second projection meant that no further projection was possible *at all*. For nuclear projections, the second projection does not have to be the last one. A nucleus at the second projection can still take a complement to the left, where this complement can be an xO or a projection thereof.

Now, why is it important that nuclear projections are restricted in some way? Later on in this chapter I will discuss words like *bee* biː, for which I assume the following structure.

(20) NYC English *bee* biː
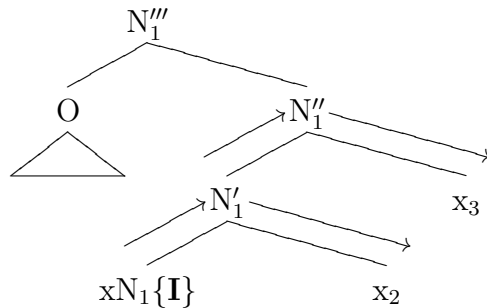
At this point we are not concerned about the internal structure of the initial onset, which is therefore shown in an abbreviated form.[12] Neither do we have to worry now about why the nuclear head xN_1 in a word like *bee* has to have no less than two unannotated slots it can m-command (*i. e.* x_2 and x_3 in (20)). What *is* of importance to us here is that the nuclear head in (20) could not take another complement to the right before selecting the preceding onset. The iː in *bee* biː comprises three positions (xN_1, x_2 and x_3) and this is the upper limit. If we refer to the actually existing word *bee* biː as bee_1, then it is not the case that English could have a word like *bee_2

---

[12] The word-initial position will be discussed in more detail in section 3.4.

pronounced as bi꞉꞉꞉ (*i. e.* with an i꞉꞉꞉ comprising four positions). In order to exclude such words like **bee₂*, there has to be a restriction on the number of nuclear projections. If there were no such restriction, we should expect to find the following structure in (21) alongside (20).

(21)   * N_1''''

O N_1'''

N_1'' x_4

N_1' x_3

$xN_1\{\mathbf{I}\}$ x_2
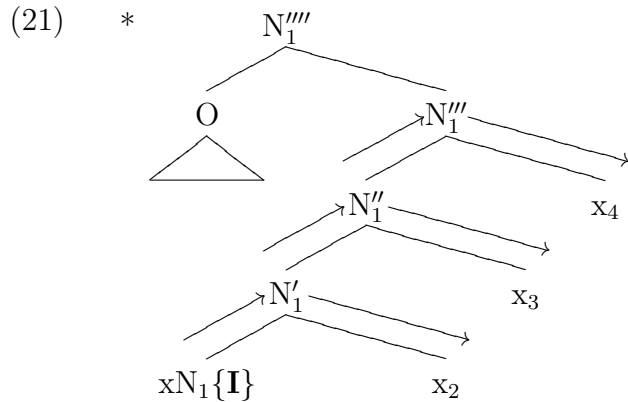
Of course, as we have said, (21) does not occur. (21) represents a word with a nucleus comprising four positions (xN_1, x_2, x_3, x_4), *i. e.* even longer than in (20). Such a structure does not exist, neither in English, nor—as I claim—anywhere else. And of course if there were no restriction on nuclear projections, we could keep adding on further projections, where the nucleus then takes up five, six, seven etc. positions.

Clearly this is not what we want. There has to be an upper limit. Let us repeat the structure of *bee*.

(22) NYC English *bee* bi꞉꞉

N_1'''

O N_1'' $\Longleftarrow$

N_1' x_3

$xN_1\{\mathbf{I}\}$ x_2
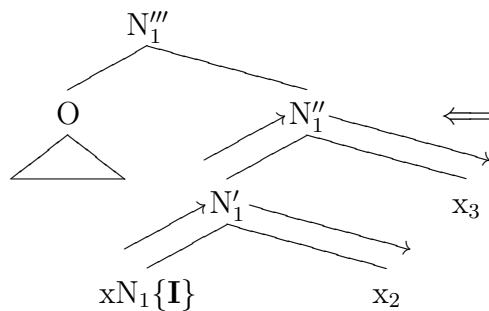
What is interesting about the structure in (22) is that N_1'', *i.e.* the node where a "switch" in the position of the complement occurs, is the second projection of xN.[13] This second projection, indicated with an arrow $\Longleftarrow$, seems to have a special status. In the structure dominated by it, the complements (x_3, x_2) are all to the right of their heads (N_1', xN_1), while N_1'' itself takes its complement (O) to the left. In the case of onset projections discussed in section 3.2.1 we saw that an onset head xO can project up to O'' but no further. In the case of nuclei, projection does not have to stop at N''. In (22) we see that N_1'' projects further to N_1''', taking an onset head or a projection thereof (abbreviated simply as O) as its complement. The definition in (13) takes this into account: An onset complement to the left can be selected at the latest at the second projection.

In the course of this and the following chapters we will see that the domain head (and only the domain head) can project even higher than N'''. We will discuss those cases in the relevant context.

3.2.3 The complete expansion (c-expansion)

In section 3.2.2 we said that a nuclear head xN *can* project twice (up to N'') and then take an onset to its left, but we also stated that xN does not *have to* project twice. That is, we will also encounter structures such as the following ones. (Again, the initial onset abbreviated as O can, but does not have to be present.)

(23) a.   b.

---
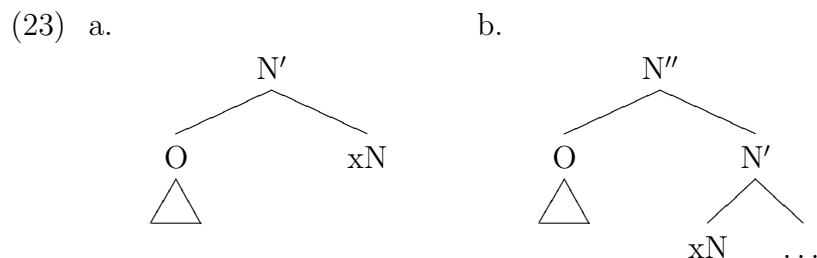
[13] The word "switch" is simply meant to indicate that all the complements below that point were to the right of their head, while now the complement is to the left. It has no deeper meaning than that.

That is, we will encounter structures where xN does not take a complement to the right or where the *first* projection of xN, *i. e.* N$'$, does not take a complement to the right.[14]

However, as we shall see at various points, the structure where both xN and N$'$ take a complement to the right has a special status. In order to be clear on this point, the particular structure I am referring to is given in (24). I will call this structure **complete expansion** or **c-expansion** for short.

(24)   **The complete expansion (c-expansion)**

$$
\begin{array}{c}
N_c'' \\
\diagup \quad \diagdown \\
N_c' \qquad \beta \\
\diagup \quad \diagdown \\
xN_c \qquad \alpha
\end{array}
$$
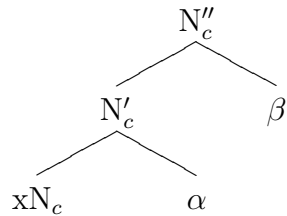
Whenever both xN and N$'$ take a complement to the right, we will talk of a c-expansion. The word "complete" in complete expansion/c-expansion does *not* mean that there could not be any further projection. That is, under no circumstances must we confuse a c-expansion with a maximal projection. When the structure in (24), or rather its highest projection (N$_c''$) takes an onset to its left, we arrive at the structure we have already seen in (22).

---

[14]   It has to be noted straight away that for all the languages discussed in this dissertation, the structures in (23) are too small to make up complete domains of their own. Still, the structures in (23) *do* occur in those languages, but only as part of yet bigger structures, and never by themselves.

(25) Maximal projection $\neq$ c-expansion

$$
\begin{array}{l}
\text{N}_1''' \quad \Longleftarrow \text{ maximal projection} \\
\qquad \text{O} \qquad\qquad \text{N}_1'' \quad \Longleftarrow \text{ c-expansion} \\
\qquad\qquad\qquad \text{N}_1' \qquad\qquad \text{x}_3 \\
\qquad\qquad\qquad \text{xN}_1 \qquad\qquad \text{x}_2
\end{array}
$$
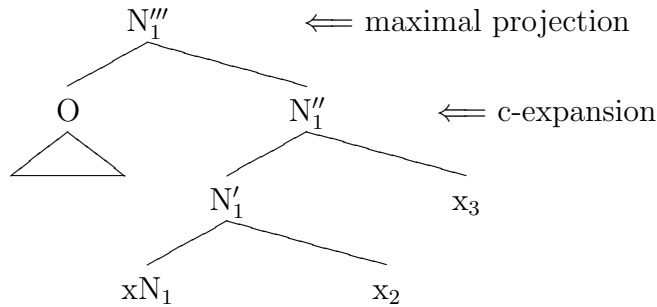
The tree in (25), rooted in N_1''', *contains* a c-expansion (everything dominated by and including N_1''), but of course N_1''' is not the *same* as N_1''. N_1''' is a maximal projection, while N_1'' is a c-expansion.

The formal definition of a c-expansion is given in (26).

(26) **Definition of c-expansion**
A nuclear projection N_c of a head xN_c is called a c-expansion *iff*

    a. the head xN_c has a complement to its right and

    b. the first projection of the head, N_c', has a complement to its right.

This seems to be the most straightforward definition one can give for c-expansions.[15] The purpose of the notion of c-expansion is to give a useful name to a particular structure that we will have to refer to several times in the course of the following text. From the definition in (26) it follows that structures like the ones in (23) do not qualify as a c-expansions. In (23a), neither xN nor N′ have a complement to their right. In (23b), xN has a complement to its right, but N′ does not. Neither structure in (23) is a c-expansion. (This does not mean that the structures in (23) are ungrammatical in principle, of course, it just means that they are too small to be c-expansions.)

---

[15] The definition is straightforward, but certainly not very beautiful. It is perfectly conceivable that (26) can eventually be derived from more basic principles.

3.3 Three types of domains

With these preliminaries out of the way, let us now come to a discussion of entire domains. For reasons of space, I will restrict the discussion to cases where the domain head is the first realised nucleus of the domain. Since the domain head is assigned stress, this is equivalent to saying I will restrict myself to domains with initial stress. While this certainly does not do justice to the wealth of English stress patterns, it will be enough to drive home certain central points such as the length patterns.

Let us recall the structure of the nuclear projection, our basic building block that we were talking about in (12), repeated here as (27)

(27) **Projections of the nucleus (repeated)**
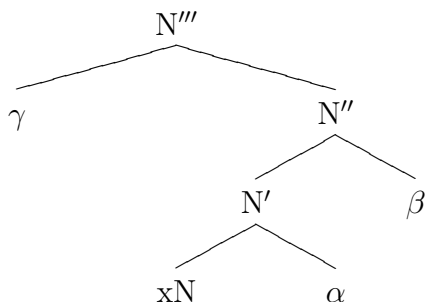
$\alpha \in \{x, O\}$, $\beta \in \{x, O, N\}$, $\gamma \in \{O\}$

In what follows we will not talk about γ any more. In all the words to be discussed there will be a γ, *i. e.* an O. The consequences of its presence or absence have been discussed in section 3.2.2. We are only concerned with α and β.

Let us assume that xN stands for the head of the domain. We now have the choice to substitute x or O for α and x, O, or N for β. As we have said before, we will restrict ourselves to cases where $\alpha = x$ in this chapter (if there *is* any α in a given structure). That means we only have to worry about the three possibilities that β provides: x, O, or N. In what follows, we will discuss three types of domains. Those three types can be characterised by what β stands for.

(28)   a. $\beta = \text{x}$

   b. $\beta = \text{O}$

   c. $\beta = \text{N}$

As we shall see, type (28a) is exemplified by a word like *bee*, (28b) by a word like *bid* and (28c) by a word like *Libby*. I will refer to the three types by those three examples and speak of a *bee*-type, a *bid*-type and a *Libby*-type, respectively. As we shall see, the structures of those three types are slightly different from each other, which is responsible for the different behaviour they display.

3.3.1   The '*bee*'-type

Let us begin with the structurally simplest case, where the variable β in (27) stands for an unannotated x.

(29)
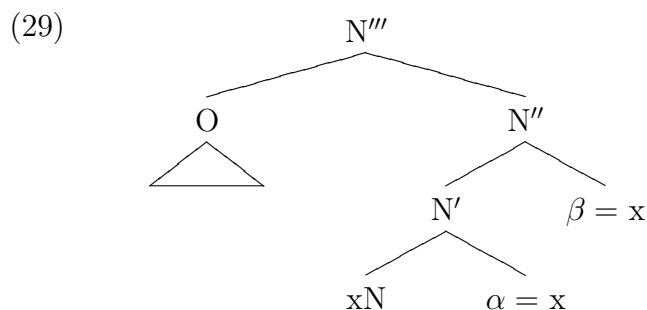
The type in (29) is exemplified by words like NYC English *bee* or *shoe*, *i. e.* monosyllabic words that end in a nucleus. The length of the nuclear expression in *bee* biː is identical to that of the word *bead* biːd, and not to that of the word *beat* biːt. In fact, English has not a single word like *biː. As we shall see in detail in section 3.3.2, the nuclear expression in a word like *bit* bɪt takes up one point, the nuclear expressions in *bid* bɪd and *beat* biːt comprise two points, and the nuclear expression in *bead* biːd takes up three

points.[16] Since the nuclear expression in *bee* biːː is of the same length as the one in *bead* biːːd, we must conclude that the nuclear expression in *bee* takes up three points, too. The structure of the entire domain is given in (30). The initial onset is abbreviated here.

(30) NYC English *bee* biːː

$$N_1'''$$

O N_1''

N_1' x_3

$xN_1\{\mathbf{I}\}$ x_2
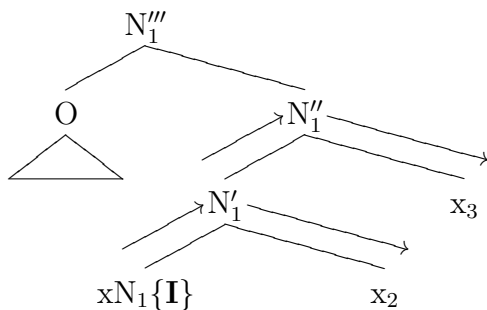
English has no nucleus-final words with only one nucleus that are any shorter than that. That is, *bee* biːː is well-formed, *biː or *bi are not. As it turns out, the well-formedness of *bee* biːː (and the absence of *biː or *bi) is part of a more general pattern. In all English words that (i) end in a realised nucleus and (ii) have stress on the final nucleus the final nuclear expression must consist of three points. In other words, *bee* biːː is grammatical for exacly the same reason why *referee* rɛfəˈriːː is (while *rɛfəˈriː or rɛfəˈri are not). Both *bee* biːː and *referee* rɛfəˈriːː end in a realised nucleus (i) and have stress on that final nucleus (ii). Stress is an indication that the position in question is the domain head. What I want to propose in order to capture the English pattern is the following condition.

(31) **Condition on domain heads in English:**
      If the domain head is the last nucleus in the domain, it must expand into a c-expansion.

---

[16] Since the nuclear expressions in both *bid* bɪːd and *beat* biːt take up two points, one might wonder why they are different. We shall see in section 3.3.2 that the two relevant points are in different structural positions in *bid* and *beat*, respectively. It is extremely likely that this structural difference will also replace notions like headedness: Recall that in standard GP the nuclear expression in *bid* bɪːd was assumed to be headless (and short), while the one in *beat* biːt was assumed to be headed (and long).

Obviously, this holds for both *bee* biː and *referee* rɛfə'riː (as well as *trainee*, *evacuee* etc.). Let us look at *bee* biː. The representation in (30) fulfills the condition in (31): N_1'' qualifies as a c-expansion as defined in (26): Both the nuclear head xN_1 and its first projection xN_1' have a complement to their right. The condition in (31) makes sure that the vowel in words like *bee* biː comprises three points. In (30) $xN_1\{I\}$ m-commands two unannotated x's, x_2 and x_3. From the condition in (31) it is also clear that the following two structures must be illicit in English.

(32) a. *biː

$$* \qquad N_1''$$

O N_1'

$xN_1\{I\}$ x_2

b. *bi

$$* \qquad N_1'$$
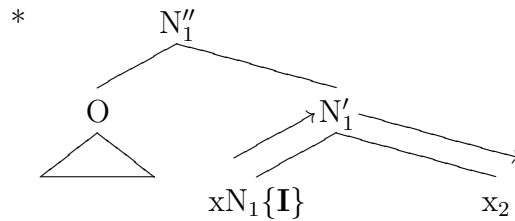
O $xN_1\{I\}$
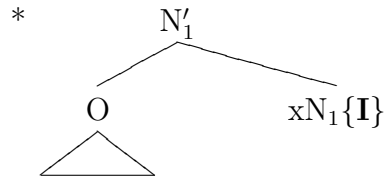
The structures in (32) have only one nucleus (xN_1), which therefore has to be the domain head. Trivially, this domain head is the last nucleus in the domain. (32a–b) run afoul of (31), since the domain head does not expand into a c-expansion. In (32a) xN_1 has a complement to its right, but the projection N_1' does not, as a result of which (32a) does not meet (31). In (32b) not even the nuclear head xN_1 has a complement to its right, and again, the condition in (31) is not met.

3.3.2 The '*bid*' type

Let us now come to the second type of domain we want to discuss here. Its characteristic property is that the domain head or its first projection takes a node of the type O as its right complement. In other words, our variable β is replaced by O. As we have said, we will concentrate on cases where the lower complement (if there is one) is an unannotated x. This gives us two possibilities for what the domain head projects into. (We will see in a moment that the *bid*-type is unaffected by the condition in (31).)

(33) Two possibilities for the domain head in the *bid*-type:
c-expansion or smaller
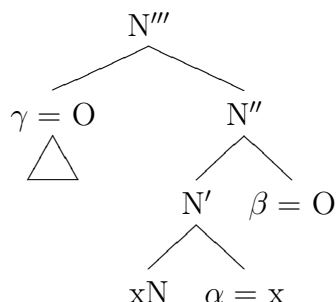
a.   b.
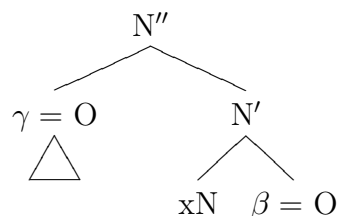
The head xN can project twice (33a) or only once (33b) before taking an onset as its left complement. (Let me repeat that the onset to the left, *i. e.* the position γ in the structures in (33), is optional and that it could be missing as well.) The highest complement to the right, β, is of the type O. Note that the structures in (33) are not complete domains yet (as we shall see in a moment).

Why do we assume that an onset is the (highest) complement? In words like *bid*, after which the type is named, we notice a close interaction between the *i* and the *d*: the *d* is lenis, *i. e.* it comes with an unused x-slot, and that x-slot will be m-commanded by the preceding nuclear head. This close relationship should be reflected in the structure we propose. It can be captured in a representation where the nuclear head xN (or its first projection N′) takes the following onset as its complement. The structures in (33) are actually

not entirely new, we have already seen fragments of them in the last chapter, *e. g.* in the following shape.

(34) *bid* (relevant sequence)

$$
\begin{array}{c}
\text{N}' \\
\diagup \quad \diagdown \\
\text{xN}\{\textbf{I}\} \qquad \text{O}'' \\
\diagup \quad \diagdown \\
\text{x}_1 \qquad \text{O}' \\
\diagup \quad \diagdown \\
\text{x}_2 \quad \leftarrow \quad \text{xO}\{\textbf{A}\}
\end{array}
$$
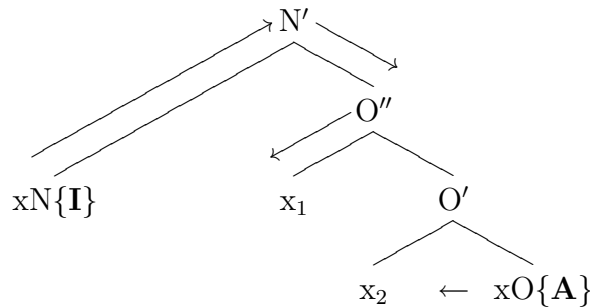
It is now time to present the complete representation of the word *bid*. (Again, the initial onset *b* is abbreviated.)

(35) NYC English *bid* bɪːd

$$
\begin{array}{c}
\text{N}_1''' \\
\diagup \qquad\qquad \diagdown \\
\text{N}_1'' \qquad\qquad \text{xN}_5 \\
\diagup \quad \diagdown \\
\text{O} \qquad \text{N}_1' \\
\diagup \quad \diagdown \\
\text{xN}_1\{\textbf{I}\} \qquad \text{O}_4'' \\
\diagup \quad \diagdown \\
\text{x}_2 \qquad \text{O}_4' \\
\diagup \quad \diagdown \\
\text{x}_3 \quad \leftarrow \quad \text{xO}_4\{\textbf{A}\}
\end{array}
$$
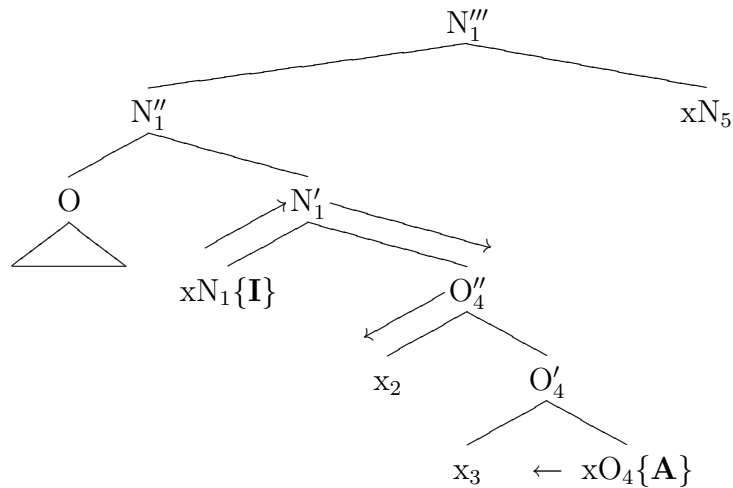
In (35) the nuclear head xN_1 m-commands x_2. This explains the length of the *i*, which comprises two points. The **d** at the end of the word is lenis and x_3 is m-commanded by xO_4. Before we move on to a discussion of the formal properties of this structure, let us compare it to the representation of the words *bit*, *bead* and *beat* to see the contrast.

(36) NYC English *bit* bɪt

$$N_1'''$$
$$N_1'' \qquad\qquad xN_5$$
$$O \qquad N_1'$$
$$xN_1\{\mathbf{I}\} \qquad O_4''$$
$$x_2 \qquad O_4'$$
$$x_3 \quad \leftarrow \quad xO_4\{\mathbf{A}\}$$
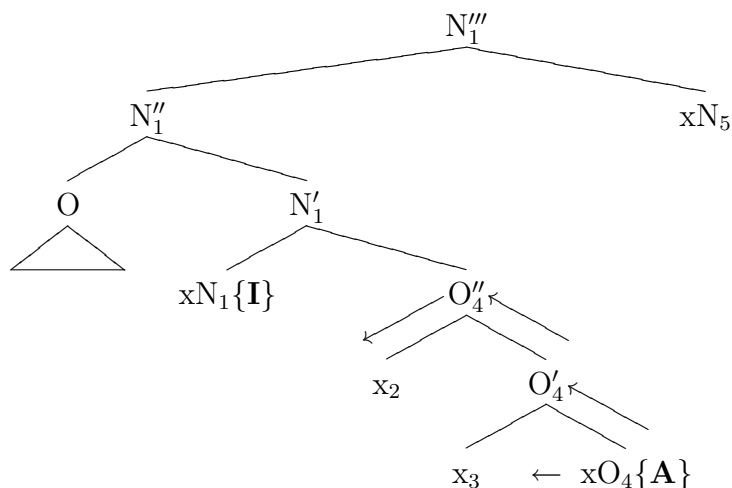
The word *bit* ends in a fortis t and accordingly x_2 is m-commanded by xO_4. The nuclear expression only takes up xN_1 and is short.

In both *bid* and *bit* the domain head xN takes the final onset (*d* and *t*, respectively) to its right, *i. e.* it projects into a structure as under (33b). Let us now come to examples where xN takes an unannotated x as its complement (position α) and its first projection takes an onset as a complement (position β), *i. e.* the kind shown in (33a). Examples of this are the words *bead* and *beat*. Here, the sister of xN is an unannotated x, and the final onset (*d* in *bead*, *t* in *beat*) is a complement of the first projection N_1'. The structures are shown in (37).

(37)   a. NYC English *bead* bi:d

$$N_1''''$$

Tree diagram with:
- N_1'''' dominating N_1''' and xN_6
- N_1''' dominating O (triangle) and N_1''
- N_1'' dominating N_1' and O''
- N_1' dominating $xN_1\{\mathbf{I}\}$ and x_2
- x_3
- O'' dominating O'
- O' dominating $x_4 \leftarrow xO_5\{\mathbf{A}\}$

b. NYC English *beat* bi:t

$$N_1''''$$

Tree diagram with:
- N_1'''' dominating N_1''' and xN_6
- N_1''' dominating O (triangle) and N_1''
- N_1'' dominating N_1' and O''
- N_1' dominating $xN_1\{\mathbf{I}\}$ and x_2
- x_3
- O'' dominating O'
- O' dominating $x_4 \leftarrow xO_5\{\mathbf{A}\}$
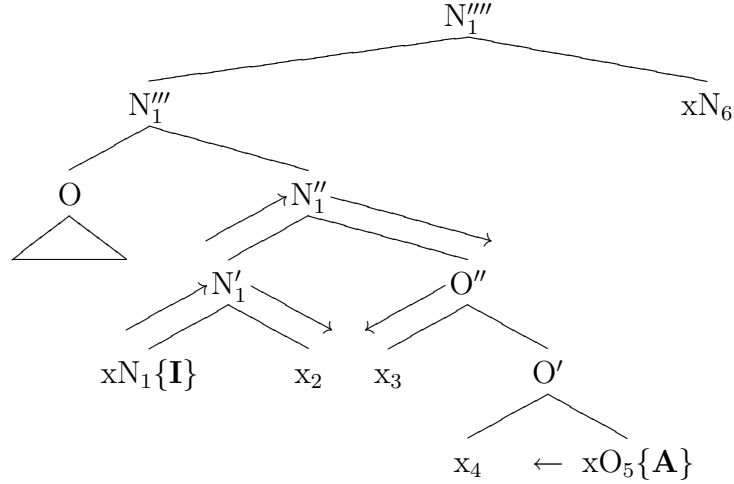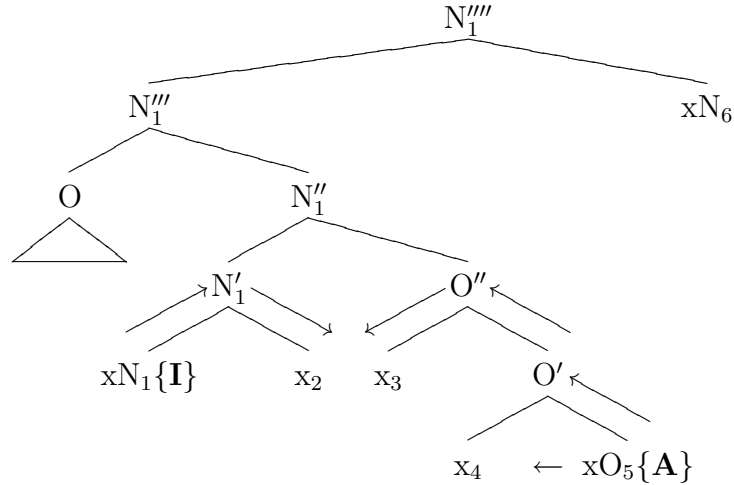
In (37a) we have the word *bead*: xN_1 m-commands its sister, the unannotated slot x_2, as well as x_3 (which is part of the final onset projection). In (37b), *beat*, xN_1 only m-commands its sister, *i. e.* the unannotated slot x_2. The terminal x_3 is m-commanded by xO_5. Thus, in *bead*, the nuclear expression takes up three points, but in *beat* only two. This gives us exactly the difference in length that we want.

Let us now come to the formal properties of the representations in (35), (36) and (37). There are two important points that we have to address. Firstly, in all four structures the nuclear head xN_1 (35–36) or its first projection N'_1 (37) takes an onset projection, O''_4/O''_5, as its complement. As we have said before, such a structure seems reasonable, given the close inter-dependency between the nucleus and the following onset. We will have to discuss the conditions under which this is possible, *i. e.* when a nuclear head can take an onset to its right.

Secondly, all the structures in (35), (36) and (37) contain a final nucleus that is a daughter of the maximal projection. In (38), a repetition of (35), this position is circled.

(38) NYC English *bid* bɪːd (repeated)
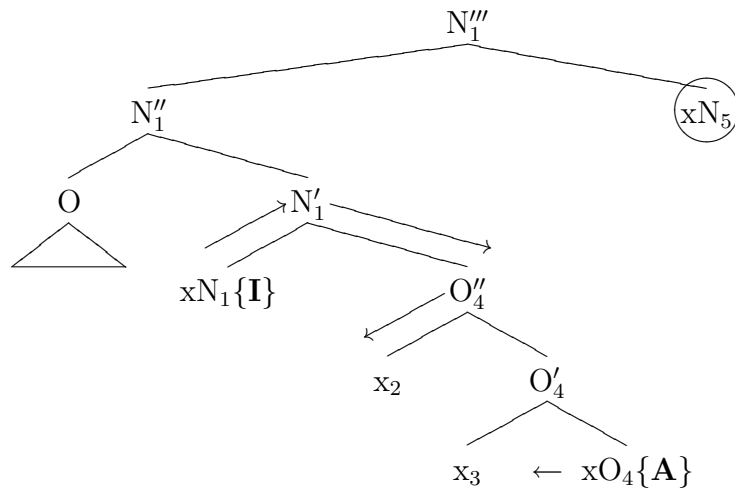
N'_1 takes an onset to its left, the initial *b*, and projects to N''_1. This conforms to our schema of the projections of the nucleus as given in (12). N''_1 is not the maximal projection, however; rather, it projects into N'''_1 and takes a final empty nucleus as its complement, *i. e.* xN_5 in (38). This final empty nucleus xN_5 is the direct successor of the final empty nucleus in standard GP. In standard GP, domains always ended in a nucleus, no matter whether that nucleus was realised (as in words like *city*) or not (as in *bid*). The reasons for this have been discussed extensively in Kaye (1990a). We will also see in a moment that the length facts from English provide further evidence for the final empty nucleus in words like *bid*. This insight is kept in the new

theory presented here. What we have to say then is that the last head in every domain must be nuclear. This is stated in (39).[17]

(39) The rightmost head in every domain must be a nuclear head.

From (39) it follows that a *domain* as under (40) is ill-formed in *any* language.

(40) An ill-formed structure violating (39)

$$N''_1$$

O N'_1

$xN_1\{\mathbf{I}\}$ O''_4

x_2 O'_4

x_3 $\leftarrow$ $xO_4\{\mathbf{A}\}$
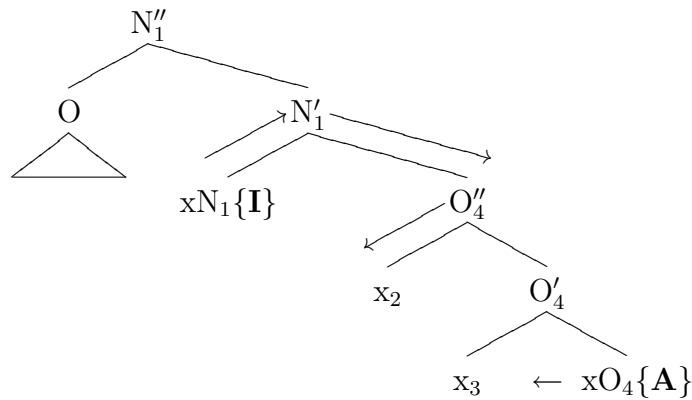
The rightmost head in (40) is xO_4, which is not a nuclear head, but an onset head. (40) is ungrammatical.

A final nucleus as in (37) is unavoidable. English allows for final nuclei to remain uninterpreted, *i. e.* p-licensed. Words can audibly end in a consonant (followed by a p-licensed empty nucleus). This idea also goes back to Kaye (1990a) and I want to adopt standard GP's parameter about the p-licensing of final empty nuclei in the new theory presented here. This parameter is given in (41).

---

[17] The exact wording is important. Of course we cannot say in the new theory that every domain must *end* in a nuclear head, as this would preclude perfectly acceptable structures like the one of the word *bee* given in (30). Domains can end in unannotated x's, but the last head in the domain has to be nuclear. Note that (30) conforms to (39).

(41) **Licensing of final empty nuclei**
Domain-final nuclear heads (but not their projections) are p-licensed
(YES/NO).

Parameters such as under (41) or the requirement that the last head in a domain must be a nuclear head are of of course not specific to the *bid*-type, but hold of every kind of domain.

In English the parameter in (41) is set to YES. Notice that (41) refers to nuclear *heads* only, but not to *projections* of nuclear heads. In other words, if (41) is set to YES, this only means that a single, final nuclear head can be p-licensed, but not other nodes contained in its projections. (42) illustrates this.

(42) a.   b.

                                        N′

           xN   xN   x
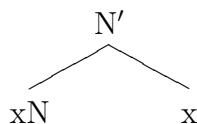
A single nuclear head as under (42a) can be licensed to remain uninterpreted by (41), while the complex structure in (42a) cannot.

Let us now return to the peculiarity of the *bid*-type, *viz.* the fact that an onset is taken as a complement to the right. (43) repeats the structure of NYC English *bid* bɪːd once again to make this point clear.

(43) NYC English *bid* bɪːd (repeated)

N‴₁
├── N″₁
│   ├── O (△)
│   └── N′₁
│   ├── xN₁{**I**}
│   └── O″₄
│   ├── x₂
│   └── O′₄
│   ├── x₃
│   └── ← xO₄{**A**}
└── xN₅

$$N_1''' \qquad N_1'' \qquad xN_5 \qquad O \qquad N_1' \qquad xN_1\{\mathbf{I}\} \qquad O_4'' \qquad x_2 \qquad O_4' \qquad x_3 \quad \leftarrow \quad xO_4\{\mathbf{A}\}$$
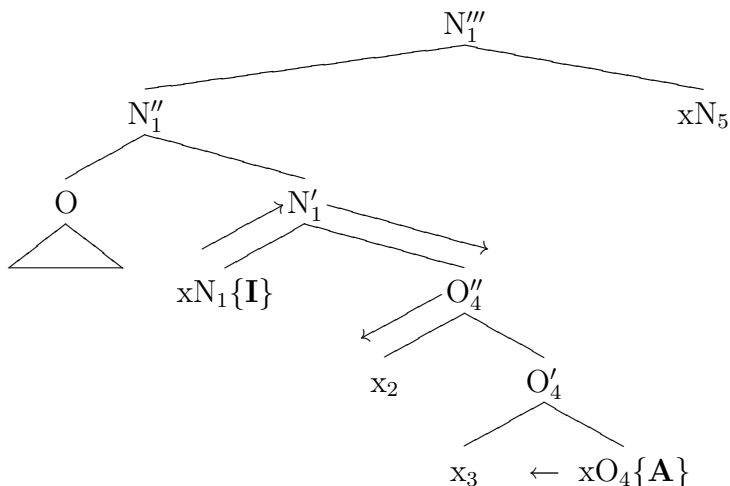
We now have to look at the condition under which an onset can be taken
as the complement of a nuclear head xN or its first projection N′. Do we have
a *choice* whether an onset is taken as a complement or not? In section 3.1
we compared word pairs like *big* bɪːg and *bigot* bɪgət or *rIb* rɪːb and *Libby*
lɪbi. In the words *big* and *rib* the unused x-slot of the final lenis onset (*g* in
big, *b* in *rib*) can be made use of by the preceding nuclear head: we get a
long ɪː in both *big* and *rib*. (The structures of those two words are of course
identical to the one of *bid* given in (35).) This is impossible in *bigot* bɪgət
and *Libby* lɪbi. That is, in order for the unused x-slot in a lenis consonant to
be available for m-command from the preceding nucleus, the onset cannot be
followed by another realised nucleus. In order to capture those facts, I would
like to propose the following conditions:

(44) A nuclear head xN or its first projection N′ has to merge with a
      following onset O, *iff*

      a. xN is the domain head and

      b. the onset O is a projection of the final onset head of the domain
         and

      c. the final nucleus of the domain is p-licensed (YES/NO)

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(44) holds for every word in every language, *i. e.* there is no way some words could follow it and others not. However, as we shall see in the discussion of Italian in section 5.4, (44a–b) are universal, while (44c) is a parameter. In English it is set to YES, in Italian to NO. The consequences for Italian will become clear in section 5.4, for English this simply means that words like *bid*, *bit*, *bead*, *beat*, where the final onset follows the domain head, have to be given structures as in (35), (36) and (37). The final onset (*d* in *bid*, *t* in *bit* etc.) *has* to be a complement of the nuclear head or its first projection.

So far we have only talked about words that end in a *d* or *t*. The basic principles of the theory should be familiar enough at this point to predict what the representations of words with other final onset should look like. I present some representations without further ado. In (45a) we see *give*, in (45b) *riff*, in (45c) *leave*, in (45d) *leaf*, in (45e) *bin* and in (45f) *bean*.

(45)   a. *give*

b. *riff*

$$N_1'''$$

$$N_1''$$ xN$_4$

O

xN$_1${**I**} O_3'

x$_2$ xO$_3${**U**}

c. *leave*

$$N_1''''$$

$$N_1'''$$ xN$_5$

O

$$N_1''$$

$$N_1'$$ O_4'

xN$_1${**I**} x$_2$ x$_3$ xO$_4${**U**}

d. *leaf*

$$N_1''''$$

$$N_1'''$$ xN$_5$

O

$$N_1''$$

$$N_1'$$ O_4'

xN$_1${**I**} x$_2$ x$_3$ xO$_4${**U**}

e. *bin*

$$N_1'''$$

$$N_1'' \qquad xN_5$$

$$O \qquad N_1'$$

$$xN_1\{\mathbf{I}\} \qquad O''$$

$$x_2 \qquad O'$$

$$x_3\{\mathbf{L}\} \qquad xO_4\{\mathbf{A}\}$$

f. *bean*

$$N_1''''$$

$$N_1''' \qquad xN_6$$

$$O \qquad N_1''$$

$$N_1' \qquad O''$$

$$xN_1\{\mathbf{I}\} \qquad x_2 \qquad x_3 \qquad O'$$

$$x_4\{\mathbf{L}\} \qquad xO_5\{\mathbf{A}\}$$
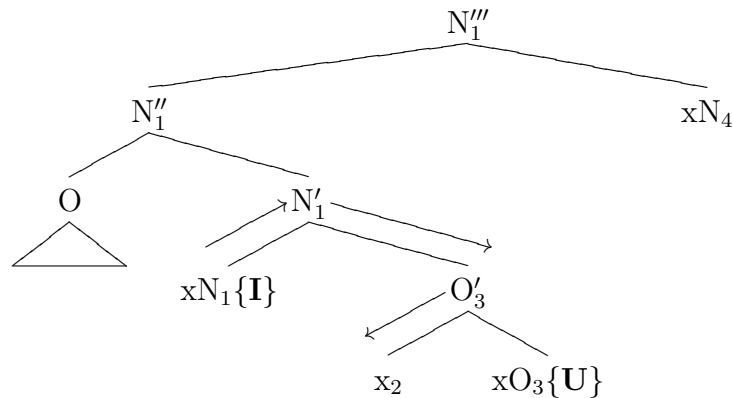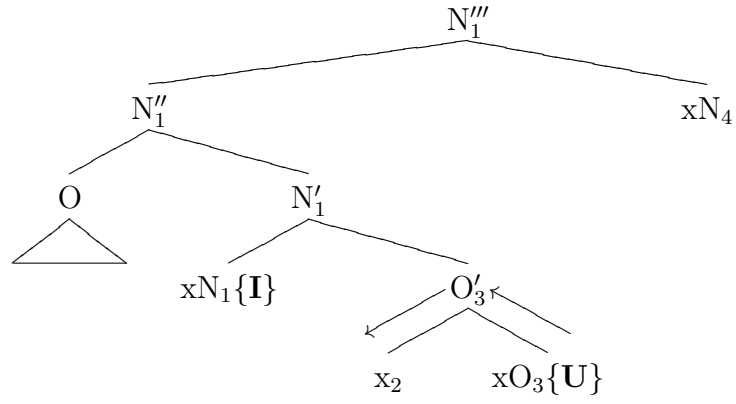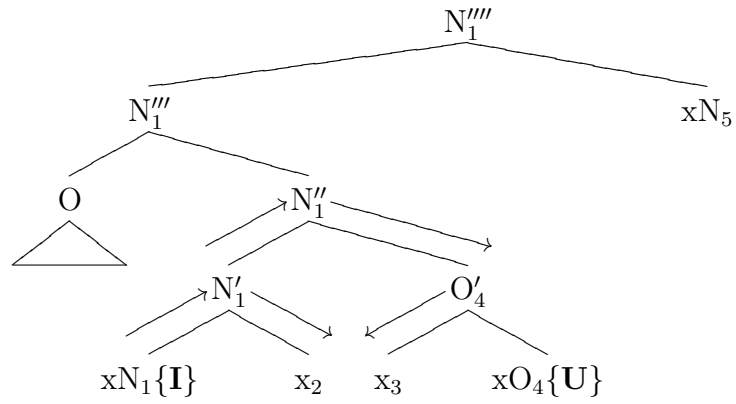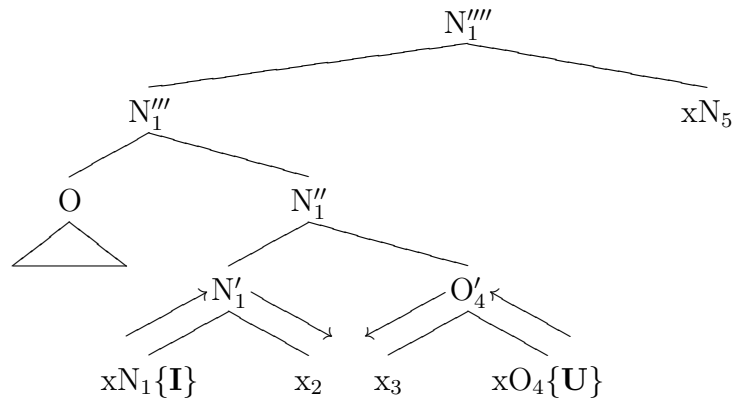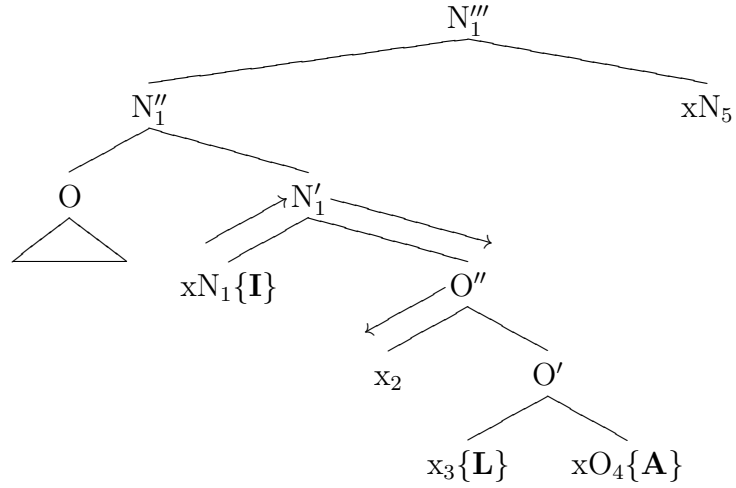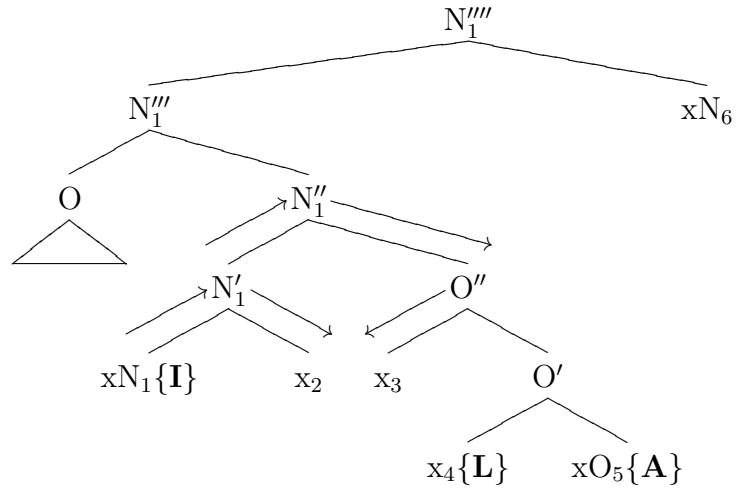
What is important to notice in this context is the difference between a word of the *bee*-type and one of the *bid*-type. (46) compares *bee* and *bid*.

(46)   a. NYC English *bee* biː

$$
\begin{array}{c}
\text{N}_1''' \\
\diagup \qquad \diagdown \\
\text{O} \qquad\qquad \text{N}_1'' \\
\triangle \qquad\quad \diagup\qquad \diagdown \\
\text{N}_1' \qquad\quad \text{x}_3 \\
\diagup\qquad\diagdown \\
\text{xN}_1\{\textbf{I}\} \qquad \text{x}_2
\end{array}
$$

    b. NYC English *bid* bɪːd

$$
\begin{array}{c}
\text{N}_1''' \\
\diagup\qquad\qquad\qquad\diagdown \\
\text{N}_1'' \qquad\qquad\qquad \text{xN}_5 \\
\diagup\qquad\diagdown \\
\text{O} \qquad\quad \text{N}_1' \\
\triangle \quad\diagup\qquad\diagdown \\
\text{xN}_1\{\textbf{I}\}\qquad \text{O}_4'' \\
\diagup\qquad\diagdown \\
\text{x}_2 \qquad \text{O}_4' \\
\diagup\qquad\diagdown \\
\text{x}_3 \quad \leftarrow \quad \text{xO}_4\{\textbf{A}\}
\end{array}
$$
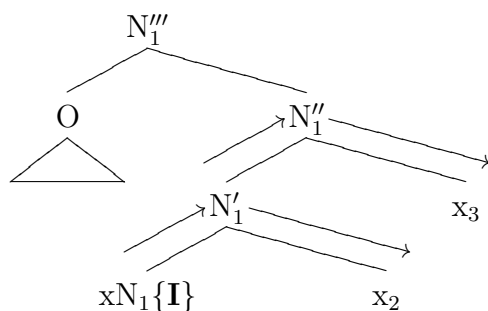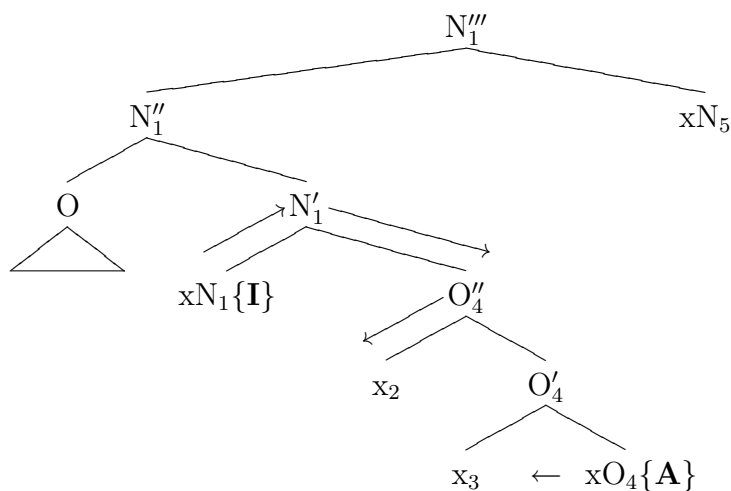
In (31) in section 3.3.1 we said that if a domain head in English is the last nucleus in the domain, then it must expand into a c-expansion. (46a) fulfills this condition: Both xN_1 and N_1' have a complement to their right. (46b), on the other hand, does not contain a c-expansion. This is not a problem for the statement in (31), of course, since xN_1 is not the last nucleus in the domain. It is followed by another nucleus, *viz.* xN_5. The condition in (31) simply does not apply. Words of the *bid*-type *can* of course contain a c-expansion, but they are not required to do so. An instance of the *bid*-type containing a c-expansion would be the words *bead* and *beat* as given in (37). Still, the word

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bid (whose head is *not* a c-expansion) is as well-formed as the word *bead* (whose head *is* a c-expansion).

What this means is that we have a clear difference between (i) words like *bid* and *bead* on the one hand and (ii) *bee* on the other. The formal difference between the two types is easily captured by reference to the position of the domain head. In *bee* (ii) the domain head is the last nucleus in the domain, while in *bid* and *bead* (i) the domain head *is* followed by another nucleus. The difference in behaviour we observe between (i) and (ii) thus provides further evidence for retaining the final empty nucleus. Only the presence of the final empty nucleus in (ii) makes sure that it can be distinguished from (i).

Let me add a last note on the condition in (31), *i. e.* that English domain heads must expand into a c-expansion unless they are followed by another nucleus. This condition in (31) is not as *ad hoc* as it might seem at first glance. In fact, as we shall see in chapter 4, (31) recurs in Estonian in only a slightly different form:

In English, the domain head must expand into a c-expansion if it is the last nucleus in the domain. In Estonian, on the other hand, the domain head must expand into a c-expansion if it is the last *realised* nucleus in the domain. That is, in English the condition on an obligatory c-expansion holds for words like *bee* (where the domain head is the last nucleus in the domain), but not for words like *bid* etc. (where the domain head is followed by a p-licensed nucleus). This is in contrast to Estonian, where the domain head has to expand into a c-expansion if it is the last realised nucleus in the domain, regardless of whether that realised nucleus is not followed by any other nuclear head at all (*bee*-type) or if there is another one that is simply not realised (*bid*-type). We will discuss this in more detail in the next chapter.

3.3.3   The '*Libby*' type

Let us now come to the third and last type. The variable β is replaced by a node of the type N. Again, we have two possibilities.

(47) Two possibilities for the domain head in the *Libby*-type: c-expansion or smaller

a.   b.

$$N'''$$

$$\gamma = O \qquad N''$$

$$N' \quad \beta = N$$

$$xN \quad \alpha = x$$

$$N''$$

$$\gamma = O \qquad N'$$

$$xN \quad \beta = N$$
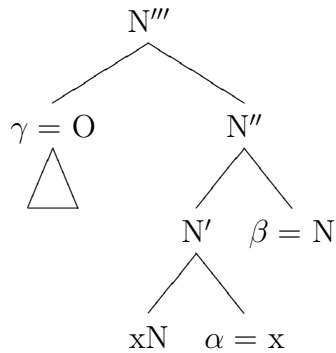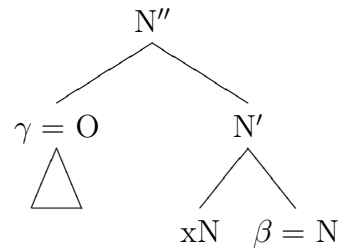
The type is named after the English name *Libby*, which is an instructive example: Despite the lenis **b** the preceding nuclear expression is *not* long. The representation of *Libby* looks as follows. Again, the initial onset is abbreviated. The question of what x_2 is licensed by will be dealt with in a moment.[18]

(48)

$$N_1''$$

$$O \qquad N_1'$$

$$xN_1\{\mathbf{I}\} \qquad N_5'$$

$$O_4'' \qquad xN_5\{\mathbf{I}\}$$

$$x_2 \qquad O_4'$$

$$x_3 \quad \leftarrow \quad xO_4\{\mathbf{U}\}$$

---
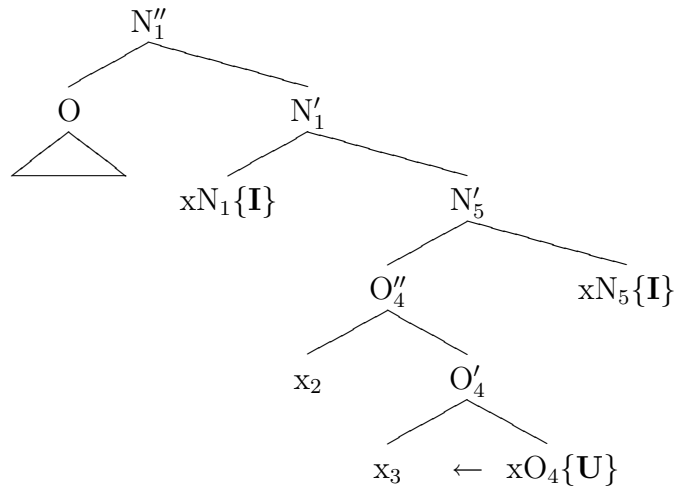
[18] The final y in *Libby* is actually long in most varieties of English, *i. e.* xN_5 would have to take an unannotated x as a complement to the right, project to N_5' and then take O_4'' as its complement to the left. Since nothing crucial hinges on that, I will represent the final y in *Libby* as short throughout this dissertation.

The domain head xN_1 takes another N as its complement. The structure of *Libby* is in fact a combination of two nuclear projections. Those two nuclear projections are indicated by boxes in (49).

(49)

$$
\begin{array}{c}
N_1'' \\
\diagup \quad \diagdown \\
O \qquad\qquad N_1' \\
\triangle \qquad\qquad \diagup \quad \diagdown \\
\qquad xN_1\{\mathbf{I}\} \qquad\qquad N_5' \\
\qquad\qquad\qquad \diagup \quad \diagdown \\
\qquad\qquad O_4'' \qquad\qquad xN_5\{\mathbf{I}\} \\
\qquad\qquad \diagup \quad \diagdown \\
\qquad\quad x_2 \qquad\qquad O_4' \\
\qquad\qquad\qquad \diagup \quad \diagdown \\
\qquad\qquad\qquad x_3 \quad \leftarrow \quad xO_4\{\mathbf{U}\}
\end{array}
$$
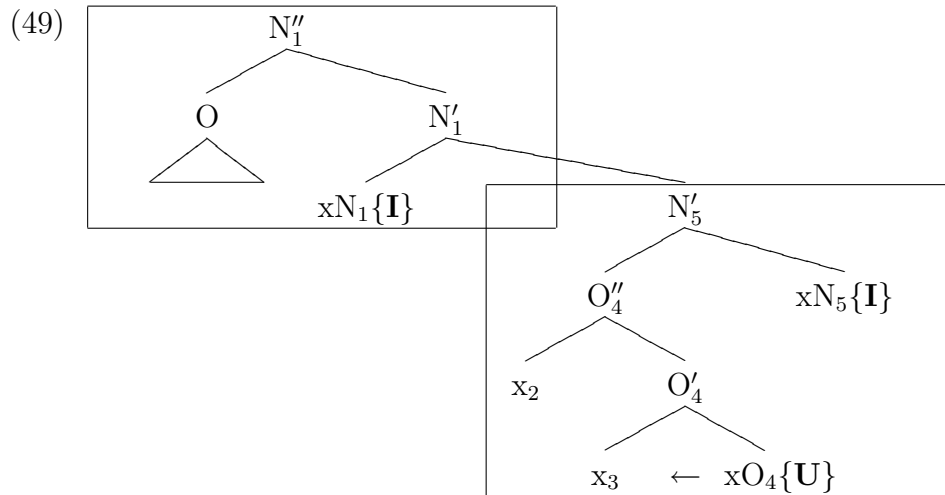
Again, as in the *bid*-type, there are no conditions on whether the domain head must expand into a c-expansion or not. In the structure in (48) we do not have a c-expansion of the nuclear head: xN_1 takes a complement to its right, but N_1' does not; N_1' has its complement to the left. An example of the *Libby*-type where the domain head does expand into a c-expansion would be the word *lady*, whose structure is given in (50).

(50)

$$
\begin{array}{c}
N_1''' \\
\diagup \quad \diagdown \\
O \qquad\qquad N_1'' \\
\triangle \qquad\qquad \diagup \quad \diagdown \\
\qquad N_1' \qquad\qquad\qquad N_6' \\
\diagup \quad \diagdown \qquad\qquad \diagup \quad \diagdown \\
xN_1\{\mathbf{A},\mathbf{I}\} \quad x_2 \qquad O_5'' \qquad\quad xN_6\{\mathbf{I}\} \\
\qquad\qquad\qquad \diagup \quad \diagdown \\
\qquad\qquad\quad x_3 \qquad\quad O_5' \\
\qquad\qquad\qquad\qquad \diagup \quad \diagdown \\
\qquad\qquad\qquad\quad x_4 \quad \leftarrow \quad xO_5\{\mathbf{A}\}
\end{array}
$$

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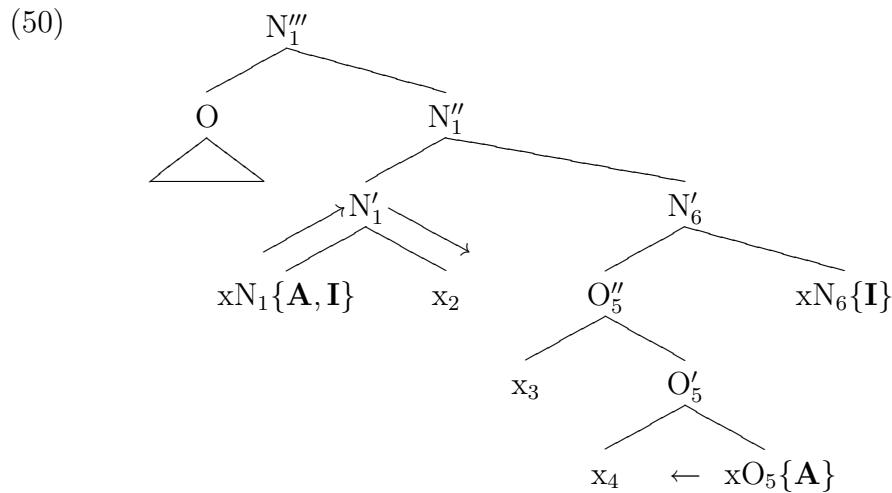
The domain head xN_1 takes a complement to its right, and so does its first projection, N_1'. This qualifies as a c-expansion. As in the *bid*-type, we find words whose domain head expands into a c-expansion and others where it does not. This is in stark contrast to the *bee*-type discussed in section 3.3.1. That there should be such a difference is not surprising, though. The condition on c-expansions in (31) only refers to domains where the domain head is the final nuclear head of the domain. Since the *Libby*-type is defined as the type where the domain head or its first projection takes another nuclear projection as its complement, obviously none of the words of the *Libby*-type could ever be subject to (31).

Let us now come to the question of why the domain head in words like *Libby* is not long, despite that fact that it is followed by a lenis **b**. That is, why do we not get *lɪːbi, in much the same way that we get *rib* rɪːb? This must be related to the question of what the unused x-slot in lenis consonants in such structures is licensed by. (51) repeats the structure of *Libby*.

(51)
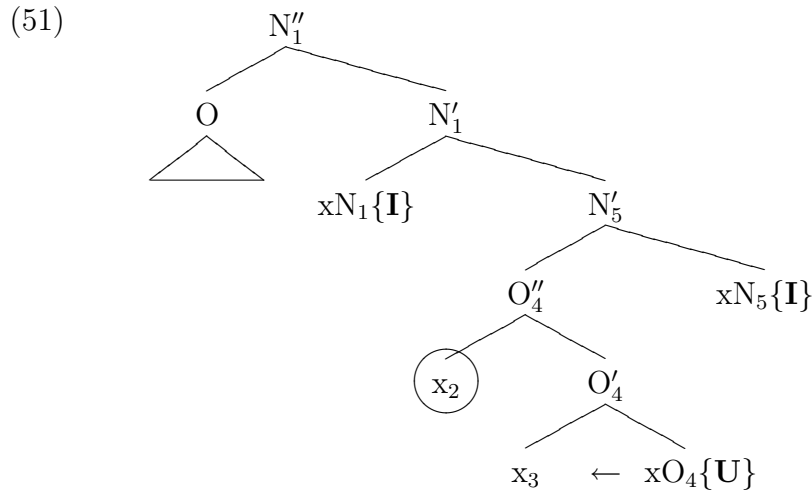
Since the ɪ in *Libby* is short, it cannot be the case that xN_1 m-commands x_2. (51) raises two questions: (i) Why can't xN_1 m-command x_2? What blocks such a relationship? (ii) If x_2 is neither m-commanded by xN_1 nor by the onset head xO_4 (since the **b** is lenis), then what is it licensed by? Recall that we stated in (26) on p. 76 that every unannotated x-slot needs to be licensed.

Compare (51) to the structure of the word *hippie*.

(52)

$$N_1''$$

O N_1'

$xN_1\{\mathbf{I}\}$ N_5'

O_4'' $xN_5\{\mathbf{I}\}$

x_2 O_4'

x_3 $\leftarrow$ $xO_4\{\mathbf{U}\}$
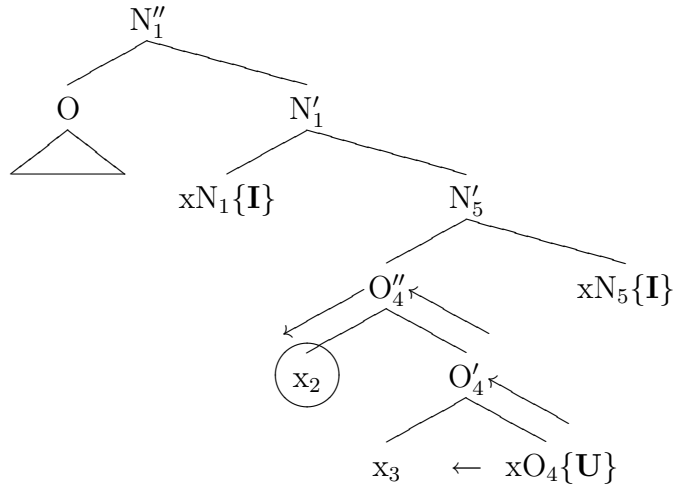
Obviously, nothing in particular has to be said about x_2 in (52). In *hippie* the domain head is followed by a fortis onset, *i. e.* x_2 is m-commanded by xO_4. The representation of *hippie* does not raise any questions, but the one of *Libby* does. In (51), x_2 is neither m-commanded by xO_4 (the **b** is lenis), nor by xN_1 (otherwise the nuclear expression would be long). What we need to find out is why xN_1 does not m-command x_2 in (51).

What I want to claim is that there is a principle of "closest licenser" (a formal definition will be given in a moment). That is, xN_1 in (51) does not, in fact cannot m-command x_2 and license it, because there is a closer licenser for x_2 that licenses it. This closer licenser is the final nucleus, xN_5.

(53)

$$N_1''$$

O N_1'

$xN_1\{\mathbf{I}\}$ *licensing* N_5' $\leftarrow$ *licensing*

licensing O_4'' $\underline{xN_5}\{\mathbf{I}\}$

x_2 O_4'

x_3 $\leftarrow$ $xO_4\{\mathbf{U}\}$
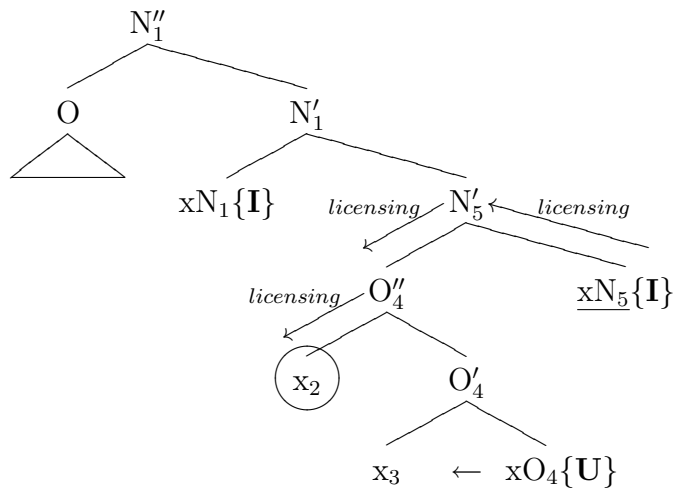
What kind of a relationship do we have holding between x_2 and xN_5? Does xN_5 m-command x_2? I will claim that the particular relationship is not one of m-command, but let us assume (for the sake of argument), that it were m-command. What if xN_5 m-commanded x_2? We have seen cases of m-command between a nuclear head and an unannotated x before, *e. g.* in the representation of the word *lady* in (50), where xN_1 m-commanded x_2. A head that m-commands another point is realised as longer than a head that does not m-command another point. What does this assumption (*viz.* that there is m-command between x_2 and xN_5) mean for the representation of the word *Libby* as compared to the representation of *hippie*? (54) compares the relevant subparts of the two words, *i. e.* the last onset and the last nucleus in the respective domains.
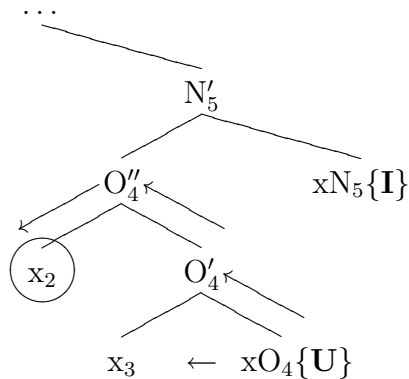
(54) a. *(hi)ppie*   b. *(Li)bby*
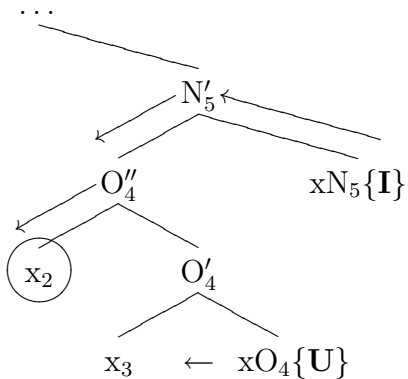
In (54a) xO_4 m-commands x_2. We are dealing with a fortis onset. In (54b) we are dealing with a lenis onset and x_2 is m-commanded by xN_5. Under the assumption that the relationship between x_2 and xN_5 in (54b) is one of m-command, we predict that the final nuclear expression in *Libby*, *i. e.* the *-y*, should be longer than the final nuclear expression in *hippie*: In (54b) xN_5 m-commands another point, while in (54a) xN_5 does not m-command any other point. We predict a difference in length, which is certainly not correct. The final *-y* is identical in *Libby* and *hippie*.

We have to conclude then that the relationship between xN_5 and x_2 in (53) *cannot* be one of m-command. It has to be something else. What other licensing relationships do we have at our command? We have already made

appeal to the notion of p-licensing in (41), where we said that final empty nuclei in English can remain unrealised since they are p-licensed by parameter. The mechanism of p-licensing, which allows an empty position to remain uninterpreted, played an important role in standard GP: final empty nuclei could be p-licensed by parameter, proper government (a particular kind of p-licensing) was seen as the motor behind vowel-zero alternations etc.[19] What I would like to propose is that p-licensing be extended to cover cases like the one at hand. In other words, in the representation of *Libby*, repeated here as (55), the nuclear head xN_5 p-licenses x_2, which therefore counts as licensed.

(55)
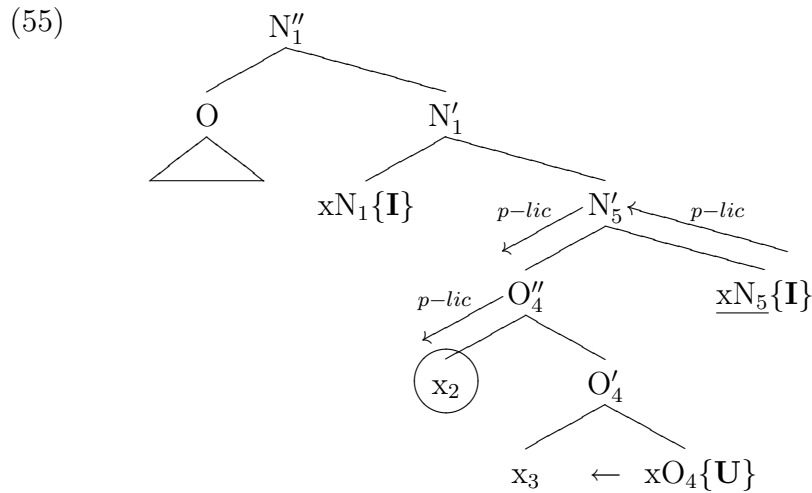
That is, alongside m-command and control we now have a third way of licensing unannotated x-slots.

(56) An unannotated x-slot counts as licensed if

      a. it is m-commanded or

      b. it is controlled or

      c. it is p-licensed.

---

[19] For a more thorough discussion *cf. e. g.* Kaye (1990b): Kaye, Lowenstamm & Vergnaud (1990): Charette (1991): Kaye (1992).

Those relationships are mutually exclusive, which follows from the condition we introduced in (26) on p. 76: Every unannotated x must be licensed by exactly one licenser. If an x is m-commanded, it cannot be p-licensed or controlled, if an x is p-licensed, it cannot be m-commanded or controlled, and if an x is controlled, it can neither be p-licensed nor controlled. In structures such as (55) English chooses p-licensing, not m-command.[20]

P-licensing of unannotated x's is itself restrained by (57).[21]

(57) **P-licensing of unannotated x's**

A nuclear head xN that is not itself p-licensed can p-license an unannotated x-slot contained within the onset projection immediately preceding xN.

(An example of a nuclear head that is itself p-licensed would be a final nucleus that is p-licensed by parameter, *cf.* (41).)

So far we have established that in a structure as in (55) the relationship between xN_5 and x_2 is one of p-licensing, but we have not seen why there has to be any kind of relationship between xN_5 and x_2 and not *e. g.* between xN_1 and x_2. We have said before that xN_5 is a closer licenser for x_2 than xN_1 is. How do we calculate closeness? The definition of a closer licenser is given in (58).

(58) Let the nodes α and β be potential licensers and the node γ a potential licensee.

Node α is a closer licenser for γ than node β is *iff* there is at least one projection P that dominates α and γ, but does not dominate β.

What this basically means is that a licenser is sought within the smallest possible projection. Let us apply (58) to (55), where α is represented by xN_5, β by xN_1 and γ by x_2.

---

[20] In chapter 4 we shall see that in exactly the same environment Estonian opts for m-command.

[21] The definition in (57) only refers to p-licensing of unannotated x's, but not to other instances of p-licensing, such as Proper Government, which I will not go into here.

(59)
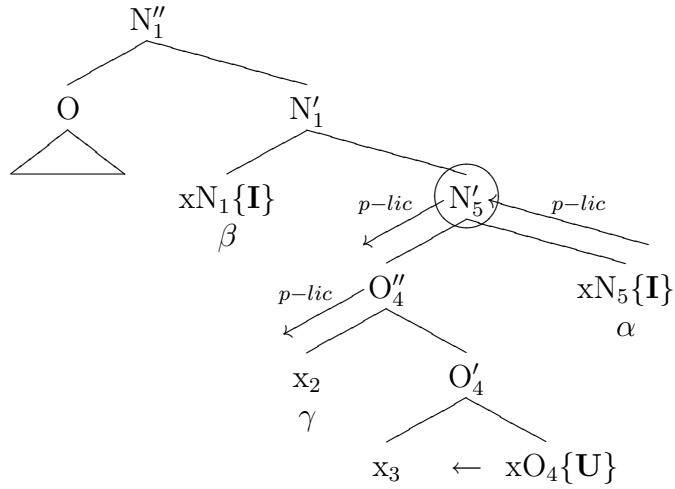
What we want to show is that xN_5 is a closer licenser for x_2 than xN_1 is. This means we have to find a projection P that dominates xN_5 and x_2, but not xN_1. The projection that meets this requirement is N'_5 (circled in). N'_5 dominates both xN_5 and x_2, but it does not dominate xN_1. (Instead, xN_1 and N'_5 are sisters.) We have thus shown that xN_5 is a closer licenser for x_2 than xN_1: (59) contains at least one projection that dominates xN_5 and x_2, but does not dominate xN_1.

The idea of the closer licenser can also be demonstrated more visually by indicating the relevant substructure that contains licenser and licensee.

(60)

135
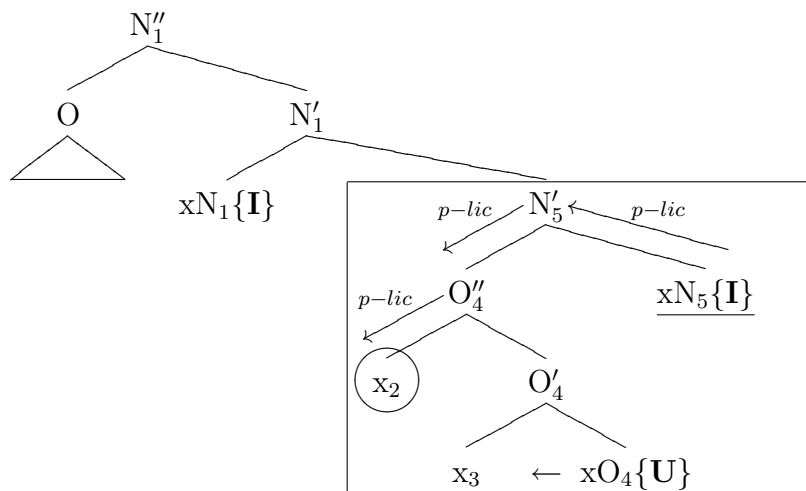
The boxed substructure in (60) singles out the projection N_5' and all the nodes dominated by it. Among them we also find xN_5 and x_2, but of course not xN_1. The size of the boxed substructure in (60) is much smaller than that of the substructure containing xN_1 and x_2, as shown in (61).

(61)
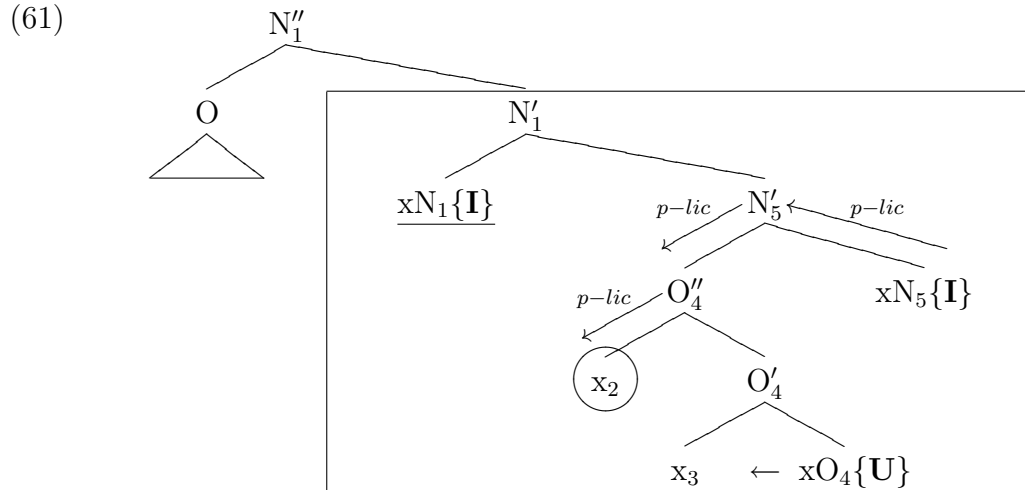
This demonstrates quite clearly the idea behind the notion of a 'closest licenser': Closeness means 'contained in the lowest possible projection'. The node xN_5 is a closer licenser for x_2 than xN_1 is, because xN_5 is found in a lower projection (N_5') than xN_1 (which is contained under N_1'). This is what is formalised in (58).

This completes our discussion of various types of domains. One important question is still open, though, and that is the domain-initial onset that has always been represented in an abbreviated form. We will turn to this issue now.

3.4 Initial position

Consider the representation of the words *pea* and *bee* in (62).

136

(62)   a. *pea* pi::

N_4''' dominates O_3'' and N_4''.

O_3'' dominates x_1 and O_3'.

O_3' dominates x_2 and $xO_3\{\mathbf{U}\}$.

N_4'' dominates N_4' and x_6.

N_4' dominates $xN_4\{\mathbf{I}\}$ and x_5.

b. *bee* bi:: (not complete yet)

N_4''' dominates O_3'' and N_4''.

O_3'' dominates (x_1) and O_3'.

O_3' dominates x_2 and $xO_3\{\mathbf{U}\}$.

N_4'' dominates N_4' and x_6.

N_4' dominates $xN_4\{\mathbf{I}\}$ and x_5.
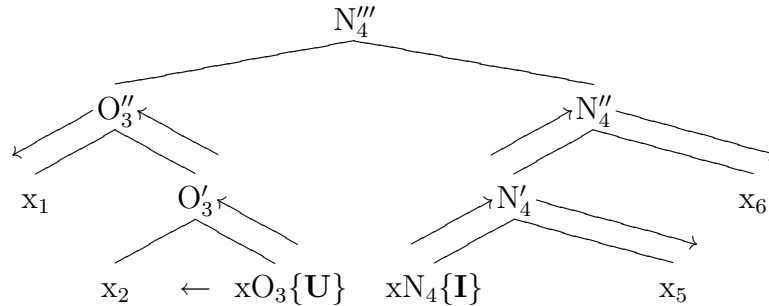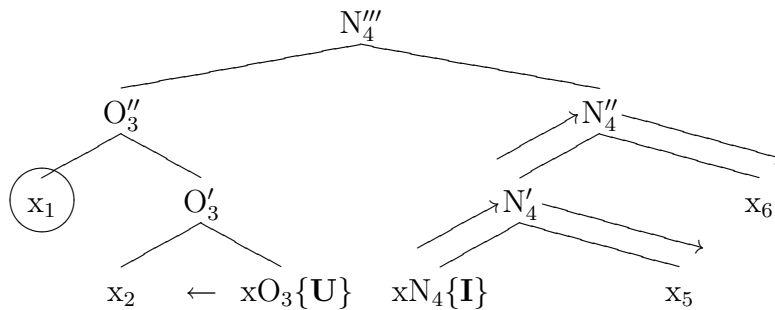
In both structures x_5 and x_6 are m-commanded by xN_4. In (62a), the structure of *pea*, the highest complement of O_3'', *i.e.* x_1, is m-commanded by the onset head xO_3. We are dealing with a fortis p here. Compare this to (62b), where the initial onset is a lenis b, *i.e.* x_1 is not m-commanded by xO_3. Still, words like *bee* are perfectly fine in English. English has a fair number of words beginning with lenis onsets. In other words, since (62a) is grammatical, something must license the initial point x_1 in (62a). Drawing on our experience with the word *Libby* in the last section, we can assume that xN_4 must be the node that licenses x_1. To be more precise, xN_4 must p-license x_1. That we are dealing with p-licensing here and not m-command is clear: If xN_4 did m-command x_1 in (62b), we should expect that the nuclear expression in *bee* would be longer than in *pea* (where the initial x_1 is already m-commanded by xO_3, and would therefore not have to be licensed by the nuclear head). This is not what we get: The i:: in *bee* is no longer than the one in *pea*. What this tells us is that the relationship between xN_4 and x_1 cannot be one of m-command, but must be one of p-licensing. This is shown in (63).

(63) *bee* biːː (complete)

$$N_4''' \xleftarrow{\ p-lic\ } \quad \xleftarrow{\ p-lic\ }$$

$$\xleftarrow{\ p-lic\ } O_3''$$

$$x_1 \qquad O_3'$$

$$\xrightarrow{\ p-lic\ } N_4''$$

$$\xrightarrow{\ p-lic\ } N_4'$$

$$x_6$$

$$x_2 \quad \leftarrow \quad xO_3\{\mathbf{U}\} \qquad xN_4\{\mathbf{I}\} \qquad x_5$$
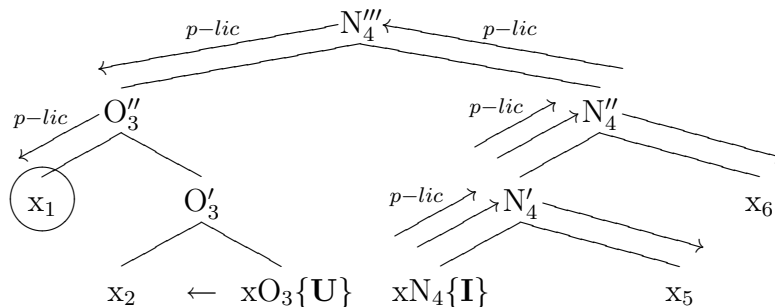
3.5   Lenis onsets after non-domain heads

Let us finally come to an issue which remains somewhat problematic in the present model and where further research is required. Recall the following two words from (1).

(64)   *wicked* wˈɪkəd   *wicket* wˈɪkət

The unstressed nuclei in *wick<u>e</u>d* and *wick<u>e</u>t* are of equal length. While a clear difference in length is to be observed in pairs like *bid/bit*, nothing of that kind can be found with the unstressed nuclei in *wicked/wicket*.

Let us look at the representations of *wicket* (65a) and *wicked* (65b).

(65)   a. *wicket* wˈɪkət

$$N''_2$$

$xO_1\{\mathbf{U}\}$ — N'_2

$xN_2\{\mathbf{I}\}$ — N''_6

O''_5 — N'_6

x_3 — O'_5 — xN_6 — N'_{10}

$x_4 \leftarrow xO_5$ — O''_9 — xN_{10}

x_7 — O'_9

$x_8 \leftarrow xO_9\{\mathbf{A}\}$

b. *wicked* wˈɪkəd

$$N''_2$$

$xO_1\{\mathbf{U}\}$ — N'_2

$xN_2\{\mathbf{I}\}$ — N''_6

O''_5 — N'_6

x_3 — O'_5 — xN_6 — N'_{10}

$x_4 \leftarrow xO_5$ — O''_9 — xN_{10}

(x_7) — O'_9

$x_8 \leftarrow xO_9\{\mathbf{A}\}$
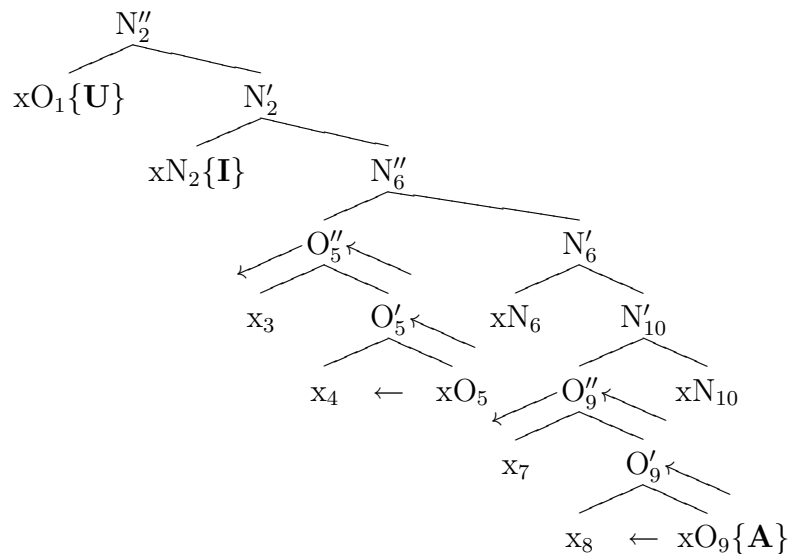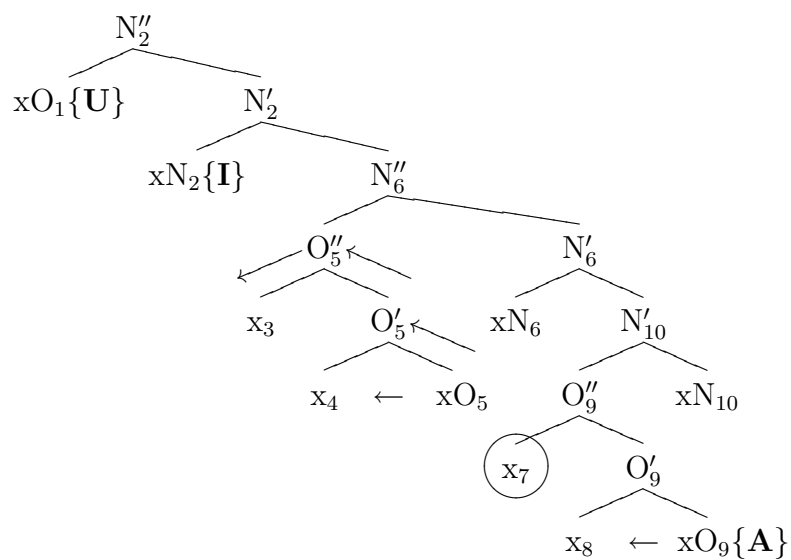
The structures of the two words are quite impressive, so let us go through them step by step. The only respect in which they differ is the status of x_7. In (65a) x_7 is m-commanded by xO_9, in (65b) it is not. In terms of their

structure, the two words are identical. The domain head is xN_2, which takes another nuclear projection, N_6'' as its complement. N_6'' itself is headed by xN_6, and xN_6 in turn takes another nuclear projection as its complement N_{10}'. Note that xN_6 could not take the final onset as its complement, since xN_6 is not the domain head. In section 3.3.3 we said that only domain heads can take onset projections as a complement to their right.

The domain head xN_2 is annotated with melody, while xN_6 and xN_{10} are both empty. The node xN_{10} is licensed to remain uninterpreted due to its domain-final position (*cf.* the discussion in section 3.3.2), while xN_6 is not licensed and spelt out.[22] This gives us the unstressed nucleus *wick<u>e</u>t/wick<u>e</u>d*. The domain-initial onset is a non-projecting $xO_1\{\mathbf{U}\}$ (w), the intervocalic onset (O_5'') is a fortis double-layered structure with no melody (k) and the final onset (O_9'') is a lenis d in *wicked* and a fortis t in *wicked*.

The crucial difference is the status of x_7, which is part of the final onset projection. In *wicket* (65a) x_7 is m-commanded, in *wicked* (65b) it is not. So what is x_7 licensed by in (65b)? There could be no m-command relationship between xN_6 and x_7, because xN_6 is not the closest licenser for x_7; rather x_{10} is (*cf.* the discussion in section 3.3.3). This closer licenser, x_{10}, however, is in final position and p-licensed, and a nucleus that is p-licensed cannot itself p-license another position, *cf.* (57). So we cannot assume that xN_{10} p-licenses x_7, either. But if there is no way x_7 can be licensed, neither by m-command, nor by p-licensing, the structure in (65b) should be ungrammatical. In other words, the theory so far leads us to expect that English should not allow for final lenis consonants which are preceded by non-domain heads (as in *wicked*). English should not be able to make a difference between words like *wicked* and *wicket*. All we should find is *wicket*, with a fortis t at the end. Its structure, as we see in (65a), is grammatical, since x_7 is m-commanded by xO_9. The structure of *wicked*, (65b), should be illicit. The theory predicts that words like *wicked* are out, while *wicket* is fine, which seem like a rather outlandish claim that is immediately falsified.

There is an interesting phenomenon, however, which suggests that the prediction of our theory is at least partly true. While *wicked* is licit, for

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[22] A detailed discussion of this would require some kind of Proper Government, which remains to be worked out in the present theory. Proper Government is one kind of p-licensing, but xN_{10} cannot properly govern xN_6 because it is p-licensed itself. The exact details are not of importance here, however. It is clear that xN_6 cannot be licensed since it receives interpretation.

reasons we do not understand yet, our theory seems to be right with words like *plaintive* and *plaintiff*. There are many speakers who do not usually make a contrast between *plaintive* and *plaintiff*—both are realised with a final *fortis* f, exactly as predicted.[23] (66) gives the relevant part of the structure of those words.

(66)   *plaintive* and *plaintiff* (relevant sequence)

$$
\begin{array}{l}
\ldots \\
\quad N_4'' \\
O_3'' \qquad\qquad N_4' \\
x_1 \quad O_3' \qquad xN_4\{\mathbf{I}\} \quad N_7' \\
\quad x_2 \leftarrow xO_3\{\mathbf{A}\} \qquad O_6' \quad xN_7 \\
\qquad\qquad\qquad x_5 \quad xO_6\{\mathbf{U}\}
\end{array}
$$
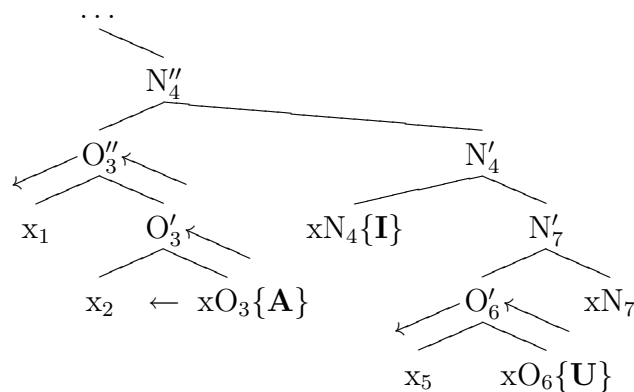
Both words are normally realised with a final f. In (66), xO_6 m-commands the preceding x_5, giving us a fortis f. Crucially, a situation as in (67), with a final v, is disallowed.[24]

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[23] Data elicitation is somewhat tricky here. The effect can best be observed with unrelated pairs like *dative* and *tariff*. When explicitly asked, many of my informants (though not all) said that *plaintive* and *plaintiff* were clearly different for them. However, when they were unaware of what the issue was (*e. g.* when reading sentences where those words occured), the two words usually merged.

[24] Notice that there is no general ban against v's following an unstressed nucleus. As the words *relevant* (with v) and *elephant* (with f) show, English does make a distinction between v and f after unstressed nuclei, as long as the onset is not in final position; v is impossible only in final position, where no licenser can be found.

(67) Illicit structure

$$* \quad \ldots$$

$$N_4''$$

$$O_3'' \qquad N_4'$$

$$x_1 \qquad O_3' \qquad xN_4\{\mathbf{I}\} \qquad N_7'$$

$$x_2 \quad \leftarrow xO_3\{\mathbf{A}\} \qquad O_6' \qquad xN_7$$

$$\widehat{x_5} \quad xO_6\{\mathbf{U}\}$$
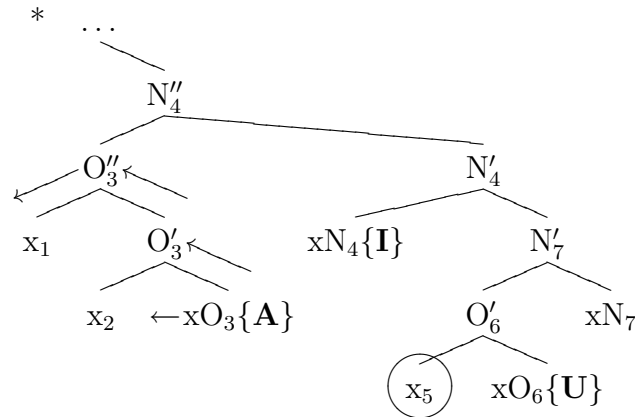
The ungrammaticality of (67) must have to do with the fact that there is no licenser for x_5. In other words, the state of affairs we find in pairs like *plaintive* and *plaintiff* in English is exactly as the theory leads us to expect. What remains to be worked out, and that will have to be the topic of future research, is why one-layered onset projections (as at the end of *plaintive/plaintiff*) behave as predicted, while two-layered onset projections (as at the end of *wicked/wicket*) do not. After all, pairs like *wicked* and *wicket are* different.

3.6   Summary

In this chapter we discussed further properties of length in NYC English and introduced higher level structure, where those properties would find an explanation. We looked at the structure of simple domains, which we divided into three kinds: words like *bee*, words like *Libby* and words like *bid*. We discussed restrictions on the levels of projection and gave examples of entire domains. We also had a look at lenis configurations in the initial position and the final position after non-heads.

Chapter 4

Estonian meets English

In the last chapters we presented the basics of a new theory of constituent structure that could explain the length facts of NYC English. Obviously, we do not want to construct a theory that can only deal with the phonology of English. If we want to show that our model truly expresses deep phonological insights, we must take it beyond English.

This is the objective of the present chapter. We will have a look at Estonian, which holds pride of place amongst the languages exhibiting what is commonly referred to as "overlength", *i. e.* a difference between a short, a long and an overlong degree of length. Due to this (purportedly outstanding) property, Estonian has been of interest to phonologists for a long time. Accordingly, the literature on the subject is vast.[1] Estonian is often assumed to be radically different from languages that do not have such overlength.[2] I intend to show that Estonian is in fact nearly identical to NYC English.

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[1] To give but a small selection: Bye (1997): Eek (1975, 1986, 1990): Eek & Meister (1997, 1998): Ehala (2003): Gordon (1997): Hammarberg (1979): Harms (1962): Hint (1973, 1997b, 1998): Lehiste (1960, 1965, 1966, 1968, 1970b,a, 1980, 1985, 1997, 1998): Lehiste & Fox (1992): Must (1959): Odden (1997): Ojamaa (1976): Posti (1950): Prince (1980): Raag (1981): Raun (1954): Raun & Saareste (1965): Tauli (1966, 1968, 1973b,a): Tugwell (1997): Viitso (1997): Wiik

[2] For the explicit statement of such an understanding *cf. e. g.* Hajek (2000), but the idea that Estonian is "different" is also found implicitly in many of the works given in the previous footnote. Note however Hint (1998: 173): "The description of Estonian cannot proceed from the conviction that in Estonian everything may be fundamentally different from all the other languages [...].".

The parallels between the two languages are too numerous to be accidental, and the areas where Estonian does differ from English can be delineated quite easily. Such a comparison will also require that we have a look at the morphology involved (in the next chapter), a factor that previous analyses of Estonian generally disregarded.

The parallels that emerge between the two languages give further support for our model and make it clear that a major revision of the theory of constituent structure of Standard GP was inevitable.

The chapter is organised as follows: In section 4.1 the basics of Estonian overlength will be discussed. We will see that Estonian and English are more similar to each other than is commonly assumed. Section 4.2 discusses restrictions on the shapes of domains in Estonian. We will also discuss the role of the element **A**. In section 4.3 we will have a closer look at a length alternation in Estonian and see how that can be captured in our model. Last but not least, section 4.4 leads over to the next chapter in that it discusses the role of morphology.

4.1 Basics of Estonian overlength

Let us have a look at the details of length in Estonian step by step and point out the parallels to English at each of those steps. Examples for the three degrees of length are given in (1). Q1, Q2 and Q3 are the labels standardly used in analyses of Estonian, where Q1 (quantity 1) spells out as 'short', Q2 (quantity 2) as 'long' and Q3 (quantity 3) as 'overlong'. What is important to know is that Q3 can only occur in stressed position. All the words in (1) have only one realised nucleus, the domain head. This domain head is assigned stress.

(1)

			NUCLEAR EXPRESSION	NON–NUCLEAR EXPRESSION
siid	siːːd	'silk'	Q3	Q1
kiit	giːd:	'praise'	Q2	Q2
jutt	judːː	'story'	Q1	Q3

The words in (1) illustrate a trade-off phenomenon similar to what we have seen before in the course of this dissertation, *e. g.* in section 1.2. There

is a total amount of space that can be divided up between the a nucleus and the following onset. The more points that are m-commanded by the nucleus, the less there are left for the onset to m-command and vice versa. This follows from the fact that every unannotated x must be m-commanded, but every unannotated x can be m-commanded only once. After an overlong nuclear expression (Q3) we get a short non-nuclear expression (Q1), after a long nuclear expression (Q2) we get a long non-nuclear expression (Q2) and after a short nuclear expression (Q1) we get an overlong non-nuclear expression (Q3).[3]

Let us take a look at the words in (1) one by one. In *siid* siːːd we have an overlong iːː (Q3) followed by a short d (Q1). The iːː is the domain head, it receives main stress. Being the domain head is the prequisite that a nuclear expression can be overlong, as stated above. The representation is given in (2).[4]

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[3] Lehiste (1966) (as well as others) refers to both the iː and the dː in words like *kiit* giːdː as being overlong (Q3). This (wrong) interpretation is due to the particular analyses such a claim is couched in, the details of which need not concern us here. As a matter of fact, both the phonological behaviour of *kiit* giːdː as well as detailed measurements (even of Lehiste herself!) show quite clearly that both the iː and the dː are long (Q2), and not overlong (Q3). This is reflected in the transcription I use throughout this dissertation.

[4] Recall from section 2.3.2.3 that the lowest complement of a two-layered onset projection is controlled by the head xO, not m-commanded. This is indicated by the little arrow between xO_5 and x_4.

(2)   Common structure for Estonian *siid* si::d and NYC English *bead* bi::d

$$N_1''''$$

(tree diagram)

N_1''' xN_6

O N_1''

N_1' O_5''

$xN_1\{\mathbf{I}\}$ x_2 x_3 O_5'

x_4 $\leftarrow xO_5\{\mathbf{A}\}$
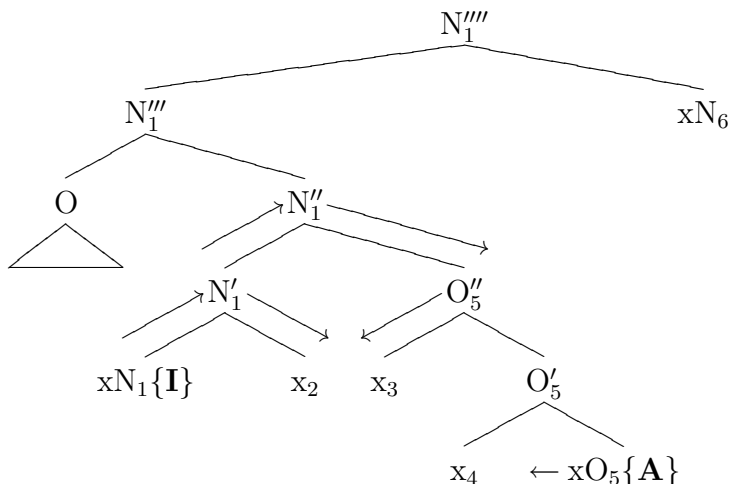
The representation of Estonian *siid* si::d in (2) is of course identical to the one of the English word *bead* bi::d, *cf.* (37) on p. 117. The domain head m-commands two x-slots, one of which comes with the following lenis *d*. We saw that this was only possible for the domain head, *i. e.* under identical conditions as in Estonian: only the domain head (or its first projection) can take an onset as its complement to the right. In such a configuration the point x_3 is available as an m-commandee for xN_1. If the i:: in Estonian *siid* si::d is referred to as overlong, then certainly we can say the same about English *bead*. Likewise, if the *d* at the end of English *bead* is lenis, we could say the same about the final *d* in Estonian *siid*. In other words, Q1 is really a synonym for "does not m-command any other point".[5] In terms of structure and how the available space is divided up between the nucleus and the onset, Estonian *siid* si::d is absolutely identical to English *bead* bi::d. The structure in (2) is an instance of the *bid*-type, *i. e.* N_1' takes an onset projection, O_5'', as its complement. We said in section 3.3.2 that any domain consisting of a domain-head and a final p-licensed nucleus only would have to be assigned a *bid*-structure. This holds not only for English, but of course also for Estonian.

Now, if *bead* finds an equivalent in Estonian *siid* si::d, then what about NYC English *beat*? Again, an interesting parallel to Estonian can be observed: In (1) we have the word *kiit* gi:d:, with a long i: followed by a long

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[5] This is of course exactly the same definition we gave for "lenis" in (18) on p. 70.

d:. The final onset in gi:d: takes up more room than the one in *siid* si::d (Q2 instead of Q1), while the nucleus takes up less (Q2 instead of Q3). Clearly, Estonian *siid* si::d is to *kiit* gi:d: what *bead* bi::d is to *beat* bi:t. In other words, what we transcribed as a fortis t in English *beat* is really the same object as the final d: in Estonian *kiit* gi:d:.[6] The representation underlying both English *beat* bi:t and Estonian *kiit* gi:d: is given in (3).

(3) Common structure for NYC English *beat* bi:t and Estonian *kiit* gi:d:
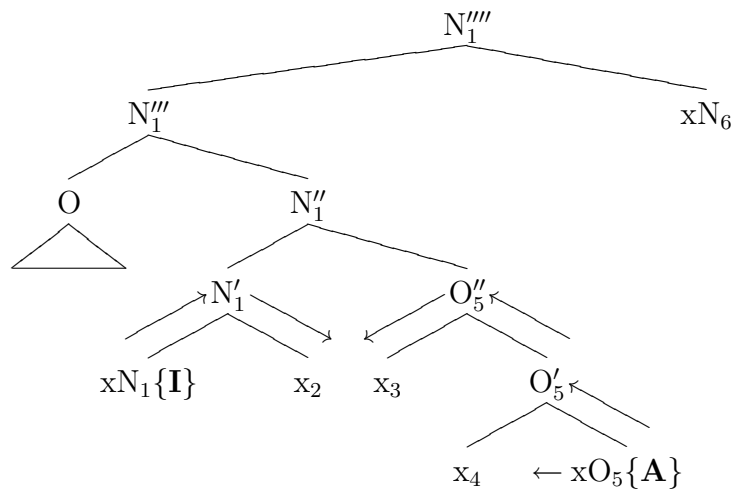
The final onset head xO_5 m-commands exactly one unannotated x-slot, x_3, which is of course no longer available for m-command from the preceding nucleus. Both xN_1 and xO_5 m-command exactly one x-slot each. In other words, the distribution of length is parallel in both languages. The environment where this happens, *i. e.* the stressed position, is identical, too. The label Q2 translates as "m-commands exactly one x-slot".[7]

---

[6] The transcriptions I use keep as close as possible to the ones normally used in the literature on the two languages. The transcription as such is of course nothing real, it is only a rough guide to pronunciation. The only real objects we are dealing with are phonological representations, which consist of nodes, elements etc.

[7] As we shall see in section 4.3, Q2 is not necessarily the same as "fortis". We only speak of a fortis configuration when an xO m-commands the highest unannotated x within its projection, while Q2 is more general and simply refers to an xO m-commanding exactly one x-slot, without specifying the exact position of that x-slot.

What this shows is that there is no difference *in kind* between English and Estonian. We have found a clear parallel between NYC English and Estonian. The same structures occur in both languages under the same condition, *i. e.* being in stressed position. Overlength is not a particular property of Estonian that sets it apart from other languages; as far as the structures in (2–3) are concerned, it is present in identical form in English. We have made a major step towards unifying phonological systems that have always claimed to be very different. An *ad hoc* theory for Estonian is no longer necessary.

All this is not to say that the two languages are identical in every respect, of course. One crucial difference can be seen as we come to the third word in (1), *jutt* jud::. The final onset is overlong (Q3), while the nuclear expression is short (Q1). Let us look at the representations of *siid* si::d (2) and *kiit* gi:d: (3) again. In (2) the nuclear head xN_1 m-commands two x-slots, x_2 and x_3. This gives us an overlong i::. In (3) xN_1 m-commands only one unannotated point, x_2. There is of course a third possibility, which we have not seen so far, *viz.* a representation that has the same structure as the words under (2) or (3), but where xN_1 does *not* m-command any unannotated x-slot. This is exactly the representation I want to propose for the word *jutt* jud::.

(4)   *jutt* jud:: 'story'
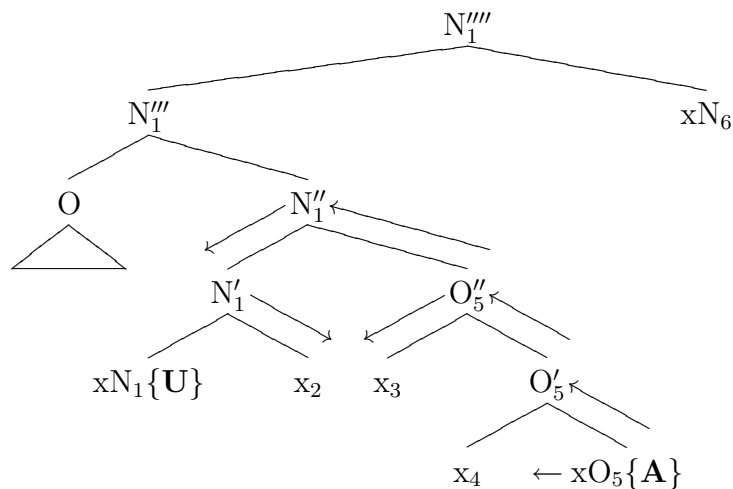
The terminal xN_1 does not m-command any other point (Q1), while xO_5 m-commands two. Q3 can then be glossed as "m-commands exactly two points".

In (4) we see an m-command relationship we have not encountered so far, going from xO_5 to the complement of the preceding nucleus, x_2. What is remarkable about this relationship is that here we have m-command going from the onset head *beyond* its maximal projection. In all the English cases discussed before, m-command coming from an onset head never left the maximal projection. I will refer to this phenomenon as **transgression**. A formal definition is given in (5).

(5) **Transgression**

A relationship between two points is said to transgress *iff* it crosses two nodes A and B such that

a. either A dominates B or B dominates A and

b. the maximal projection of an onset head, O_{max}, intervenes between A and B, *i.e.* either A dominates O_{max} and O_{max} dominates B or B dominates O_{max} and O_{max} dominates A.

The crucial idea captured in (5) is that one of the nodes, A or B, has to be within the maximal projection of the onset and the other one outside. This notion of transgression will come up several times in the course of the following discussion.

Let us see why the structure of *jutt* jud:: 'story' contains a transgressing m-command relationship. (6) repeats the representation.

(6) *jutt* jud:: 'story' (repeated)
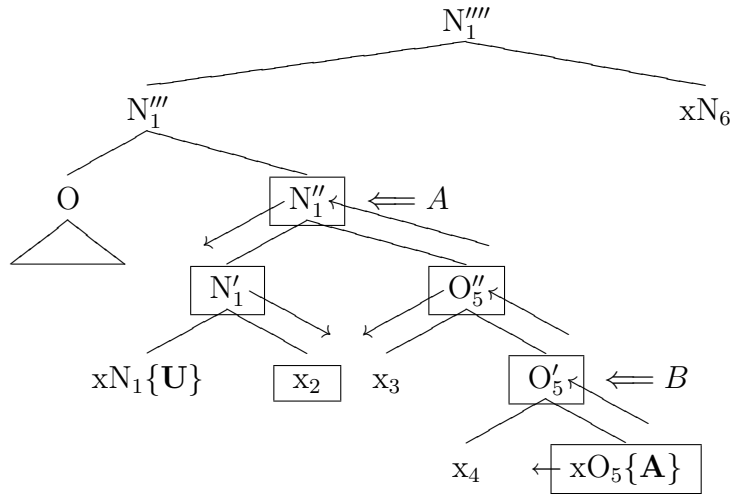
What is of interest to us is the m-command relationship holding between xO_5 and x_2. The relevant nodes that must be crossed on the way from xO_5 to x_2 are boxed: xO_5, O_5', O_5'', N_1'', N_1' and x_2. In order to show that the m-command xO_5–x_2 transgresses, we have to find two nodes A and B that fulfill the definition in (5). Let us assume that N_1'' represents A and O_5' represents B. In (6) then, A dominates B, so condition (5a) is met. Furthermore, a maximal onset projection O_5'' intervenes between A and B, so (5b) is fulfilled, too. We have shown that the m-command relationship from xO_5 to x_2 in (6) transgresses.

Under the definition in (5), English *bead* or Estonian si::d must of course also be classified as cases of transgression. This time it is the m-command coming from the nuclear head that transgresses. A quick look at the structure in (2), repeated here as (7), and the definition in (5) makes this clear.

(7)   NYC English *bead* bi::d and Estonian *siid* si::d (repeated)

$$N_1''''$$

$$N_1''' \qquad\qquad xN_6$$

$$O \qquad \boxed{N_1''} \Longleftarrow A$$

$$\boxed{N_1'} \qquad\qquad \boxed{O_5''}$$

$$\boxed{xN_1\{\mathbf{I}\}} \qquad x_2 \qquad \boxed{x_3} \qquad O_5'$$

$$\Uparrow$$

$$B \qquad x_4 \qquad \leftarrow xO_5\{\mathbf{A}\}$$
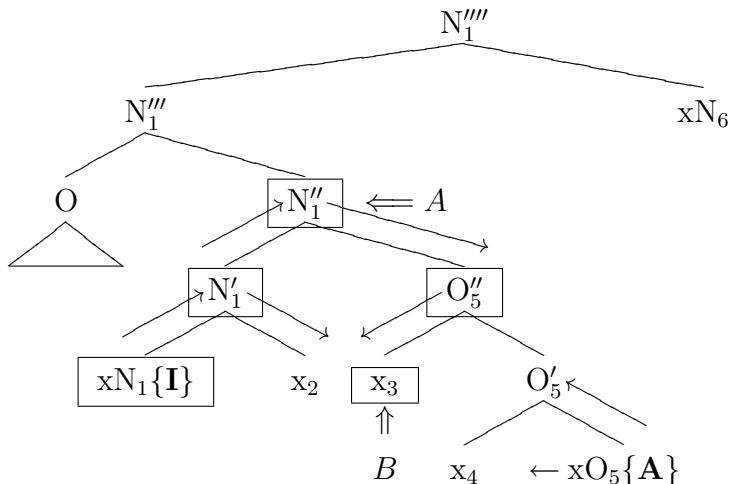
The crucial m-command relationship goes from xN_1 via N_1', N_1'' and O_5'' to x_3. Again, two nodes A and B fulfilling the conditions in (5) can be found. Let N_1'' stand for A and x_3 for B. A dominates B and a maximal onset projection, O_5'', intervenes between A and B. The conditions in (5) are met.

What is special about Estonian (and sets it apart from English) is that it also allows for transgression going "upwards" (bottom-up) from within an onset projection, *i. e.* that m-command from an xO actually goes *beyond* the maximal projection of that xO. This is what we saw in (6): m-command from xO_5 goes beyond O_5'' and targets x_2, which lies outside the maximal projection O_5''. In the English examples discussed in the last chapter and in Estonian *siid* si::d (7) we only saw cases of "downward" transgression (top-down) into an onset projection, *i. e.* where an xN m-commanded a point that was contained in an onset projection. The notion of transgression going upwards allows us to make a clear distinction between fortis onsets and geminates. In fortis onsets m-command does not go beyond the maximal onset projection, *cf. e. g.* the representation of English *beat* bi:t or Estonian *kiit* gi:d: in (3). In geminates, on the other hand, m-command does go beyond the maximal onset projection, *cf.* Estonian *jutt* jud:: in (6). The importance of such a distinction (beyond Estonian) will become clear in section 5.4, where we discuss the metrical facts of Italian.

4.2 The size of domains

All three Estonian words we have discussed so far have the same structure, *viz.* the one in (8). The final nucleus xN_6 is p-licensed by parameter, *cf.* (41) on p. 121.

(8)

$$N_1''''$$

tree structure:
- N_1'''' branches into N_1''' and xN_6
- N_1''' branches into O (triangle) and N_1''
- N_1'' branches into N_1' and O_5''
- N_1' branches into xN_1 and x_2
- O_5'' branches into x_3 and O_5'
- O_5' branches into x_4 $\leftarrow$ xO_5
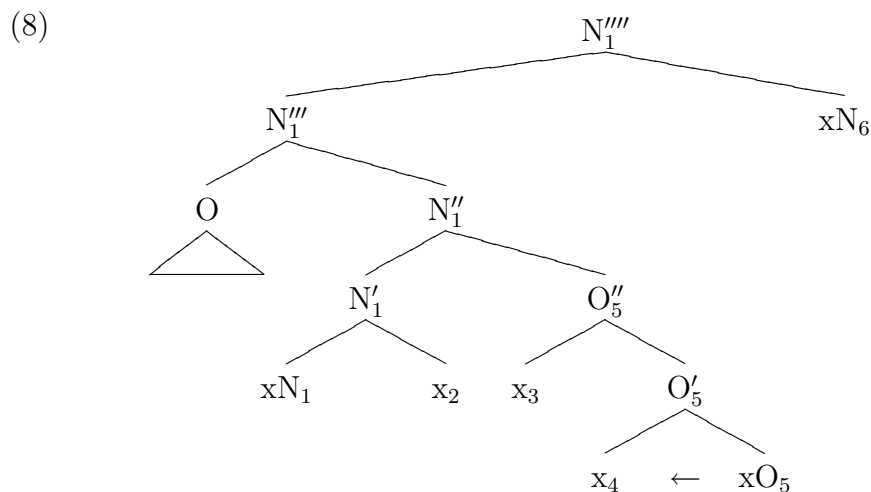
(2), (3) and (4) only differ in the m-command relationships involving x_2 and x_3. All logical combinations have been exhausted, as given in (9). Each unannotated x must be m-commanded, and no x can be m-commanded more than once, *cf.* (26) on p. 76.

(9)

			xN_1 m-commands	xO_5 m-commands
siid	siːd	'silk'	x_2, x_3	—
kiit	giːd	'praise'	x_2	x_3
jutt	judː	'story'	—	x_2, x_3

Notice that the head of the structure in (8), xN_1, expands into a c-expansion (*cf.* section 3.2.3): Both xN_1 and its first projection, N_1', take a complement to their right. Let us assume that the fact that xN_1 expands into a c-expansion in (8) is not an accidental property of the words we have investigated so far. What I want to propose is that it is a general property

of all *bid*-type words in Estonian (and in fact also the *bee*-type words) that their domain head has to expand into a c-expansion. From this assumption it follows that the representations of the NYC English words *bid* and *bit*, repeated in (10), could not be possible domains in Estonian.

(10) a. NYC English *bid* bɪːd (impossible in Estonian)

$$N_1'''$$

N_1'' xN_5

O N_1'

$xN_1\{\mathbf{I}\}$ O_4''

x_2 O_4'

x_3 $\leftarrow$ $xO_4\{\mathbf{A}\}$

b. NYC English *bit* bɪt (impossible in Estonian)

$$N_1'''$$

N_1'' xN_5

O N_1'

$xN_1\{\mathbf{I}\}$ O_4''

x_2 O_4'

x_3 $\leftarrow$ $xO_4\{\mathbf{A}\}$
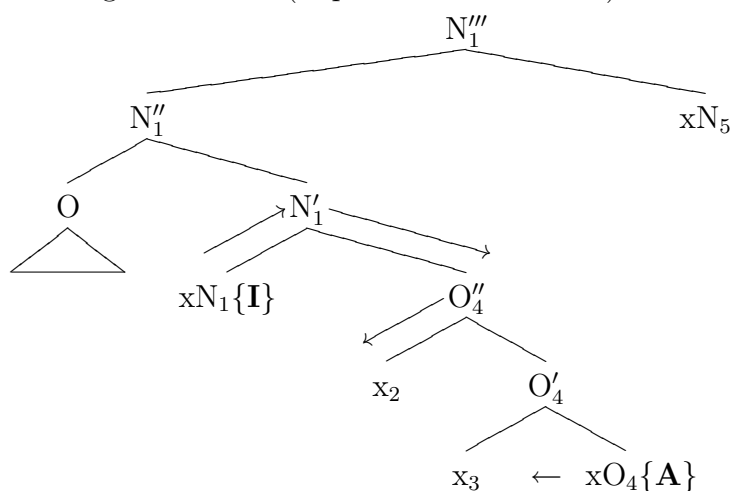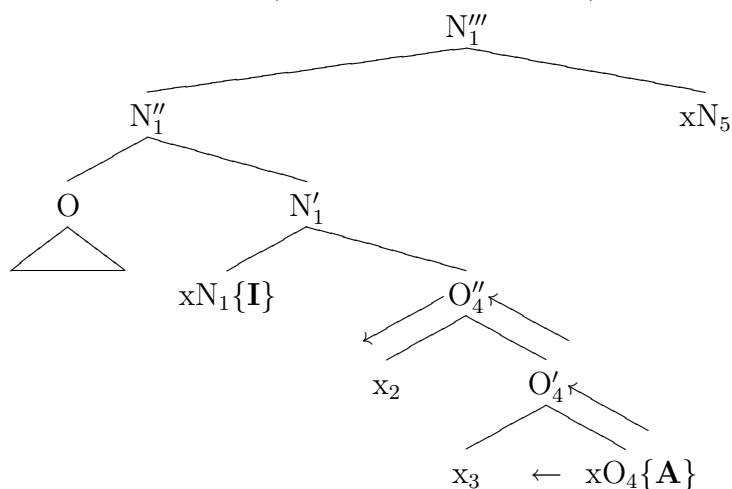
While both structures in (10a–b) are licit in English, they are impossible in Estonian, since the nuclear head does not expand into a c-expansion. The

domain head xN_1 takes a complement to its right, but its first projection N'_1 does not.

That under certain conditions the domain must expand into a c-expansion is something we have also seen in the discussion of English. Recall the structure of the word *bee* from the previous chapter (example (30) on p. 113).

(11) NYC English *bee* biː

$$N'''_1$$

O

$$N''_1$$

$$N'_1$$

x_3

$xN_1\{\mathbf{I}\}$

x_2
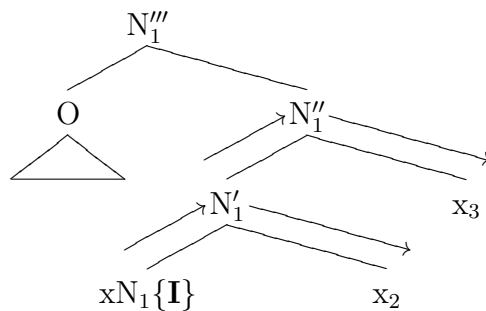
The condition we posited for English was the following one (repeated from (31) on p. 113).

(12) **Condition on domain heads in English (repeated):**
If the domain head is the last nucleus in the domain, it must expand into a c-expansion.

The condition in (12) does not apply to the words in (10), as was already discussed in section 3.3.2. In the structures in (10) the domain head is not the last nucleus in the domain.

The fact that the representations in (12) are not well-formed in Estonian makes clear that some language-specific condition on the shape of domains must hold. What I want to propose for Estonian is the following.

(13) **Condition on domain heads in Estonian**
If the head of the domain is not followed by a realised nucleus, it must expand into a c-expansion.

(13) is crucially different from (12). A domain head in English is only required to be a c-expansion if it is final, *i. e.* if no other nucleus follows. In Estonian, on the other hand, a domain head has to be a c-expansion unless it is followed by a realised nucleus. The condition for Estonian as stated in (13) excludes structures like the ones in (10). In both (10a) and (10b) the domain head is followed by another nucleus, xN_5, but that nucleus is not realised: it is p-licensed due to its position. The domain head is therefore required to be a c-expansion, a condition that (10a) and (10b) fail to meet.

Of course, (13) also applies to words of the *bee*-type. In a structure like under (11), the domain head is not followed by another realised nucleus, thus structures of the *bee*-type fall under the purview of (13) as well. That is, we predict that in Estonian, just like in NYC English, words of the *bee*-type will always have a head that expands into a c-expansion. This is indeed correct. The following two structures are illicit as domains in both English and Estonian.

(14) Illicit domains in Estonian and English
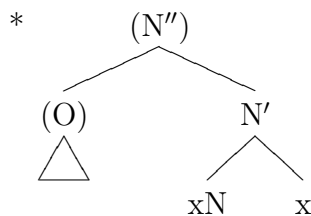
    a.   b.
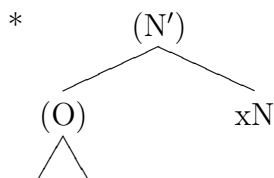
(The presence of the initial onset is of course completely irrelevant, which is why O and the node dominating it are enclosed in brackets.)

Estonian has domains like *maa* maː ‘country’, *suu* suː ‘mouth’ or *tee* deː ‘road’, but no domains like *maː or *ma.[8] The structure of *maa* maː ‘country’ is given in (15), which is of course identical to the structure of NYC English *bee* biː in (11). The only difference is in the melody.

---

[8] The only forms shorter than *maa* maː ‘country’ are pronouns like *ma* ma ‘I’, *sa* sa ‘you’ and other function words, all of which are clitics and could not qualify as domains of their own due to the constraint in (13).

(15) Estonian *maa* maːː 'country'

$$N_1'''$$

O

$$N_1''$$

$$N_1'$$

$$x_3$$

$$xN_1\{\mathbf{A}\} \qquad x_2$$
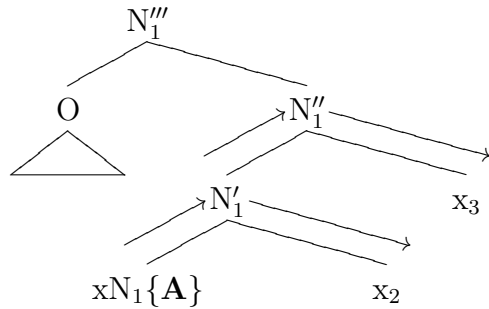
Obviously, the condition in (13) will not apply if the domain head is followed by another realised nucleus. In other words, in structures of the *Libby*-type there will be no conditions on the domain head. This can be seen in words like *tuli* duliˑ 'fire' or *sada* sadaˑ 'hundred'. (The importance of the 'ˑ' in the transcription will become clear in a moment.) The representation of the word *sada* is given in (16).

(16)

$$N_1''$$

O

$$N_1'$$

$$xN_1\{\mathbf{A}\}$$

$$N_5'$$

$$O_4''$$

$$xN_5\{\mathbf{A}\}$$

$$x_2 \qquad O_4'$$

$$x_3 \quad \leftarrow \quad xO_4\{\mathbf{A}\}$$
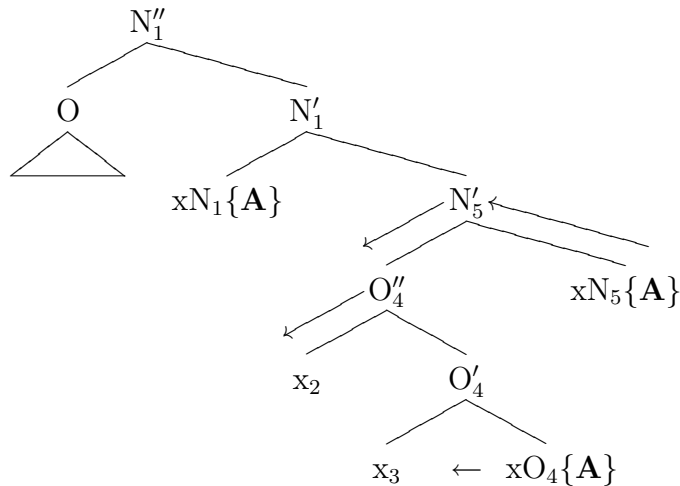
The domain head, xN_1, is followed by another *realised* nucleus, xN_5, and therefore xN_1 does not have to expand into a c-expansion: xN_1 takes a complement to the right, but the first projection N_1' does not. Still, the structure in (16) is well-formed.

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In fact, (16) illustrates more than just what the conditions on domain heads are. In addition to that we also see an m-command relationship between xN_5 and x_2, which licenses x_2. We know that m-command is the mechanism underlying length, so since the final nucleus xN_5, annotated with the element **A**, m-commands another point, we should expect to find a long final *a*. As it turns out, in Estonian the final nuclear expressions in *Libby*-type words are indeed long, which has been the topic of debate ever since Posti (1950). This long final nuclear expression is commonly referred to as the "half-long vowel" in the literature. The term "half-long" owes its existence to the fact that those so-called "half-long vowels" are in unstressed position and therefore measurably shorter than "long vowels" in stressed position (*i. e.* a Q2 nuclear expression). This "half-length" is recorded in the transcription with a '·'. From the point of view of phonology, of course, this difference in realisation ("half-long" *vs.* long) is irrelevant. What is important to us is that xN_5 m-commands x_2 and that this gives us a long(er) final nuclear expression. We will return to this issue in more detail in section 4.3.

Let us sum up the parallels we have established between Estonian and NYC English so far.

(17)

			NUCLEAR EXPRESSION	NON–NUCLEAR EXPRESSION		
siid	siːːd	'silk'	Q3	Q1	*bead*	biːːd
kiit	giːdː	'praise'	Q2	Q2	*beat*	biːt
jutt	judːː	'story'	Q1	Q3	—	
—			Q2	Q1	*bid*	bɪːd
—			Q2	Q1	*bit*	bɪt
maa	maːː	'country'	Q3	—	*bee*	biːː

All the words in (17) end in a *d/t* (if they end in an onset at all), *i. e.* a double-layered onset projection. What about other possibilities? We have seen for NYC English that the distribution of length in *leave*/*leaf* parallels that of *bead*/*beat*, and that the nuclear expression in *feel* comprises as many points as the one in *bead*. So let us have a look at some structures with final onsets other than *d* in Estonian and see how far the parallel between Estonian and English goes.

4.2.1 AL-constructions

Let us stick with two-layered structures for the moment and investigate the second important type we identified in section 2.3.3, *i. e.* the structures we referred to as AL-constructions. (18) gives examples of words of the *bid*-type ending in l, m and n.[9]

(18)   a. Q3 + Q1: *toon* doːːn 'tone', *kaan* gaːːnʲ 'leech', *jaam* jaːːm 'station', *keel* geːːl 'language', etc.

   b. Q1 + Q3: *linn* linːː 'city', *kann* ganːː 'jug', *kamm* gamːː 'comb', *kell* gelːː 'clock', etc.

   c. Q2 + Q2: *liːnː, *gaːnː, *gaːmː, *geːlː, etc.

(18) reveals an interesting asymmetry: We find both *keel* geːːl (18a) and *kell* gelːː (18b), but no *geːlː (18c). That is, there is no equivalent to the type vaːd in the case of words ending in AL-constructions. In other words, maximal projections of an AL-construction are always transgressed, either from within the onset (*kell* gelːː) or from outside the onset (*keel* geːːl). Let us state this as an observation (19) for the time being. We shall see in a moment that the observation in (19) follows from a more general property of Estonian.

(19) **An observation:**

   At the end of a *bid*-structure, the maximal projection of an AL-construction must be transgressed.

In other words, we have lenis AL-constructions and transgressing AL-constructions, but no fortis AL-constructions. The structures for *keel* geːːl and *kell* gelːː are given in (20).

---

[9] Estonian has no final ŋ. Words like *rong* 'train' and *hing* 'soul' are realised as roŋːg and hiŋːg, *i. e.* as clusters. We will discuss them in chapter 6.

(20)   a. *keel* ge::l (Q3 + Q1) 'language'

$$N_1''''$$

N_1''' ⟶ xN_6

O (triangle) N_1''

N_1' O_5'' ⟸ transgressed

$xN_1\{\mathbf{A}, \mathbf{I}\}$ x_2 x_3 O_5'

$x_4\{\mathbf{A}\}$ xO_5

b. *kell* ge::ll (Q1 + Q3) 'clock'

$$N_1''''$$

N_1''' xN_6

O (triangle) N_1''

N_1' O_5'' ⟸ transgressed

$xN_1\{\mathbf{A}, \mathbf{I}\}$ x_2 x_3 O_5'

$x_4\{\mathbf{A}\}$ xO_5
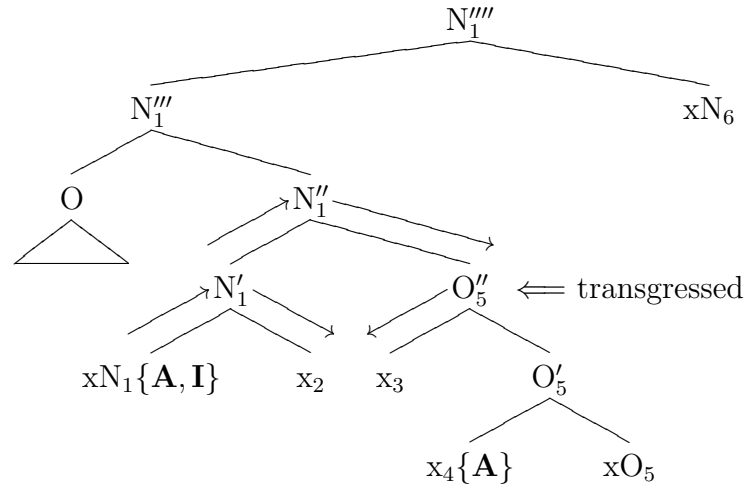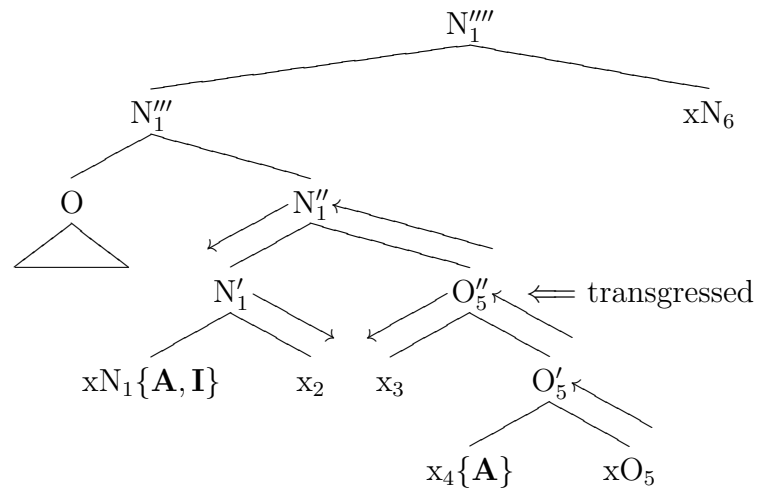
Contrast this to ungrammatical *ge:l: given in (21).

(21) *geːl (Q2 + Q2)

$$N_1''''$$

$$N_1'''$$ $$xN_6$$

O $$N_1''$$

$$N_1'$$ $$O_5'' \Longleftarrow \text{not transgressed}$$

$$xN_1\{\mathbf{A}, \mathbf{I}\}$$ $$x_2$$ $$x_3$$ $$O_5'$$

$$x_4\{\mathbf{A}\}$$ $$xO_5$$
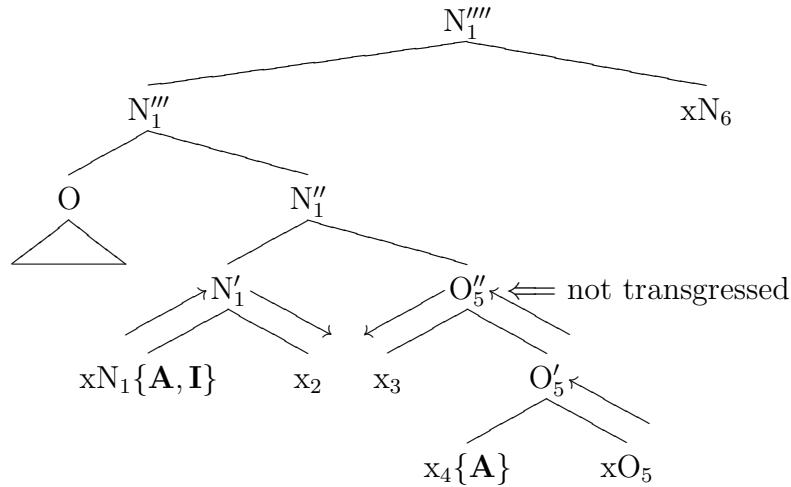
Unlike (20a–b), the structure in (21) fails to display transgression in either direction. The m-command going from xO_5 does not go beyond the maximal onset projection, instead it targets x_3, which is still inside the maximal projection. The m-command coming from xN_1 does not go across a maximal onset projection, either.

(20a–b) are in no way special for *l*, of course. Exactly the same structures can be assumed for pairs like *toon* doːn 'tone' *vs. tonn* donː 'ton' or *kõõm* gɜːm 'dandruff' *vs. kõmm* gɜmː 'bang'.

The structures in (20a–b) also raise another question with respect to AL-constructions that needs to be addressed. In (20a) the point x_4 is annotated with the element **A** and the onset head xO_5 is empty. This gives us a short l (Q1). Compare this to (20b): the element **A** sits in x_4 again and the onset head xO_5 m-commands two other points, *viz.* x_2 and x_3, giving us an overlong lː (Q3). However, if the m-command relationship holds between xO_5, x_2 and x_3 while the melody sits in x_4, *i. e.* a point not involved in any m-command, then how can the configuration in (20b) give us an overlong lː? The m-commanding head xO_5 itself is devoid of any melodic material (the **A** sits in x_4, not xO_5), still it is the fact that xO_5 m-commands two other points that gives us an overlong final lː. How do we explain this? (22) repeats the relevant part of the structure of *kell* gelː.

(22) The relevant part of *kell* gel:: 'clock'

$$
\begin{array}{c}
N_1'' \\
\swarrow \qquad \searrow \\
N_1' \qquad\qquad O_5'' \\
\swarrow\quad\searrow \qquad \swarrow\quad\searrow \\
\dots \qquad x_2 \quad x_3 \qquad O_5' \\
\swarrow\quad\searrow \\
x_4\{\mathbf{A}\} \qquad xO_5
\end{array}
$$
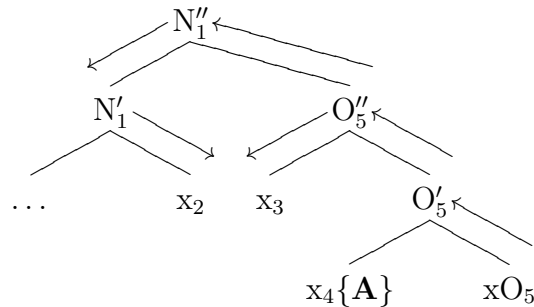
What we have assume is that the melody of the complement point x_4 is somehow visible in or accessible to xO_5. Once it is visible in xO_5, it can be "passed on" to other points via m-command. Furthermore, it is clear that this cannot mean that there is a relationship of m-command between x_4 and xO_5, because any further m-command would mean additional length. That the melody of non-heads in AL-constructions must be visible in the head position is also required independently of m-command. Consider the representation of a (lenis) m, repeated here from (39). The head xO does not m-command any other points.

(23) a. m

$$
\begin{array}{c}
O'' \\
\swarrow\quad\searrow \\
x_1 \qquad O' \\
\swarrow\quad\searrow \\
x_2\{\mathbf{L}\} \quad xO\{\mathbf{U}\}
\end{array}
$$
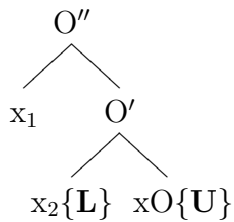
The two elements, $\mathbf{L}$ and $\mathbf{U}$ are interpreted together, and not in succession, *i. e.* they must form a unit of some kind. What this requires is a more elaborate theory of melody, however, so the question cannot be answered satisfactorily here. For the time being I will simply assume that melody in non-head positions is visible in the respective head positions and that, as a result, it can be transmitted via m-command.

4.2.2 A revision of non-projecting onsets and the properties of A

So far we have only dealt with final double-layered structures in Estonian. Before we move on to single-layered structures in our discussion, let us first have a look at non-projecting onsets. They illustrate a phenomenon that we will have to return to when talking about single-layered structures. Consider the words in (24).

(24)   a. Q3 + Q1: *hiir* hiːːr 'mouse', *saar* saːːr 'island' etc.

　　　 b. Q1 + Q3: *vurr* vurːː 'moustache', *porr* borːː 'creeper' etc.

　　　 c. Q2 + Q2: *hiːrː, *vuːrː, *saːrː, *poːrː etc.

With the non-projecting onsets, Estonian only allows for r in the final position, but not for j, which we assumed to be xO{**I**}. A w, *i. e.* xO{**U**}, is completely absent from the system.

What is interesting about (24) is that we notice a pattern entirely parallel to what we saw with *bid*-structures ending in AL-constructions in section 4.2.1. We find hiːːr 'mouse' (Q3 + Q1) and vurːː 'moustache' (Q1 + Q3), but no *hiːrː (Q2 + Q2) etc. In the case of final AL-constructions we observed that transgression was obligatory (*cf.* (19), but recall that I have already hinted at the fact that we will derive this observation from a more general principle later on). To what extent does that observation help us here? Since we see that final r behaves like a final AL-construction, we would want to say that transgression is obligatory with final r as well. In section 2.3.4 we said that the structure of an r was simply an xO{**A**}, *i. e.* a non-projecting onset annotated with the melody **A**. But this cannot be right for reasons we will see immediately. The assumption that r is simply xO{**A**} should give us the representations in (25) for hiːːr and vurːː. As we will see, they will have to be rejected.

(25)   a. *hiir* hiːr 'mouse' (to be rejected)
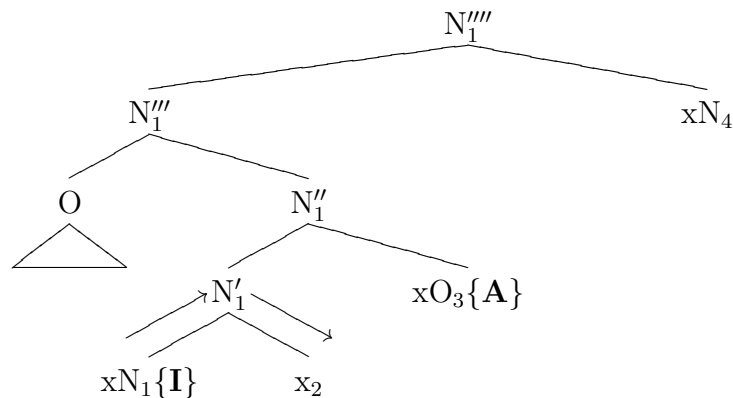
b. *vurr* vurː 'moustache' (to be rejected)
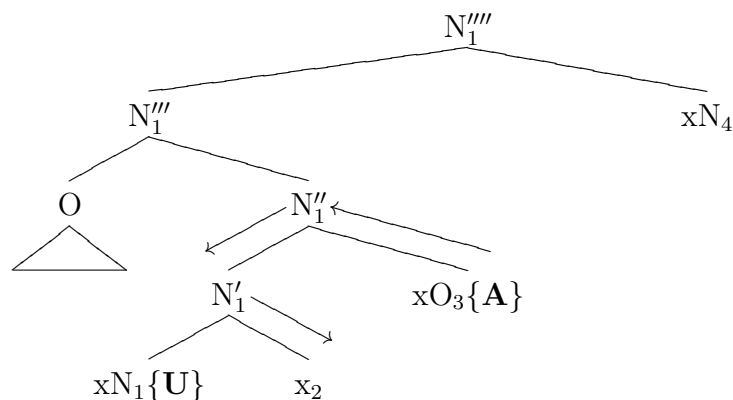
There are two problems with the structures in (25). Firstly, the word *hiir* hiːr contains an overlong iː (Q3). Above we said that Q3 corresponds to a head m-commanding two unannotated x-slots, *cf. e. g.* the word siːd 'silk' (2). The nuclear head in (25a), xN_1, m-commands *one* x-slot, x_2, but not two. The same holds for *vurr* vurː in (25b). Its r is overlong, *i. e.* xO_3 should m-command two unannotated x-slots, but again, xO_3 m-commands only one other slot.[10] In other words, the structures in (25) are not big enough: We are one point short in both representations.

---

[10] The length alternations to be discussed in section 4.3 provide clear evidence that the iː in *hiir* hiːr and the rː in *vurr* vurː have to comprise three points each.

The second argument against the structures in (25) comes from the lack of forms like *hiːrː or *vuːrː. As we have said, this gap suggests that transgression must be obligatory again. However, neither structure in (25) contains an m-command relationship that qualifies as transgression. In (25a) the only m-command goes from xN_1 to x_2. No maximal onset projection is crossed. What about (25b)? Here we have an m-command from xO_3 to x_2. This does not qualify as transgression, either. The definition of transgression in (5) states that a maximal onset projection must *intervene*. But xO_3 cannot intervene anywhere, since it is a terminal: it does not dominate any other node.

Let us have a closer look at our first problem, *viz.* that the structures are too small. If we are one point short in both cases, then where should that additional point we need come from and where would it be? The nuclear head already expands into a c-expansion, *i. e.* it is already as complex as it could possibly be. The extra point has to be in the r. But how can that be, if an r is simply an onset head labelled with **A**?

In the discussion of superheavy rhymes in section 2.2 we saw that **A** seems to have the property of licensing extra structure. It provides extra room that other elements cannot provide. But what does that mean? We cannot simply let xO{**A**} project one level up, as that would be the structure of a fricative (*viz.* ð), *cf.* the parallel structures of v and ð.

(26) The structure of v   The structure of ð

          O′   O′

     x   xO{**U**}   x   xO{**A**}
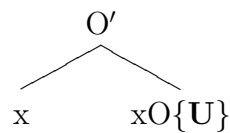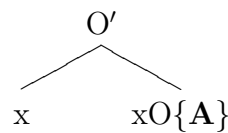
That is, if we cannot use the structure in (26b) to represent r, we will have to find an alternative representation, one that provides extra room without the head having to project to O′. What I want to propose is that the element **A** allows for an **adjunction structure** as given in (27). (A formal definition of adjunction will be given in a moment.)

(27) Possible adjunctions

a.   b.   c.

```
        xO                      x                      xN
       /  \                    / \                    /  \
      x    xO{A}              x   x{A}           xN{A}     x
```
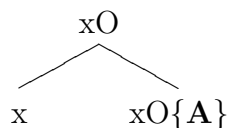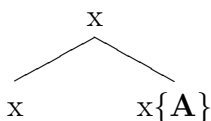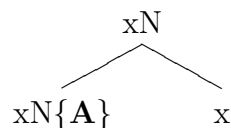
Only nodes annotated for **A** license adjunction structures. Adjunction expands a node by stretching its outermost layer into two parts and inserting an unannotated x between them. This expansion does not raise the level of projection.[11] That is, in (27a) we have an xO annotated for **A**. This **A** licenses adjunction: the node that **A** sits in, xO, is split in two parts (giving us two xO's, one dominating the other) and an x is inserted between those two parts. Both the head xO{**A**} (the lower xO) and the node dominating the inserted x and the head are of the type xO, since adjunction does not raise the level of projection. The dominating node is still an xO, and not an O′. Only the lower node of an adjunction structure is annotated with melody, not the higher one. (The importance of this will become clear in section 6.2.3.) For example, in (27a) the head node xO{**A**} is annotated with **A**. The node dominating the head node and the unannotated x, however, is simply an xO. The same kind of adjunction can be found with x{**A**} (27b) or xN{**A**} (27c).[12] All the structures in (27) still count as *non-projecting*, since their topmost node is an xO, x, or xN. To make this point clear, consider the following representations.

---

[11] The notion of adjunction is borrowed from syntax of course. In phonology, adjunction is to be understood as a particular configuration, not as a process of adjoining something.

[12] To keep in line with the usual position of complements with respect to their heads, I assume that the adjoined x is to the left of an onset head in (27a) and to the right of a nuclear head in (27c). In (27b), where we have an adjunction structure involving non-heads only, I have labelled the right x with **A**. (But notice in this context the discussion of directionality in section 3.2.2.)

(28) a.   b.   c.

                                    xO   O′
                                  ╱   ╲   ╱   ╲
        xO{**U**}   x   xO{**A**}   x   xO{**A**}
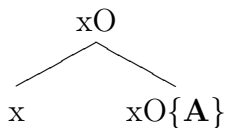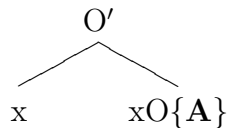
Both (28a) and (28b) count as non-projecting, since the highest nodes of
both structures belong to the set of terminals as defined in section 2.3.2.1.
The structure in (28c), on the other hand, is a projecting structure: it is the
single-layered structure of what comes out as a fricative (θ or ð, depending
on m-command). (28b) and (28c) are thus crucially different from each other.

Let us now give a formal definition of adjunction.

(29) **Adjunction:**

Adjunction is defined as a structure where

   a. a node α is split in two parts, α_1 and α_2, and

   b. α_2 dominates both α_1 and an unannotated x, yielding the
      following structure:

   c. α_2
                   ╱   ╲
              x α_1
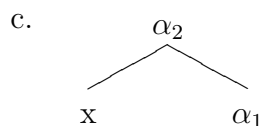
      (On the position of x and α_1 with respect to each other *cf.*
      footnote 12.)

   d. The nodes α_1 and α_2 are identical with respect to their level
      of projection.

   e. Only α_1 is annotated with melody.

Adjunction is possible *iff*

   f. α_1 is annotated for the element **A** and

   g. α_2 does not project.

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(29a–e) have been discussed before. (29f) singles out nodes labelled for **A**. Only **A** can license adjunction structures. (Since only terminals can be labelled for melody, it follows that only terminals can license adjunction.) Note that a node labelled for **A** *can* license an adjunction structure, but does not *have* to. The condition in (29g) imposes a further restriction and helps us curb over-generation: a node that is involved in an adjunction structure cannot project to a higher level. It prevents structures as in (30).

(30) Illicit structure

$$
\begin{array}{c}
* \quad O' \\
\diagdown \\
x_1 \qquad xO \qquad \Longleftarrow \alpha_2 \\
\diagdown \\
x_2 \qquad xO\{\mathbf{A}\} \qquad \Longleftarrow \alpha_1
\end{array}
$$
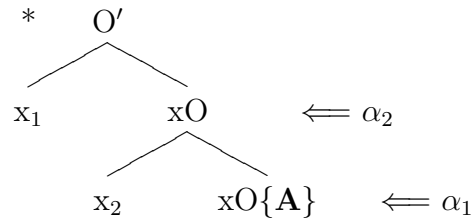
The node $xO\{\mathbf{A}\}$ (α_1) contains **A** and can license an adjunction structure, *i. e.* it can be split up in two xO's (α_1 and α_2), with the higher xO (α_2) dominating the lower xO (α_1) and an unannotated x. This higher xO (α_2) cannot project, as stated in (29g): it is the topmost node of an adjunction structure and therefore incapable of projecting. A structure as in (30) is thus excluded by (29g), and by extension also a structure where O' would project to O''.

Notice that by allowing for **A** to license adjunction structures an interesting prediction is made: We should expect that the phonology of a language has more objects containing **A** than objects containing any other element. There will be certain objects with nodes labelled for **A** where **A** does not license adjunction, and there will be other objects with nodes labelled for **A** where **A** does license adjunction. For nodes labelled with other elements, like **I**, **U** or **L**, no such second possibility exists: **I**, **U** and **L** do not license adjunction. Our prediction that there are more objects containing **A** is of course correct. English, for example, has a, æ, l, r, d, t, ð, θ, s, z and r, all of which only contain **A** and no other elements. The number of objects containing only **U** is much smaller, we find u, ʊ, w, v and f.

Let us now return to Estonian. How does the adjunction structure help us here? Our dilemma was that in the case of r we were one point short.

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Suppose we replace the structure of r that we had assumed so far (31a) by the structure in (31b).

(31) a. r (old representation)   b. r (new representation)

$$
\begin{array}{c}
\\
\text{xO} \\
\diagup\;\diagdown \\
\text{x}\qquad \text{xO}\{\mathbf{A}\}
\end{array}
$$

xO$\{\mathbf{A}\}$

That is, r is really an xO$\{\mathbf{A}\}$ licensing an adjunction structure (31b). Notice that this does not mean that (31a) is an illicit structure. It simply means that (31a) is not the representation of r. Nothing in the theory *excludes* (31a), so it must exist: (31a) is a likely candidate as the representation of the tap r.

Under this reanalysis of the structure of r, the representations of *hiir* hiːr 'mouse' and *vurr* vurː 'moustache' will be as follows.

(32)   a. *hiir* hiːr 'mouse' (correct)

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b. *vurr* vurː 'moustache' (correct)

Where we had a simple xO{**A**} before, *i. e.* in (25), we now find an adjunction structure. This gives us exactly the room we need. In (32a) xN_1 m-commands x_2 and x_3, while xO_4 does not m-command anything. This gives us an overlong iː followed by a short r. In (32b) xO_4 m-commands x_3 and x_2, giving us an overlong rːː. The structures in (32) allow us to express the length patterns without any problems.

Note that the structures in (32) also make it possible for us to explain the absence of forms like *hiːr or *vuːrː, *cf.* (24c). With the adjunction structures in (32) we can fall back on the notion of transgression again. The absence of *hiːr (Q2 + Q2) or *vuːr (Q2 + Q2) is entirely parallel to what we saw in the case of AL-constructions, where we noticed the lack of forms like *geːlː (Q2 + Q2), *cf.* (19). We can state yet another observation as in (33).

(33) **Another observation:**

At the end of a *bid*-structure, the maximal projection of a non-projecting xO must be transgressed.

As in the case of AL-constructions, this is only an observation so far. We will see in section 4.3 that there is more general principle that the behaviour of AL-constructions and non-projecting xO's can be subsumed to.[13]

---

[13] From (33) it also follows that a non-projecting onset like j could not occur at the end of *bid*-structures, since j is simply xO{**I**} and could therefore not be transgressed.

In (32a), repeated here as (34), m-command from xN_1 crosses (the higher) xO_4, which is a maximal projection, since it does not project any further.

(34) hiːr 'mouse' (correct, repeated)
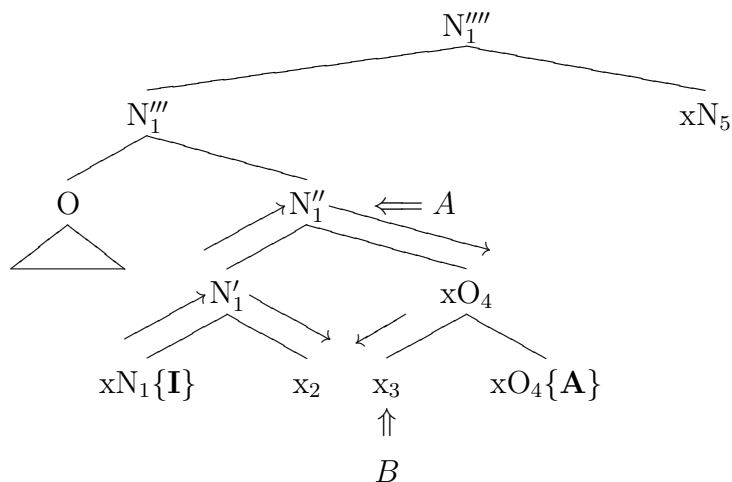
We now have to check whether the condition on transgression is fulfilled. We take N_1'' as our variable A and x_3 as B. A dominates B and a maximal projection, *viz.* the higher xO_4, intervenes between the two. The definition of transgression as per (5) is met.

In (32b), repeated as (35), we also see an m-command relationship crossing the higher xO_4, only this time it comes from the lower $xO_4\{\mathbf{A}\}$.

(35) hiːːr 'mouse' (correct, repeated)

$$N_1'''''$$
$$N_1''' \qquad xN_5$$
$$O \qquad \Rightarrow N_1'' \qquad \Leftarrow A$$
$$\Rightarrow N_1' \qquad xO_4$$
$$xN_1\{\mathbf{I}\} \qquad x_2 \qquad x_3 \qquad xO_4\{\mathbf{A}\}$$
$$\Uparrow$$
$$B$$
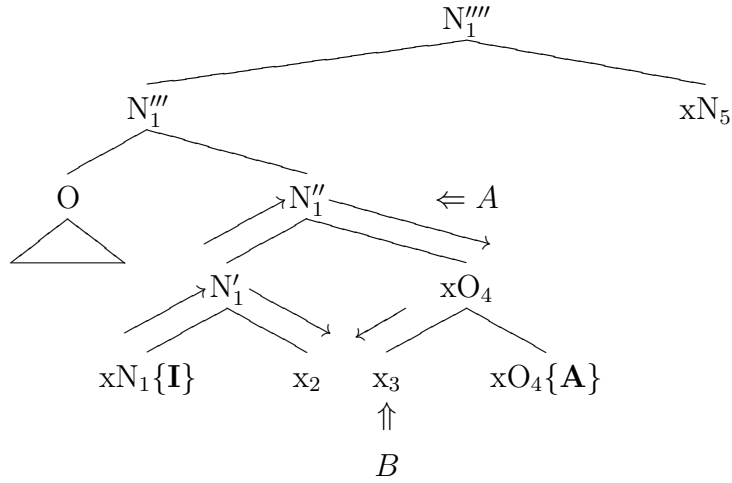
Again, let N_1'' equal A and x_3 B. A dominates B and the maximal projection, the higher xO_4, intervenes. Again we have transgression.

We can now see why *vuːrː is impossible. Its representation is given in (36). A structure as under (36) is disallowed since there is no transgression.

(36) An illicit structure in Estonian: *vuːrː

$$N_1'''''$$
$$N_1''' \qquad xN_5$$
$$O \qquad N_1''$$
$$\Rightarrow N_1' \qquad xO_4$$
$$xN_1\{\mathbf{U}\} \qquad x_2 \qquad x_3 \qquad xO_4\{\mathbf{A}\}$$
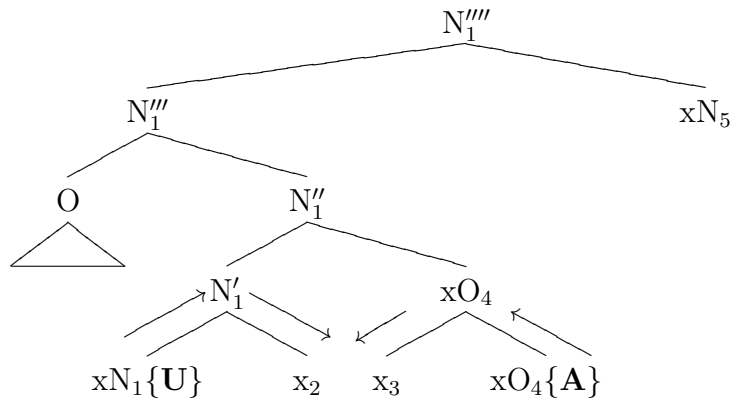
There are no two nodes A and B along the path of either m-command relationship such that (i) A dominates B and (ii) a maximal onset projection

intervenes between *A* and *B*. (36) fails to meet the definition of (5) and is illicit in Estonian.

4.2.3 Two-layered structures

So far we have considered words ending in a double-layered onset structure and r. Let us next turn to words ending in a single-layered structure. Our selection is somewhat restricted here, since Estonian has only v and s—only loans contain f, ʃ or ʒ. In other words, there is a split between v and f: in native words, only v occurs. This is different from s, which can be short, long, or overlong. Here we notice an interesting asymmetry, however:

(37) *moos*   moːːs   'jam'
      poiss poisː   'boy'
      —   *poːsː —
      loss   losːː   'castle'

A long sː can be preceded by what is commonly referred to as a diphthong, but not a long monophthong. Long s can also occur in clusters, *e. g.* in the word *varss* værsː 'foal'. This suggests that the sequence oi in poisː is really a nucleus (o) plus the first part of a cluster i.[14] After nuclear expressions we only find short s and overlong sːː, but no long sː. The structures of moːːs and losːː will be given in a moment.

Let us have a look at final v first, *e. g.* in the word *liiv* liːːv 'sand'. The representation of that domain is given in (38).

---

[14] Many analyses of Estonian use "diphthong" to lump together a large number of different kinds of sequences, which display rather different behaviour. I will not go into an analysis of those so-called "diphthongs" here, as the matter is quite complex and would require elaborate discussion.

(38) *liiv* liːːv 'sand'

$$N_1''''$$

(tree structure for example 38, with nodes)

N_1''' ... xN_5

O ... N_1''

N_1' ... O_4'

$xN_1\{\mathbf{I}\}$ x_2 x_3 $xO_4\{\mathbf{U}\}$
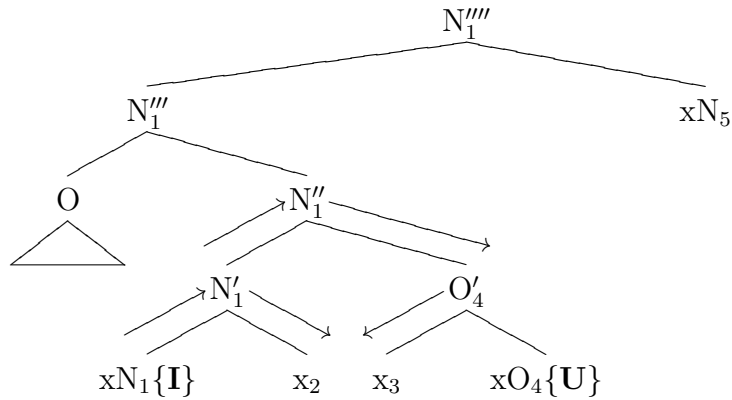
This is of course identical to the representation of the NYC English word *leave* liːːv, which we had seen in the last chapter (example (45c) on p. 124). The onset head xO_4 does not m-command any other points, while xN_1 m-commands x_2 and x_3, giving us an overlong iːː.

What is the structure of s now? So far we have not discussed that question. In order to give an answer, let us look at English, which has t, θ and s. A θ is distributionally very similar to a t, in that both can head a structure commonly referred to as a branching onset, *e. g.* we find *tree* and *three*, *true* and *through*, and neither **tl-* nor **thl-*. This is quite different from *s*: it has been demonstrated that *s*C sequences cannot possibly form branching onsets, *cf. e. g.* the discussion in Kaye (1992). This difference should be reflected in our theory: t and θ should be quite similar to each other and clearly different from s. I assume the following structures for t and θ.

(39) a. t   b. θ

O'' O'

x_1 O' x_1 $xO\{\mathbf{A}\}$

x_2 ← $xO\{\mathbf{A}\}$

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The corresponding lenis structures are given in (40).

(40) a. d

$$O''$$
$$x_1 \quad\quad O'$$
$$x_2 \quad \leftarrow xO\{\mathbf{A}\}$$

b. ð

$$O'$$
$$x_1 \quad\quad xO\{\mathbf{A}\}$$

If (39b) is realised as θ and (40b) as ð, then what kind of a structure do we want to put up for an s? We want to be able to express the difference between a lenis s as in NYC English *his*, a fortis s as in NYC English *hiss*, and a geminate as in Estonian *loss* los::. In section 4.2.2 I proposed that an r is to be represented as in (41a), *i. e.* an adjunction structure. The structure in (41b) is what I have in mind for a lenis s in English *his* and (41c) shows a fortis s.

(41) a. r   b. lenis s c. fortis s

$$xO$$
$$x \quad\quad xO\{\mathbf{A}\}$$

$$O'$$
$$x_2 \quad\quad xO$$
$$x_1 \quad x_2\{\mathbf{A}\}$$

$$O'$$
$$x_2 \quad\quad xO$$
$$x_1 \quad x_2\{\mathbf{A}\}$$

That is, s is an AL-construction, since it is annotated with melody in a non-head position. All the AL-constructions we had seen so far were double-layered, *i. e.* the head xO projects as far as O″, but of course there is nothing in our theory that excludes single-layered AL-constructions, *i. e.* we expect them to exist. In other words, s, which is such a single-layered AL-construction, fills the gap. The difference between fortis and lenis s is again due to m-command relationships. In (41b) xO does not m-command x_1 (lenis), while in (41c) it does (fortis). In the definition of the terms fortis and

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lenis in (18) on p. 70 we said that in a fortis structure the head m-commands the highest unannotated x. In order to be clear about the "highest unannotated x", (42) compares the structure of fortis θ and fortis s.

(42) a. θ b. fortis s

$$O'$$
$$x_1 \qquad xO\{\mathbf{A}\}$$

$$O'$$
$$x_2 \qquad xO$$
$$x_1 \qquad x_2\{\mathbf{A}\}$$

The structure in (42a) is by now self-explanatory. The slot x_1 is the highest unannotated x, so m-command from xO gives us a fortis onset, in this case a θ. Let us now look for the highest unannotated x in (42b). This is clearly x_1. The lower x_2 is annotated with $\mathbf{A}$, *i. e.* it is not unannotated, and the higher x_2 is not a terminal x that could be the target of m-command. Thus, m-command between xO and x_1 is the relationship that gives us a fortis s.

Let us see what this gives us for Estonian. The representation of *moos* moːs is given in (43a), while (43b) shows *loss* losː.

(43)   a. *moos* moːs 'jam'

$$N_1''''$$
$$N_1''' \qquad\qquad xN_6$$
$$O \qquad N_1''$$
$$N_1' \qquad\qquad O_5'$$
$$xN_1\{\mathbf{A}, \mathbf{U}\} \quad x_2 \qquad x_4 \qquad xO_5$$
$$x_3 \qquad x_4\{\mathbf{A}\}$$

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b. *loss* los:: 'castle'

$$
\begin{array}{c}
N_1''''' \\
N_1'''' \quad\quad\quad xN_6 \\
O \quad\quad N_1'' \\
N_1' \quad\quad O_5' \\
xN_1\{\mathbf{A}, \mathbf{U}\} \quad x_2 \quad\quad x_4 \quad\quad xO_5 \\
x_3 \quad x_4\{\mathbf{A}\}
\end{array}
$$

In (43a), the representation of *moos* mo::s 'jam', xN_1 m-commands two x-slots, x_2 and x_3, which gives us an overlong o::. The terminal xO_5, on the other hand, does not m-command any other point. This gives us a short s. In (43b), representing *loss* los:: 'castle', xN_1 does not m-command any x-slots, while xO_5 m-commands both x_2 and x_3. The result is los::.

4.3   The *Libby*-type and the Estonian length alternation

So far we have seen that our model not only allows for a successful analysis of NYC English, but also gives us the tools to make sense of the Estonian length patterns. The two languages are very much alike. In this section I intend to show that the parallels go further than what we have seen up to now.

So far we have talked a fair deal about words of the *bee-* and the *bid-*type, and only mentioned words of the *Libby*-type very briefly. Let us recall what we know about the *Libby*-type from English. In section 3.1 we saw the following differences in the distribution of length between the *bid*-type and the *Libby*-type; the chart in (44) is a repetition of (2) from p. 94.

(44)   a. *bid*-type   b. *Libby*-type

      rub   rʌːb   *rubber*   'rʌbə
      rib   rɪːb   *Libby*   'lɪbi
      men   meːn   *many*   'meni
      big   bɪːɡ   *bigot*   'bɪɡət
      laid   leːːd   *lady*   'leːdi
      leave   liːːv   *beaver*   'biːvə
      league liːːɡ   *beleager* bə'liːɡə

In (44a), the *bid*-type, we find that the domain head can be long (*big* bɪːɡ) or overlong (*laid* leːːd) before a lenis onset. In (44b), the *Libby*-type, we only find short (*bigot* 'bɪɡət) or long domain heads (*lady* 'leːdi), but no overlong ones. That is, English has words like *lady* 'leːdi, but none like *'leːːdi. The reason for this, we argued, was structural. (45) repeats the representation of the word *lady* from (50) on p. 129.

(45)
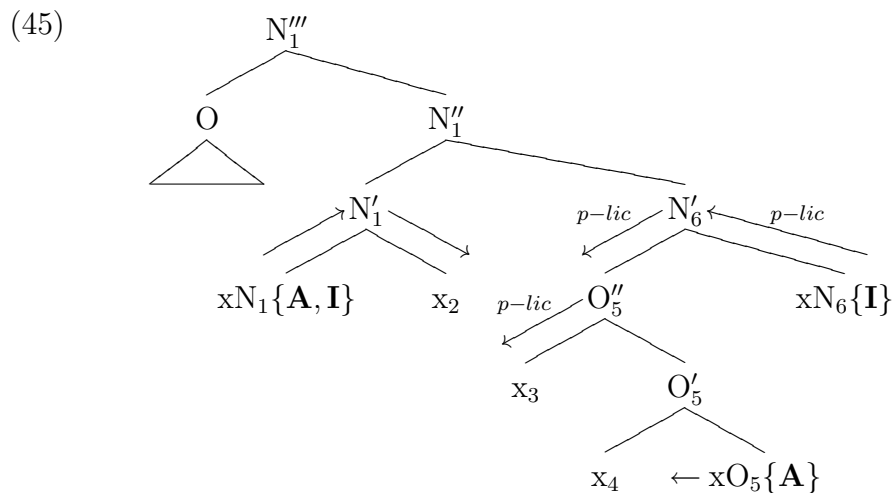
The nuclear head xN_1 cannot m-command x_3, since xN_6 is a closer licenser. In English, xN_6 p-licenses x_3.

Now, so far in this chapter I have argued that English and Estonian are to large extents absolutely identical. What about the *Libby*-type, then? Surely, if English and Estonian are only a variation on the same theme, we should hope to find the same distribution of length as we found for English in (44).

With this in mind, consider the following chart, which contrasts nominatives and genitives in Estonian.

(46)

NOM. SG.			GEN. SG.			gloss
siid	siːːd	Q3 + Q1	*siidi*	Q2 + Q1	siːdiˑ	'silk'
liiv	liːːv	Q3 + Q1	*liiva*	Q2 + Q1	liːvaˑ	'sand'
keel	geːːl	Q3 + Q1	*keele*	Q2 + Q1	geːleˑ	'language'
lood	loːːdʲ	Q3 + Q1	*loodi*	Q2 + Q1	loːdʲiˑ	'plummet'

If we compare *siid* siːːd to *siidi* siːdi, we notice that the domain head in *siid* siːːd is overlong (Q3), while in *siidi* siːdiˑ it is long (Q2). The same holds for all the words in (46): in the form that ends in an empty nucleus we see an overlong domain head (Q3), in the form that ends in a realised nucleus, we find that the domain head is long (Q2). The final nucleus in all the genitive forms is followed by a 'ˑ', which denotes the so-called "half-long vowel", which we have already mentioned on p. 157.

The distribution of length in the domain head is strikingly parallel to what we saw for NYC English. Recall words like *laid* leːːd and *lady* leːdi. In *laid* leːːd the nucleus is overlong, in *lady* leːdi it is long. The environment is the same in both Estonian and English: we get an overlong nucleus if no other realised nucleus follows (Estonian *siid* siːːd, English *laid* leːːd) and a long nucleus if another realised nucleus follows (Estonian *siidi* siːdiˑ, English *lady* leːdi). We have identified yet another parallel between English and Estonian, suggesting once again that the length phenomena we find in the two languages are really just a variation on the same theme.

For English we claimed that this difference in the distribution of length was due to structural properties of the respective domains. The word *laid* has a *bid*-structure, *lady* a *Libby*-structure. Since the Estonian pairs like *siid* siːːd ∼ *siidi* siːdiˑ behave in the same fashion, we can assume that they have the same underlying structures. (47) illustrates this. (The m-command relationship between xN_6 and x_3 in (47b) will be discussed shortly.)

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(47)   a. Estonian *siid* si::d, a *bid*-structure

$$N_1''''$$

$$N_1'''$$ xN_6

O

$$N_1''$$

$$N_1'$$ $$O_5''$$

$xN_1\{\mathbf{I}\}$ x_2 x_3 $$O_5'$$

x_4 $\leftarrow xO_5\{\mathbf{A}\}$

b. Estonian *siidi* si:di·, a *Libby*-structure

$$N_1'''$$

O $$N_1''$$

$$N_1'$$ $$N_6'$$

$xN_1\{\mathbf{I}\}$ x_2 $$O_5''$$ $xN_6\{\mathbf{I}\}$

x_3 $$O_5'$$

x_4 $\leftarrow xO_5\{\mathbf{A}\}$
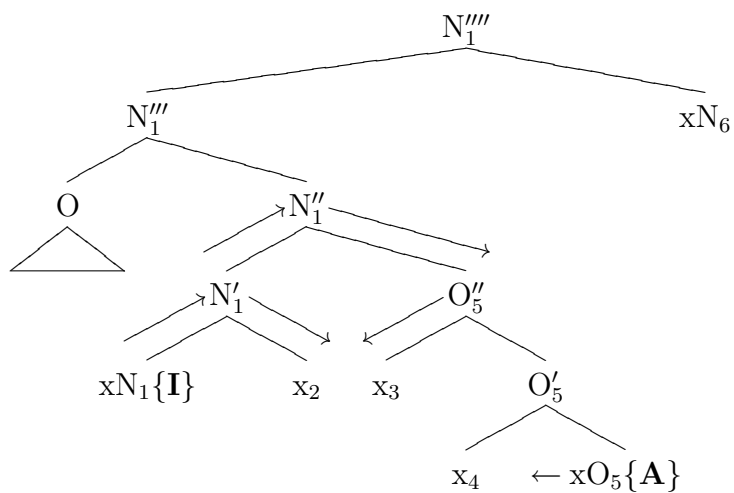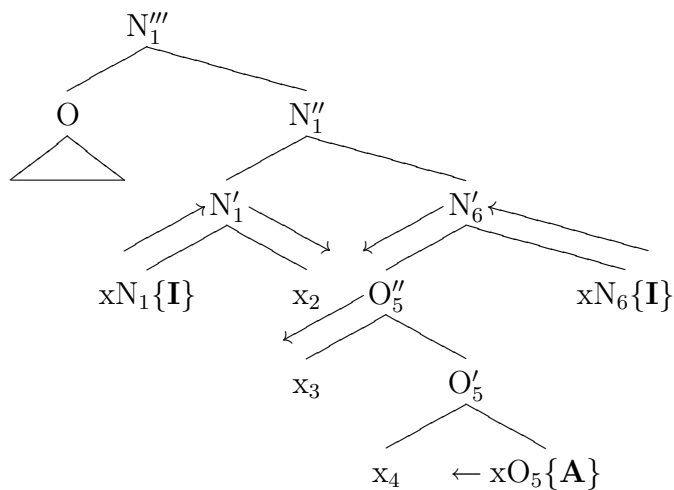
The representation of *siid* si::d (47a) has been discussed before. The structure of *siidi* si:di· (47b) is identical to the one of the NYC English word *lady* given in (45), with only one exception. (48) repeats the structure of *lady* to make the comparison easier.

(48) NYC English *lady* leːdi

$$
\begin{array}{c}
N_1''' \\
\diagup \qquad \diagdown \\
O \qquad\qquad N_1'' \\
\triangle \qquad\qquad \diagup\quad\diagdown \\
\;N_1'\;\qquad\qquad\; N_6' \;\\
xN_1\{\mathbf{A},\mathbf{I}\}\quad x_2 \qquad O_5'' \qquad xN_6\{\mathbf{I}\} \\
x_3 \qquad O_5' \\
x_4 \qquad xO_5\{\mathbf{A}\}
\end{array}
$$

(with labels *p–lic* on the branches to N_6', to O_5'', and to x_3)
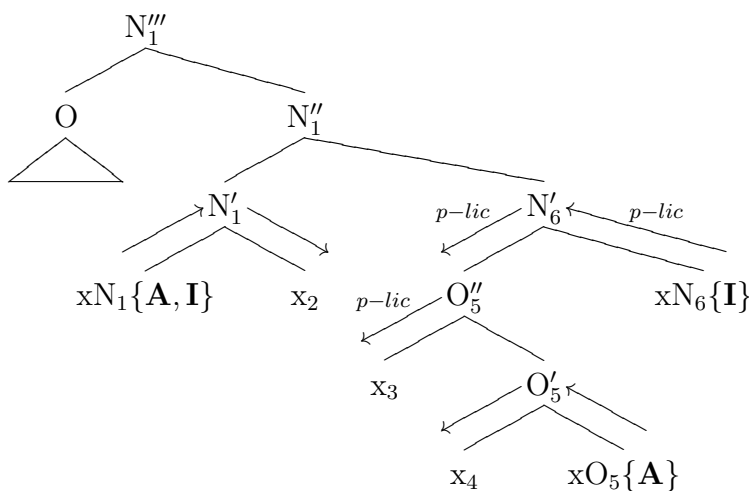
Crucially, the relationship between xN_6 and x_3 in the English example in (48) is one of p-licensing, not of m-command. Let us now turn to (47b). Again, we have a relationship holding between xN_6 and x_3. But unlike in the English case, this relationship is one of m-command. In English, xN_6 p-licenses x_3, while in Estonian xN_6 m-commands x_3. Notice that this serves two purposes. On the one hand, this m-command relationship licenses x_3. On the other hand, it explains another interesting feature of Estonian, *viz.* the so-called "half-long vowel" that has already been mentioned on p. 157.[15] The final iˑ in a word like *siidi* siːdiˑ is clearly longer than the i (Q1) in a word like *pikk* bigː 'long', while clearly shorter than the iː (Q2) in *piik* biːgː 'lance'. (49) gives the representations of those two words.

---

[15] This "half-long vowel" has a long history in Estonian linguistics and has figured quite prominently in a number of analyses of the Estonian length system. It has been the topic of hot debates, dividing scholars into various camps, depending on (i) whether they accept the existence of the half-long vowel or not and (ii) if they do, whether they accept it as "phonologically relevant". Measurements by Eek (1975) or Eek & Meister (1997: 83ff), however, show very clearly that the final nucleus in words like *siidi* siːdiˑ is longer than Q1.

(49)   a. *pikk* big:: 'long'
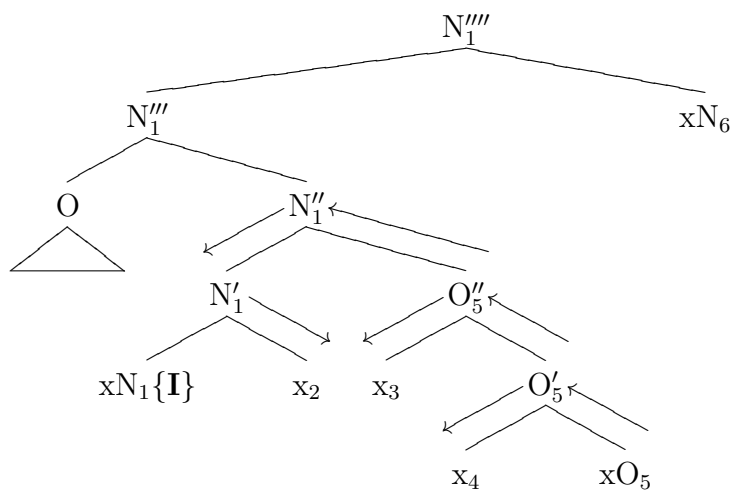
   b. *piik* biːgː 'lance'
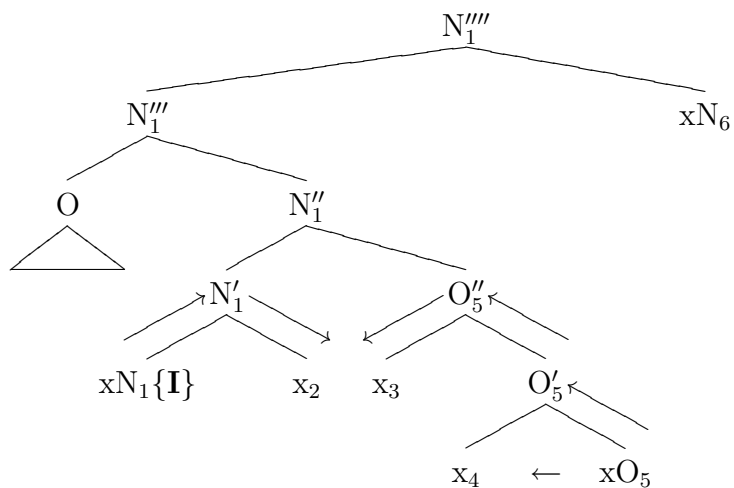
In (49a), xN_1 does not m-command any other point and we get a short i (Q1). In (49b), xN_1 m-commands exactly one point and the interpretation is a long iː (Q2). The final iˑ in *siidi* siːdiˑ is realised as longer than Q1 but as shorter than Q2. Now, obviously we cannot say that the final iˑ in *siidi* siːdiˑ m-commands *half* a point, as this is non-sensical. The difference in duration

then has to be due to other factors. (50) repeats the structure of the genitive *siidi* siːdiˑ one more time.

(50) Estonian *siidi* siːdiˑ, a *Libby*-structure
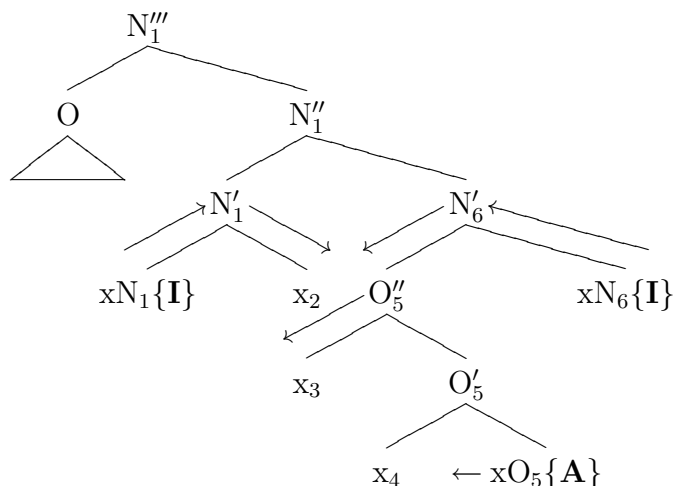
In (50) xN$_6$ m-commands x$_3$, *i. e.* it m-commands exactly one x-slot. The nucleus xN$_1$ in (49b) also m-commands exactly one unannotated x-slot. Still, the iː in (49b) is realised as longer than the final iˑ in (50). The difference in length cannot be due to the number of points involved, but must be due to other factors. One obvious difference between xN$_1$ in (49b) and xN$_6$ in (50) is that xN$_1$ in (49b) is the domain head and receives stress, while xN$_6$ in (50) does not. I will assume that this is the responsible factor for the difference in duration. That is, from the point of view of phonology, both the final iˑ in *siidi* siːdiˑ (50) as well as the iː in *piik* biːgː (49b) are long, since in both cases we are dealing with a nuclear head m-commanding exactly one other point. The difference in duration (iː *vs.* iˑ) is phonologically irrelevant, it is simply a consequence of whether the m-commanding point receives stress or not. The difference in realisation is marked in the transcriptions (with the signs "ː" and "ˑ", respectively). I will refer to a nucleus like xN$_6$ in (50) as "unstressed long".

So far we have seen the structures underlying *siid* siːːd (Q3 + Q1) and the corresponding genitive *siidi* siːdiˑ (Q2 + Q1). The length of the nucleus

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alternates between overlong (Q3) and long (Q2), and the **d** is uanffected, *i. e.* it stays short (Q1). This, as we have seen, is parallel to the English pair *laid* **leːd** (Q3 + Q1) and *lady* **leːdi** (Q2 + Q1). The only difference is that in Estonian the final nucleus m-commands the the highest x of the preceding onset **d**, while in English it p-licenses it. Let us now have another look at two English words we have seen before, *viz. Libby* and *hippie*. The structures of those two words are basically identical (ignoring the initial *l-* in *Libby* or the initial *h-* in *hippie*), the crucial difference lies in the m-command relationships holding within the onset O_4''. The two structures are compared in (51), with the relevant substructure boxed.

(51)   a. *Libby*
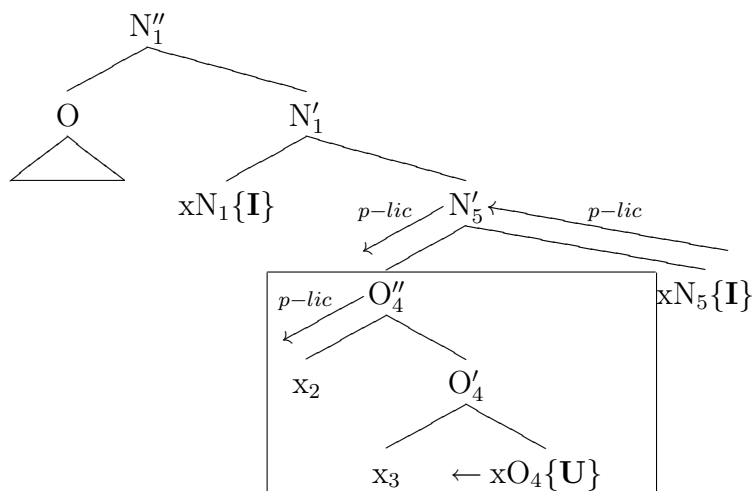
b. *hippie*
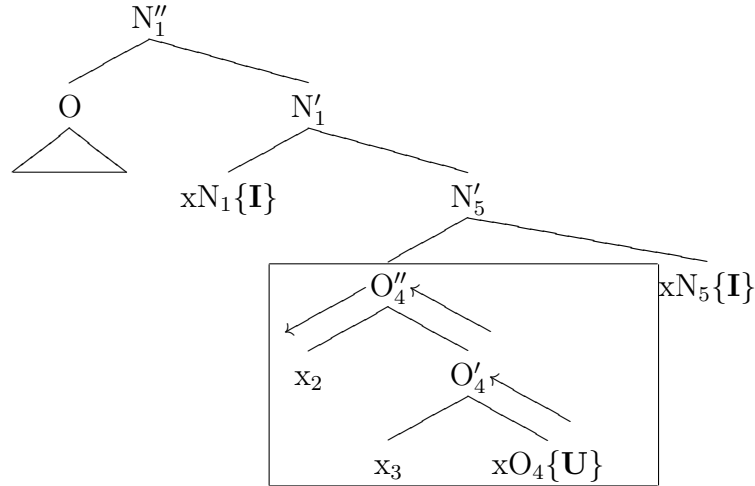
In (51b) x_2 is m-commanded by xO_4, giving us a fortis onset. In (51a), on the other hand, xO_4 does not m-command x_2, which gives us a lenis **b**. The point x_2 is p-licensed by xN_5. What is crucial is that English allows for both lenis and fortis onsets in the position O''_4. Both (51a) and (51b) are licit.

With this in mind, let us have a look at the following Estonian patterns.

(52)

NOM. SG.			GEN. SG.			gloss
kiit	giːd:	Q2 + Q2	*kiidu*	giːduˑ	Q2 + Q1	'praise'
vaat	vaːd:	Q2 + Q2	*vaadi*	vaːdiˑ	Q2 + Q1	'barrel'
kaap	gaːb:	Q2 + Q2	*kaabi*	gaːbiˑ	Q2 + Q1	'cupboard'
taak	daːg:	Q2 + Q2	*taaga*	daːgaˑ	Q2 + Q1	'burden'

All the nominative forms have a Q2 nucleus followed by a Q2 onset. Those structures have been discussed before, *cf.* the representation of *kiit* giːd: in (3), repeated here as (53). As we said in section 4.1, this is absolutely the same structure underlying English words like *beat* biːt.

(53) *kiit* giːdː

$$N_1''''$$

```
                    N_1''''
                   /        \
              N_1'''          xN_6
             /     \
            O       N_1''
           /\      /      \
          /__\    N_1'      O_5''
                 /    \     /    \
            xN_1{I}   x_2  x_3   O_5'
                                 /    \
                                x_4  ← xO_5{A}
```
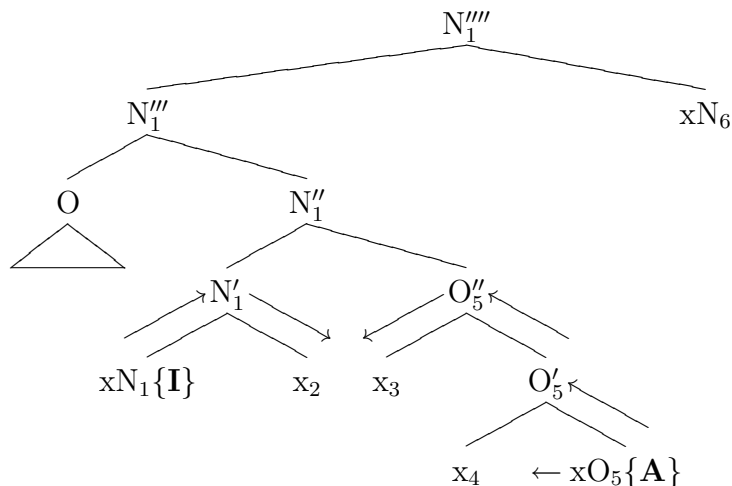
Now let us compare this to the corresponding genitive, which is *kiidu* giːduˑ, with a long iː (Q2) and a short d (Q1). The structure of this form is given in (54).

(54) The genitive *kiidu* giːduˑ

```
              N_1'''
             /      \
            O        N_1''
           /\       /      \
          /__\    N_1'      N_6'
                 /    \     /    \
            xN_1{I}  x_2  O_5''   xN_6{U}
                          /    \
                         x_3   O_5'
                              /    \
                             x_4  ← xO_5{A}
```
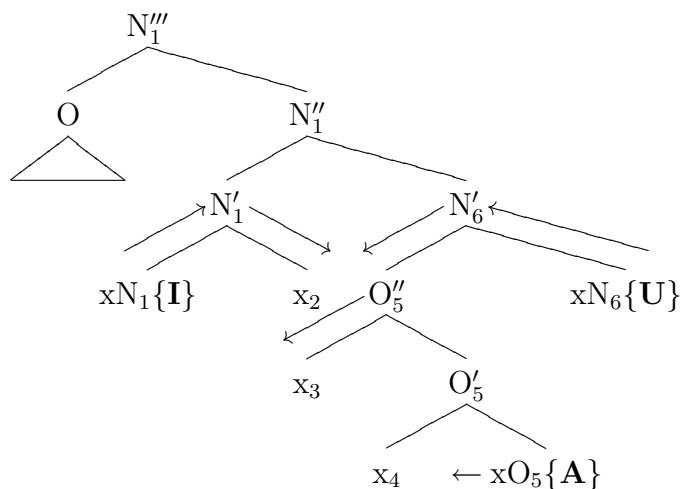
The structure in (54) is of course absolutely identical to that of the genitive form *siidi* siːdiˑ (Q2 + Q1), *cf.* (50). (55) contrasts the nominative and the genitive forms of those two words.

(55)

NOM. SG.			GEN. SG.			gloss
siid	si::d	Q3 + Q1	*siidi*	si:di·	Q2 + Q1	'silk'
kiit	gi:d:	Q2 + Q2	*kiidu*	gi:du·	Q2 + Q1	'praise'

While *kiit* gi:d: allows for a fortis configuration (d:) following the domain head, *kiidu* gi:du· does not. This is not only true of *kiidu* gi:du·, but of all the genitive forms in (52). We always find a short onset following the domain head. Now, what is the difference between *kiit* gi:d: and *kiidu* gi:du·? Clearly the two are very different structurally: *kiit* gi:d: is a structure of the *bid*-type, while *kiidu* gi:du· has a *Libby*-structure. In *bid*-structures we have seen both lenis onsets (*siid* si::d) and fortis onsets (*kiit* gi:d:) following the domain head, while in the *Libby*-structures in (55) we only seem to find lenis onsets following the domain head (both *siidi* si:di· and *kiidu* gi:du·). This is in stark contrast to English, where pairs like *Libby* and *hippie* showed us that the domain head in *Libby*-structures can be followed both by a lenis b and a fortis p. In Estonian on the other hand, the domain head of a *Libby*-structure cannot be followed by a fortis onset. In other words, a structure as the one in (56) is illicit in Estonian.

(56) An illicit structure in Estonian
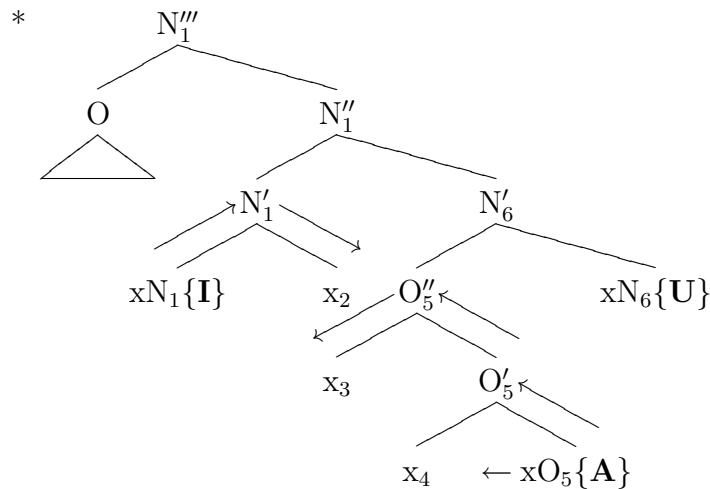
What this means is that Estonian imposes tight restrictions on where fortis structures can occur. In (18) on p. 70 we defined "fortis" as an onset

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where the head xO m-commands exactly one point, *viz.* the highest unannotated x. As we shall see in a moment, Estonian is not only very restrictive in where fortis onsets can occur, but the restriction is even more general. In fact, Estonian imposes tight restrictions on when an xO can m-command the highest unannotated x of the onset projection, irrespective of whether that unannotated x is the *only* point m-commanded by xO or not. What I want to propose is that an xO can only m-command the highest unannotated x of its projection if the onset projection occurs after the domain head of *bid*-type structures.

(57) **M-command of the highest unannotated x:**

In Estonian, an onset head xO can only m-command the highest unannotated x of its projection if the onset projection is a complement to the right of the domain head.

That is, an xO can only m-command the highest unannotated x of the onset projection if it is in the position of the boxed onset in (58).

(58)
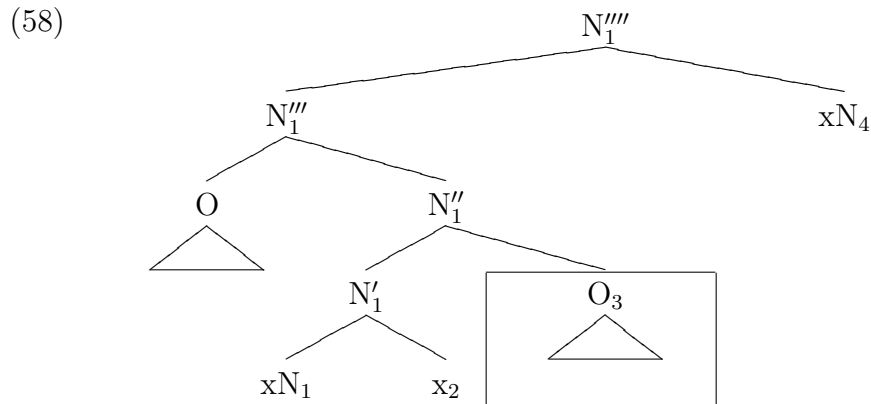
The domain head in (58) expands into a c-expansion as required by (13). In Estonian, an onset head can only m-command the highest x of the projection if it occurs in the position of O_3, which is a complement to the right of the domain head.[16]

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[16] In chapter 6, where we discuss clusters, we will see that instead of x_2 we could also find

Our statement in (57) excludes fortis onsets following the domain head in *Libby*-structures, *cf.* the structure in (56). As we said, a fortis structure is nothing but a special case of an onset head m-commanding the highest x of the projection: it is a special case in the sense that xO does not m-command any other points. In (57), xO_5 m-commands x_3. This point x_3 is the highest x-slot of the onset projection. (57) is illicit, since it violates (57).

The condition in (57) also makes a number of further predictions. One of them is that we should not find fortis onsets *preceding* a domain head (be it the domain head of a *bee-*, *bid-* or *Libby*-structure). This is indeed borne out by the facts: Estonian has words like *tee* deː ‘road’, *pikk* bigː ‘long’ or *kala* galaˑ ‘fish’ etc., but none like *dːeː, *bːigː or *gːalaˑ with initial fortis onsets. A quick look at the structure of an illicit form like *dːeː in (59) makes clear why the form does not exist.

(59) Another illicit structure in Estonian: *dːeː
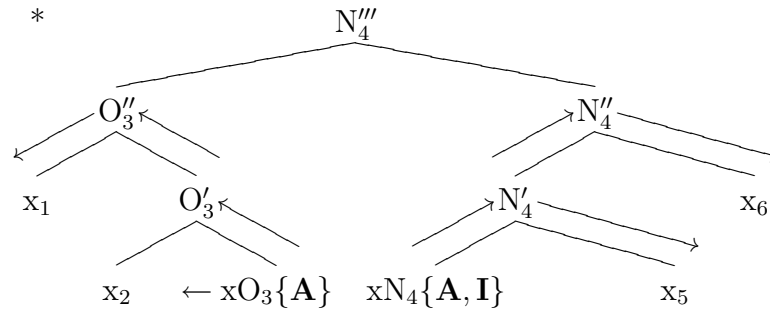
The structure in (59) contains a fortis onset that is not a complement to the right of the domain head. That is, xO_3 m-commands x_1, giving us a fortis dː. This fortis onset is not a complement to the right of the domain head xN_4. Accordingly, a structure as in (59) is ruled out. Again, this is in stark contrast to English. English allows for both fortis and lenis onsets preceding the domain head; recall the words *pea* piː and *bee* piːː, which we discussed in section 3.4. Again we see that Estonian is far more limited in the distribution of fortis onsets than English.[17] This follows from the condition in (57).

_____

a complete onset projection. Following (57), we would expect that in this second onset preceding O_3 the onset head can also m-command the highest x of the projection. However, as we shall see, there are independent principles that exclude such m-command in the first member of a cluster.

So far we have looked at nominatives *siid* siːd (Q3 + Q1) 'silk' and *kiit* giːd (Q2 + Q2) 'praise' and their corresponding genitive forms *siidi* siːdiˑ (Q2 + Q1) and *kiidu* giːduˑ (Q2 + Q1). Let us now look at a word like *jutt* judːː (Q1 + Q3) 'story' and its genitive. (60) gives some examples of that type.

(60)

NOM. SG.			GEN. SG.			gloss
jutt	judːː	Q1 + Q3	*jutu*	judːuˑ	Q1 + Q2	'story'
kepp	gebːː	Q1 + Q3	*kepi*	gebːiˑ	Q1 + Q2	'stick'
kell	gelːː	Q1 + Q3	*kella*	kelːaˑ	Q1 + Q2	'clock'
linn	linːː	Q1 + Q3	*linna*	linːaˑ	Q1 + Q2	'city'
loss	losːː	Q1 + Q3	*lossi*	losːiˑ	Q1 + Q2	'castle'

In the nominative we find a short domain head (Q1) followed by an over-long non-nuclear expression (Q3). In the genitive forms we have a short domain head (Q1) followed by a long non-nuclear expression (Q2). How do we explain this? In fact, what we see in (60) falls out from the principles we have already established. The representation of the nominative was shown in (4), repeated here as (61).

(61) *jutt* judːː 'story' (repeated)

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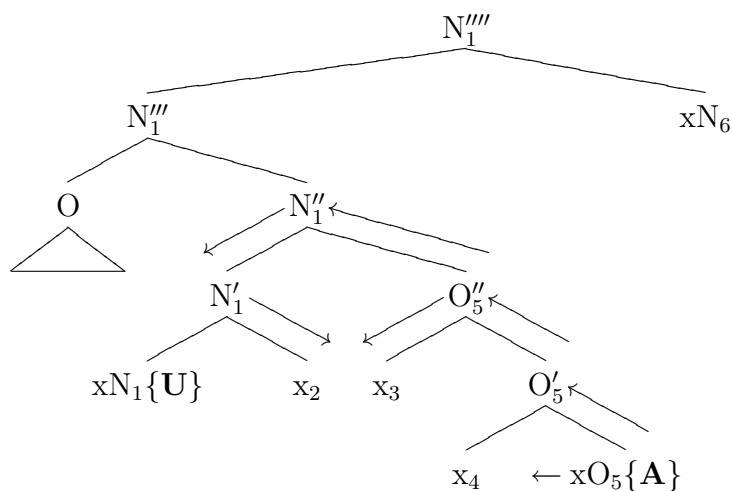
[17] Loans like *faas* faːːs 'phase' with an initial fortis f (as opposed to *vaas* vaːːs 'vase' with a lenis v) violate this generalisation.

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Not much has to be said about this form: xN_1 does not m-command any other points, while the onset head xO_5 m-commands both x_2 and x_3. This gives us a short **u** followed by an overlong **d:**.

(62) presents the genitive, where we see two m-command relationships crossing each other. (In order to keep the two m-command relationships clearly apart, I use a broken arrow to indicate the one between xN_6 and x_3.)

(62) The genitive *jutu* **juːduʔ**
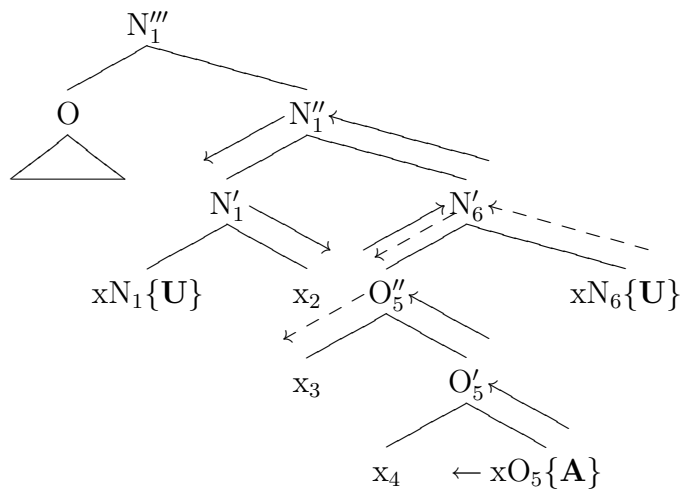
In (62) we are dealing with a structure of the *Libby*-type. The onset O_5'' is not a complement to the right of a domain head in a *bid*-structure. Accordingly, xO_5 cannot m-command x_3, *cf.* (57). However, there is nothing that excludes m-command between xO_5 and x_2, which is exactly what we find in (62). Since x_3 cannot be m-commanded by xO_5, it has to be taken care of by the only other potential licenser: xN_6 has to m-command x_3.[18] In other words, the structure of **juːduʔ** in (62) behaves exactly as we should expect from what we have seen so far. We know that there are tight restrictions on when an onset head can m-command the highest x of the projection; restrictions

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[18] I do not see it as a problem that we have two m-command relationships crossing each other. In the discussion of clusters in chapter 6 we will see further instances of such crossings.

which (62) fails to meet. Accordingly, xO_5 can only m-command one other point, giving us a long d:. What this means is that there a two possibilities for a given non-nuclear expression to be long (Q2). We can either be dealing with a structure as in (62), where an onset head (xO_5) m-commands an unannotated x *outside* its maximal projection (x_2) or with a fortis structure as in a word like *kiit* gi:d:, where an onset head m-commands an unannotated x *within* its maximal projection, *i. e.* a fortis configuration as *e. g.* in (53).

We have seen that Estonian only allows for onset heads to m-command the highest x of the projection only in one particular position. (63) repeats the condition stated in (57).

(63) **M-command of the highest unannotated x (repeated):**

In Estonian, an onset head xO can only m-command the highest unannotated x of its projection if the onset projection is a complement to the right of the domain head.

In sections 4.2.1 and 4.2.2 we had noticed that Estonian has words like *keel* ge::l (Q3 + Q1) 'language, tongue' and *kell* gel:: (Q1 + Q3) 'clock', but no *ge:l (Q2 + Q2), or *hiir* hi::r (Q3 + Q1) 'mouse' and *vurr* vur:: (Q1 + Q3) 'moustache', but no *vu:r (Q2 + Q2) etc. What we are missing is the combination Q2 + Q2, *i. e.* a structure such as the one in (64), which is a repetition of (36).

(64) An illicit structure in Estonian: *vu:r (repeated)

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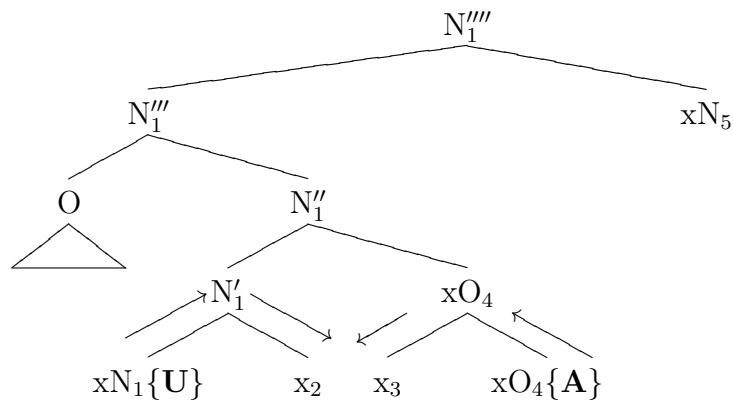
Earlier on we assumed that Estonian requires obligatory transgression for AL-constructions and r. A fortis structure such as the one in (64) would then be disallowed, since the higher xO_4 is not transgressed. However, in the present section we have seen that Estonian is quite "fussy" about fortis onsets, or, more generally: when an xO can m-command the highest x of the projection, as stated in (63).

What this suggests is that the reason for why (36) is illicit does not lie in conditions on transgression, but rather in conditions on what x_3 (the highest unannotated x in the projection) can be m-commanded by. According to (63) we have no reason to assume that a structure as in (64) is disallowed. In (64), the onset xO_4 is exactly in the position where fortis onsets should be possible, *i. e.* it is a complement to the right of the domain head, but still the r cannot be fortis (*vuːr:). The condition in (63) by itself will not do. How can we then exclude forms like *vuːr: etc., if we want to exploit the special status of the highest x-slot of an onset projection that we have seen in this section?

What I want to propose is the condition in (65).

(65) **Fortis onsets in Estonian:**

In Estonian, an onset head xO can only be fortis *iff* the onset projection is a double-layered projection with no melody in non-head positions.

Let us have a careful look at this. The condition in (63) has already restricted the possibilities of having an onset head xO m-command the highest x of the projection. As we have seen, what this means is that *only* following the domain head of a *bid*-structure do we have the full range, *i. e.* lenis onsets (*siid* siːd), fortis onsets (*kiit* kiːd:) and geminates (*jutt* jud::). The condition in (65) now imposes further restrictions, by cutting back *fortis* structures, *i. e.* structures where xO m-commands *exactly one* point, and that point is the highest x of the projection, *cf.* the definition of fortis in (18) on p. 70.

Following (65), an onset can only be fortis if the projection is double-layered and there is no melody in non-head positions. This excludes non-projecting onsets (like r) and single-layered projections right away. As we saw in section 4.2.3, Estonian does not have many single-layered onset projections. In native words we only find v (which only occurs in its lenis form

anyway) and *s*: we have already noticed in (37) that Estonian has words like *moos* moːːs (Q3 + Q1) 'jam' and *loss* losːː (Q1 + Q3) 'castle', but no *loːsː (Q2 + Q2). In other words, excluding single-layered onset projections is justified.[19]

(65b) also successfully excludes *keːl or *keːnː. Even though *l*, *n* etc. are double-layered projections, they contain melody in non-head position (*cf.* section 2.3.3). In other words, the only objects we are left with are bː, dː, dʲː and gː.

Let us take stock at this point. (66) sums up the structures we have discussed so far in this section.

(66)	NOM. SG.			GEN. SG.			gloss
	siid	siːːd	Q3 + Q1	*siidi*	siːdiˑ	Q2 + Q1	'silk'
	kiit	giːdː	Q2 + Q2	*kiidu*	giːduˑ	Q2 + Q1	'praise'
	jutt	judːː	Q1 + Q3	*jutu*	judːuˑ	Q1 + Q2	'story'

In all the words in (66) the distribution of length in the nominative is different from the distribution in the genitive. In the nominative forms we always have a total of four points that have to be distributed between nucleus and onset (Q3 + Q1 or Q2 + Q2 or Q1 + Q3), while in the genitive we only have three (Q2 + Q1 or Q1 + Q2). We have shown that this difference is a consequence of the underlying structure and can to a certain extent also be found in English.

In the literature on Estonian this phenomenon forms part of what is usually called **gradation**.[20] The term gradation is unfortunately used to

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[19] There is one complication, however: While fortis sː does not occur after long nuclear expressions (*loːsː), it does occur as the second member in clusters, *e. g. varss* værsː 'foal', and after what is commonly referred to as diphthongs, *e. g. poiss* poisː 'boy' (on the insuffiency of the term diphthong *cf.* footnote 14 on p. 172). As we shall see in chapter 6, the role of *s* in clusters is still somewhat unclear. Further research will hopefully shed some light on why fortis sː can occur in clusters, but not after long nuclear expressions. Furthermore, Estonian has a number of loans with fortis *f*, *e. g. graaf* graːfː, which clearly violates (65), *cf.* also fn. 17 on p. 189. If one wanted to include them, the wording of (65) would have to be changed from "double-layered projections with no melody in non-head positions" to "single- or double-layered projections with no melody in non-head positions". This would include fortis *f*, but still exclude sː, as it has melody in a non-head position.

lump together a range of alternations, most of which have nothing to do with regular phonological phenomena such as the ones we have looked at so far. For example, the word *sõda* sɜda· 'war' has the genitive *sõja* sɜja·. This is usually seen as a case of gradation. The alternation between d and j is of course *not* phonological, it is a completely idiosyncratic property of the word *sõda*. A reasonably similar word like *häda* hæda· 'trouble, need' has a genitive *häda* hæda· (*i. e.* identical to the nominative), where no gradation occurs. While the changes in the distribution of length (usually called "quantitative" gradation) in the words in (66) are perfectly predictable, exceptionless and occur in quite similar fashion in English, the alternation between d and j (an example of "qualitative" gradation) is unpredictable, morphologised and restricted to Estonian (and related languages like Finnish or Sámi). As another example, let us take the word *haab* haːːb 'asp NOM. SG.' ∼ *haava* haːva· 'id. GEN. SG.' The alternation between b and v (qualitative gradation) is unpredictable, while the length of the nucleus in the nominative and the genitive is perfectly regular.

The approach presented in this dissertation makes a clear distinction: while the distribution of length in (66) follows from principles of the theory, alternations like the one between d and j or b and v are not treated as part of phonology, but belong to the morphology of the language. Furthermore, the condition on when an onset head xO can m-command the highest unannotated x of its projection allows us to kill two birds with one stone: (i) we can predict the distribution of length in the word pairs in (66) and (ii) we can explain the lack of initial fortis onsets in Estonian, *cf.* (59). To the best of my knowledge, no such link has been established before.

There is one last issue that we have to turn to in this context. In section 3.4 we discussed structures of the *bee*-type. (67a) repeats the representation of English *bee* biːː from (63) on p. 138. (67b–c) give the Estonian words *tee* deːː (Q3) 'road' and *öö* øːː (Q3) 'night', respectively.

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[20] The details of gradation can be found in any grammar of Estonian, *e. g.* Hasselblatt (1992): Jänes (1971): Raun & Saareste (1965): Tauli (1973b). More detailed discussions can be found in Hint (1997a), in particular Hint (1991).

(67)   a. *bee* bi꞉꞉ (repeated)

$$p\text{-}lic \;-\,-\,-\; N_4''' \leftarrow\,-\,-\,-\; p\text{-}lic$$

$$p\text{-}lic \;\; O_3''$$

$$p\text{-}lic \;\nearrow\; N_4''$$

$$x_1 \qquad O_3' \qquad\qquad p\text{-}lic \;\nearrow\; N_4' \qquad\qquad x_6$$

$$x_2 \quad \leftarrow \quad xO_3\{\mathbf{U}\} \quad xN_4\{\mathbf{I}\} \qquad\qquad x_5$$

b. Estonian *tee* de꞉꞉ (Q3) 'road'

$$p\text{-}lic \;-\,-\,-\; N_4''' \leftarrow\,-\,-\,-\; p\text{-}lic$$

$$p\text{-}lic \;\; O_3''$$

$$p\text{-}lic \;\nearrow\; N_4''$$

$$x_1 \qquad O_3' \qquad\qquad p\text{-}lic \;\nearrow\; N_4' \qquad\qquad x_6$$

$$x_2 \quad \leftarrow \quad xO_3\{\mathbf{A}\} \quad xN_4\{\mathbf{A}, \mathbf{I}\} \qquad\qquad x_5$$
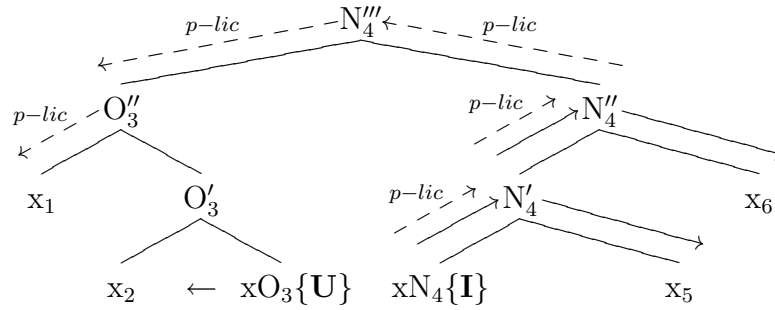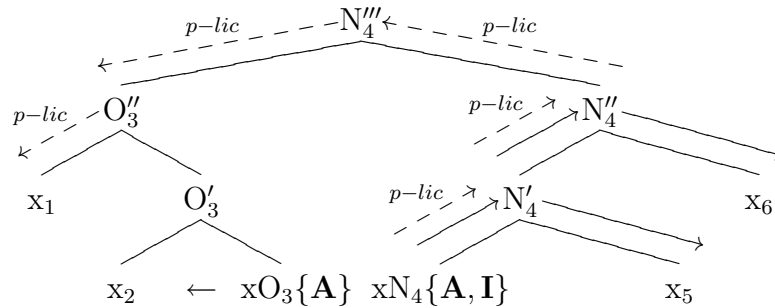
c. Estonian *öö* ø꞉꞉ (Q3) 'night'

$$N_2''$$

$$N_2' \qquad\qquad x_4$$

$$xN_2\{\mathbf{A}, \mathbf{U}, \mathbf{I}\} \qquad\qquad x_3$$
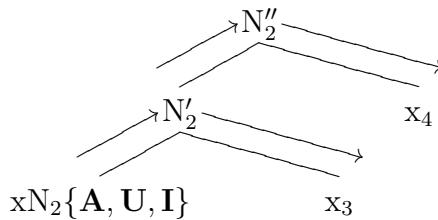
The initial onsets in (67a–b) are both lenis. In Estonian the onset could
not be fortis due to its position, in English it is a lexical property of the word
bee that it begins with a lenis b. We said in section 3.4 that in English (67a)
the position x_1 is p-licensed by xN_4. The same must be true of Estonian; it is

clear that the the relationship between xN_4 and x_1 in (67b) cannot be one of m-command, but p-licensing. If it were m-command, the nuclear expression in (67b) should be longer than the one in (67c), since in (67b) would m-command one point more (*viz.* x_1) than in (67c), where there is no onset at all. Since the nuclear expression are of equal length in (67b) and (67c), we must conclude that in both English (67a) and Estonian (67b) x_1 is p-licensed by xN_4. The two languages behave alike in this respect.

Having said that, let us now consider onsets in internal position. (68) repeats the structures of English *Libby* (51a) and Estonian *siidi* si:di· (50).

(68)   a. *Libby* (repeated)

b. Estonian *siidi* si:di˙, a *Libby*-structure (repeated)

$$N_1'''$$

O $\quad$ N_1''

$\nearrow N_1' \qquad N_6' \nwarrow$

$xN_1\{\mathbf{I}\} \qquad x_2 \quad O_5'' \qquad xN_6\{\mathbf{I}\}$

$x_3 \qquad O_5'$

$x_4 \qquad \leftarrow xO_5\{\mathbf{A}\}$
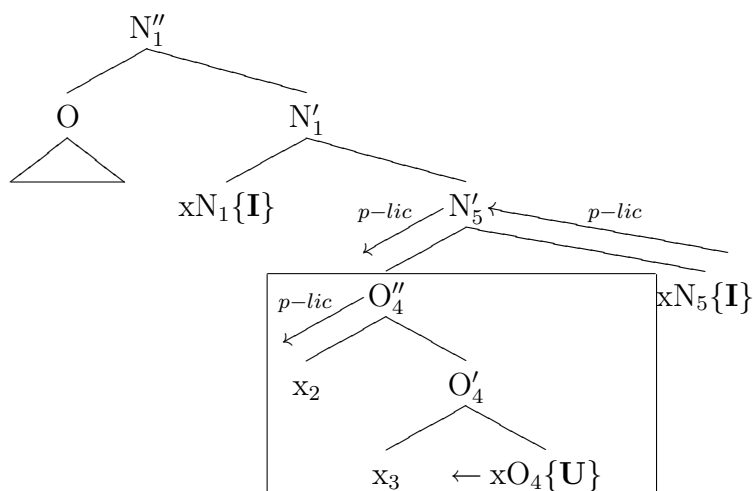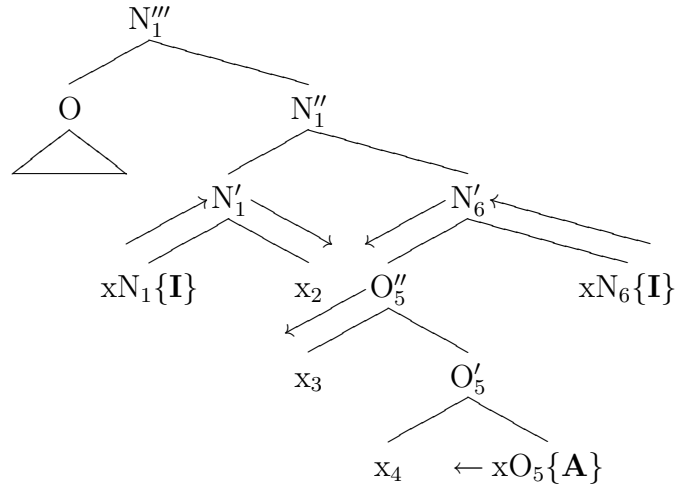
Here we notice a clear difference between the two languages. While in English x_2 is p-licensed by xN_5 (68a), the relationship holding between x_3 and xN_6 (68b) is one of m-command. The question now is *why* things should be that way. Why does Estonian opt for m-command, while in English the relevant relationship is one of p-licensing? Notice that in both cases the licenser (xN_5 in English, xN_6 in Estonian) is in unstressed position. Now, one other crucial difference that sets English and Estonian apart with respect to unstressed positions is that English has vowel reduction, while Estonian does not. A short, unstressed nucleus in English can only be a schwa ə or ɨ, neither of which can occur in stressed position. We observe a complementary distribution. In Estonian on the other hand, no reduction occurs. It is true that the set of expressions that can occur in unstressed position (a, e, i, u and marginally o) is a proper subset of the expressions that can occur in stressed position (a, e, i, o, u, æ, œ, y, ɜ), but there is no (qualitative) reduction. This difference between reduction *vs.* lack of reduction might well be the reason for the choice between p-licensing and m-command. One could stipulate that an unstressed nucleus can only m-command if it is not subject to reduction. At this point it is still unclear, however, why such a link would exist. Understanding the properties of reduced nuclei clearly requires a more elaborate theory of melody. It is to be hoped that future research will give more insightful answers to those questions.

4.4   Morphology and an apparent problem

It is now time to say a couple of words about the relationship between the nominatives and genitives discussed in the previous sections. In what way are they related? I claim that in the case of genitives we are dealing with non-analytic morphology in the sense of Kaye (1995).[21] That is, in a word like *siidi* siːdiˑ we can identify a genitive ending (the final iˑ), but for phonology such a form is simply one domain with no internal structure. Phonology does not *see* that *siidi* siːdiˑ contains a root and a suffix. For phonology, *siidi* siːdiˑ is an unanalysable domain, just like the nominative *siid* siːːd is. The two forms are certainly related by word-formation rules, but those word-formation rules are part of the morphology, and have nothing to do with phonology. There is no phonological operation that takes *siid* siːːd to *siidi* siːdiˑ or vice versa. Both of them are domains in their own right. Phonology treats the two as unrelated; they come out of the lexicon as ready-made structures. That is, there is no phonological operation that changes a *bid*-structure to a *Libby*-structure or the other way round.

Estonian has more to offer than just nominatives and genitives. Let us have a look at yet another case form, the partitive singular, which will present us with another important detail of the Estonian length system. The chart in (69) repeats the tables of (46), (52) and (60) and adds on the corresponding partitive singular forms.[22]

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[21]   We will discuss the difference between analytic and non-analytic morphology in more detail in the following chapter.

[22]   (60) also contains the word *keel* geːːl, genitive *keele* geːle. It belongs to a different inflectional class than the other words and has the partitive form *keelt* geːːldː. Due to this difference it is not included in the table.

(69)

	NOM. SG.		GEN. SG.		PAR. SG.		gloss
a.							
	siid		*siidi*		*siidi*		'silk'
	siːːd	Q3 + Q1	siːdiˑ	Q2 + Q1	siːːdi	Q3 + Q1	
	liiv		*liiva*		*liiva*		'sand'
	liːːv	Q3 + Q1	liːvaˑ	Q2 + Q1	liːːva	Q3 + Q1	
	lood		*loodi;*		*loodi*		'plummet'
	loːːdʲ	Q3 + Q1	loːdʲi	Q2 + Q1	loːːdʲi	Q3 + Q1	
b.							
	kiit		*kiidu*		*kiitu*		'praise'
	giːdː	Q2 + Q2	giːduˑ	Q2 + Q1	giːdːu	Q2 + Q2	
	vaat		*vaadi*		*vaati*		'barrel'
	vaːdː	Q2 + Q2	vaːdiˑ	Q2 + Q1	vaːdːi	Q2 + Q2	
	kaap		*kaabi*		*kaapi*		'cupboard'
	gaːbː	Q2 + Q2	gaːbiˑ	Q2 + Q1	gaːbːi	Q2 + Q2	
	taak		*taaga*		*taaka*		'burden'
	daːgː	Q2 + Q2	daːgaˑ	Q2 + Q1	daːgːa	Q2 + Q2	
c.							
	jutt		*jutu*		*juttu*		'story'
	judːː	Q1 + Q3	judːu	Q1 + Q2	judːːu	Q1 + Q3	
	kepp		*kepi*		*keppi*		'stick'
	gebːː	Q1 + Q3	gebːiˑ	Q1 + Q2	gebːːi	Q1 + Q3	
	kell		*kella*		*kella*		'clock'
	gelːː	Q1 + Q3	kelːaˑ	Q1 + Q2	kelːːa	Q1 + Q3	
	linn		*linna*		*linna*		'city'
	linːː	Q1 + Q3	linːaˑ	Q1 + Q2	linːːa	Q1 + Q3	
	loss		*lossi*		*lossi*		'castle'
	losːː	Q1 + Q3	losːiˑ	Q1 + Q2	losːːi	Q1 + Q3	

What structure underlies the partitives in the chart in (69)? Can they be *Libby*-structures? Let us take a partitive like *siidi* siːːdi (Q3 + Q1) and

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compare it to the genitive. The partitive has an overlong i:: (Q3), while the genitive *siidi* si:di˙ only has a long i: (Q2). (70), which is a repetition of (47b), puts up the structure of the genitive form again, of which we know that it is a *Libby*-structure.

(70) Estonian *siidi* si:di˙, a *Libby*-structure (repeated)

$$N_1'''$$

O N_1''

N_1' N_6'

$xN_1\{\mathbf{I}\}$ x_2 O_5'' $xN_6\{\mathbf{I}\}$

x_3 O_5'

x_4 $\leftarrow$ $xO_5\{\mathbf{A}\}$
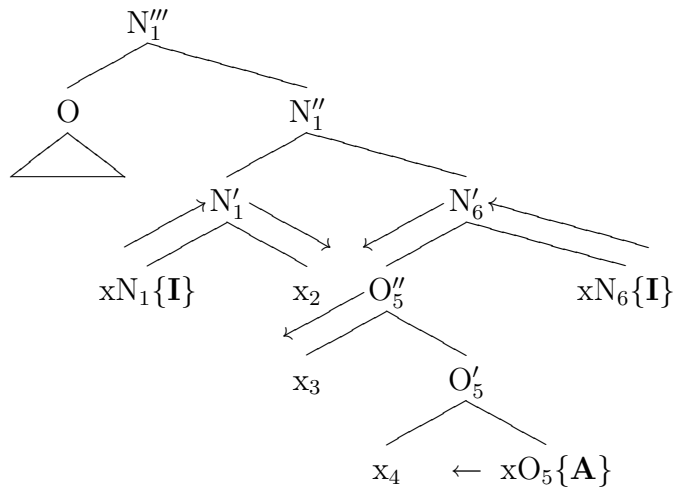
As we have said before, xN_6 m-commands x_3. The node x_3 could not be m-commanded by xN_1 since xN_6 is a closer licenser than xN_1, *cf.* the definition in (58) on p. 134. The nuclear head xN_1 only m-commands x_2, which gives us a long i: in *siidi* si:di˙. That means, in a *Libby*-structure as in (70) we could never get an overlong i::. The domain head in (70) expands into a c-expansion, *i. e.* we have already reached the maximum number of nuclear projections. That is, we could not have another nuclear projection between, say, N_1' and N_1'' to provide room for an overlong i:: in the partitive form. In other words, none of the partitive forms in (69) can be of the *Libby*-type.

Basically what we want to say is that the partitive is absolutely identical to the nominative with the suffix added on. That is, *siid* si::d differs from *siidi* si::di only in that the partitive has a suffix -i, while the nominative does not. The domain head is overlong in both the nominative and the partitive. We know of the nominative that it is of the *bid*-type. If it is correct that the partitive is like the nominative plus a suffix, we must conclude that the

partitive is of the *bid*-type as well. The structure of the nominative *siid* si::d was given in (47a) and is repeated here as (71).

(71) Estonian *siid* si::d, a *bid*-structure
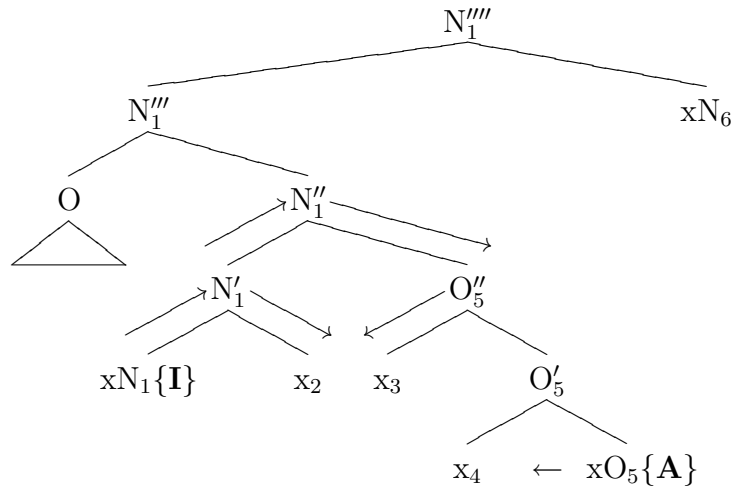
In this structure xN_1 can m-command both x_2 and x_3 without any problems. The result is an overlong i::. The representation we want for the partitive should be as similar to the structure in (71) as possible, ideally it should be identical. So let us assume that the structure of the partitive is identical to that of the nominative given in (71). Where do we put the suffix of the partitive, *i. e.* the final -i of *siidi* si::di? Can we argue that it is in xN_6 as shown in (72)?

(72) The partitive *siidi* si::di?

$$N_1''''$$

Tree diagram:
- N_1'''' branches to N_1''' and $xN_6\{\mathbf{I}\}$
- N_1''' branches to O (triangle) and N_1''
- N_1'' branches to N_1' and O_5''
- N_1' branches to $xN_1\{\mathbf{I}\}$ and x_2
- O_5'' branches to x_3 and O_5'
- O_5' branches to x_4 and $\leftarrow xO_5\{\mathbf{A}\}$
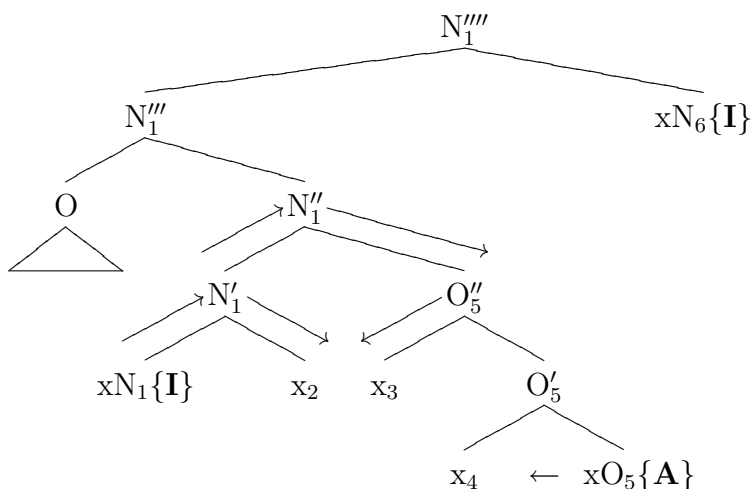
This would allow us to have xN_1 m-commanding x_2 and x_3. At the same time this explains another thing: xN_6 does not have any unannotated x's it could govern. That means that we should get a length difference in the final nucleus between the partitive *siidi* si::di and the genitive *siidi* si:di·. This is indeed correct. The final i in the partitive is shorter than in the genitive.

The question of course is: *can* we have a structure as in (72), where xN_6 is filled? So far, all the instances of a *bid*-structure as in (72) involved a final *empty* nucleus that was p-licensed by its position. In (72) the final xN_6 is annotated with melody, unlike anything else we have seen before.

What I want to claim is that in Estonian, *bid*-structures as under (72), where the final nucleus is not p-licensed but annotated with melody, are possible. However, they can only arise as the result of analytic morphology. I will argue that the partitive form *siidi* si::di consists of two domains, *i. e.* it is [[*siid*]*i*]. This makes it crucially different from the genitive, which, as we had said, involves non-analytic morphology. The morphological structure of the three case forms we have looked at so far is as follows.

(73) NOMINATIVE SG.   [si::d]
      GENITIVE SG.   [si:di·]
      PARTITIVE SG.   [[si::d]i]

The nominative has no suffix, it is simply [si::d]. The genitive has a suffix, *-i*, but this suffix is of the non-analytic kind. The partitive also has a suffix *-i*, but this suffix is analytic. To understand the implications of this claim, we will have to have a closer look at analytic morphology. This is the topic we turn to in the next chapter.

4.5 Summary

In this chapter we discussed the basic patterns of the distribution of length in Estonian and saw that English and Estonian are in large areas identical. We saw that the difference between the *bid*-type and the *Libby*-type is crucial for the distribution of length in Estonian, just like in English. We introduced the notion of transgression as well as the concept of adjunction. We re-evaluated the role of **A** and concluded that it is the crucial ingredient licensing adjunction. Furthermore, we discussed the restrictions that Estonian imposes on onset heads, *i.e.* when they can m-command the highest unannotated x. At the end of the chapter we had a first look at the role of morphology, which will occupy us throughout the following chapter.

Chapter 5

Analytic morphology

In the last chapter we saw that there are strong parallels between English and Estonian. As I am going to show in this chapter, there is one important difference, though, that has to do with analytic morphology.[1] Section 5.1 takes up the discussion from the last chapter. In section 5.2 we will discuss the notion of concatenation and have a closer look at analytic and non-analytic morphology in Estonian and the role it plays in the distribution of length. Section 5.3 discusses an important difference between English and Estonian as regards analytic morphology and section 5.4 demonstrates how the present model can be applied to Italian.

5.1   Analytic morphology in Estonian

At the end of the last chapter we saw that there is crucial a difference between the genitive and partitive forms of words as under (1).

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[1] The notions of analytic and non-analytic morphology go back to Kaye (1995).

(1)

	NOM. SG.		GEN. SG.		PAR. SG.		gloss
a.	*siid*		*siidi*		*siidi*		'silk'
	siːːd	Q3 + Q1	siːdiˑ	Q2 + Q1	siːːdi	Q3 + Q1	
b.	*kiit*		*kiidu*		*kiitu*		'praise'
	giːdː	Q2 + Q2	giːduˑ	Q2 + Q1	giːdːu	Q2 + Q2	
c.	*jutt*		*jutu*		*juttu*		'story'
	judːː	Q1 + Q3	judːuˑ	Q1 + Q2	judːːu	Q1 + Q3	

We said that the phonological shape of the partitive is like the phonological shape of the nominative, with a suffix added on. That is, if we take **siːːd** (the nominative) and simply add on the suffix -i, we get **siːːdi** (the partitive). Nothing else has to be said. This suggests that the partitive suffix is analytic. Things are different with the nominative and the genitive, however, where we notice a length alternation in the root. In the nominative **siːːd** we find an overlong iːː, in the genitive **siːdi** a long iː. We can identify a suffix in the genitive, too, but that suffix is of the non-analytic kind. The same holds for all the words in (1): the partitive is analytic, the genitive is non-analytic.[2] The chart in (2) sums this up.

(2)
NOMINATIVE SG.	$[\,\text{siːːd}\,]$	$[\,\text{siːdː}\,]$	$[\,\text{judːː}\,]$
GENITIVE SG.	$[\,\text{siːd} + \text{iˑ}\,]$	$[\,\text{kiːd} + \text{uˑ}\,]$	$[\,\text{judː} + \text{uˑ}\,]$
PARTITIVE SG.	$[\,[\,\text{siːːd}\,]\text{i}\,]$	$[\,[\,\text{kiːdː}\,]\text{u}\,]$	$[\,[\,\text{judːː}\,]\text{u}\,]$

Let us now move to the technical machinery we will need in order to deal with morphologically complex forms.

5.2   Concatenation

A model of the phonology-morphology interface for Standard GP was presented in Kaye (1995). Kaye introduces two functions, $\varphi()$ and concat(). The

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[2] I concentrate on those few case forms here, but of course the morphological system of Estonian is much richer. What we say about nominative, genitive and partitive can be extended to all other forms, however. The only distinction that is of importance to us is whether we are dealing with analytic or non-analytic morphology. Note also that the equations genitive = non-analytic, partitive = analytic hold for the particular inflectional class the words in (1) belong to. The distribution of analytic/non-analytic morphology is different in other inflectional classes.

former, $\varphi()$, is to be understood as "do phonology", the latter, concat() as "concatenate arguments". The function $\varphi()$ takes one argument, while concat() takes two (which I will separate by commas, as is customary). The bracket notation we gave in (2) is basically an abbreviation. The nominative [si::d] translates as $\varphi($si::d$)$, *i.e.* a simple application of $\varphi()$. In the genitive [si:di·] we first have a concatenation of stem and suffix, followed by the application of $\varphi()$, *i.e.* $\varphi(\text{concat}(\text{si:d}, \text{i·}))$. Last but not least, the partitive form [[jud::]u] represents $\varphi(\text{concat}(\varphi(\text{jud::}), \text{u}))$. In plain language, this translates as follows: do phonology to the inner domain (jud::), concatenate the result with the suffix u, and apply phonology to the result of that concatenation.

Kaye's (1995) original definition of concat() is that it "takes two arguments which are strings and returns the string which results from concatenating the second argument to the first". In the present theory "strings" will have to be replaced by "trees": we no longer concatenate strings, but trees. One of the arguments (*i.e.* one of the trees) will take the other one as a complement and project. That means that one of the two trees involved in concatenation will have to be head tree, *i.e.* the tree that projects to a higher node. In order to distinguish this modified concatenation function from Kaye's original one, I will refer to the modified version as tconcat() (short for <u>t</u>ree <u>concat</u>enation). The definition is given in (3).

(3) **tconcat()**:

    a. tconcat() merges two trees: one tree (the head tree) takes another tree (the complement tree) as its complement and projects.

    b. If a p-licensed xN is followed by another xN, then the first xN is removed from the structure.

All examples of analytic morphology we are going to deal with here will be of the type [[A]B], in which case A, contained in the innermost domain, takes over the role of the head tree, and B the role of the complement tree.

With these preliminaries out of the way, let us now come to back to the Estonian partitive forms. Let us take *juttu* $\varphi(\text{tconcat}(\varphi(\text{jud::}) \, \text{u}))$ with an overlong d:: (Q3). (4), a repetition of (4) on p. 148, gives the base *jutt-* jud::, which is identical to the nominative.

(4) *jutt-* jud::

$$N_1''''$$

$$N_1''' \qquad\qquad xN_6$$

$$O \qquad N_1''$$

$$N_1' \qquad\qquad O_5''$$

$$xN_1\{\mathbf{U}\} \qquad x_2 \qquad x_3 \qquad O_5'$$

$$x_4 \qquad \leftarrow xO_5\{\mathbf{A}\}$$
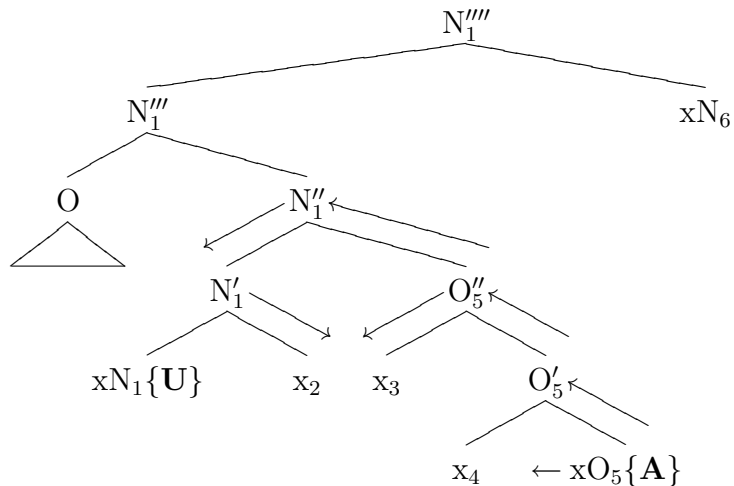
The partitive suffix of this particular word is a simple nuclear head xN annotated with the element **U**.

(5) The suffix of the partitive in *juttu* jud::u

xN{**U**}

The function tconcat() attaches this analytic suffix to its base as given in (6). The head tree N_1''' (the base) takes the suffix (xN_7) as its complement and projects one level up to N_1'''' (circled in).

(6)

$$N_1'''''''$$ (circled)
 — $xN_7\{\mathbf{U}\}$

$$N_1''''''$$
 — N_1''''', xN_6

N_1''''': O (triangle), N_1''

N_1'': N_1', O_5''

N_1': $xN_1\{\mathbf{U}\}$, x_2

O_5'': x_3, O_5'

O_5': x_4, $\leftarrow xO_5\{\mathbf{A}\}$
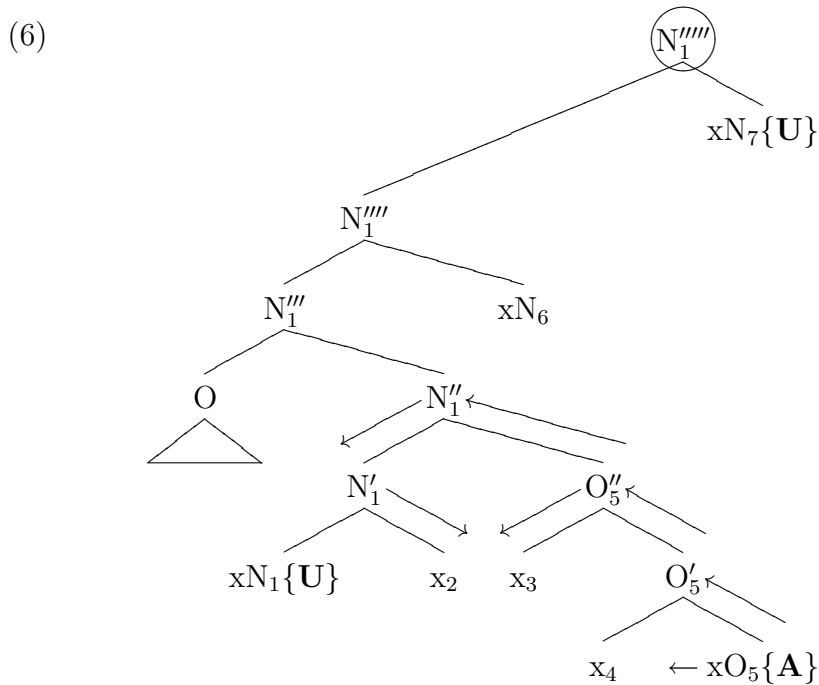
That is, the entire tree is a projection of xN_1. The function tconcat() has merged a base (jud:::) with a suffix (u) and the resulting structure is a projection of the head of the base. Clause (3b) in the definition of tconcat() states that in a sequence of a p-licensed xN followed by another xN the first xN has to be removed from the structure. (6) contains such a sequence (xN_6 and xN_7) and accordingly, the first node (xN_6) is removed by tconcat(). This leaves us with a representation such as in (7), where we have an instance of unary branching (indicated by a circle).

(7)

$$N_1''''' \quad xN_7\{\mathbf{U}\}$$

(N₁''''') [circled node]

$$N_1'''$$

O ◁

$$N_1''$$

$$N_1'$$

$$O_5''$$

$$xN_1\{\mathbf{U}\} \quad x_2 \quad x_3 \quad O_5'$$

$$x_4 \quad \leftarrow xO_5\{\mathbf{A}\}$$
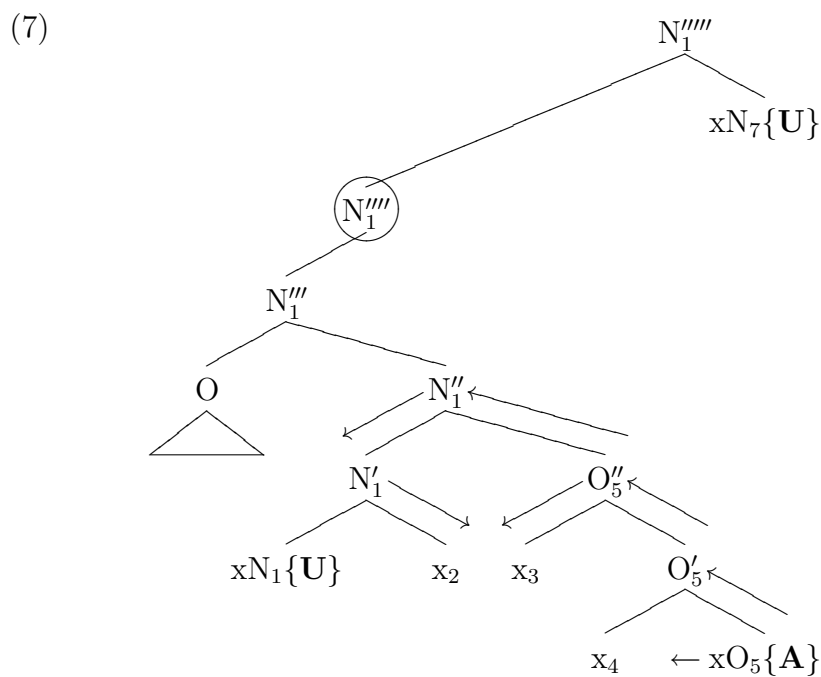
Such a structure is further pruned by Structure Minimality, *cf.* (12) on p. 65, and we arrive at the final result in (8).

(8)

$$N_1'''''$$

$$N_1''' \quad xN_7\{\mathbf{U}\}$$

O ◁

$$N_1''$$

$$N_1'$$

$$O_5''$$

$$xN_1\{\mathbf{U}\} \quad x_2 \quad x_3 \quad O_5'$$

$$x_4 \quad \leftarrow xO_5\{\mathbf{A}\}$$
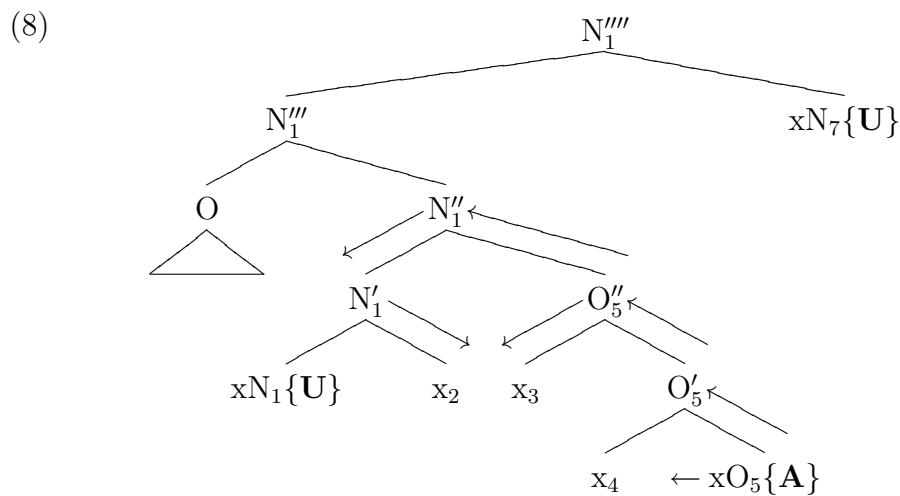
In (8) the onset head xO_5 m-commands x_2 and x_3, giving us an overlong **dː**—the correct result.

Notice that the outcome of concatenation, *i. e.* (8), is *structurally* identical to something we had constructed lexically: The representation in (8) has the same structure as the base in (4), which is also identical to the nominative. (9) repeats the structure of the base once again to make comparison easier.

(9)   *jutt-* jud::

$$N_1''''$$

N_1''' — xN_6

O — N_1''

N_1' — O_5''

$xN_1\{\mathbf{U}\}$ x_2 x_3 O_5'

x_4 $\leftarrow xO_5\{\mathbf{A}\}$
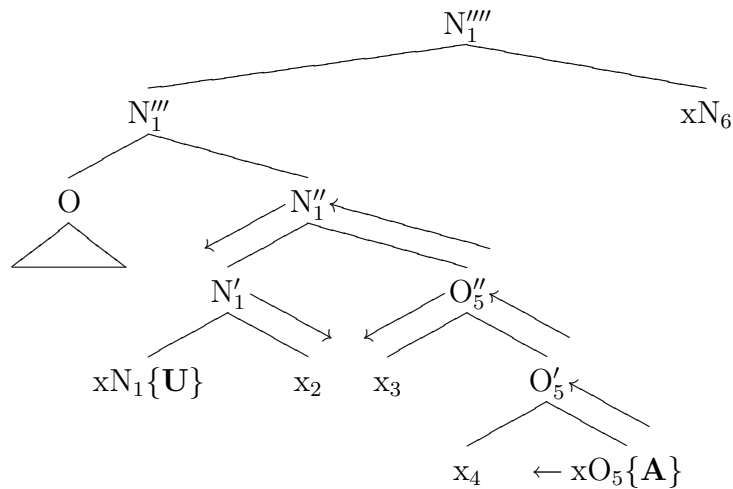
There is a crucial difference, however, between the nominative/the base in (9) and the final representation of the partitive in (8). In the nominative, the rightmost nuclear head xN_6, which is immediately dominated by the root node, is not annotated with any melody, while in the partitive the rightmost nuclear head (xN_7) is. So far, we have not seen a *bid*-type (such as (9)) where the final nucleus is annotated with melody. In Estonian, a structure as in (8) can only arise as the result of tconcat().

Let us give another example for tconcat() from Estonian. We concatenate the verbal stem *püüd* py::d (Q3 + Q1) 'to catch' in (10a) and the analytic suffix *-ja* -ja (roughly '-er') in (10b) to yield *püüdja* py::dja 'catcher' (10c).

(10) a.   b.

$$N_1''''$$

$$N_1''' \qquad\qquad\qquad xN_6 \qquad\qquad N$$

$$O \qquad N_1'' \qquad\qquad\qquad\qquad xO\{\mathbf{I}\}\quad xN\{\mathbf{A}\}$$

$$N_1' \qquad O_5''$$

$$xN_1\{\mathbf{U},\mathbf{I}\}\quad x_2\quad x_3 \qquad O_5'$$

$$x_4 \quad \leftarrow xO_5\{\mathbf{A}\}$$

c.

$$N_1'''''$$

$$N_8'$$

$$N_1'''' \qquad\qquad xO_7\{\mathbf{I}\}\qquad xN_8\{\mathbf{A}\}$$

$$N_1''' \qquad xN_6$$

$$O \qquad N_1''$$

$$N_1' \qquad O_5''$$

$$xN_1\{\mathbf{U},\mathbf{I}\}\qquad x_2\quad x_3 \qquad O_5'$$

$$x_4 \quad \leftarrow xO_5\{\mathbf{A}\}$$
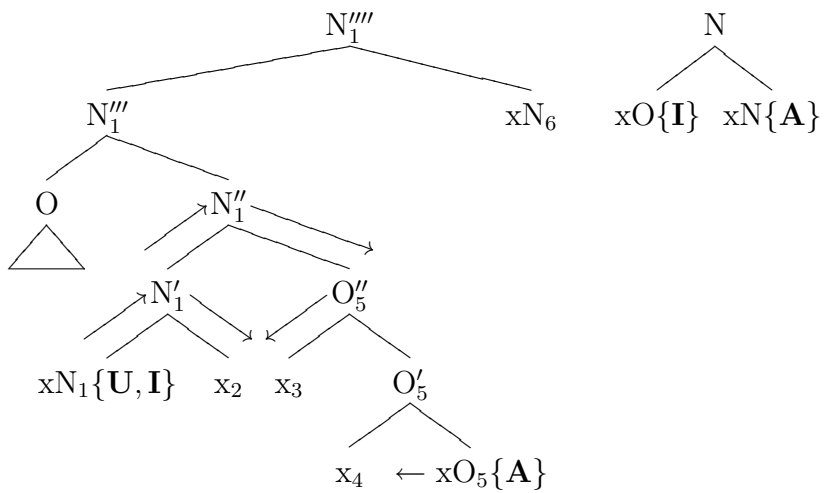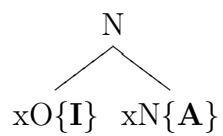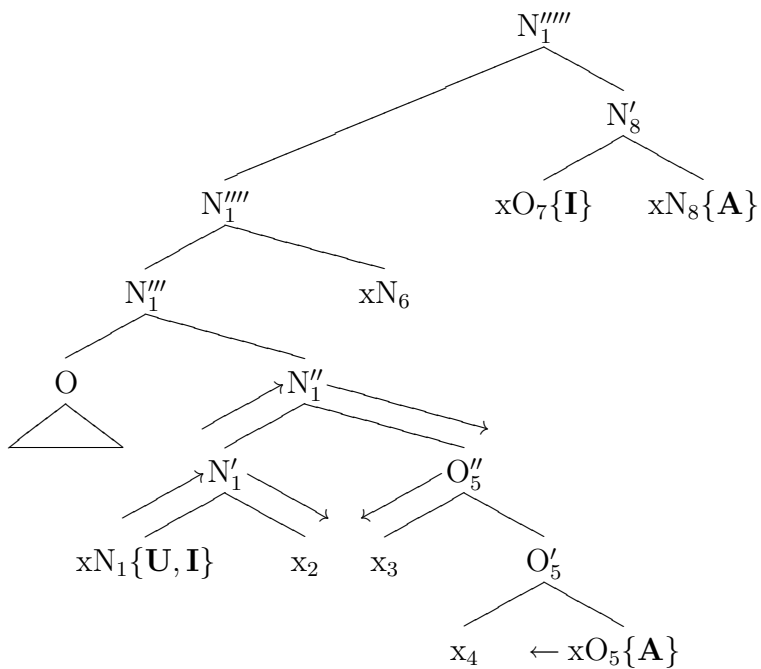
(10c) is the final result. The nuclear head xN_1 can m-command x_2 and x_3 and we get an overlong **y::**, which is correct. The structure in (10c) does not contain a sequence of a p-licensed xN and another xN, so nothing has to be removed.

Both suffixes we have discussed up to now (*-u* and *-ja*) were analytic; the difference was simply whether the suffix begins with a nucleus or an onset. Nothing else has to be said about the final outcomes in (8) and (10c).

At the beginning of this section I claimed that genitive and partitive forms in (2) differ in that one involves non-analytic morphology, while the other involves analytic morphology. (11) repeats this for the word *siid* **si::d** *silk*.

(11)   NOMINATIVE SG. $\left[\,\text{si::d}\,\right]$
       GENITIVE SG. $\left[\,\text{si:d}+\text{i·}\,\right]$
       PARTITIVE SG. $\left[\,\left[\,\text{si::d}\,\right]\text{i}\,\right]$

From the point of view of *morphology* both genitive and partitive are complex. However, a partitive like $\left[\,\left[\,\text{si::d}\,\right]\text{i}\,\right]$ involves analytic morphology, which is visible to the phonology, while a genitive like $\left[\,\text{si:d}+\text{i·}\,\right]$ involves non-analytic morphology, *i. e.* the kind of morphology that is invisible to the phonology. (12) repeats the structure of the genitive $\left[\,\text{si:d}+\text{i·}\,\right]$.

(12) Estonian *siidi* **si:di·**, a *Libby*-structure

212
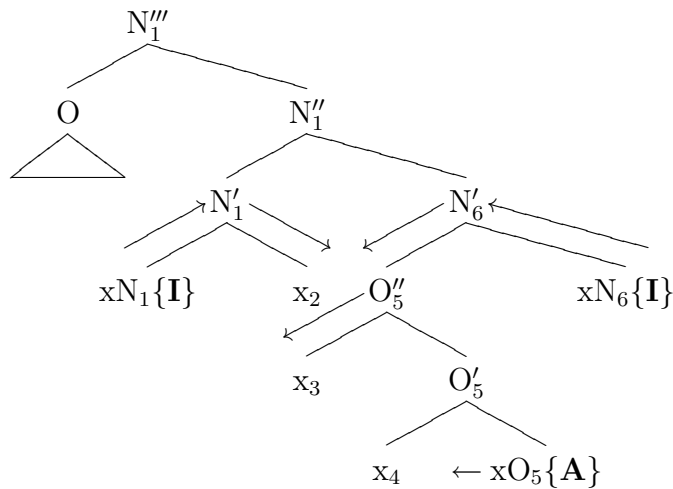
That is, from the point of view of phonology, a non-analytic form like (12) is the same as a form that does not involve any morphology *at all.* If we can find forms that are clearly *not* morphologically complex and that behave phonologically like the genitive in (12), then our case for the distinction between genitives (non-analytic) and partitives (analytic) would be strengthened. We have to look for morphologically simplex words which are, like the genitives, of the *Libby*-type.

The only case form without any marker in the inflectional system of the noun is the nominative. Most native nominatives do not have a *Libby*-structure, but rather a *bid*-structures, such as *jutt* jud:: in (9). They will not be of any use to us. Interestingly, however, there are a number of loans whose nominative is of the *Libby*-type. We should expect that they are all like the genitives, *i. e.* we should find forms like siːdiˑ or giːduˑ or judːuˑ. With this in mind, consider the loans in (13).

(13) a. | *teema* | 'topic' | 'deːmaˑ | (Q2) |
floora	'flora'	'floːraˑ	(Q2)
draama	'drama'	'draːmaˑ	(Q2)
liiga	'league'	'liːgaˑ	(Q2)

  b. | *Miki* | 'Mickey (Mouse)' | 'mikːi | (Q2) |
loto	'lottery'	'lotːo	(Q2)
foto	'photo'	'fotːo	(Q2)
summa	'sum'	'sumːa	(Q2)
kassa	'till'	'kasːa	(Q2)
lasso	'lasso'	'lasːo	(Q2)

Our prediction is correct. Crucially, there are *no* loans with an overlong domain head and a final realised nucleus, *i. e.* there are no loans like *'liːːga.[3] The nominative *liiga* 'liːgaˑ 'league', for example, is completely identical to a genitive form like *siidi* siːdiˑ. The two forms are contrasted in (14).

---

[3] The form 'liːːga does exist though; it means 'too much' and is actually a partitive, *i. e.* it has the structure $\varphi(\text{tconcat}(\varphi(\text{liːːg}), \text{a}))$.

(14)   a. The genitive *siidi* siːdiˑ, a *Libby*-structure

$$N_1'''$$

O N_1''

N_1' N_6'

$xN_1\{\mathbf{I}\}$ x_2 O_5'' $xN_6\{\mathbf{I}\}$

x_3 O_5'

x_4 $\leftarrow xO_5\{\mathbf{A}\}$

b. The nominative *liiga* liːgaˑ, a *Libby*-structure

$$N_1'''$$

O N_1''

N_1' N_6'

$xN_1\{\mathbf{I}\}$ x_2 O_5'' $xN_6\{\mathbf{A}\}$

x_3 O_5'

x_4 $\leftarrow$ xO_5
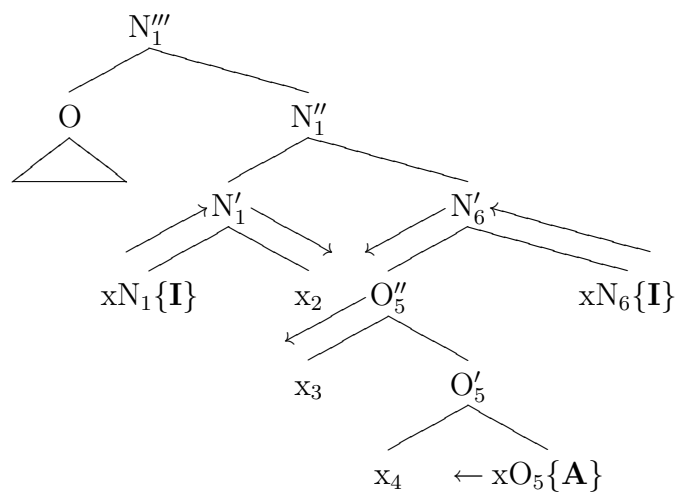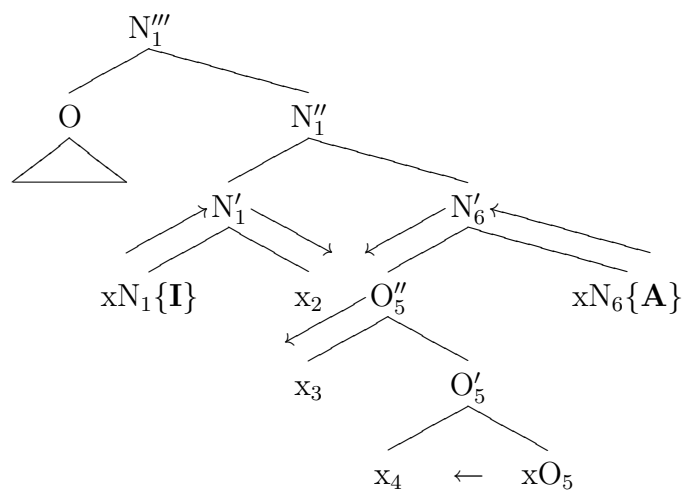
Forms that are not morphologically complex (14b) behave like forms involving non-analytic morphology (14a). In both structures the domain head xN_1 can only m-command x_2, but not x_3. As a result, we get a long domain head in both words.

What all this means is that the distribution of length is a reliable clue of whether a form contains analytic morphology or not. Take the adjectives in (15).

(15) *kaame*   ɡɑːme   'pale'
      leebe   leːbe   'mild'
      lääge   læːge   'insipid'
      ruuge   ruːge   'light brown'
      tüüne   tyːne   'calm'

In all the words in (15) we find an overlong domain head. We must conclude that all the forms in (15) involve analytic morphology. This is not surprising, given that all words are adjectives and all end in -*e*. This -*e* is an analytic suffix, even though the forms in (15) are usually not treated as morphologically complex in the literature on Estonian.[4] The morphological structure of the adjective *leebe* leːbe 'mild' is $\varphi(\mathrm{tconcat}(\varphi(\text{leːb}), \text{e}))$. This is identical to a partitive like *siidi* siːdi, which is $\varphi(\mathrm{tconcat}(\varphi(\text{siːd}), \text{i}))$. The two structures are given in (16).

(16)   a. The final result of $\varphi(\mathrm{tconcat}(\varphi(\text{leːb}), \text{e}))$

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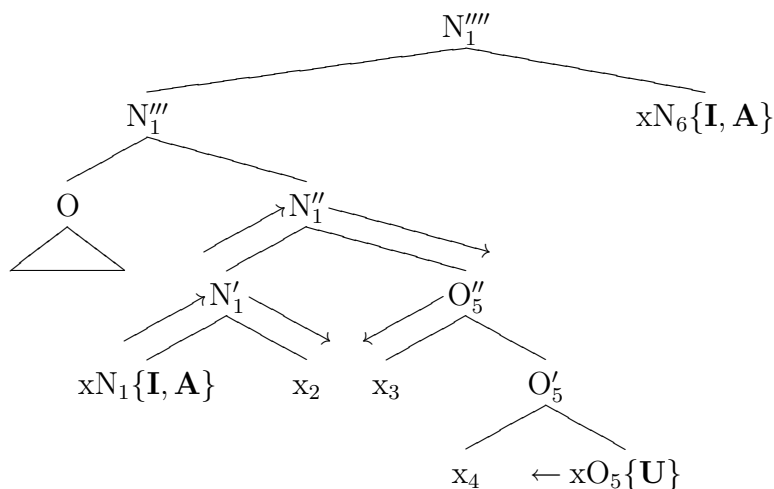
[4] An even more extreme example is the English word *anecdote*, which does not show any sign of being composed of two meaningful units, but its phonological makeup is certainly that of a compound. Both stress and the otherwise non-existing cluster kd make clear that the structure must be [[*anec*][*dote*]].

b. The final result of $\varphi(\text{tconcat}(\varphi(\text{si::d}), \text{i}))$

$$
\begin{array}{c}
\text{N}_1''''' \\
\end{array}
$$
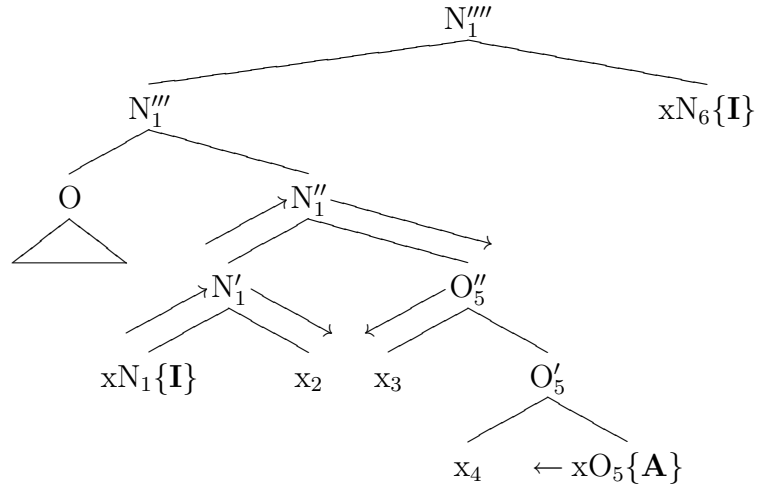
In both words the domain head xN_1 can m-command x_2 and x_3. As a result we find an overlong e:: in $\varphi(\text{tconcat}(\varphi(\text{le::b}), \text{e}))$ and an overlong i:: in $\varphi(\text{tconcat}(\varphi(\text{si::d}), \text{i}))$.

Let us have another look at the structures in (16). This section presented us with the first cases of *bid*-structures where the right branch of the root, *i. e.* xN_6 in (16) actually has melody in it. Admittedly, in Estonian such structures could only arise as a result of the tconcat()-function. Still, the mere existence of such forms raises two important questions: (i) are there restrictions on what the right branch of the root in a *bid*-structure can contain?, and (ii) are there languages where the structures in (16) could exist *without* previous application of tconcat()? The answer to both questions is "yes". I will discuss question (i) in section 5.3, and question (ii) will be the subject matter of section 5.4.

5.3   English and tconcat()

The first question can be illustrated with examples from English. Consider the words in (17).

(17) *staid*   steːd   *staidly*   steːdli
      state   steːt   *stately*   steːtli

The suffix *-ly* is analytic, *i. e.* the forms in question are $[\,[\,staid\,]\,ly\,]$ and $[\,[\,state\,]\,ly\,]$, respectively. This explains, among other things, why d/t and l can occur next to each other (they are separated by an empty nucleus), and it also promises to give an insight into why the length in *staid* is unaffected by the suffix. The structure of *-ly* is given in (18).

(18)

$$
\begin{array}{c}
N'_4 \\
\diagup \quad \diagdown \\
O''_3 \qquad xN_4\{\mathbf{I}\} \\
\diagup \quad \diagdown \\
x_1 \qquad O'_3 \\
\diagup \quad \diagdown \\
x_2\{\mathbf{A}\} \qquad xO_3
\end{array}
$$
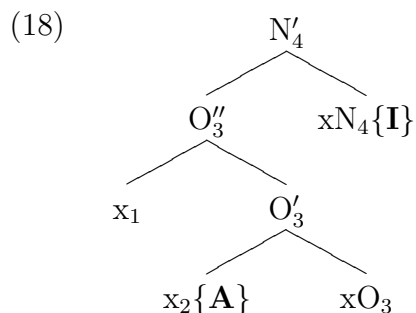
Let us now take $[\,[\,staid\,]\,ly\,]$, *i. e.* $\varphi(\text{tconcat}(\varphi(staid), ly))$. After phonology has applied to the inner domain (*staid*), tconcat() joins the outcome of the inner domain with the suffix *-ly*. The resulting structure is given in (19). The projection created by tconcat(), N'''''_1, is circled in.[5]

---

[5] I disregard the initial *st* in *staid*, which is definitely not contained within a single onset, as (19) suggests. The structure of *st* is irrelevant to our point, however.

(19)

```
                                           N₁'''''' (circled)
                                          /        \
                                         /          N₁₀'
                                        /          /    \
                                 N₁'''''         O₉''    xN₁₀{I}
                                /     \         /    \
                           N₁''''    xN₆   x₇   O₉'
                          /    \                /   \
                         O      N₁''        x₈{A}   xO₉
                        /\     /    \
                      (triangle)  N₁'      O₅''
                              /    \      /    \
                          xN₁{A,I}  x₂   x₃   O₅'
                                              /   \
                                             x₄   ← xO₅{A}
```

$$N_1''''''$$

$$N_{10}', \quad N_1''''', \quad O_9'', \quad xN_{10}\{I\}, \quad N_1'''', \quad xN_6, \quad x_7, \quad O_9', \quad x_8\{A\}, \quad xO_9$$

$$N_1''', \quad O, \quad N_1'', \quad N_1', \quad xN_1\{A,I\}, \quad x_2, \quad O_5'', \quad x_3, \quad O_5', \quad x_4, \quad \leftarrow xO_5\{A\}$$
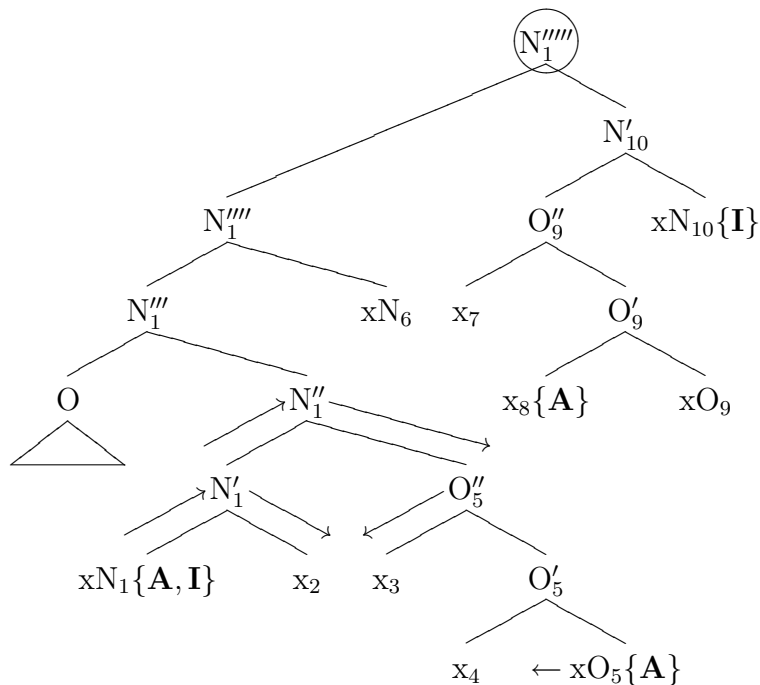
This is completely identical to the situation we had in Estonian. The structure in (19) is licit. Furthermore, the length in the base *staid* steːd is completely unaffected by the suffix. The domain head xN_1 m-commands two unannotated points, *viz.* x_2 and x_3. The eː is overlong. As we shall see in a moment, this is an important point.

The analytic suffix *-ly* begins with an onset, as we saw in (18). Let us next turn to another analytic suffix, but this time to one that begins with a nucleus. The participle marker *-ing* is such a candidate.[6] Its structure is given in (20).[7]

---

[6] That *-ing* is analytic can be seen in a form like *singing*, where the final *ng* of the base (*singing*) is realised as ŋ and not as ŋg. The realisation ŋ indicates that a domain boundary follows, *i. e.* that *-ing* must be analytic. For further details *cf.* Kaye (1995).

[7] The final ŋ has the structure of a cluster and is only given in its abbreviated form here, as it is not relevant to my point here. Clusters are discussed in the next chapter.

(20)

$$N_1''$$

$$N_1' \qquad\qquad N_4'$$

$$xN_1\{\mathbf{I}\} \qquad O_2 \qquad O_3 \qquad xN_4$$
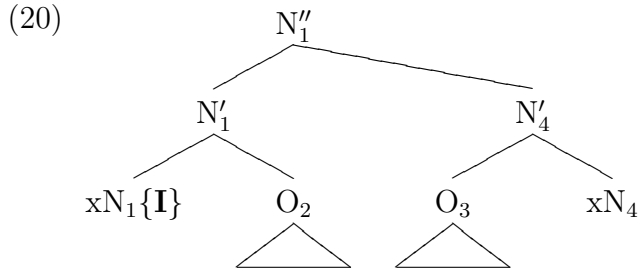
We now take a verb like *to lube* and create its present participle *lubing*. The structure of this word is $\varphi(\text{tconcat}(\varphi(lube), ing))$. Once phonology has applied to the inner domain (*lube*), we attach *-ing*, *i. e.* the head of the inner domain takes the suffix as its complement and projects up. This is the form given in (21).

(21)

$$N_1'''''$$

$$N_1''''$$

$$N_1''' \qquad xN_6 \qquad\qquad N_7''$$

$$O \qquad N_1'' \qquad\qquad N_7' \qquad N_{10}'$$

$$N_1' \qquad O_5'' \qquad\qquad xN_7\{\mathbf{I}\} \quad O_8 \qquad O_9 \quad xN_{10}$$

$$xN_1\{\mathbf{U}\} \quad x_2 \qquad x_3 \qquad O_5'$$

$$x_4 \quad \leftarrow xO_5\{\mathbf{U}\}$$
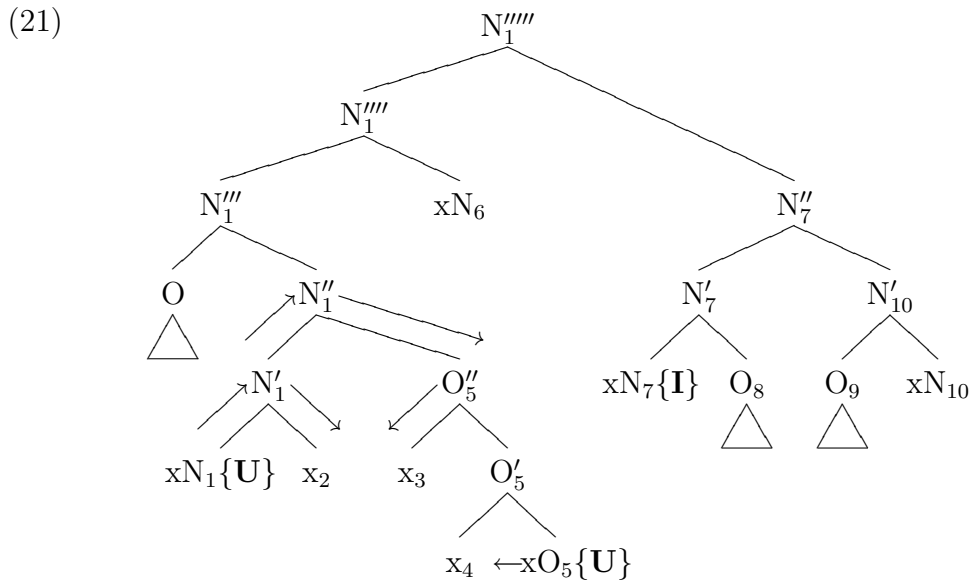
(21) contains a sequence of an empty nuclear head (xN_6) followed by another nuclear head (xO_7). The first one, xN_6, is removed from the structure as required by the definition of tconcat() in (3). This leaves us with a unary branching node (circled in).

(22)
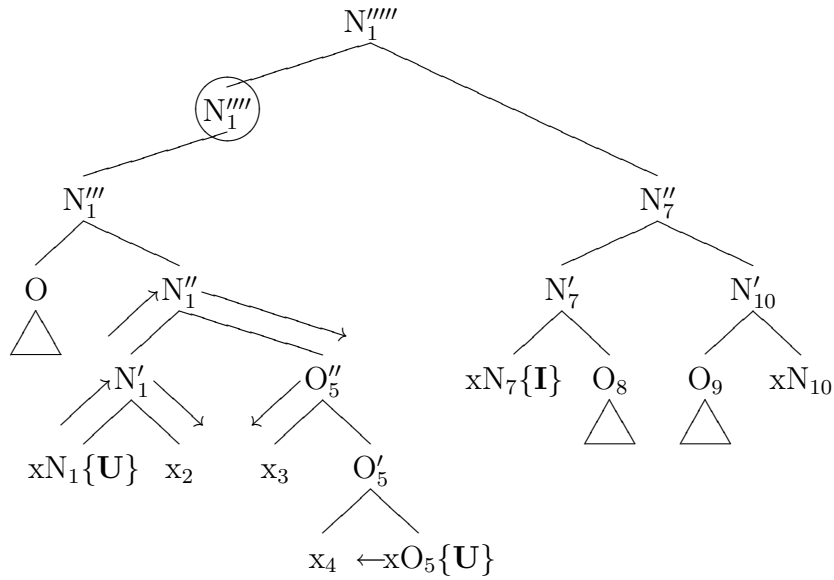
The tree is further pruned by Structure Minimality to get rid of the unary branching node and the derivation comes to its end. The final outcome is shown in (23).

(23)
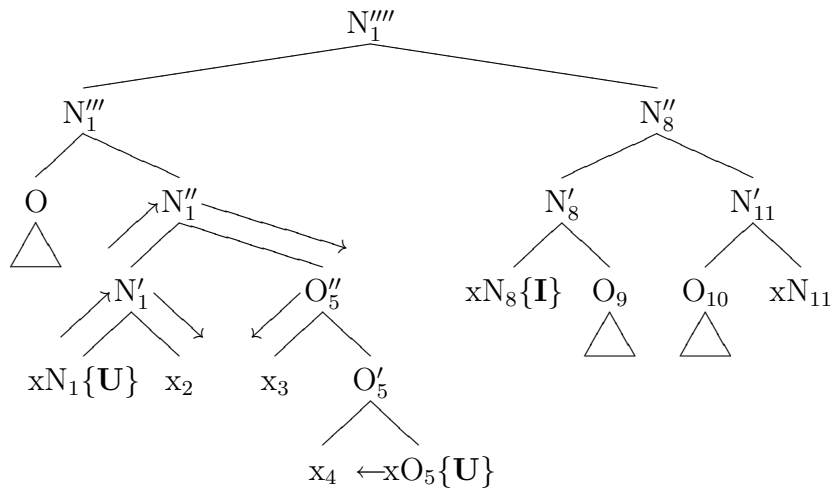
In other words, the theory as it stands so far predicts that *any* analytic suffix should leave the distribution of length within the base it is attached to

unscathed. This, however, is not borne out by the facts. The result we have in (23) must be incorrect. Consider the crucial forms in (24).

(24) *to lube*   luːːb   *lubing*   luːbɪŋ
      to loop   luːp   *looping*   luːpɪŋ

As a comparison of *to lube* luːːb and *lubing* luːbɪŋ shows, the length of the uːː is *not* retained. While the infinitive has an overlong uːː, the participle has a long uː. The participle forms *lubing* and *looping* are identical in the length of the uː, they only differ in that *lubing* has a lenis **b** and *looping* a fortis **p**. The infinitive forms *to lube* and *to loop* are clearly different in the length of the nuclear expression. This is in stark contrast to the pair *stately/staidly* we were talking about before. Affixation of *-ly* had no influence on the length of the domain head, while *-ing* does.

What this means is that (23) cannot be the correct result. The fact that in *lubing* the unused x-slot in the lenis **b** is not accessible to the domain head suggests that the word has a structure similar to the (non-complex) word *lady* (which is of the *Libby*-type). The final representation we want for *lubing* luːbɪŋ is thus not the one in (23), but rather the one given in (25).

(25)
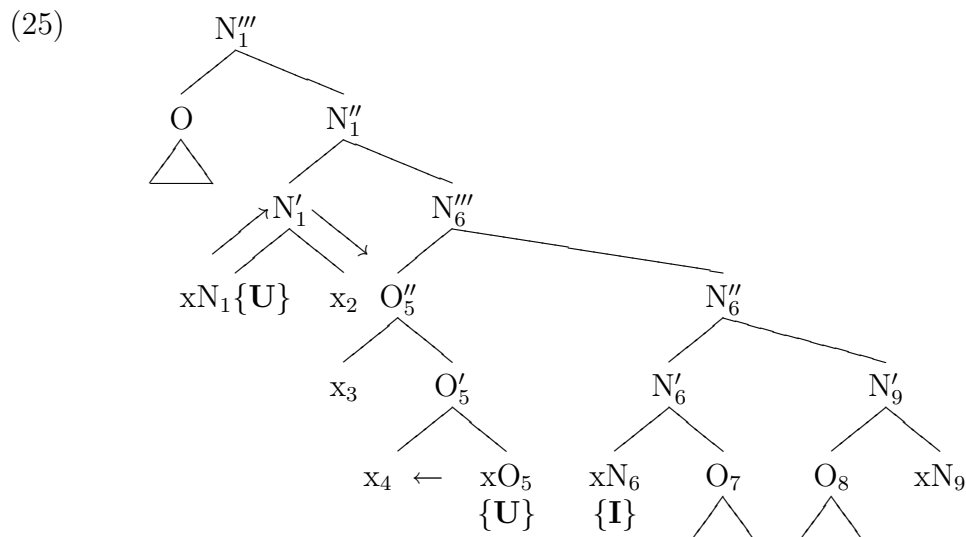
From a representation like (25) it is clear why the domain head xN_1 cannot m-command x_3. We are dealing with a *Libby*-structure here and xN_6 is a closer licenser for x_3 than xN_1 could be:[8] xN_6 p-licenses x_3 (which is not indicated in the already quite complex representation). As a result, the **uː** in *lubing* could not be overlong, but only long.

If (23) is incorrect and has to be reorganised into a structure as in (25), then two questions arise: (i) Under which conditions does a structure have to be reorganised? Note that both *-ly* and *-ing* are analytic suffixes, yet one involves a large-scale reorganisation (*-ing*) while the other one (*-ly*) does not. (ii) How can a structure like (23) turn into one like (25)? What are the structural changes?

Let us start with question (i). The suffixes *-ly* and *-ing* are both analytic, and yet they differ in their behaviour. We have to understand why. (26) compares two licit forms and an illicit one, all of which we have seen before. The two licit forms are the words *bead* (26a), repeated from (2) on p. 145, and *staidly* (26b), a repetition of (19); *bead* is a lexical form, while *staidly* is the result of tconcat(). The illicit form in (26c) is a repetition of (23), *i. e.* the result we should expect for $\varphi(\text{tconcat}(\varphi(lub), ing))$.

(26)   a.

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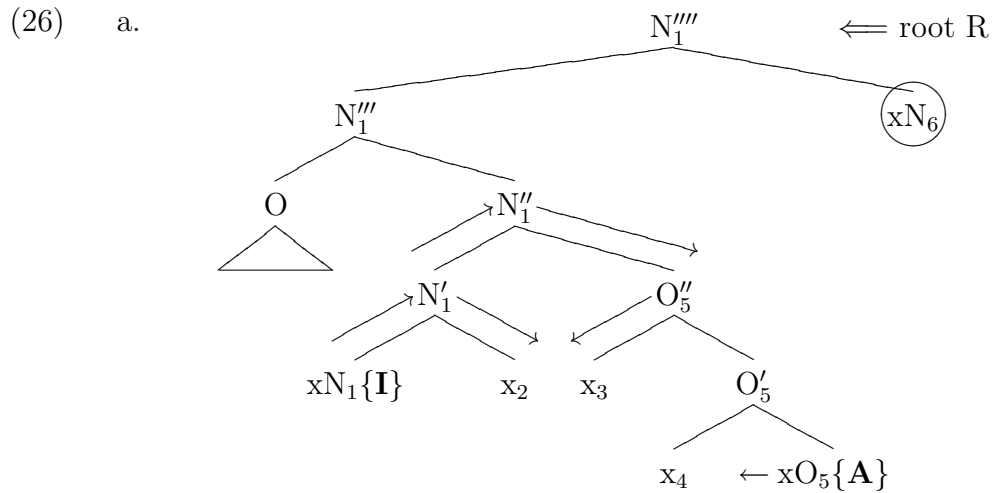
[8] For the notion of closer licenser *cf.* (58) on p. 134.

b.

N_1''''' $\Longleftarrow$ root R

N_{10}'

N_1'''' O_9'' $xN_{10}\{\mathbf{I}\}$

N_1''' xN_6 x_7 O_9'

O N_1'' $x_8\{\mathbf{A}\}$ xO_9

N_1' O_5''

$xN_1\{\mathbf{A},\mathbf{I}\}$ x_2 x_3 O_5'

x_4 $\leftarrow xO_5\{\mathbf{A}\}$
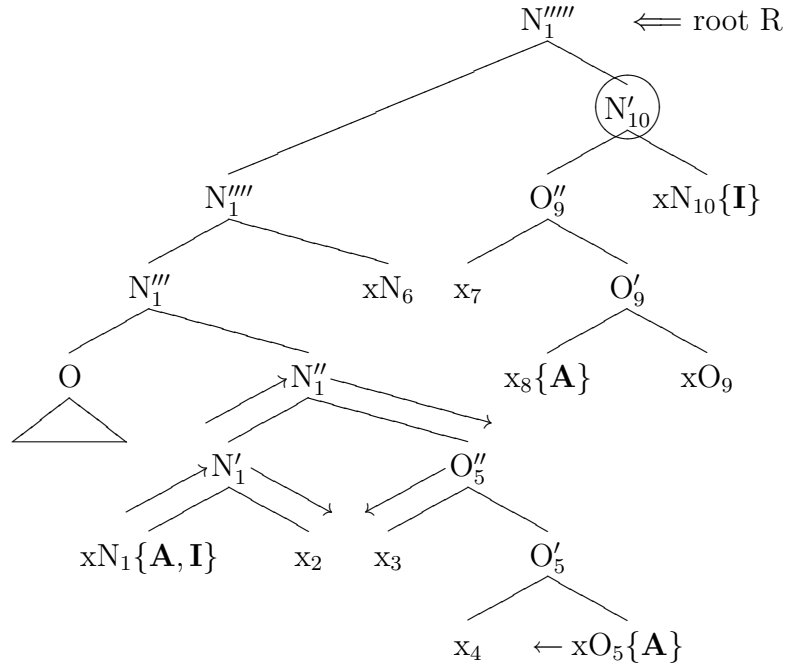
c. The illicit outcome of $\varphi(\mathrm{tconcat}(\varphi(lub), ing))$

* N_2''''' $\Longleftarrow$ root R

N_2''''

O_1 N_2''

N_2'

$xN_2\{\mathbf{U}\}$ x_3 O_6'' N_8''

x_4 O_6' N_8' N_{11}'

x_5 $\leftarrow xO_6$ xN_8 O_9 O_{10} xN_{11}
$\{\mathbf{U}\}$ $\{\mathbf{I}\}$

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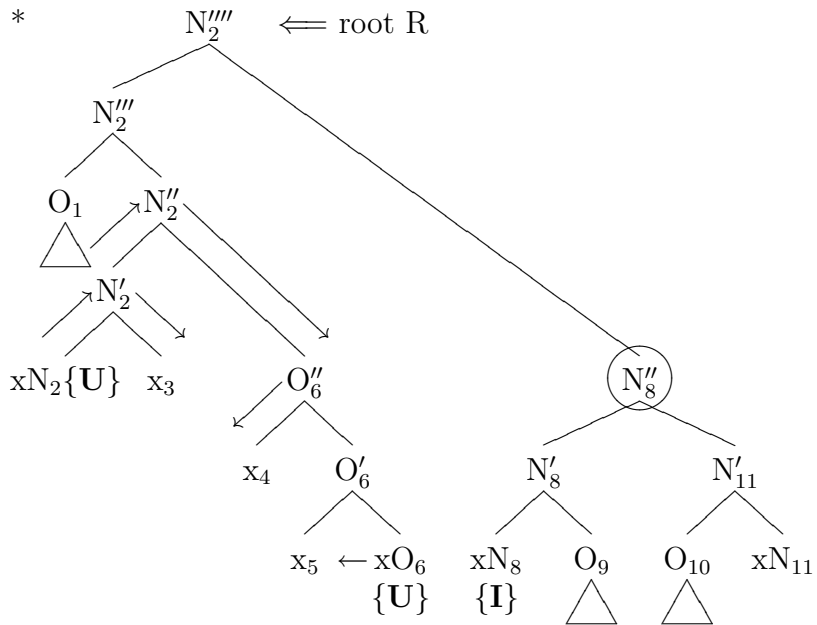
What are the formal properties that set them apart? In all three forms, the root node R branches into a nuclear projection on the left and a nuclear head or a nuclear projection on the right. What will be of interest to us are the right branches (circled in). English tolerates a p-licensed, non-complex nuclear head xN (26a) or a nuclear projection that branches into an onset and a nucleus (26b). In the structure in (26c), we neither have a nuclear projection branching into an onset and a nucleus, nor do we have a p-licensed, non-complex nuclear head xN as the right branch of the root node. What we have is a projection of an xN with two complements to the right, but with no onset to the left. This seems to be the offending property. Summing up:

(27) **English:**

> If a root node R branches into a nuclear type on the left (N_L) and a nuclear type on the right (N_R), then N_R can only begin with an xN_i if that xN_i is p-licensed.

Any structure that does not meet the condition in (27) is illicit and has to be reorganised. (26a), the structure of *bead*, fulfills the condition in (27): the right branch of the root node begins with (in fact, is) a p-licensed nuclear head xN. This is a licit structure. (26b), the final outcome of $\varphi(\text{tconcat}(\varphi(staid), ly))$, complies with (27) since it does not begin with an xN. The structure in (26c), the incorrect outcome of $\varphi(\text{tconcat}(\varphi(lub), ing))$, violates (27), since it begins with an xN, but that xN is not p-licensed. It is therefore illicit and the structure has to be changed. This brings us back to question (ii) from above: What are the structural changes involved in such a reorganisation? We will go through the necessary changes step by step and then give a summary at the end.

The structure in (26c), the incorrect outcome of $\varphi(\text{tconcat}(\varphi(lub), ing))$, repeated here as (28), is illicit since the right branch of the root node R, N_R ($= N_8''$) begins with an xN that is not p-licensed. As the first step in the reorganisation, both N_8'' and O_6'' are delinked from their mothers (indicated by the crossed-out lines.)

(28)

$$N_2'''''$$

$$N_2''''$$

R

$$O_1 \quad N_2''$$

$$N_2'$$

$$N_R$$

$$xN_2\{\mathbf{U}\} \quad x_3$$

$$O_6''$$

$$N_8''$$

$$x_4 \quad O_6'$$

$$N_8' \quad N_{11}'$$

$$x_5 \ \leftarrow xO_6 \quad xN_8 \quad O_9 \qquad O_{10} \quad xN_{11}$$
$$\{\mathbf{U}\} \quad \{\mathbf{I}\}$$
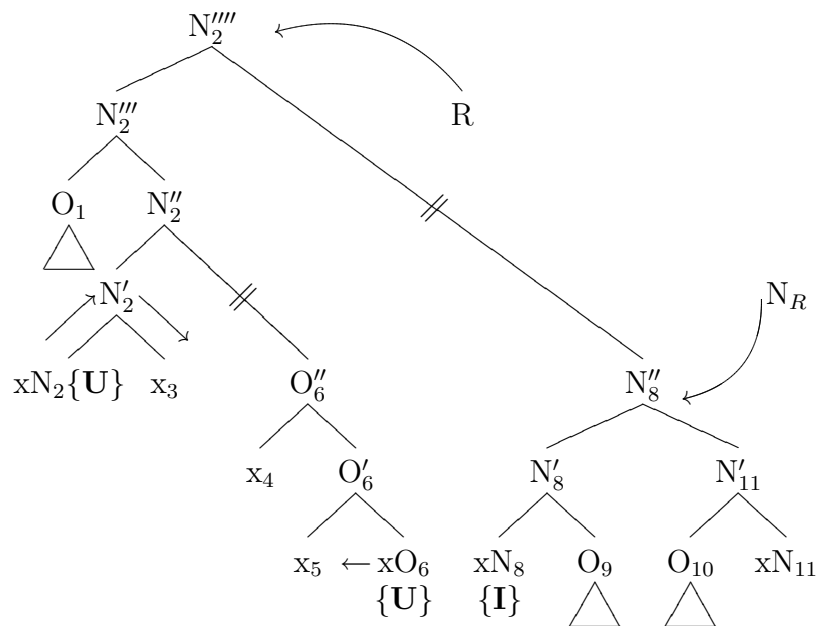
N_8'' and O_6'' merge and we project one level up to N_8''' (circled in). This newly created node N_8''' is inserted in exactly the same place that O_6'' was delinked from, *i. e.* as a daughter of N_2''.

(29)

$$N_2''''$$

$$N_2'''$$

$$O_1 \quad N_2''$$

$$N_2'$$

$$\boxed{N_8'''}$$

$$xN_2\{\mathbf{U}\} \quad x_3$$

$$O_6'' \qquad\qquad N_8''$$

$$x_4 \quad O_6' \qquad N_8' \qquad N_{11}'$$

$$x_5 \ \leftarrow xO_6 \quad xN_8 \quad O_9 \quad O_{10} \quad xN_{11}$$
$$\{\mathbf{U}\} \quad \{\mathbf{I}\}$$
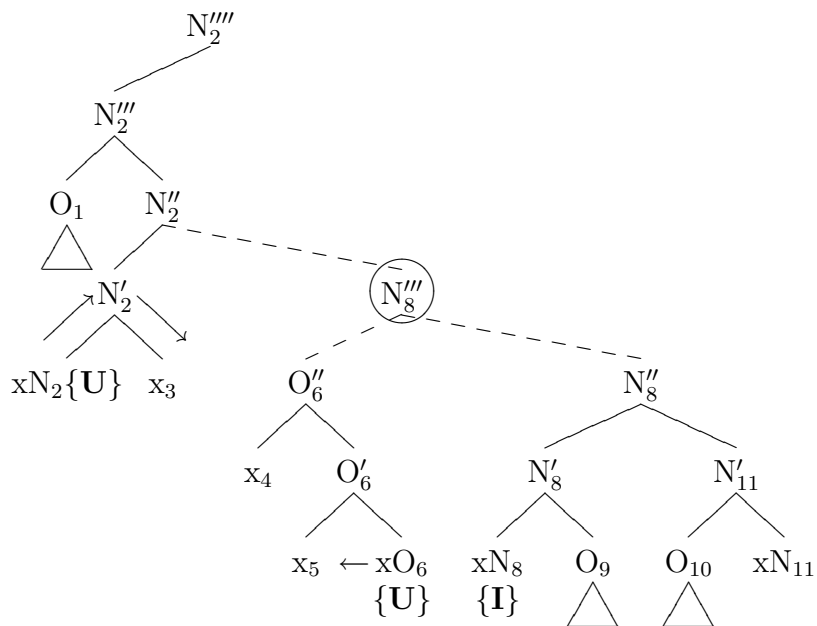
The original root node, N_2'''', is now unary branching and has to be reduced from the structure by the principle of Structure Minimality, *cf.* (12) on p. 65.

(30)

$$N_2''''$$

$$N_2'''$$

$$O_1 \quad N_2''$$

$$N_2' \qquad\qquad N_8'''$$

$$xN_2\{\mathbf{U}\} \quad x_3$$

$$O_6'' \qquad\qquad N_8''$$

$$x_4 \quad O_6' \qquad N_8' \qquad N_{11}'$$

$$x_5 \ \leftarrow xO_6 \quad xN_8 \quad O_9 \quad O_{10} \quad xN_{11}$$
$$\{\mathbf{U}\} \quad \{\mathbf{I}\}$$
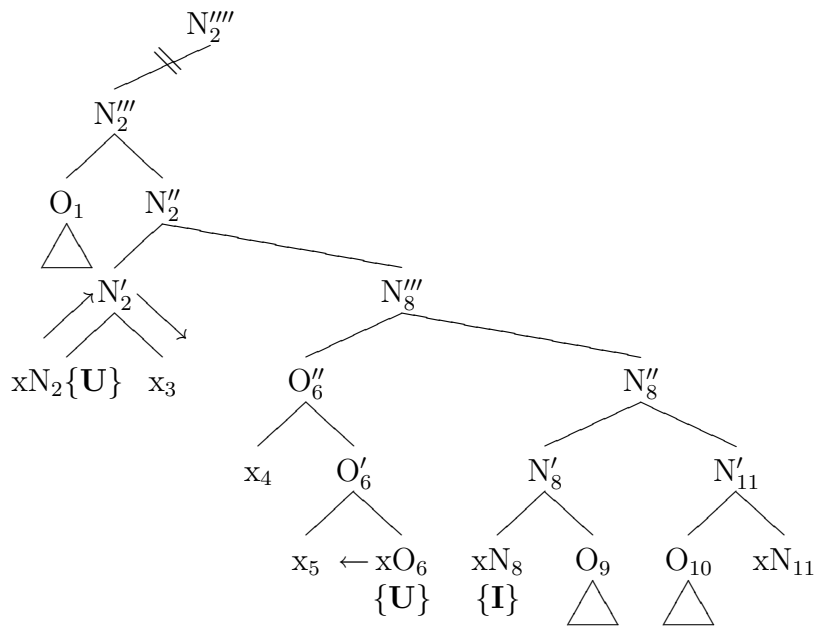
The final result is given in (31).

(31)
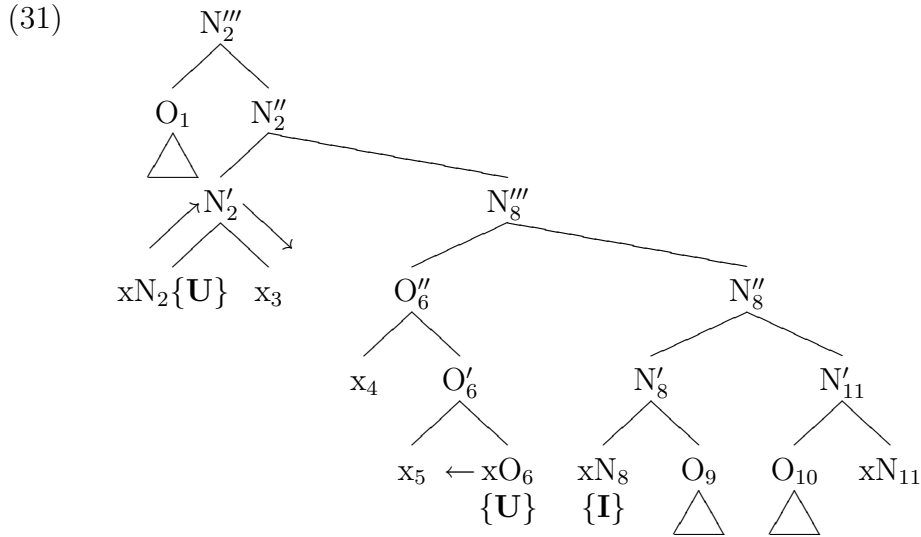
This is exactly the structure we want for *lubing*. The domain head xN_2 can only m-command x_3, but not x_4. The node xN_8 is a closer licenser for x_4 than xN_2 is. As a consequence, we get *lubing* with a long **uː**.

(32) gives a succinct description of the changes the structure has gone through.

(32) **Reorganisation:**

If the right branch N_R fails to meet the condition set out in (27), the tree has to be reorganised:

   a. N_R and O_{R-1}, the highest projection of the preceding onset head xO_{R-1}, are delinked from their mothers.
      The entire node N_R is merged with O_{R-1} and projects to N'_R.

   b. N'_R is merged as a complement within the preceding nuclear projection, *viz.* in the position where O_{R-1} used to be.

As a graphical summary, the structure in (33) collapses all those steps into one.

(33)

N_2''''

N_2''' R

O_1 N_2'' N_R'

N_2' N_8''' N_R

$xN_2\{U\}$ x_3 O_6'' N_8''

x_4 O_6' N_8' N_{11}'

O_{R-1} x_5 $\leftarrow xO_6$ xN_8 O_9 O_{10} xN_{11}
$\{U\}$ $\{I\}$

While reorganisation can easily be described, it raises a more general question. Standard GP had at its core the projection principle, stating that governing relationships (a subtype of licensing relationships) must not be changed in the course of a derivation. This limited the expressive power of the theory considerably, eliminating tools such as "resyllabification" and the like that other phonological theories make use of. While the present model has nothing like government, the basic insight remains, *viz.* that structure should not be tinkered around with in order to restrain the power of the theory. In the reorganisation described above, this principle has been violated several times: Nodes were delinked and reinserted in different places. Does that mean that the projection principle (or its successor) is abandoned in the present framework altogether?

In order to answer this question, we first have to know whether reorganisation is actually part of the phonological derivation. I want to claim that it is not. Recall the tconcat()-function, which is an operation performed on phonological structures, but which is not phonological in nature itself, *i. e.* it is not contained in the φ()-function, but different from it. The same has to be said about reorganisation. It is an auxiliary operation that 'mops up' a representation once tconcat() has done its job. After all, the only time illicit

structures such as in (28) can arise is through the application of tconcat(). Like tconcat(), reorganisation is not a phonological process, it is not part of $\varphi()$. What is special about it, however, is that unlike tconcat(), it applies in English, while it does not apply in Estonian.

All this is not to say that there is no further work to be done. So far we have seen reorganisation at work in a single language. Future research will have to show whether English is unusual in that respect or whether reorganisation is in fact quite common and what kind of insights we can gain from its application in languages other than English.

5.4   Italian

Let us finally come to the issue whether a structure as under (8) could exist without previous application of tconcat(). To answer this question, let us have a look at some properties of Italian. There are two crucial issues we will have to take into account, *viz.* the structure of geminates and the site where a trade-off in length can occur.

We begin with the first issue. In chapter 1 of this disssertation I compared English to Italian and argued that the distribution of length in the words *bid* and *bit* is reminiscent of what we observe in an Italian pair like *fato* (with a long *a*) *vs. fatto* (with a short *a*). This was the basis for the fortis/lenis hypothesis, which is part and parcel of the framework presented here. The representation of a lenis d as in English *bid* and a fortis t as in *bit* is repeated once again in (34).
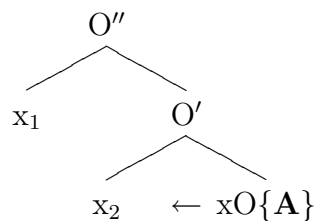
(34)   a. lenis d   b. fortis t
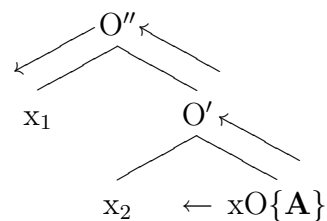
So far we have only established that there is a parallel between *bid* and *fato* on the one hand and *bit* and *fatto* on the other, in the sense that there is

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a trade-off between the nuclear expression and the following onset. We have not given any representations of the Italian words in the new model yet. Let us start with *fatto*: what is the correct representation of the *tt*? Does it have a structure as in (34b)? Can we say that an Italian geminate *tt* is the same object as an English fortis t in *bit*? Consider (35), which shows an interesting difference in behaviour.[9] (Underlining in (35) indicates stress.)

(35)   a. Italian

am<u>i</u>co 'friend'	*m<u>ù</u>sica* 'music'	*gal<u>o</u>ppo* 'gallop'	*<u>ga</u>loppo*
com<u>e</u>ta 'comet'	*c<u>à</u>napa* 'hemp'	*tab<u>a</u>cco* 'tobacco'	*<u>ta</u>bacco*
pil<u>o</u>ta 'pilot'	*d<u>è</u>bito* 'obligation'	*con<u>o</u>bbi* 'I knew'	*<u>co</u>nobbi*
		ag<u>o</u>sto 'August'	*<u>a</u>gosto*
		ag<u>e</u>nda 'agenda'	*<u>a</u>genda*

   b. English
   Lenis after penultimate: *C<u>a</u>nada*, *tr<u>a</u>gedy*, *c<u>u</u>stody*, *<u>o</u>mega*, *m<u>e</u>lody*, etc.
   Fortis after penultimate: *Am<u>e</u>rica*, *l<u>e</u>xicon*, *<u>A</u>frica*, *s<u>a</u>nity*, *c<u>a</u>nopy*, *th<u>e</u>rapy*, etc

   Consider the English examples first. All the words in (35b) have stress in the antepenultimate position. What is of importance to us is that stress can be in *antepenultimate* position regardless of whether the *penultimate* position is followed by a fortis onset (the *p* in *c<u>a</u>nopy*) or a lenis onset (the *d* in *m<u>e</u>lody*). This is quite different from Italian simpleton and geminate stops as given in (35a). Italian has words like *gal<u>o</u>ppo* 'gallop' or *tab<u>a</u>cco* 'tobacco', but none like *<u>ga</u>loppo* or *<u>ta</u>bacco*. Stress cannot be in antepenultimate position

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[9] For the details on Italian *cf.* Bertinetto (1981): Chierchia (1986): Saltarelli (1970).

if the penultimate position is followed by a geminate (*pp* in **ga̲loppo*, *cc* in **ta̲bacco*). If the penultimate position is followed by a simpleton stop, stress in antepenultimate position is possible (though not required). We find words like *mu̲sica* or *ca̲napa*. In other words, a simpleton *k* in Italian behaves like an English lenis b *and* a fortis p. The odd one out is the Italian geminate. Since geminates in Italian behave differently from both fortis and lenis onsets in English, we must conclude that a geminate like the *tt* in *fatto* cannot have either one of the structures in (34). Its structure has to be different. This will be the first clue we have to keep in mind. Note in particular that the behaviour of Italian geminates lines up perfectly with clusters: as (35a) shows, Italian has words like *agosto* 'August', but none like **ago̲sto*. The cluster *st* behaves like a geminate, *e. g. pp* in *galo̲ppo* (**ga̲loppo*).[10]

Let us come to the second issue I mentioned at the beginning of this section: the site where a trade-off in length takes place. In English we saw that in words like *bid* and *bit* or *bead* and *beat* there is a close connection between the domain head and the following onset: a lenis d comes with an unused x-slot that can be m-commanded by the domain head, while a fortis t provides no such unused x-slot. In section 3.3.2 we argued that this trade-off phenomenon suggested that the domain head and the following onset form a constituent. This gave rise to what we called the *bid*-structure. (36) repeats the representations of *bead* and *beat* to show this.

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[10] Stress in English usually behaves in same fashion with respect to clusters, with only a handful of exceptions like *ba̲nister*, *ca̲nister*, *ca̲rpenter* and *ca̲lender*. Interestingly, however, all those words end in *-er* and might be cases of dummy morphology.

(36) a. English *bead* biːːd

$$N_1''''$$

$$N_1''' \qquad xN_6$$

$$O \qquad N_1''$$

$$N_1' \qquad O''$$

$$xN_1\{\mathbf{I}\} \qquad x_2 \qquad x_3 \qquad O'$$

$$x_4 \quad \leftarrow \quad xO_5\{\mathbf{A}\}$$

b. English *beat* biːt

$$N_1''''$$

$$N_1''' \qquad xN_6$$

$$O \qquad N_1''$$

$$N_1' \qquad O''$$

$$xN_1\{\mathbf{I}\} \qquad x_2 \qquad x_3 \qquad O'$$

$$x_4 \quad \leftarrow \quad xO_5\{\mathbf{A}\}$$
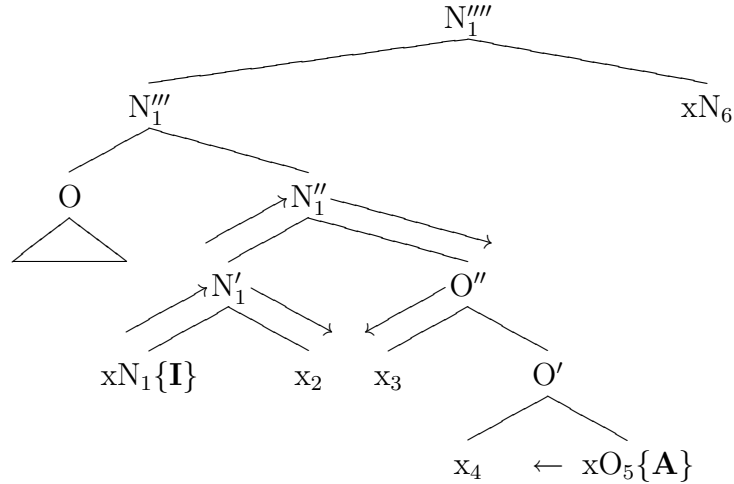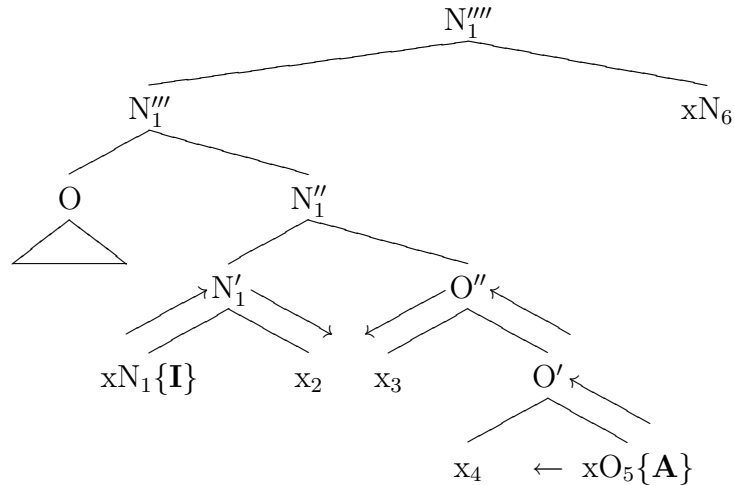
The domain head immediately precedes the final empty nucleus. The behaviour of *bead* biːːd and *beat* biːt is crucially different from *vegan* ˈviːɡən vs. *beacon* ˈbiːkən. In *vegan* viːɡən, the domain head cannot access the unused x-slot contained in the lenis ɡ. The iː in *vegan* ˈviːɡən is of the same length as the iː in *beacon* ˈbiːkən. We concluded that the pair *vegan/beacon* must be structurally different from *bead/beat*. The *Libby*-structure was born.

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Let us apply this to Italian now. In pairs like *fato*/*fatto* we observe a trade-off in length. In *fatto* the geminate *tt* takes up more room and can only be preceded by a short *a*. In *fato* the simpleton *t* takes up less room and leaves more for the *a*. That is, the domain head (*a*) and the following simpleton *t*/geminate *tt* interact, which suggests that they form a constituent of some sort. This was exactly the argumentation the led us assume that there is something like a *bid*-structure. We should then assume that *fato*/*fatto* have a *bid*-structure. What is different from English is that the domain head in *bead*/*beat* is followed by an *unrealised* nucleus, while the domain head in *fato*/*fatto* is followed by a *realised* nucleus.

To sum up now, there are two important pieces of information on what the representations of Italian words like *fato* and *fatto* have to look like. On the one hand we know that Italian geminates like *tt* cannot have the same structure as a fortis t in English. On the other hand we want a *bid*-structure for both *fato* and *fatto*. Our requirements on the shape of the representations are quite precise. (37) gives the representation I have in mind for the word *fatto*.

(37) *fatto* 'done'
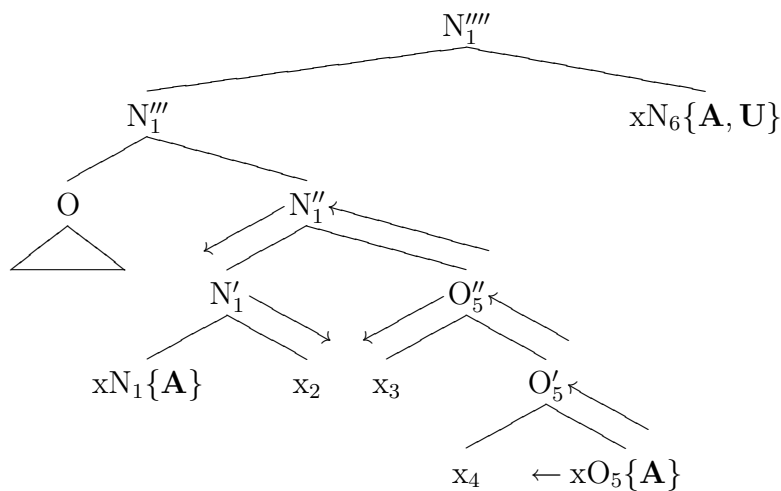
(37) meets our bill. It is a *bid*-structure and the geminate *tt* is clearly different from a fortis t. In (37) we are dealing with a case of transgression, since the m-command relationship from xO_5 goes beyond the maximal onset

projection O_5''. This makes the geminate *tt* quite different from an English fortis t as given in (34b). In a fortis t, the onset head only m-commands one point (*viz.* the highest x of the onset projection), while in a geminate *tt* it m-commands two points. This amounts to saying that the *tt* in *fatto* is overlong, just like in the Estonian word *jutt* jud::.[11] What is crucial for stress then is the the presence of the point x_2 in (37), *i. e.* the sister of a nuclear head in a c-expansion. This is the very point that gives us a geminate (and not just a fortis object) and it is also the point that will be seen by the metrical system. As we shall discuss in the next chapter, the first member of a cluster is also in the same position, *i. e.* the sister of a nuclear head in a c-expansion. This makes sure that a geminate and a cluster both count as metrically heavy. This can be formalised as in (38).

(38) The sister of the nuclear head in a c-expansion counts as metrically heavy.
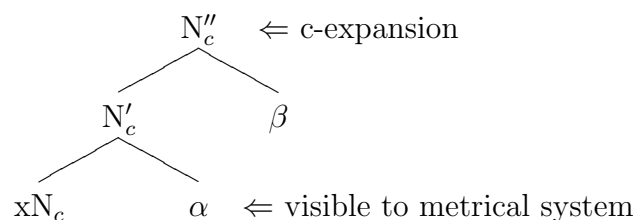
Let us move on to *fato*. We have seen that an Italian simpleton *t* behaves like both an English lenis d or a fortis t as regards stress. Based on metrical facts alone, we could choose either (34a) or (34b). I will opt for the lenis structure and propose the following representation for *fato*.

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[11] This differs from the representations we assumed in chapter 1, where we did not distinguish between an English fortis t and an Italian geminate *tt*. That is, the structures in chapter 1 were not quite correct, but they were incorrect in *any* case, since the theory they were expressed in (standard GP) was wrong: Standard GP's theory of constituent structure had to be rejected since it did not allow us to incorporate the fortis/lenis hypothesis (or Jensen's (1994) proposal). The idea in chapter 1 was only to show the parallels in the trade-off. That standard GP could not distinguish between fortis onsets and geminates can be seen as another argument against it.

(39) *fato* 'fate'

$$N_1''''$$

Tree diagram:
- N_1''''
  - N_1'''
    - O (△)
    - N_1''
      - N_1'
        - $xN_1\{\mathbf{A}\}$
        - x_2
      - x_3
      - O_5''
        - O_5'
          - x_4
          - $\leftarrow xO_5\{\mathbf{A}\}$
  - $xN_6\{\mathbf{A}, \mathbf{U}\}$
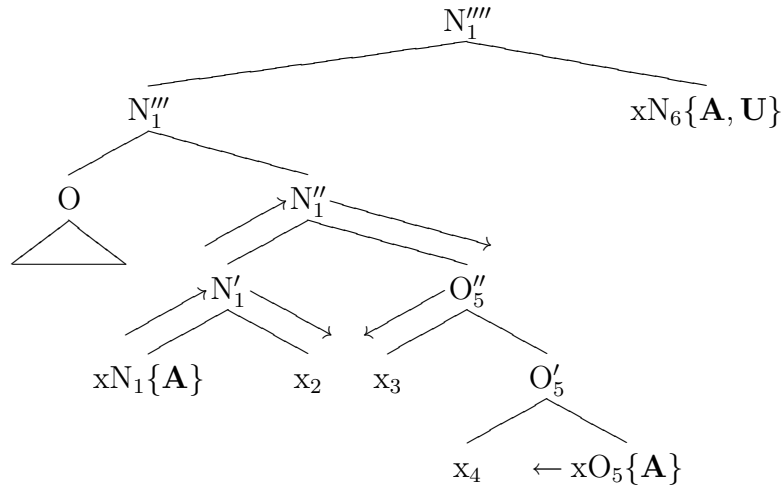
The *t* in *fato* is lenis, while the *a* preceding it is overlong: xN_1 m-commands two unannotated x-slots. In choosing the lenis structure for the *t* in *fato* I follow the old insight of Standard GP that an Italian or French *t* as in *tu* 'you' (in both languages) is the same as an English *d* in *do*, *cf. e. g.* Harris (1994: 133ff). Note in this context that Italian is an **L**-voicing language: Alongside *t* and *tt* in *fato* or *fatto* we also find *d* and *dd* in *Alfredo* (proper name) or *freddo* 'cold'. The difference between *t* and *tt* on the one hand and *d* and *dd* on the other is characterised by the element **L**, *i. e.* *d/dd* contain **L**, *t/tt* do not. The difference is purely melodic and has of course no consequences on structure. An example for this could already be seen in (35a): stress in the antepenultimate position is impossible both in *galoppo and *conobbi, irrespective of whether the penultimate is followed by a geminate containing **L** (*bb*) or one without (*pp*).

Both in the representation of *fato* (39) and *fatto* (37) the domain head expands into a c-expansion. This seems to be a general condition on Italian *bid*-type structures, which we can capture in (40).

(40) **Italian:**

The domain head of a *bid*-structure has to be a c-expansion.

This is in fact very similar to the condition we proposed for Estonian in (13) on p. 154.

There is yet another similarity to Estonian. Structures as in (37) and (39) are not new to us, we have already seen them before, *viz.* as the outcome of tconcat() in Estonian. The structure of *fatto* (37) equals the final result of Estonian $[\,[\,\mathsf{jud\!::}\,]\,\mathsf{u}\,]$, while *fato* (39) is like the outcome $[\,[\,\mathsf{si\!::d}\,]\,\mathsf{i}\,]$. (41) gives those two structures from Estonian.

(41) a. The final result of $\varphi(\mathrm{tconcat}(\varphi(\mathsf{jud\!::}),\mathsf{u}))$

b. The final result of $\varphi(\mathrm{tconcat}(\varphi(\mathsf{si\!::d}),\mathsf{i}))$

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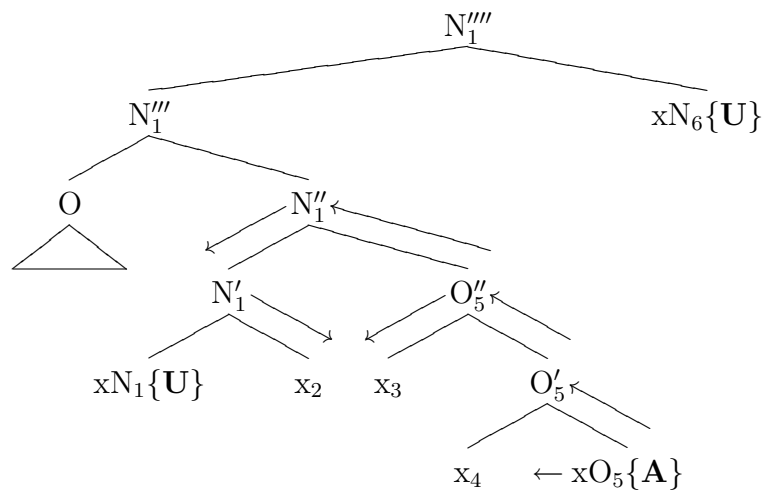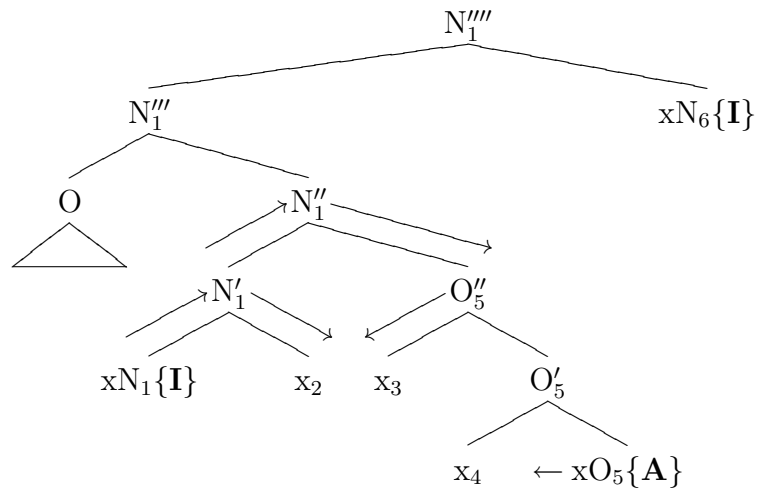
The Estonian structures were the result of the application of tconcat(); both structures involve analytic morphology. If the Italian structures look exactly like something that is the output of tconcat() in Estonian, then how can we make sure that Italian *fato* and *fatto* are not complex themselves, *i. e.* results of tconcat()? After all, the final *-o* is indicative of the inflectional class the word goes into and also serves to indicate grammatical gender. If the *-o* smells of morphology, why not assume we are really dealing with $[\,[\,fatt\,]\,o\,]$ and $[\,[\,fat\,]\,o\,]$? This would save us from the stipulation that Italian can have lexical forms that in Estonian could only occur through tconcat()?

The answer is simple: If, for example, *fatto* were in fact $[\,[\,fatt\,]\,o\,]$, we should expect that its inner domain, $[\,fatt\,]$, could exist on its own, which of course it does not: With the exception of very few loans, Italian has no words with an inaudible final nucleus. Note the clear contrast to Estonian, where a domain like *jutt* $[\,\mathsf{jud\!:\!:}\,]$ can very well stand on its own.

We thus have to conclude that a *fato* and *fatto* are lexical representation and not the result of tconcat(). This makes Italian different from English or Estonian. All the lexical *bid*-structures we have seen in English and Estonian had a final nucleus that was p-licensed. We have to assume that this is a particular property of those two languages, and that Italian differs in that it also allows for *bid*-structures even though the final nucleus is filled. That there should be such a difference between English and Estonian on the one hand and Italian on the other might well have to do with the parameter on final empty nuclei, *cf.* (41) on p. 121. It has been known at least since Kaye (1990a) that one difference between languages like English and Italian lies in whether final nuclei are licensed to remain empty or not. It might well be that there is a connection between this parameter and whether final nuclei in *bid*-structures can be filled. That is, it might well be a general property of phonological systems that if final nuclei are not allowed to remain empty, then there can be *bid*-structures where the final nucleus is lexically filled (unlike English or Estonian). Further research will have to show whether this conjecture is true or not.[12] The chart in (42) sums up what final simpleton nuclei in *bid*-structures can look like.[13]

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[12] Note that this is only a possible connection, not a necessary one: One could also imagine a scenario where a language L does not allow for final nuclei to remain empty while it only allows for *bid*-structures where the final nucleus is p-licensed. Under such a setting L could never have domains with a *bid*-structure.

[13] Note that the chart in (42) refers to final *simpleton* nuclei in *bid*-structures only.

(42)   Italian: always filled

        Estonian: lexically empty, but can be filled as result
                         of tconcat()

        English: always empty

There is another issue that has to be addressed with respect to (37) and (39). The structure in (37) gives us a short a followed by an overlong t, while in (39) we find an overlong a followed by a short t. This does not exhaust all logical possibilities. The third option, which is absent from Italian, would be the following.

(43)   An illicit structure in Italian
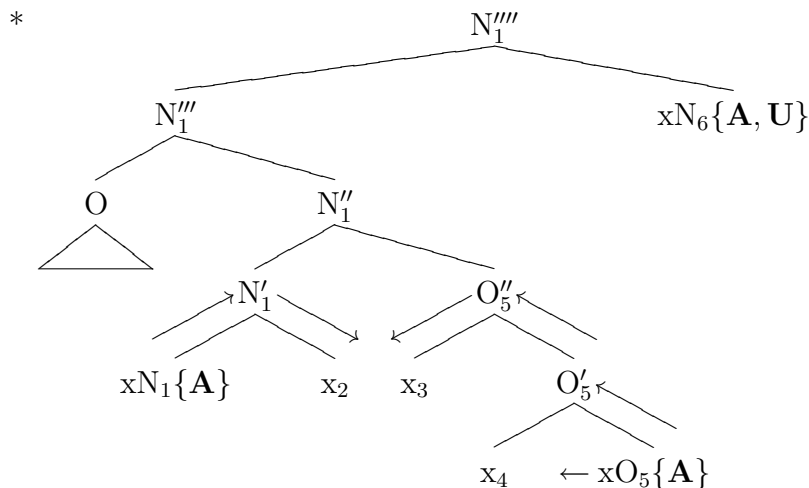
(43) shows a long (not overlong) a followed by a fortis t, something we do not find in Italian. While the *structure* of (43) is licit, the *m-command* relationships are not. What is characteristic about the illicit representation in (43) in comparison to the licit Italian structures we have seen before is that in (43) we find a fortis onset. Recall our definition of fortis in (18) on

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Recall from section 5.3 that English does allow for material in the right branch of *bid*-structures as the result of tconcat() under very specific conditions. Crucially, those conditions do not allow for a filled simpleton nucleus.

p. 70: An onset is fortis *iff* its head xO m-commands exactly one point, *viz.* the highest complement of the onset projection. The head xO_5 in (43) m-commands exactly one unannotated x (x_3), and x_3 is the highest unannotated x of the onset projection. The presence of this fortis onsets seems to be (at least part of) the problem.

We have seen a similar restriction on the distribution of fortis onsets before, *viz.* in Estonian: fortis configurations were only allowed as the complement to the right of the domain head in *bid*-structures (*e. g.* in the word *kiit* ɡiːdː 'praise'), and even then fortis lː, mː etc. were excluded, *cf.* the discussion in section 4.3. Italian seems to be even more restricted, in that fortis configurations as in (43) can *never* arise. This is stated in (44).

(44)   **Italian onset condition**
       Italian onsets can never be fortis.

In other words, a principle we have already identified for Estonian comes back in more general fashion in our analysis of Italian, which suggests that there is some substance to it. The principle in (44) makes sure that structures like (43) can never occur, since they contain a fortis onset.[14]

So far we have only talked about *bid*-structures. We have seen that Italian allows for *bid*-structures where the final nucleus is filled. What is important to notice is that this is the *only* difference between *bid*-structures in Italian and English. In all other respects they are identical. In particular, a *bid*-structure is only possible if the domain head immediately precedes the final nucleus (be it filled or not).

This is in fact an important ingredient in understanding yet another property of Italian. The trade-off in length is restricted to the penultimate position. Let us look at a word where the domain head is in antepenultimate position: the *è* in *dèbito* 'obligation' is not long, even though it is followed by a *b* (which is lenis and **L**-voiced). What does this mean in our model? The

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[14] The principle in (44) also predicts that we cannot find fortis onsets in any other position, *e. g.* initially. This is of course correct: Italian has words like *detto* 'said' *vs. tetto* 'roof', but this is a difference between a lenis onset containing **L** and a lenis onset without **L**.

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domain head is in antepenultimate position, therefore *dèbito* could not possibly be assigned a *bid*-structure, but rather has to have a *Libby*-structure. The representation is given in (45).

(45)

$$
\begin{array}{c}
N_1'' \\
\diagdown \\
O \qquad N_1' \\
\triangle \\
xN_1\{\mathbf{A}, \mathbf{I}\} \quad N_5'' \xleftarrow{\ p-lic} \\
O_4'' \qquad N_5' \\
x_2 \quad O_4' \quad xN_5\{\mathbf{I}\} \quad N_9' \xleftarrow{\ p-lic} \\
x_3 \ \leftarrow xO_4\{\mathbf{U}\} \quad O_8'' \quad xN_9\{\mathbf{A}, \mathbf{U}\} \\
x_6 \quad O_8' \\
x_7 \ \leftarrow xO_8\{\mathbf{A}\}
\end{array}
$$
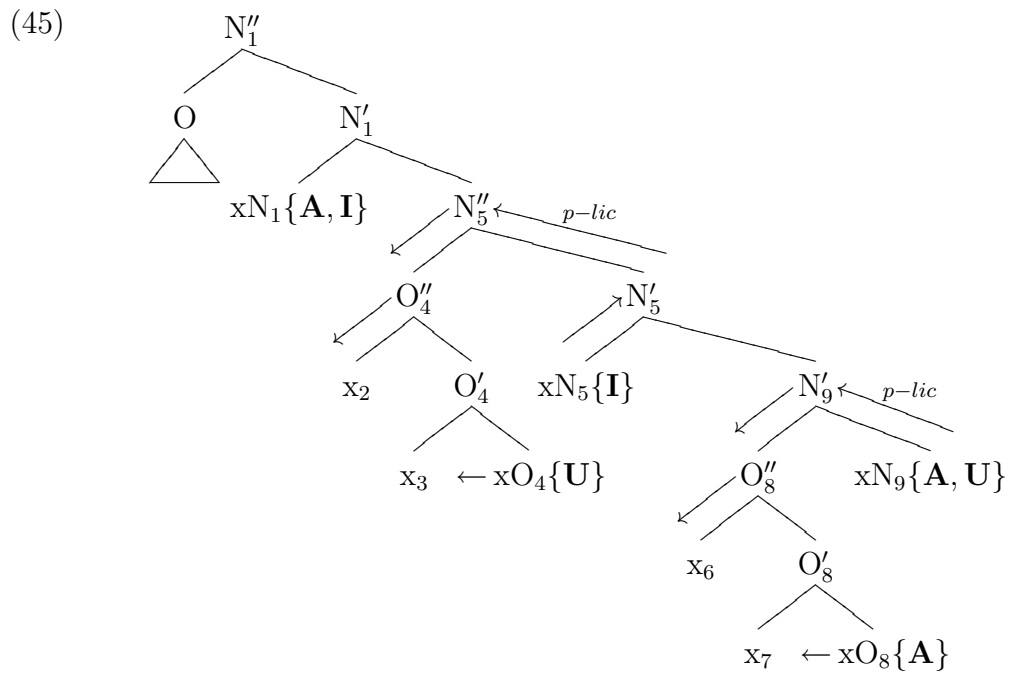
The domain head, xN_1, could not m-command x_2, since xN_5 is a closer licenser for x_2 than xN_1 could be. However, this alone does not explain why we cannot have a structure like the following one.

(46)   *

$$N_1'''$$

$$O \qquad N_1''$$

$$N_1' \qquad N_6'' \xleftarrow{p-lic}$$

$$xN_1\{\mathbf{A}, \mathbf{I}\} \quad x_2 \quad O_5'' \qquad \qquad N_6'$$

$$x_3 \qquad O_5' \qquad xN_6\{\mathbf{I}\} \qquad \qquad N_{10}' \xleftarrow{p-lic}$$

$$x_4 \leftarrow xO_5 \qquad \qquad O_9'' \qquad xN_{10}\{\mathbf{A}\,\mathbf{U}\}$$

$$x_7 \qquad O_9'$$

$$x_8 \quad \leftarrow xO_9\{\mathbf{A}\}$$
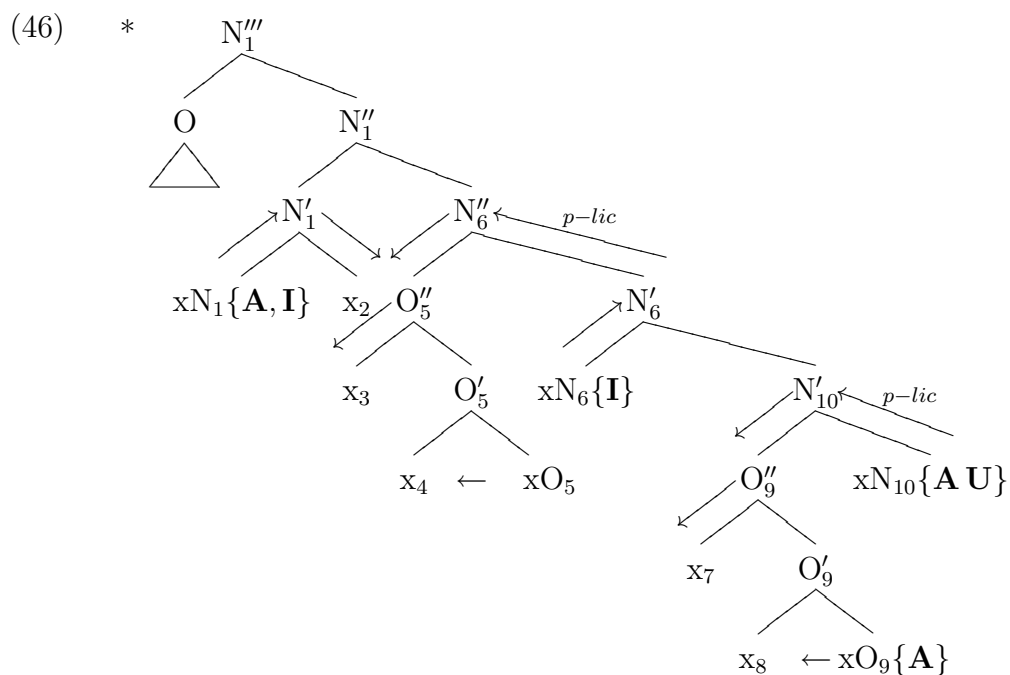
In (46) the domain head xN_1 expands into a c-expansion, while in (45) it does not. We could say that Italian does not allow the domain head in a *Libby*-structure to expand into a c-expansion. The domain heads of all the Italian *bid*-structures have to be a c-expansion, *cf.* (40), so maybe it is a defining property that *bid*-structures must be headed by a c-expansion, while *Libby*-structures cannot be headed by a c-expansion in Italian. However, such an explanation runs into immediate problems. While (46) does not occur, the structure in (47), representing the word *màcchina* 'machine, car', is completely well-formed.

(47)

$$N_1''' \quad O \quad N_1'' \quad N_1' \quad N_6'' \quad xN_1\{\mathbf{A}\} \quad x_2 \quad O_5'' \quad N_6' \quad x_3 \quad O_5' \quad xN_6\{\mathbf{I}\} \quad N_{10}' \quad \textit{p--lic} \quad x_4 \leftarrow xO_5 \quad O_9'' \quad xN_{10}\{\mathbf{A}\} \quad x_7 \quad O_9' \quad x_8\{\mathbf{A},\mathbf{L}\} \quad xO_9$$
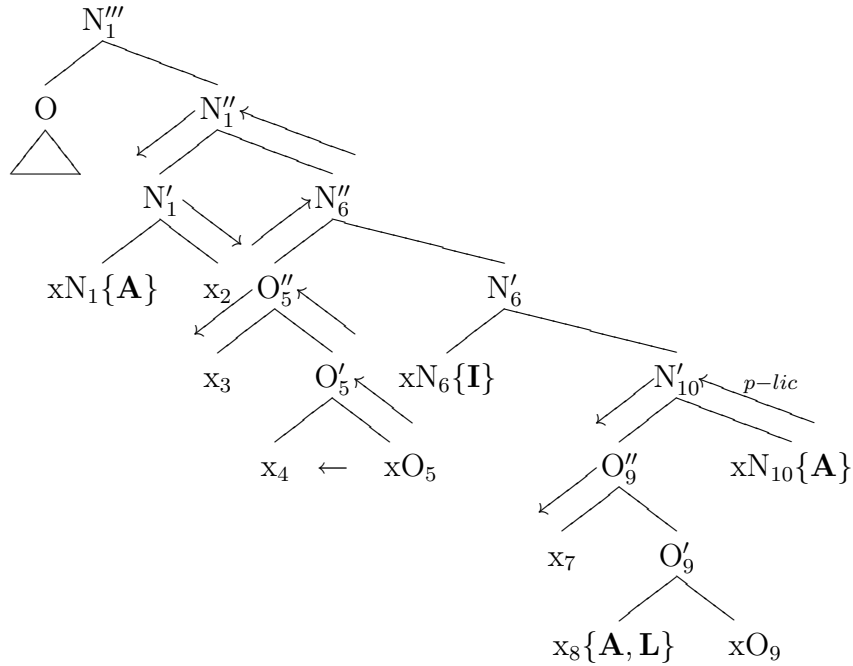
In (47), the domain head xN_1 does expand into a c-expansion, and the structure is well-formed. The onset head xO_5 m-commands x_2 and x_3, which gives us a geminate. Again, geminates in this position pattern with clusters, *i. e.* alongside *màcchina* we also find words like *càndido* '(snow) white' or *cùlmine* 'peak, pinnacle'. What we are forced to say then is that an xN can only m-command its sister if it is the head a *bid*-structure. This excludes the structure in (46), where xN_1, which is *not* the head a *bid*-structure, m-commands its sister. At the same it includes (47), where xN_1 does not m-command anything anyway.

In other words, the distinction between *bid*-structures (such as *fato*, *fatto*) on the one hand and *Libby*-structures (*dèbito*, *màcchina*) on the other allows us to state different conditions on domain heads. There are two ingredients we have isolated: (i) For the *bid*-type we said that the domain head must expand into a c-expansion. (ii) An xN can only m-command its sister if it is the head a *bid*-structure.

However, this cannot belie the fact that further work needs to be done. Distinguishing between two types of domains might well be only the first step in a complex puzzle. What we discussed in the present section was of

course only a sketch of the most salient aspects of length in Italian. Many more questions still need to be answered, but at least we have seen that our model not only works for English and Estonian, but is also able to handle a language like Italian.

5.5   Summary

In this chapter we discussed the role of morphology in the distribution of length in Estonian and English. We discussed the application of the function tconcat() and saw that there was an important difference between the two languages with respect to what an output structure could look like. We discussed the notion of reorganisation which would change illicit structures to licit ones. Eventually we turned to Italian and had a look at what the present model has to say about it.

Chapter 6

Clusters

In this final chapter I wish to give a brief discussion of how clusters can be implemented in the present model. Due to the complexity of the matter I will restrict myself to clusters with two members. We will discuss the most important cases from English and Estonian and see that the parallels between the two languages continue. We will be concerned with the distribution of length as well as questions of phonotactics. In section 6.1 we will discuss formal properties of clusters, and in section 6.2 we move on to substantive constraints. Section 6.3 looks at the interaction between *bid-* and *Libby*-type structures and the distribution of length within clusters.

Note that all the clusters discussed here are what standard GP called coda-onset clusters. We will not be concerned with branching onsets.

6.1   Formal conditions on clusters

In section 3.3 we discussed a number of possible types of domains; the *bee*-type, the *bid*-type and the *Libby*-type. Those three types could be characterised by what β in (1) is replaced by. In all the cases discussed in this dissertation so far, the variable α (if present at all) was an unannotated x-slot.

(1)
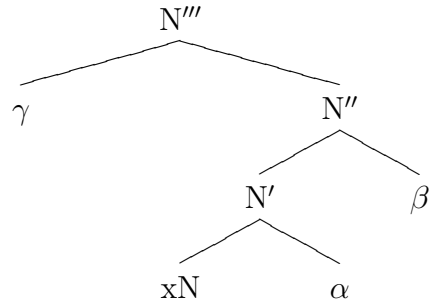
$$
\begin{array}{c}
\text{N}''' \\
\diagup \quad \diagdown \\
\gamma \qquad \text{N}'' \\
\diagup \quad \diagdown \\
\text{N}' \qquad \beta \\
\diagup \quad \diagdown \\
\text{xN} \qquad \alpha
\end{array}
$$

$\alpha \in \{\text{x, O}\}, \; \beta \in \{\text{x, O, N}\}, \; \gamma \in \{\text{O}\}$

As (1) shows, α ranges over x and O. It is now time discuss the case where $\alpha = $ O. This is the subject matter of the present chapter. The variable β can vary among x, O, or an N. In this chapter we will encounter cases where β is an O (a *bid*-structure) or an N (a *Libby*-structure).[1] This gives us two kinds of structure we will have to look at, given in (2).

(2)   a. $\alpha = $ O in a *bid*-structure

$$
\begin{array}{c}
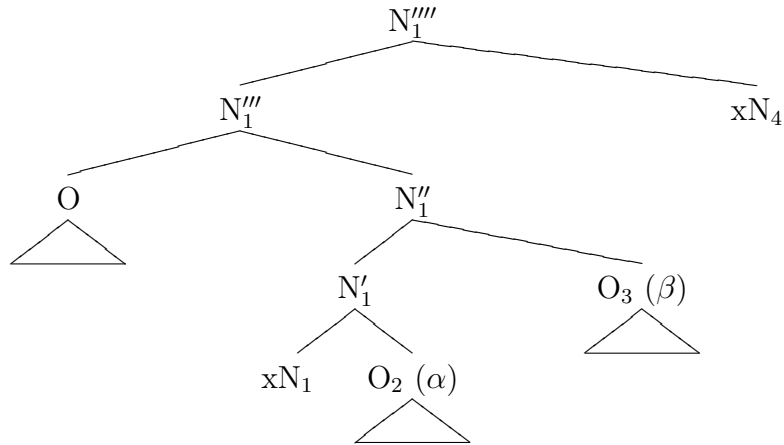\text{N}_1'''' \\
\diagup \qquad\qquad \diagdown \\
\text{N}_1''' \qquad\qquad \text{xN}_4 \\
\diagup \quad\quad \diagdown \\
\text{O} \qquad \text{N}_1'' \\
\triangle \quad\quad \diagup \quad \diagdown \\
\text{N}_1' \qquad \text{O}_3\,(\beta) \\
\diagup \quad \diagdown \quad\quad \triangle \\
\text{xN}_1 \quad \text{O}_2\,(\alpha) \\
\triangle
\end{array}
$$

---

[1] It will become clear in a moment why β cannot be x.

(1)

$$
\begin{array}{c}
\text{N}''' \\
\diagup \quad \diagdown \\
\gamma \qquad \text{N}'' \\
\diagup \quad \diagdown \\
\text{N}' \qquad \beta \\
\diagup \quad \diagdown \\
\text{xN} \qquad \alpha
\end{array}
$$

$\alpha \in \{\text{x, O}\}, \; \beta \in \{\text{x, O, N}\}, \; \gamma \in \{\text{O}\}$

As (1) shows, α ranges over x and O. It is now time discuss the case where $\alpha = $ O. This is the subject matter of the present chapter. The variable β can vary among x, O, or an N. In this chapter we will encounter cases where β is an O (a *bid*-structure) or an N (a *Libby*-structure).[1] This gives us two kinds of structure we will have to look at, given in (2).

(2)   a. $\alpha = $ O in a *bid*-structure

$$
\begin{array}{c}
\text{N}_1'''' \\
\diagup \qquad\qquad\qquad \diagdown \\
\text{N}_1''' \qquad\qquad\qquad \text{xN}_4 \\
\diagup \quad\quad\quad \diagdown \\
\text{O} \qquad\quad \text{N}_1'' \\
\triangle \quad\quad \diagup \quad\quad \diagdown \\
\text{N}_1' \qquad \text{O}_3\,(\beta) \\
\diagup \quad \diagdown \qquad \triangle \\
\text{xN}_1 \quad \text{O}_2\,(\alpha) \\
\triangle
\end{array}
$$

[1] It will become clear in a moment why β cannot be x.

b. $\alpha = $ O in a *Libby*-structure
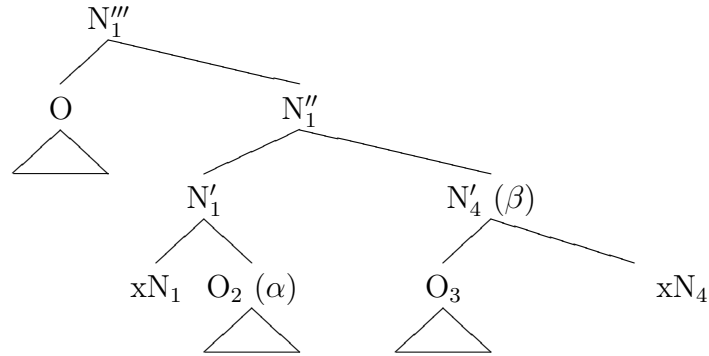
In both (2a–b) two onsets (O_2 and O_3) stand next to each other, they form a **cluster**. In this chapter, several aspects of clusters will have to be discussed. Most importantly, we will be concerned with length. Onset projections come with unannotated x-slots that need to be licensed in some way, *e. g.* by m-command. As we have seen, m-command is always the source of length, so we will have to talk about the distribution of length within clusters. In addition to that, we have seen that the possible m-command configurations are tightly connected to the distinction between *bid*-type and *Libby*-type words.

Before we can move on to length, however, some important formal and substantive requirements on clusters have to be mentioned: Under which conditions can α be replaced by an O? Consider the structure in (3), *i. e.* a *Libby*-structure where N_1' takes a "bare" N as its complement, *i. e.* a nucleus that does not take a preceding onset. I would like to claim that a structure as in (3) is impossible.

(3) An illicit structure

$*\ N_1'''$

O N_1''

    N_1' $xN_3\ (\beta)$

$xN_1\ \ O_2\ (\alpha)$
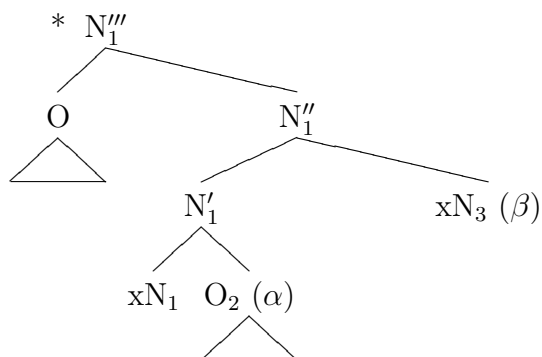
The variable α can only be replaced by a node of the type O *iff* that O is followed by another O. This gives us the principle in (4).

(4) **Cluster licensing:**

If in a c-expansion the nuclear head has an onset O_n as its sister, this O_n has to be licensed by an onset O_{n+1} following it.

The principle in (4) excludes the structure in (3). In (3) O_2 is not followed by another onset, but rather by a nucleus (xN_3). O_2 is not licensed by a following onset and the structure is illicit.[2]

So far we have not identified any principles that would restrict the number of possible clusters to those that actually occur. (4) simply states that the first member of a cluster is licensed by the second member, but it does not say what kinds of onsets can occur as the first and second member, respectively.

A first step towards reducing the number of clusters is made by the principle in (5).
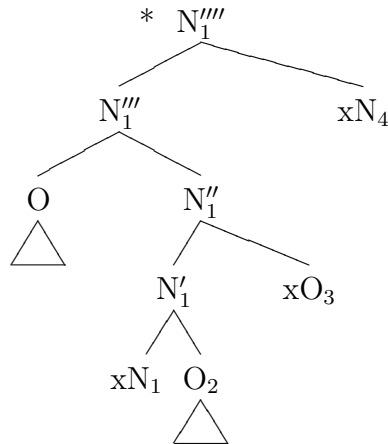
(5) **Minimal cluster licenser**

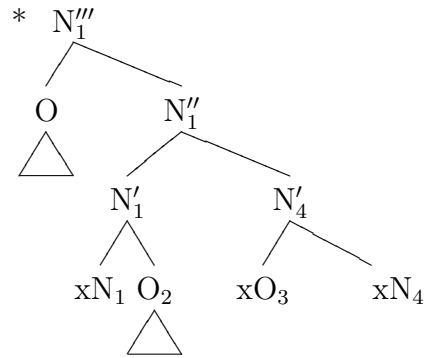An onset O_n can only be licensed by an onset O_{n+1} *iff* O_{n+1} projects.

---

[2] This also explains why β cannot be an unannotated x when α is of the type O, since the unannotated x cannot license the preceding O. The principle in (4) is very much in the spirit of 'coda licensing' (Kaye 1990a) in Standard GP.

The condition in (5) excludes structures as in (6).

(6)   a.illicit cluster
      in a *bid*-structure
                                b.illicit cluster
                                           in a *Libby*-structure

The tree for (6a) is rooted at $*$ N_1'''', which branches to N_1''' and xN_4. N_1''' branches to O (with a triangle beneath) and N_1''. N_1'' branches to N_1' and xO_3. N_1' branches to xN_1 and O_2 (with a triangle beneath).

The tree for (6b) is rooted at $*$ N_1''', which branches to O (with a triangle beneath) and N_1''. N_1'' branches to N_1' and N_4'. N_1' branches to xN_1 and O_2 (with a triangle beneath). N_4' branches to xO_3 and xN_4.

In other words, it guarantees that there will be no ("coda-onset") clusters with r, w or j as the second member.
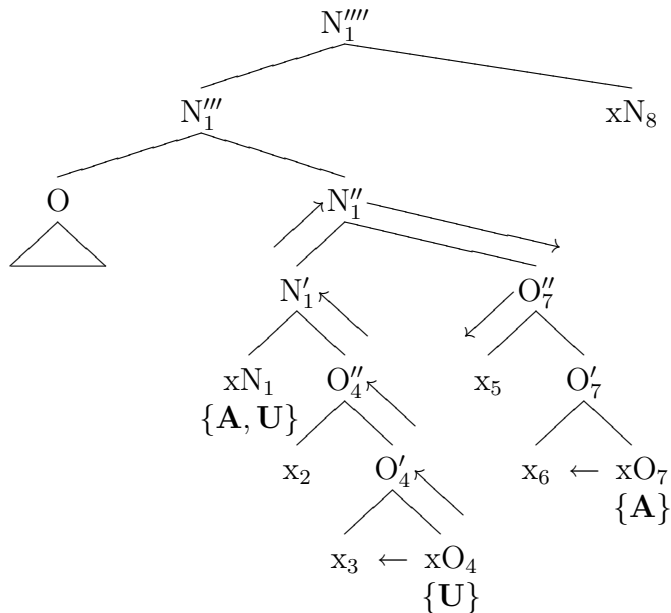
6.2 Substantive conditions on clusters

6.2.1 A-command

The principles in (4) and (5) state formal requirements for when α can be of the type O. Formal requirements alone will not explain all phonotactic details of clusters, however. We will also have to look at substantive constraints on clusters. Consider the representation of the Estonian word *kopt* gob:d 'Copt' in (7).

(7) *kopt* gob:d 'Copt NOM. SG.'

$$
\begin{array}{c}
N_1'''''\\
\diagup\qquad\diagdown\\
N_1'''\qquad\qquad xN_8\\
\diagup\quad\diagdown\\
O\qquad N_1''\\
\triangle\quad\diagup\quad\diagdown\\
N_1'\qquad O_7''\\
\diagup\diagdown\qquad\diagup\diagdown\\
xN_1\;\;O_4''\qquad x_5\;\;O_7'\\
\{\mathbf{A,U}\}\diagup\diagdown\qquad\quad\diagup\diagdown\\
x_2\;\;O_4'\qquad x_6\leftarrow xO_7\\
\diagup\diagdown\qquad\qquad\{\mathbf{A}\}\\
x_3\leftarrow xO_4\\
\{\mathbf{U}\}
\end{array}
$$

The particular m-command relationships in (7) are not important at the moment. What is crucial about (7) is that xO_4 is labelled with $\mathbf{U}$ and xO_7 with $\mathbf{A}$, giving us the cluster b:d. The onset containing $\mathbf{A}$ licenses the onset that contains $\mathbf{U}$. The mirror image (*i. e.* xO_4 labelled with $\mathbf{A}$ and xO_7 with $\mathbf{U}$) is impossible: Estonian has *kopt* gob:d, but no *god:b. The same holds for English, which has words like *apt* or *chapter*, but none like *atp* or *chatper*.

(8)   a. Estonian

abt	ab:d	'abbot'
pakt	bag:d	'pact'
lift	lif:d	'elevator'

   b. English

apt	*fifth*
pact	*depth*
lift	

In other words, the *second* onset of the cluster, which licenses the first onset, has to contain **A**. [3] We have already seen at several times that the element **A** (a melodic property) has an effect on structure, *e. g.* in section 4.2.2, where we discussed adjunction structures and said that only **A** can license adjunctions. The special nature of **A** also plays a role in clusters. We can explain the absence of *d:b by the following principles.

(9) **A-licensing:**

In a cluster $O_1 O_2$ the onset O_1 has to be A-licensed.
An onset that is A-commanded counts as A-licensed.

A-licensing in (9) refers to A-command, a definition of which is given in (10).

(10) **A-command:**

An onset O_2 can A-command a preceding onset O_1 *iff* the head of O_2, xO_2, is labelled with **A**.

Let us go through those principles step by step. (9) introduces the notion of A-licensing. The first onset of a cluster has to be A-licensed. One way of satisfying this A-licensing requirement is by A-command, which is defined in (10).[4] Only an onset headed by **A** can function as an A-commander. In Estonian, the only onset that is headed by **A** is d (in various degrees of length, *i. e.* short, long or overlong). The principles in (9) and (10) allow us to capture that gob:d is possible, while *god:b is not. The same principles hold in English. We find *apt*, *chapter*, *lift*, *depth* or *fifth* but no *atp*, *chatper*, *litf*, *dethp* or *fithf*. The onset containing the **A** is always the second member of the cluster.[5, 6]

---

[3] This is not entirely true of Estonian, which also has a cluster d:g as in the word *hetk* hed:g 'moment'. I will disregard this rather unusual cluster.

[4] We will see another way of A-licensing the first onset below in section 6.2.3.

[5] Standard GP had a similar device in the principle of "**A** governs non-**A**", *cf.* Kaye (2000: 8).

[6] (10) requires that **A** be in the head of the A-commander. This correctly excludes *l* as the second member of clusters.

6.2.2 Length in clusters

Let us now have another look at the word *kopt* gob:d, repeated here as (11). A-command is indicated by an arrow between the two root nodes of the onsets (O_7'' and O_4''), in order to indicate that it is a relationship holding between two onsets as a whole.[7] (We will see in a moment why this is relevant.)

Our next concern will be the m-command relationships holding within the domain. We are going to see that the model presented so far is not only capable of explaining the distribution of length with simpleton onsets, but also within clusters.

(11) *kopt* gob:d 'Copt NOM. SG.' (repeated)
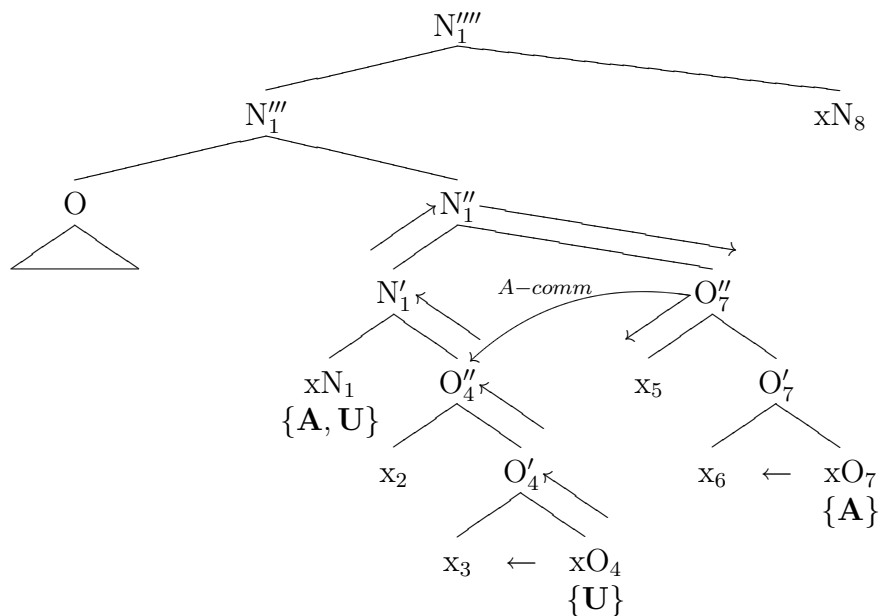
In (11), xO_4 m-commands one other point, x_5. This gives us the long b: in *kopt* gob:d. The final onset, xO_7, does not m-command any other point and we get a short d.

The structure in (11) contains one unannotated x that does not seem to be licensed by anything, *viz.* x_2. We know that x_2 is not m-commanded

---

[7] I assume that A-command only holds under adjacency, *i. e.* when the two onsets stand next to each other.

by xN_1, as this would give us *go:b:d, counter to fact. Likewise, it is not m-commanded by xO_4, as this would come out as *gob::d with an overlong b::, which is not correct, either. We have to conclude that x_2 is licensed by some other means. What I would like to propose is that x_2 is licensed as a by-product of A-licensing. The first onset of the cluster, *i. e.* O_4'' as a whole, is A-commanded by the second onset of the cluster and therefore A-licensed. A-licensing is not only a condition on cluster phonotactics, but it is also (as the name says) a licensing mechanism, which licenses x_2. This does not only hold true of the cluster in (11), but in fact of all the clusters we will deal with here: The highest complement of an A-licensed onset is always licensed.

(12) The highest complement x in an A-licensed onset counts as licensed.

Let us now have a closer look at the distribution of length within the cluster. The point x_5 in (11) is m-commanded by xO_4. Are there any other candidates that x_5 could be m-commanded by? The representation would contain two other possible m-commanders for x_5, *viz.* xN_1 and xO_7. I want to claim that neither one of the two could m-command x_5. Let us see why. We begin with xN_1. We know that xN_1 cannot m-command x_5, as this would give us *go:bd as the outcome.

(13) Illicit representation
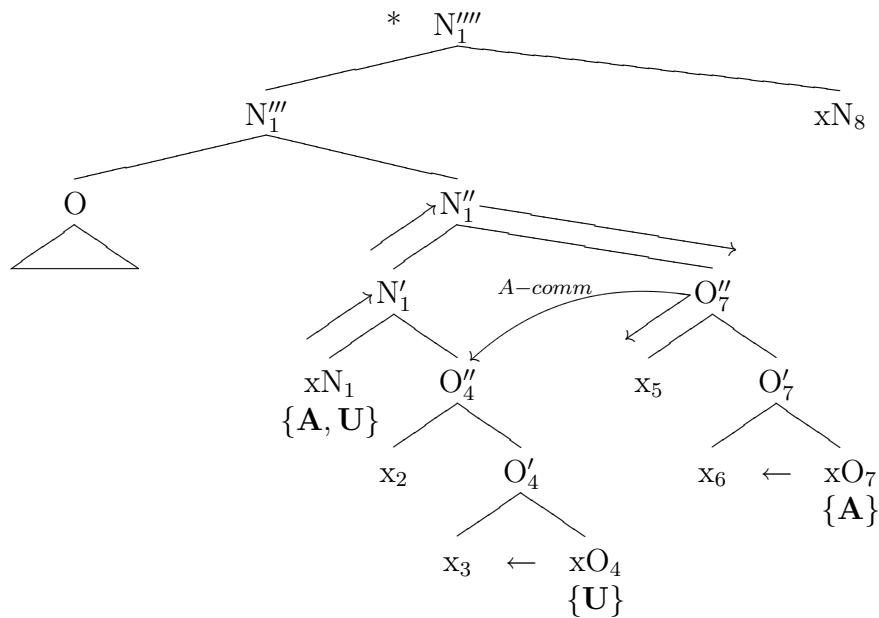
How do we explain this? The notion of closest licenser, *cf.* (58) on p. 134, is of no help to us here. Let us look at (11) again: the smallest substructure that contains both xO_4 and the m-commandee, x_5, is N_1''. As (13) shows, the very same node N_1'' also dominates xN_1, which we want to exclude as the m-commander of x_5. In other words, we cannot say that xO_4 is a closer licenser for x_5 than xN_1 is, because both xO_4 and xN_1 are equally close to x_5.

If the notion of closest licenser does not help us, then how can we exclude (11)? In (11) we see an m-command relationship from xN_1 to x_5, and this m-command relationship has to go *across* another onset, O_4''. I would like to propose that this is the crucial factor which explains why (11) is ungrammatical: The m-command relationship going into an onset must not go across a projection of the same type, *i. e.* another onset. This could be referred to as the principle of the closest licensee, as stated in (14).[8, 9]

(14) **Closest licensee:**

   A nuclear head can only m-command into the closest onset.

This principle is clearly violated in (11). Again, "closest" is defined with respect to tree structure. The relevant projection that dominates both xN_1 (the m-commander) and O_7'' is N_2''. However, there is a smaller projection contained within N_2'', *viz.* N_2', that dominates both the m-commander xN_1 and another onset projection, O_4''. O_4'' is the closest onset for xN_1, and accordingly O_4'' will block any m-command between xN_1 and x_5.

Let us now explore the second possibility we mentioned before: could x_5 in (11) be m-commanded by xO_7, giving us a cluster **bdː**, where the first member is short and the second is long? Such clusters are absent from Estonian, *i. e.* we find **bːd** but no ***bdː**. This illicit structure is given in (15).

---

[8] There is a certain formal resemblance to the syntactic principle of Relativised Minimality (Rizzi 1990).

[9] In section 2.3.2.2, where we introduced m-command, we already said that ideally we would want to restrict m-command even further, *e. g.* in scope. The principle in (14) can be seen as a first step towards a restriction of the scope of m-command.
Obviously, further research will have to address the question whether notions such as "closest licenser" and "closest licensee" can be united under one common principle.

(15) Illicit representation
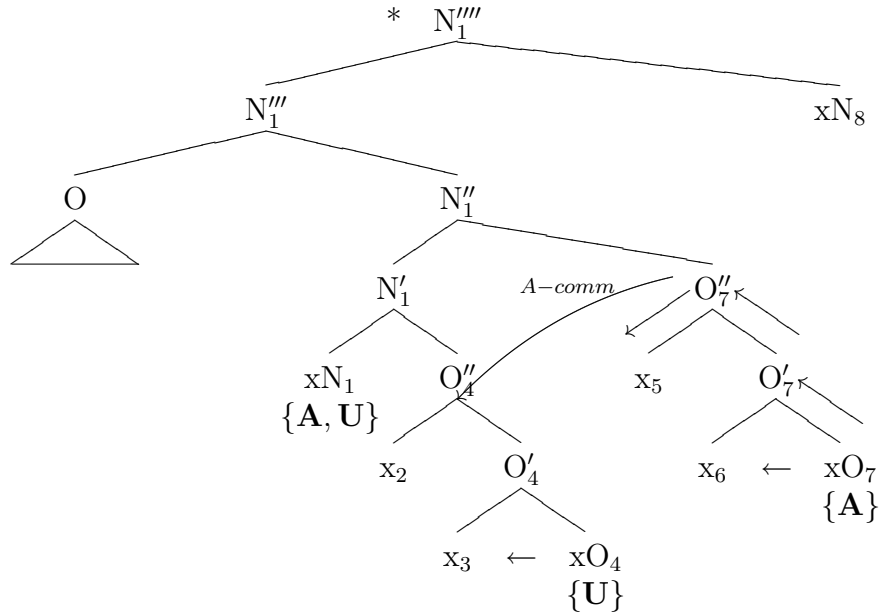
What are the formal grounds on the basis of which (15) can be excluded? Recall from section 4.3 that Estonian imposes tight constraints on when an xO can m-command the highest unannotated x of the projection, *viz.* only when the onset is a right-hand complement of domain heads in *bid*-structures. But in (15) O_7'' *is* a right-hand complement of the domain head in a *bid*-structure, but still xO_7 cannot m-command x_5. There has to be some reason that O_7'' cannot be fortis. We know that O_7'' already has to fulfill the role of an A-commander; it A-commands the preceding onset O_4''. What I want to propose is that A-command and m-command of the highest complement are mutually exclusive, as formulated in (16).

(16) **Fortis *vs.* A-command:**

   In a cluster $O_1 O_2$ the onset O_2 can *either*

   a. m-command its highest complement *or*

   b. A-command the preceding onset, but not both.

O_7'' is the A-commander of O_4'' in (15) and can therefore not be fortis at the same time. (15) is successfully excluded as ungrammatical.[10]

While the conditions introduced so far explain (most of) what usually comes under the heading of obstruent-obstruent clusters, they obviously do not explain every single cluster. Let us now extend the picture a bit. We shall see that our principles only need to be slightly supplemented to explain most of the remaining clusters.

6.2.3   A-licensing without A-command?

Up to now we have seen cases where the second onset A-commands the first onset of the cluster, *i. e.* the second onset had to contain **A**. However, there are also clusters where the second onset does not contain **A**. Those will be the topic of the present section.

Firstly, there are clusters that do not contain any **A** at all, *e. g.* in *mb* or *mp*. We will postpone the discussion of those cases for a moment. Secondly, we have seen that A-command excludes *tp and allows for *pt*. But what about a cluster like lp in English *help* or r:g in Estonian *turg* dur:g 'market'? In both clusters the **A** is contained in the first member (the l in lp and the r in r:g), while the second member of the cluster (p and g, respectively) does not contain **A**. This calls for an explanation. (17) gives a more comprehensive list of such clusters. (For references on the length facts *cf. e. g.* Raun & Saareste (1965).)

(17) a. Estonian

	i. short + long			ii. long + short	
tulp	dulb:	'pile'	*halb*	hal:b	'cheap'
nurk	nurg:	'corner'	*turg*	dur:g	'market'
kõrb	gɜr:b	'desert'	*kirp*	girb:	'flea'
murd	mur:d	'crowd'	*vart*	vard:	'flail'
kirs	gir:s	'thin ice'	*kirss*	girs:	'cherry'

---

[10] The full potential of the principle in (16) will become clear in the next section.

b. English

i. long + lenis		ii. short + fortis	
bulb	bʌlːb	*pulp*	pʌlp
to shelve	ʃɛlːv	*shelf*	ʃɛlf

The chart in (17) illustrates three important properties which we shall look at in turn. Firstly, the second member of the cluster is no longer restricted to onsets containing **A** as their head. We find lbː/lːb, rgː/rːg, rːb/rbː etc. Why are there hardly any restrictions? Why does the second member of the cluster enjoy such melodic freedom? In our discussion of clusters like bːd in Estonian *kopt* 'Copt' or English *pt* in *apt* or *ft* in *lift* we saw that the first onset needed to be A-licensed and that it receives this A-licensing via A-command from the second onset. Let us compare this to a cluster like rːg, where the second onset does not contain **A**. If the presence of **A** is not required in the second onset, then obviously the first onset cannot be A-commanded from the right. Still, all the clusters in (17) are licit. We will see in a moment why.

Before that, let us come to the second issue illustrated in (17). We have seen that there is no A-command from the second onset to the first one. Notice that the lack of A-command from the right makes an important prediction. In (16) we wanted to explain why in a cluster like bːd the second member can only be lenis, but not fortis. We concluded that A-command and m-command of the highest complement must be mutually exclusive. Since the onsets in (17) do not need A-command from the right, we should expect that the second member of the cluster can be fortis. This is indeed correct: We find both rːg and rgː, lːb as well as lbː etc. The second member of the clusters can be fortis, unlike the clusters we had a look at in section 6.2.

Note that nothing in the formulation in (16) forbids the second member being lenis in clusters like rːg (*turg* durːg 'market'). (16) only states that an onset can either act as an A-commander *or* its head can m-command the highest unannotated x; it could be doing neither. The g in rːg does not A-command the r, nor is it fortis. This is perfectly in accordance with (16).
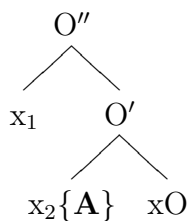
The fact that the second member can be lenis or fortis brings us to the third issue illustrated in (17): Once again we observe a trade-off relationship. The more room is taken up by the first member of the cluster, the less remains for the second member. This trade-off relationship between the two members
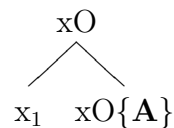
of the cluster is identical in both languages. Before we look at the distribution of length, let us go into an analysis of *why* the clusters in (17) are licit, even though their initial onset is not A-commanded.

Let us have a look at the first members of the clusters in (17), given in (18), and see which properties we can identify that explain why A-command is not required.

(18)　a. l　　　　　　　　　　　　　　　　　　b. r

$$
\begin{array}{c}
O'' \\
\diagup\diagdown \\
x_1 \quad O' \\
\quad\ \ \diagup\diagdown \\
\quad\ \ x_2\{\mathbf{A}\} \quad xO
\end{array}
\qquad\qquad
\begin{array}{c}
xO \\
\diagup\diagdown \\
x_1 \quad xO\{\mathbf{A}\}
\end{array}
$$

What do the objects in (18a–b), the first members of the clusters in (17), have in common? Both contain $\mathbf{A}$, and in both structures that $\mathbf{A}$ is *not in every* xO position. Let us look at (18a): $\mathbf{A}$ is in the complement position x_2, so trivially it is not in every xO position. We are dealing with an AL-construction here (*cf.* section 2.3.3). In (18b) we have an adjunction structure (*cf.* section 4.2.2), and only the lower xO is annotated with $\mathbf{A}$. Again it is true that $\mathbf{A}$ is not in every xO position. We saw in the previous section that the first onset of a cluster needs to be A-licensed. What I want to claim is that all the structures in (18) are A-licensed by virtue of containing an $\mathbf{A}$ that is not contained in every xO position. That is, a cluster like r:g, where the second member cannot A-command (and therefore A-license) the first member, is still licit because the *first* member of the cluster has a structure as under (18a). The A-licensing requirement of the first onset is automatically fulfilled. Since the first member is automatically A-licensed, an r or l do not need an A-commander to their right, *i. e.* they do not impose any melodic restrictions on the following onset. This, as we have seen, is indeed correct. The structures in (18) can be followed by basically anything.
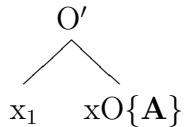
A formal characterisation of the objects in (18) is given in (19).
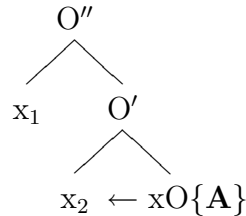
(19) An onset is automatically A-licensed if

    a. it contains **A** and

    b. this **A** is not in every xO position.

The definition in (19) also makes sure that not any onset containing **A** is automatically A-licensed. While it is true that onsets like r or l (both of which contain **A**) can be followed by basically any other onset, it is of course not true that *any* onset containing **A** can be followed by any other onset. We have already seen that *e. g.* a *t*, which also contains **A**, cannot be followed by a *p*. Contrast the structures in (18) to the ones in (20).

(20) a. ð/θ   b. d/t

$$
\begin{array}{ccc}
 & O' & \\
 & \diagup\diagdown & \\
x_1 & & xO\{\mathbf{A}\}
\end{array}
\qquad\qquad
\begin{array}{ccc}
 & O'' & \\
 & \diagup\diagdown & \\
x_1 & & O' \\
 & & \diagup\diagdown \\
 & & x_2 \;\leftarrow\; xO\{\mathbf{A}\}
\end{array}
$$

Neither of the structures in (20) fulfills the conditions in (19): They contain **A**, but this **A** is in every xO. (Of course, both structures contain only one xO.) The structures in (20) do not count as automatically A-licensed.

Let us now come to the distribution of length. (21) gives the representations of the Estonian words *nurk* nurg: 'corner' *vs. turg* dur:g 'market'.[11]

---

[11] The representation of *nurk* nurg: 'corner' (21a) and *turg* dur:g 'market' (21b) is in fact identical to the representation of *hurt* and *herd*, respectively, in rhotic varieties of English, which I will not go into here.

(21)   a. *nurk* **nurg:** 'corner'

$$N_1''''$$

N_1''' — xN_7

$N_1''' \to$ O (△), N_1''

$N_1'' \to N_1'$, O_6''

$N_1' \to xN_1\{\mathbf{U}\}$, xO_3

$xO_3 \to x_2$, $xO_3\{\mathbf{A}\}$

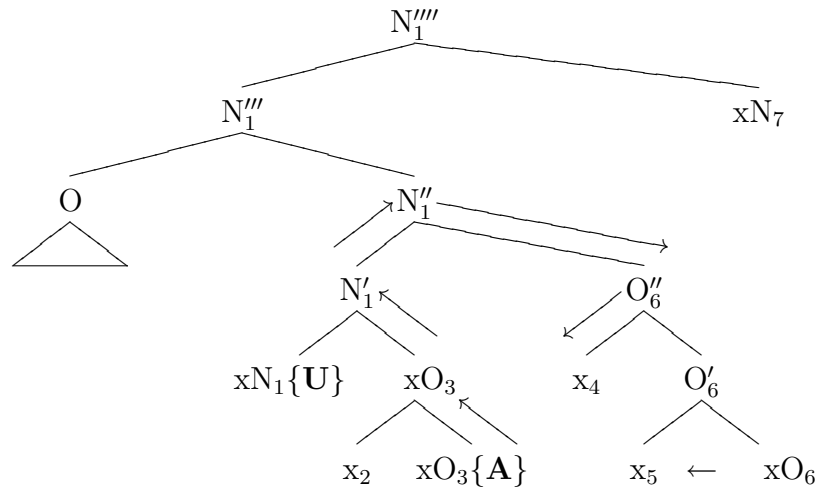$O_6'' \to x_4$, O_6'

$O_6' \to x_5 \leftarrow xO_6$

b. *turg* **dur:g** 'market'

$$N_1''''$$

N_1''' — xN_7

$N_1''' \to$ O (△), N_1''

$N_1'' \to N_1'$, O_6''

$N_1' \to xN_1\{\mathbf{U}\}$, xO_3

$xO_3 \to x_2$, $xO_3\{\mathbf{A}\}$

$O_6'' \to x_4$, O_6'

$O_6' \to x_5 \leftarrow xO_6$
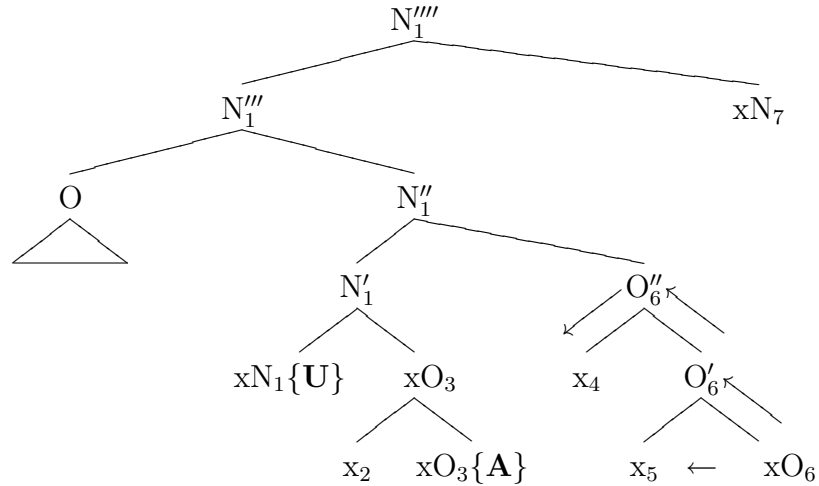
The first onset in the clusters in (21) is A-licensed since it contains an **A** that does not sit in every xO position. The two forms differ in that O_6'' is long in (21a), but short in (21b). That is, O_6'' in (21b) contains an unannotated point that is not m-commanded by the head xO_6, *viz.* x_4. In *nurk* **nurg:** (21a) the r is short, *i. e.* xO_3 does not m-command any other point. In *turg* **dur:g**, on the other hand, the r is long—its head xO_3 m-commands the very point x_4 that is not m-commanded by the onset head xO_6. The trade-off in length

within the cluster revolves around the point x_4: either it is m-commanded by xO_6 (21a), or it is m-commanded by xO_3 (21b).

As another example, let us consider a case where the initial member of the cluster is an l. (22) gives the structures I have in mind for the Estonian words *tulp* dulb: 'pile' and *halb* hal:b 'cheap'. Those structures are of course the same as the ones underlying English *pulp* pʌlp and *bulb* bʌl:b, only melody has to be changed accordingly.

(22) a. Common structure underlying Estonian *tulp* dulb: 'pile' and English *pulp* pʌlp

$$
\begin{array}{c}
N_1'''' \\
\diagup \qquad \diagdown \\
N_1''' \qquad\qquad\qquad xN_8 \\
\diagup \quad \diagdown \\
O \qquad\qquad N_1'' \\
\triangle \qquad \diagup \quad \diagdown \\
N_1' \qquad\qquad O_7'' \\
\diagup \diagdown \qquad\qquad \diagup \quad \diagdown \\
xN_1\{\mathbf{U}\} \; O_4'' \qquad x_5 \qquad O_7' \\
\diagup \diagdown \qquad\qquad \diagup \diagdown \\
x_2 \quad O_4' \qquad x_6 \; \leftarrow xO_7\{\mathbf{U}\} \\
\diagup \diagdown \\
x_3\{\mathbf{A}\} \; xO_4
\end{array}
$$
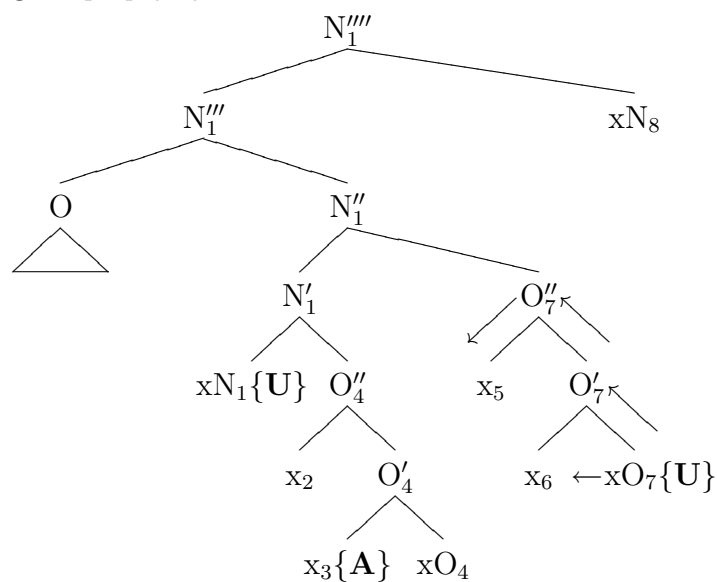
b. Common structure underlying Estonian *halb* hal:b 'cheap' and
English *bulb* bʌl:b
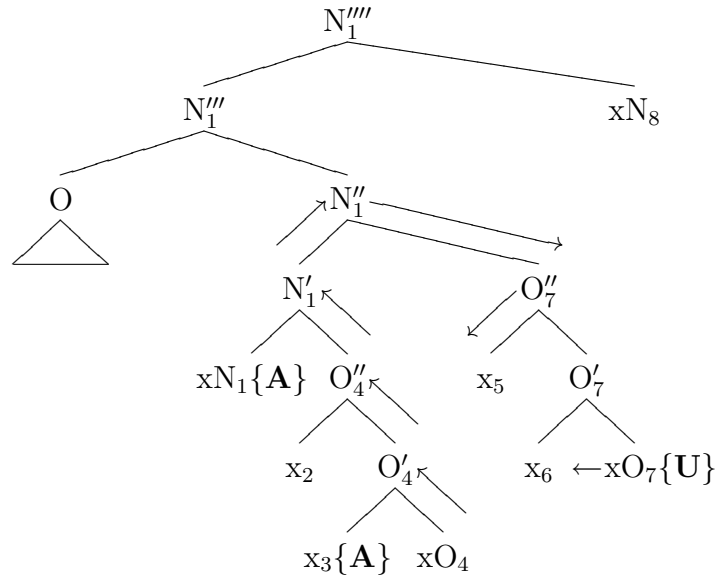
Again, the first onset is A-licensed since its **A** is not in every xO. As far as the trade-off in length is concerned, the structures in (22) are identical to those in (21). In (22a) xO_7 m-commands x_5, while xO_4 does not m-command anything. This gives us the cluster lb:. In (22b) x_5 is m-commanded by xO_4, while xO_7 does not m-command any other point. The result is l:b.

So far we have discussed two types of clusters: (i) those where the second onset contains **A** and A-commands the first onset and (ii) those where the first onset can "take care" of A-licensing itself (because it has an **A** in the appropriate position). Let us finally come to a third type of clusters, *viz.* those that do not contain any **A** at all. Consider the charts in (23).

(23)   a.   Estonian

a. short + long			b. long + short		
hunt	hund:	'wolf'	*vend*	ven:d	'brother'
vemp	vemb:	'trick'	*ramb*	ram:b	'faint'
ränk	ræŋg:	'difficult'	*hing*	hiŋ:g	'soul'

b. English

a. long + lenis		b. short + fortis	
send	sɛnːd	*sent*	sɛnt
cleanse	klenːz	*sense*	sɛns

The first member of those clusters is always a nasal. This nasal does not impose melodic restrictions on the second onset following it; rather it is itself dependent on the melody of the following onset, *i. e.* we observe homorganicity.[12] The second member of the cluster can be fortis or lenis and there is again a trade-off in length. In other words, the clusters in (23) are very similar to the ones in (17). The only difference is that the first onset of the clusters in (17) contains **A**, while in (23) it contains **L**. Since there are no restrictions on the melody of the second onset, we must conclude that there is no A-command relationship holding between the second and the first onset. This means that the first member must again be automatically A-licensed. Its representation is as follows.

(24)

```
              O″
            /    \
          x₁      O′
                /    \
            x₂{L}    xO
```
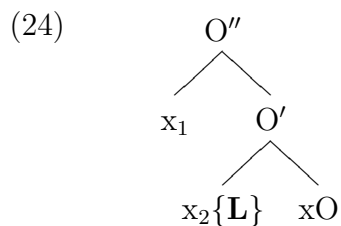
We are dealing with an AL-construction just like in the case of l. What we have to assume then is that an **L** in non-head position has the same effect as an **A** in non-head position: the onset is automatically A-licensed. Obviously, so far this is only an observation and further research will be required to answer the question why an **L** can be responsible for A-licensing (which, as the name says, has to do with the presence of **A**). In other words, why is there such an affinity between **A** and **L** if they are independent elements?

[12] The chart in (23b) is of course only a subset of what English has to offer. Interestingly, English lacks mːb and ŋːg in domain-final position, but this clearly has to do with the final position. There is no ban against mb and ŋg in general, as words like *amber* or *finger* serve to show. (As we shall see in a moment, the length of the first member of those clusters falls out from our model.)

However, we have already noted this connection between **A** and **L** when we discussed AL-constructions (*cf.* section 2.3.3), where we said that only those two elements can occur in non-head positions. There must be a more deep-seated property that unites the two. I will leave this question open for the time being.

Let us now have a look at the distribution of length. (25) gives the structures I propose for the Estonian words *hunt* hund: 'wolf' and *vend* ven:d 'brother'. Those structures are the same as the ones underlying the English words *sent* sɛnt and *send* sɛn:d, only melody has to be changed accordingly. (The broken arrows indicate homorganicity, on which more below.)

(25)   a. Common structure underlying Estonian *hunt* hund: 'wolf' and
            English *sent* sɛnt

263
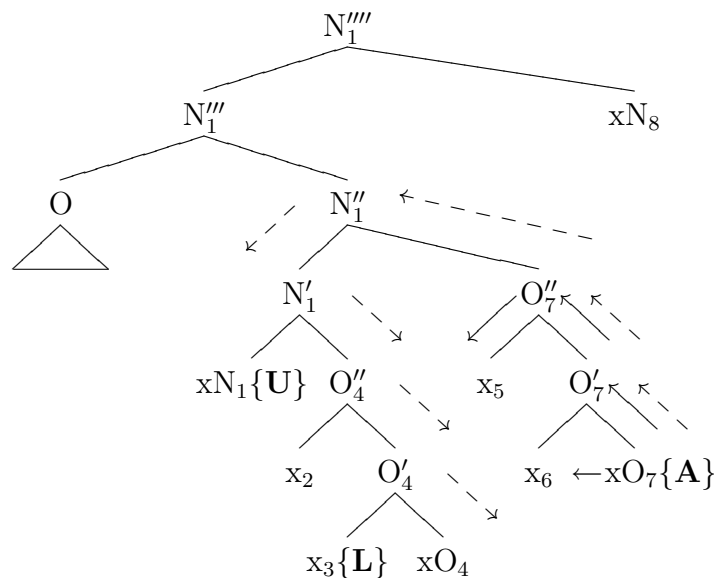
b. Common structure underlying Estonian *vend* ven:d 'brother'
and English *send* sɛn:d

$$N_1'''''$$

$$N_1'''' \qquad xN_8$$

$$O \qquad N_1''$$

$$N_1' \qquad O_7''$$

$$xN_1\{\mathbf{A},\mathbf{I}\}\; O_4'' \qquad x_5 \qquad O_7'$$

$$x_2 \qquad O_4' \qquad x_6 \;\; \leftarrow xO_7\{\mathbf{A}\}$$

$$x_3\{\mathbf{L}\} \quad xO_4$$
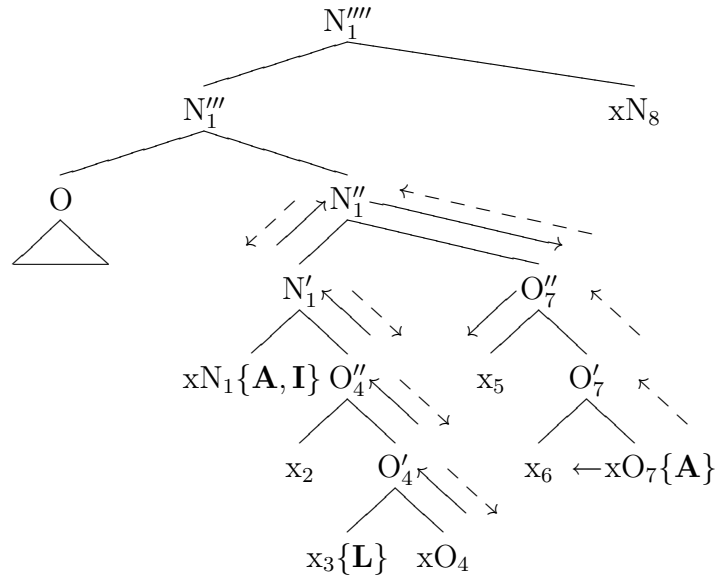
As far as the trade-off in length is concerned, the pair *hunt* hund:/*vend* ven:d in (25) works in the same way as *tulp* dulb: 'pile' and *halb* hal:b 'cheap' in (22). In (25a) xO_7 m-commands x_5, giving us the long d: in *hunt* hund:. The preceding n is short, since its head xO_4 does not m-command any unannotated point. In (25b), the representation of *vend* ven:d, xO_7 does not m-command x_5; instead, x_5 is m-commanded by xO_4. This gives us the cluster n:d with a long n: and a short d.

In addition to the m-command relationships just discussed, we also find in both structures in (25) that xO_7 m-commands xO_4, indicated by a broken arrow. This, I claim, gives us homorganicity between the members of the cluster. By this m-command relationship between xO_7 and xO_4 the melody of the second onset is blended with the nasal. The melody of the right-hand member is copied onto the first member via m-command, giving us n:d/nd: (and not *ŋ:d/*ŋd:). Two remarks are in order here. Firstly, this m-command relationship giving us homorganicity seems be induced by the element $\mathbf{L}$, which seems to "attract" the melody from xO_7. We had already mentioned in section 2.3.3 that AL-constructions (at least those involving $\mathbf{L}$) can be considered somewhat instable since their head position (xO_4) is empty, while the melody is in the complement (x_3). The fact that nasals as the first

members of clusters attract melody from the onset to their right can be seen as one way to remedy this imbalance. Crucially, no such homorganicity effect is to be observed when the first member is something other than a nasal, *e. g.* an l.[13] Secondly, when we say that xO_7 m-commands xO_4, we are actually slightly extending the notion of m-command. So far we have only seen cases where a head (an xO or an xN) m-commands a non-head (an x), but not a single instance where a head (like xO_7) m-commands another head (like xO_4). Since m-command is designed to copy melody from one position to another, it is only reasonable to assume that the relationship holding between xO_7 and xO_4 is one of m-command.[14]

Last but not least, let us have a quick look at *s*C-clusters. The chart in (26) gives examples from Estonian and English.

(26) a. Estonian   b. English

      kask   ɡɑsːɡ   'helmet'   *mist*   mɪsːd
      must   musːd   'black'   *lisp*   lɪsːb
      käsn   ɡæsːn   'wart'   *risk*   rɪsːɡ

Again we notice that the second member of the cluster is quite free in its melody, *i. e.* it behaves like an r or an l. This is not surprising. Consider the representation of *s* as proposed in (41) on p. 174 and repeated in (27).

(27)

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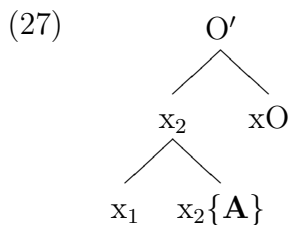
[13] Jonathan Kaye (*p. c.*) has pointed out to me that clusters with *h* as their first member also often show similar homorganicity effects, in which case homorganicity might have nothing to do with **L**, but must be due to other factors. Estonian has *h*C-clusters (which I will discuss here), but no homorganicity is to be observed.

[14] Relationships of m-command between heads might also be necessary to analyse vowel harmony in the framework discussed here. It is likely that vowel harmony involves m-command between nuclear heads. Any attempt at harmony requires a more elaborate theory of melody than what is given in the present dissertation.

There is indeed a formal similarity to the representations of r and l. The structure in (27) contains an **A** and this **A** is not in every xO position. From this property two predictions follow: (i) *s* should be unrestricted in what it is followed by and (ii) *s* should allow for fortis onsets to follow it, since it does not require A-command. As we have already seen in (26), the first prediction is correct: *s* is quite unrestricted in what it is followed by. The second prediction, however, is incorrect, at least for English and Estonian. The second onset of the cluster can *never* be fortis, only lenis. We find s:d, but no *sd:, s:g, but no *sg: etc. In other words, the theory of clusters that we have developed up to here still overgenerates. What this means is that there must be other principles at work that exclude a fortis onset as the second member of an *s*C-cluster. That of all clusters it should be *s*C-clusters which are not perfectly well-behaved, does not really come as a surprise. It has been shown time and again, also within standard GP (Kaye 1992: Nikièma 2003), that *s*C-clusters display special behaviour in several respects. Here, I will leave it at pointing out this open question. I am confident that further research into *s*C-clusters will also shed some light on why the second member only seems to be lenis.

Before we move to length alternations in clusters, let us briefly sum up the two main notions we have discussed in this section. Firstly, we have talked about A-licensing, which is responsible for phonotactics (in terms of melody). AL-constructions and r do not impose any melodic restrictions on what follows them, while others require A-command from the right. Secondly, we have seen that being an A-commander and m-commanding the highest annotated x are in complementary distribution. This explained why a fortis/ lenis distinction can only exist after onsets that do not require A-command.

6.3   Length: *bid-* vs. *Libby*-type

In chapter 4 we discussed structural differences between *bid*-type structures and *Libby*-type structures. We saw that those differences were the ultimate reason for the distribution of length in pairs like Estonian *siid* si::d and *siidi* si:di· or English *laid* le::d and *lady* le:di. What does this mean for our cluster analysis? So far we have only talked about clusters in *bid*-structures. When we now turn to clusters in *Libby*-structures, we should expect to find similar length differences. This is indeed the case. Consider the chart in (28).

(28)

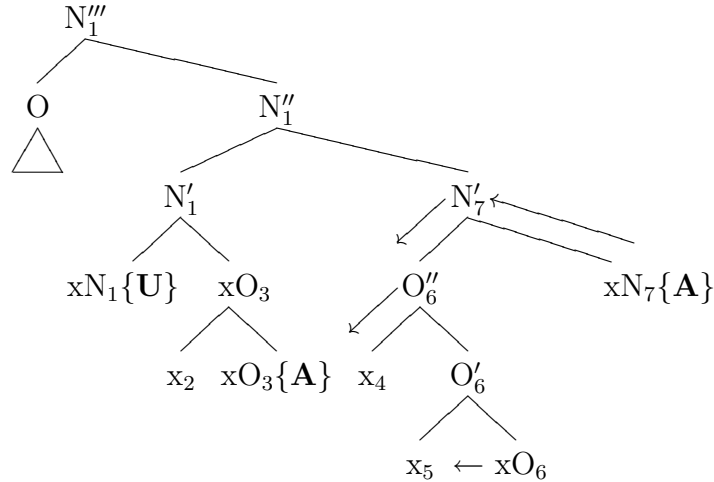| NOM. SG.	GEN. SG.	PAR. SG.	gloss
nurk	*nurga*	*nurka*	'corner'
nurgː	nurgaˑ	nurgːa	
tulp	*tulba*	*tulpa*	'pile'
dulbː	dulbaˑ	dulbːa	
hunt	*hundi*	*hunti*	'wolf'
hundː	hundiˑ	hundːi	

The nominative forms have been discussed before, *viz.* in (21a), (22a) and (25a), respectively. What is of interest to us is the length alternation we can observe when comparing the nominative and the genitive. It will suffice here to look at one instructive pair, *nurk* nurgː 'corner' and its genitive *nurga* nurgaˑ. In the nominative we have a long gː and in the genitive a short g. The preceding *r* is short in both cases. The nominative is of the *bid*-type, while the genitive is of the *Libby*-type. (29) compares the two forms; (29a) is a repetition of (21a).

(29) a. *nurk* nurgː 'corner NOM. SG.'

$$N_1''''$$
$$N_1''' \qquad xN_7$$
$$O \qquad N_1''$$
$$N_1' \qquad O_6''\!\!\nwarrow$$
$$xN_1\{\mathbf{U}\} \quad xO_3 \qquad x_4 \qquad O_6'\!\!\nwarrow$$
$$x_2 \quad xO_3\{\mathbf{A}\} \qquad x_5 \quad \leftarrow \quad xO_6$$

b. *nurga* nurgaꞏ 'corner GEN. SG.'

$$N_1'''$$

O

$$N_1''$$

$$N_1'$$ $$N_7'$$

$$xN_1\{\mathbf{U}\}$$ $$xO_3$$ $$O_6''$$ $$xN_7\{\mathbf{A}\}$$

$$x_2$$ $$xO_3\{\mathbf{A}\}$$ $$x_4$$ $$O_6'$$

$$x_5 \leftarrow xO_6$$
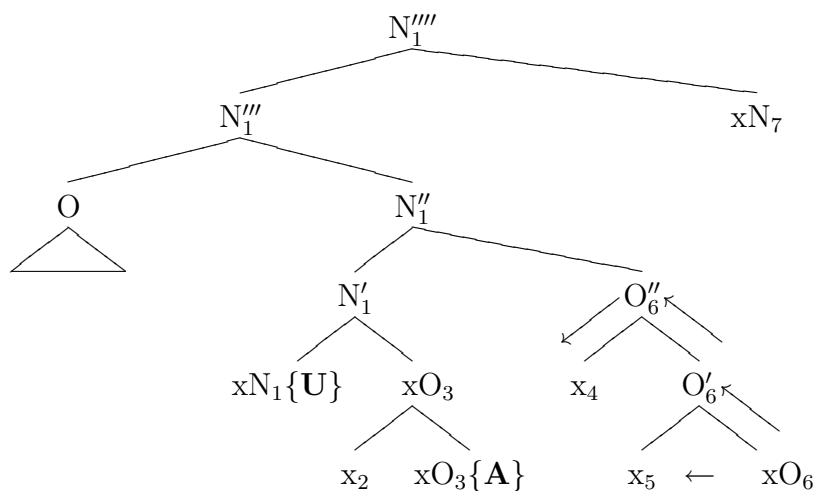
In section 4.3 we saw that in Estonian an onset head can only m-command the highest x of the onset projection if the onset projection is a complement to the right of the head of a *bid*-structure. In (29b) we are dealing with a *Libby*-structure, and accordingly, O_6'' cannot be fortis, unlike in (29a). That is, in (29b), the second onset x_4 cannot be m-commanded by xO_6. The nuclear head xN_1 cannot act as a licenser for x_4, since xN_7 is a closer licenser for x_4 than xN_1 is. As we saw in section 4.3, this relationship has to take the form of m-command in Estonian. Accordingly, x_4 is m-commanded by xN_7, giving us the final aꞏ.

The word *nurk* nurg: 'corner NOM. SG.' ends in a cluster rg: whose second member is long. Let us now look at clusters whose second member is short.[15]

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[15] With the exception of *hing*, all the words in (30) are loans. Native words with clusters ending in lenis onsets usually undergo gradation, *cf.* section 4.3. Native *sild* sil:d 'bridge NOM. SG.' ∼ *silla* sil:aꞏ 'id. GEN. SG.' shows gradation and therefore does not illustrate what we want to look at, *viz.* the length alternation of the first member of the cluster.

	NOM. SG.	GEN. SG.	PAR. SG.	gloss
a.	*gild*	*gildi*	*gildi*	'guild'
	gil:d	gildiˑ	gil:di	
b.	*verb*	*verbi*	*verbi*	'verb'
	ver:b	verbiˑ	ver:bi	
c.	*bänd*	*bändi*	*bändi*	'band'
	bæn:d	bændiˑ	bæn:di	
d.	*hing*	*hinge*	*hinge*	'soul'
	hiŋ:g	hiŋgeˑ	hiŋ:ge	

Again one crucial pair will be enough to explain the length distributions.
(31) gives the representations of *verb* ver:b 'verb' and its genitive *verb* verbiˑ.

(31)   a. *verb* ver:b 'verb NOM. SG.'

b. *verbi* verbiˑ 'verb GEN. SG.'

$$
\begin{array}{c}
\text{N}_1''' \\
\diagup \qquad \diagdown \\
\text{O} \qquad\qquad \text{N}_1''
\end{array}
$$
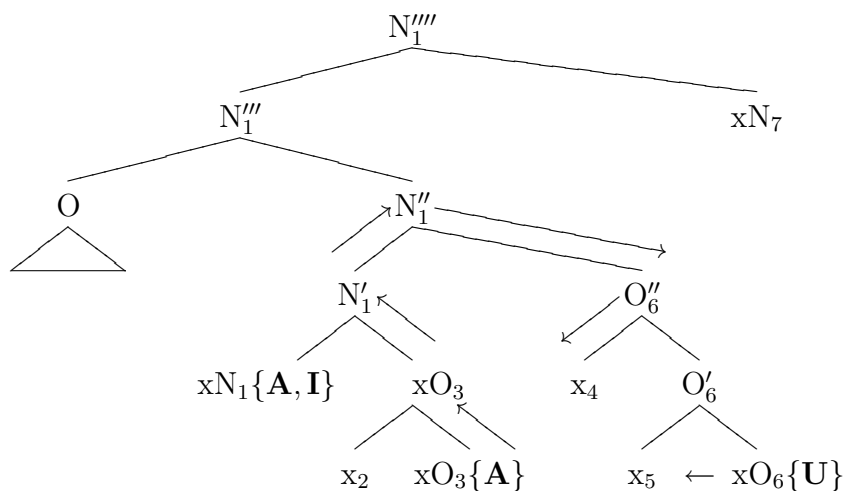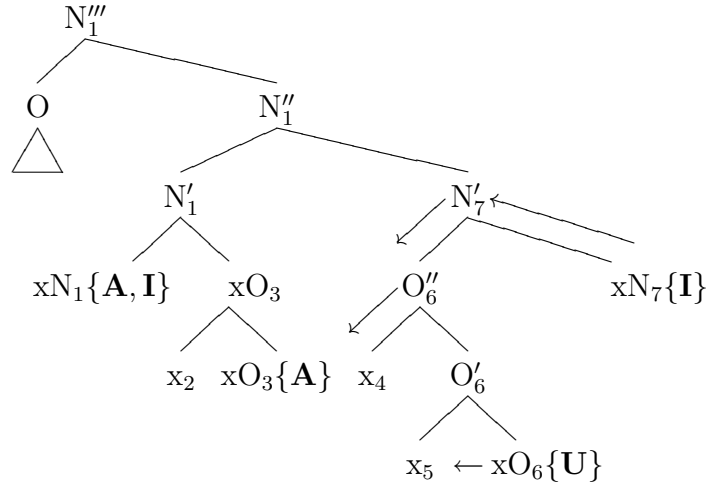
In (31a), *verb* verːb, the final **b** is short. The unannotated point x_4 is m-commanded by xO_3, which gives us a long **rː** in the cluster **rːb**. In (31b), x_4 has to be m-commanded by xN_7. Neither xO_3 nor xO_6 m-command any unannotated point and we get a cluster **rb** where both members are short. This is the correct result.
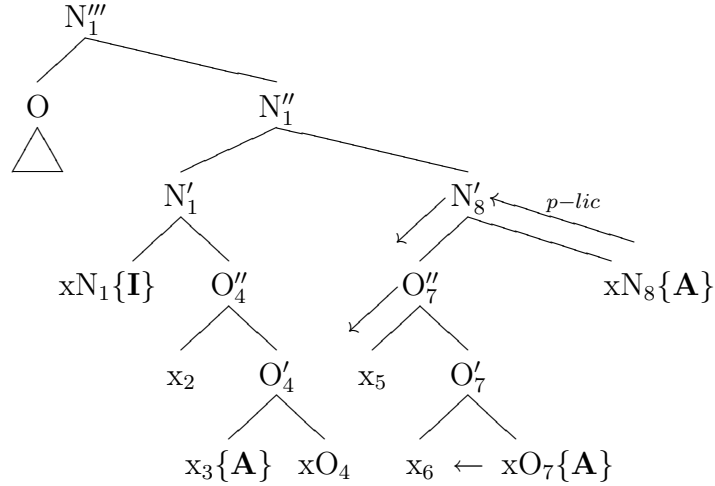
Let us finally come to English. In section 6.2.3 we saw that in *bid*-type structures there is a clear length difference in the *n* between words like *send* sɛnːd and *sent* sɛnt. Before a lenis *d* we get a long **nː** and before a fortis *t* a short **n**. No such difference in the length of the **n** is to be found in *Libby*-structures, *cf.* (32a). (32b–c), the representations of *guilder* 'gɪldə and *filter* 'fɪltə, make clear why.

(32)   a.   *bid*-type   *Libby*-type

send	*sent*	*tender*	*centre*
sɛnːd	sɛnt	'tɛndə	'sɛntə
weld	*belt*	*guilder*	*filter*
wɛlːd	bɛlt	'gɪldə	'fɪltə

b. *guilder* 'gɪldə

N_1'''
- O △
- N_1''
  - N_1'
    - $xN_1\{\mathbf{I}\}$
    - O_4''
      - x_2
      - O_4'
        - $x_3\{\mathbf{A}\}$ xO_4
  - $N_8' \leftarrow$ *p–lic*
    - O_7''
      - x_5
      - O_7'
        - $x_6 \leftarrow xO_7\{\mathbf{A}\}$
    - $xN_8\{\mathbf{A}\}$

c. *filter* 'fɪltə

N_1'''
- O △
- N_1''
  - N_1'
    - $xN_1\{\mathbf{I}\}$
    - O_4''
      - x_2
      - O_4'
        - $x_3\{\mathbf{L}\}$ xO_4
  - N_8'
    - O_7''
      - x_5
      - O_7'
        - $x_6 \leftarrow xO_7\{\mathbf{A}\}$
    - $xN_8\{\mathbf{A}\}$
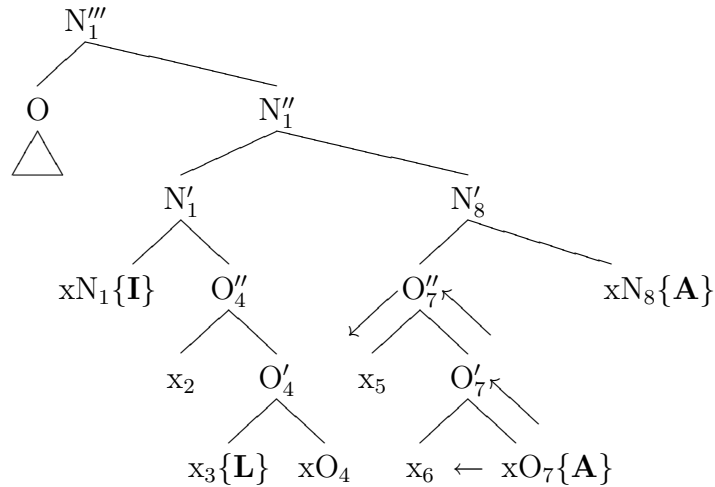
(32b) gives the representation of *guilder* 'gɪldə. The final onset in that structure, O_7'', is lenis. The preceding l (whose head is xO_4) could not be long, though, *i. e.* it could not m-command x_5, since xN_8 is a closer licenser for x_5 than xO_4 is. As we saw in section 4.3, in English this licensing relationship is one of p-licensing. Accordingly, x_5 is p-licensed by xN_8. The result is a cluster ld, where both members are short.
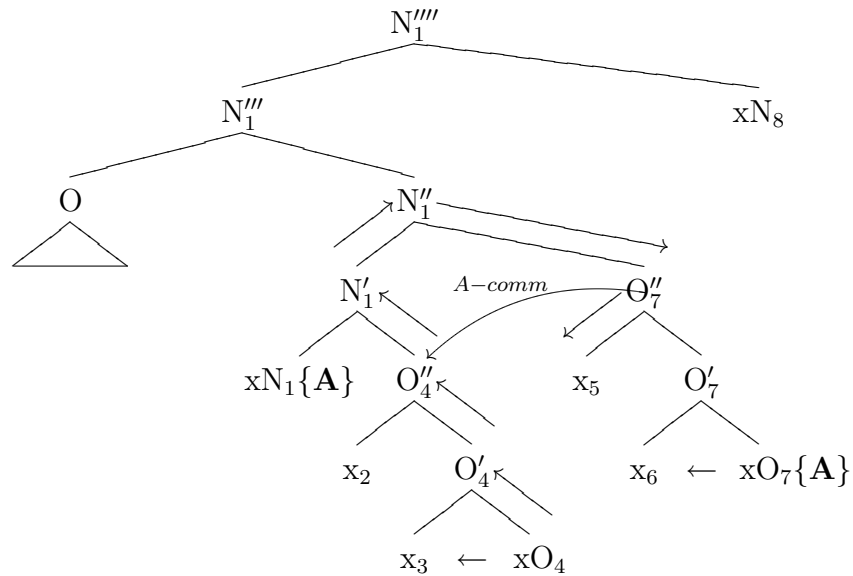
(32c) represents the word *filter* 'fɪltə. The t, *i. e.* O_7'', is fortis. The head of the l, xO_4, cannot m-command any unannotated point. We get 'fɪltə with a cluster lt.

In all the clusters we have seen so far the second onset was not required to A-command the first onset. Let us finally come to clusters where such A-command is necessary, *e. g.* the Estonian ones in (33).

(33)

NOM. SG. (*bid*-type)		GEN. SG. (*Libby*-type)		gloss
abt	ab:d	*abti*	abdiˑ	'abbot'
pakt	bag:d	*pakti*	bagdiˑ	'pact'
lift	lif:d	*lifti*	lifdiˑ	'elevator'

The representations of *pakt* bag:d (a *bid*-structure) and *pakti* bagdiˑ (a *Libby*-structure) are given in (34).

(34)   a. *pakt* bag:d 'pact NOM. SG.'

N_1''''
 ├─ N_1'''
 │   ├─ O (△)
 │   └─ N_1''
 │   ├─ N_1'
 │   │   ├─ $xN_1\{\mathbf{A}\}$
 │   │   └─ O_4''
 │   │   ├─ x_2
 │   │   └─ O_4'
 │   │   └─ $x_3 \leftarrow xO_4$
 │   └─ O_7'' (A–comm)
 │   ├─ x_5
 │   └─ O_7'
 │   └─ $x_6 \leftarrow xO_7\{\mathbf{A}\}$
 └─ xN_8

b. *pakti* bagdi· 'pact GEN. SG.'

$$N_1'''$$

O N_1''

N_1' *A−comm* N_8'

$xN_1\{\mathbf{A}\}$ O_4'' O_7'' $xN_8\{\mathbf{I}\}$

x_2 O_4' x_5 O_7'

$x_3 \leftarrow xO_4$ $x_6 \leftarrow xO_7\{\mathbf{A}\}$
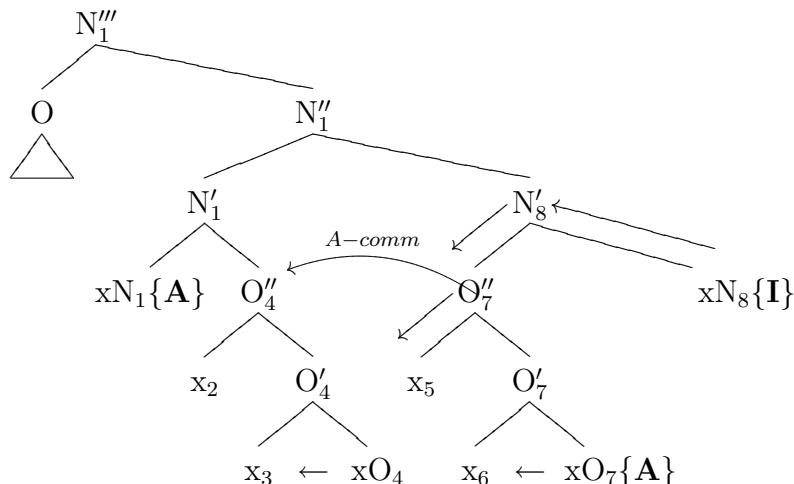
In (34a), xO_4 m-commands x_5, which explains the long g: in bag:d. In (34b) x_5 has to be m-commanded by xN_8, giving us the final i·. The point x_5 is not accessible for xO_4, and since xO_4 does not m-command any unannotated x-slot, we get a short g as the first member of the cluster gd. Our theory is perfectly capable of expressing the length alternations we find.[16]

6.4   Summary

In this chapter we had a brief look at clusters. We went through the principles that determine cluster phonotactics and had a look at the distribution of length within clusters. We saw how the representations of onsets developped in earlier chapters helped us to understand the nature of clusters. We discussed the most important cases from English and Estonian and saw that strong parallels between the two languages could also be found in the case of clusters.

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[16] The facts of the English equivalent, *i. e.* the clusters in *fact* or *apt*, are not entirely clear. While Estonian has a clear length difference in the first member of the cluster in pairs like *pakt* bag:d ∼ *pakti* bagdi·, there does not seem to any comparable length difference in English pairs like *fact/factor* or *apt/aptitude*. The only difference that can be noted is that in *fact/apt* it seems quite natural to release the first member of the cluster, but not in *factor/aptitude*.

Summary

In this dissertation a large-scale revision of standard GP was proposed. The main idea advocated was that attention be shifted from melody towards structure, which plays a more important role than generally assumed. This allowed for a unification of the length system of English with that of Estonian—two languages that are usually seen as quite different from each other.

In chapter 1 I discussed some general problems with overgeneration in GP and concluded that a model with six melodic elements was overly powerful. We then moved on to particular problem with the element **H** and the Non-Arbitrariness Principle. We saw that in NYC English the length of nuclei was clearly dependent on the presence or absence of **H**, which runs afoul of the Non-Arbitrariness Principle. **H** is a melodic property, while length is a structural one, and accordingly, there should be no interaction between those two. We compared the situation to Italian and saw that the distribution of length was entirely dependent on structural properties, *i. e.* it was non-arbitrary. Such a solution was also to be found for NYC English. I proposed the fortis/lenis hypothesis, *i. e.* that the differences formerly encoded by the element **H** are to be replaced by a structural configuration. This means that a lenis onset (like an English *d*) is the short counterpart of a fortis one (like an English *t*). At the same time we saw that such a hypothesis was hard to incorporate in standard GP's theory of constituent structure. We then moved on to a proposal by Jensen (1994) to the effect that the element **ʔ** (responsible for stopness) be reinterpreted as a structural property as well. We discussed the evidence from Pulaar and also the problems that standard GP faced when trying to incorporate Jensen's proposal. It became clear that a complete overhaul of the theory of constituent structure was inevitable. The focus had to be shifted from from melody to structure.

In chapter 2 I illustrated two further shortcomings that Standard GP suffers from, thus backing up the claim that the theory has to be redone. Firstly,

I argued that the notion of complexity is inadequate as an explanation for phonotactic restrictions. Secondly, I showed that existing attempts to explain superheavy rhymes in English failed to account for crucial data, which again indicated that the importance of melody (as opposed to structure) had largely been overestimated. After that, I outlined the basics of a new model that is to replace the standard model of constituent structure. We discussed the primitives of that theory, *i. e.* the reduced set of elements, the difference between onset heads, nuclear heads and unannotated heads and the idea of projection. The difference between stops and non-stops (formerly encoded by **ʔ**) is expressed in the number of projections of an onset: Former **ʔ** is replaced by an onset with two projections, an onset with only one projection equals a fricative, while an onset with no projections roughly equals a glide. The difference between fortis and lenis onsets and length in general is expressed by the notion of m-command. This m-command is a relationship holding between two points and regulates which points receive the same interpretation. It replaces association lines in the present model. Again, such a move was inevitable: with the number of elements going down to four and many distinctions being expressed structurally, there are a fair number of cases where there is simply no melody left that could be associated to (a) given point(s). Since association is no longer possible, a different relationship linking two points (*i. e.* m-command) had to be introduced.

Chapter 3 elaborates on the basics presented in chapter 2. So far we had only talked about the internal structure of individual onsets, but not about the larger structures they occur in, *i. e.* phonological domains. Here we discuss the properties of nuclear heads as the backbone of phonological domains. We discussed three types of domains, the *bee*-type, the *bid*-type and the *Libby*-type. This tripartition is not arbitrary, but arises as the result of which kind of a complement the domain head selects. We saw that those three types of domains differ with respect to the distribution of length. We discussed the notion of closest licenser, which has a crucial role to play in this distribution. We also had a closer look at onsets in the initial position of domains, as well as in the final position, and discussed what conditions they are subject to.

In chapter 4 we took our model beyond English and applied it to Estonian. Due to its allegedly outstanding and rare system of length, Estonian is often assumed to be radically different from languages like English. As our new model of constituent structure showed, however, those differences

are to a very large part nothing but an optical illusion. As a matter of fact, Estonian is to a great extent nearly identical to English. We saw that the distribution of length in Estonian follows the same patterns as in English. We also discussed alternations in length, which can be found in identical fashion in both languages.

In chapter 5 we took a closer look at the role of morphology, a factor that previous analyses of Estonian had generally disregarded. As we saw, an understanding of the morphological structure of a word is crucial for a proper understanding of length. We discussed the function tconcat(), an adapted version of Kaye's (1995) concat(). This function tconcat() concatenates pieces of structure in forms involving analytic morphology. We saw that analytic morphology is the one area where Estonian and English differ in crucial ways. While Estonian generally allows for concatenation to result in a *bid*-structure where the right branch of the root node is filled, English only allows for that under very specific conditions. As a consequence, length in the base is always unaffected in Estonian (concatenation of **siːːd** and the suffix **i** gives **siːːdi**), while in English this depends on the shape of the suffix (**steːːd** plus **li** gives **steːːdli**, while **riːd** plus **iŋ** gives **riːdiŋ**). This difference also led us to a brief discussion of how the model presented in this dissertation can be applied to Italian. We saw that true geminates can be successfully distinguished from fortis onsets.

Finally, in chapter 6 we discussed how clusters can be implemented in the present model. We had a look at the most important cases from English and Estonian and saw that the parallels between the two languages continue, both with respect to the distribution of length within the clusters as well as to questions of phonotactics. We saw that the element **A** plays a crucial role in "gluing" the two members of a cluster together.

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