

THE STRUCTURE OF ASPIRATION
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Chapter 1: Introduction

Aspiration and voicelessness are very general topics in phonology. We can find analyses about them in basically every single phonological framework. But what we can see is however general these phenomena are, every framework has its own obstacle preventing it from modelling these phenomena properly. In this present paper I will address this popular topic from a brand new perspective with the help of a very young framework, called Government Phonology 2.0 (GP 2.0). The framework has existed only since 2006, but its novel ideas allow us to address a lot of complex phonological phenomena in a more adequate way compared to other frameworks. What I am trying to do is to give an idea about what aspiration is and to take a look at some related phenomena that can be argued when we are talking about aspiration itself. At the same time, my goal is to make a contribution to the GP 2.0 framework itself. This is why I choose the title “The Structure of Aspiration”, which is a direct reference to Markus Pöchtrager's “The Structure of Length”. As we will see, the novel concept of m-command is a great tool to investigate the mechanics of aspiration, as it allows us to find connections and solutions that were hardly in sight in former frameworks of phonology.

The paper is structured as follows. In Chapter 2, I will provide some basic knowledge about the framework and I will cover the relevant parts briefly. In Chapter 3, we will turn to aspiration itself. At first, there is some background to the topic through discussing former ideas about /h/ and aspiration. Following this we will see the structure of /h/ when it appears segmentally and the means for a non-projecting structure to achieve a fortis status (the opposition of domain-internal and intervocalic positions). Then we continue to look at how /h/ or aspiration works in every possible phonotactic position. The phenomena this paper addresses contain the Hungarian domain-final variants for /h/, h-deletion and the fortition to [x]. We will also see how aspiration and preaspiration works in Hungarian, an L-voicing language and Icelandic, a language with pre- and postaspiration. Finally there is a short analysis of German word-final obstruent “devoicing”. Chapter 4 deals with some problems of the framework that emerged during the analysis. As we go in the paper, we will see various effects of m-command relationships and also independent arguments for placing the Final Empty Nucleus at the end of domains. Chapter 5 is a summary, and evaluation of the analysis.

Chapter 2: What is GP 2.0 and Why Should it Be?

2.1 General Introduction

GP 2.0 - sometimes referred to as Minimalist Phonology (MP) – is a phonological framework introduced by Markus Pöchtrager in his doctoral dissertation, “The Structure of Length” in 2006. Pöchtrager addresses basic problems of previous Government Phonology frameworks (referred to as GP 1.x) including Standard Government Phonology (sGP) (KLV85, KLV90, and further works following conventions introduced in these articles) and Strict CV Phonology (sCV or CVCV) (Lowenstamm, 1996, Scheer, 2004). For these problems he introduces radical solutions, and ideas that were completely alien to GP 1.x.

At first, Pöchtrager abandons the autosegmental approach to phonological strings, and replaces it with *x-bar structures*. This, of course means the abolishment of metrical and melodic tiers, as well as association lines holding them together. His approach to syntactic structures is similar to the ideas of Minimalist Syntax: structures are always branching. A unary branching node is always reduced to its daughter. (Pöchtrager 2006:65) Terminals of tree structures can be of three types: nuclear head (**xN**), onset head (**xO**), and unannotated timing slots (**x**). Heads can merge with **x**-s, and project to higher levels N', N'', O', O'', etc.¹ Melodic content, i.e. elements are not connected to timing slots (terminals) with association lines like in GP 1.x, but terminals (**xO**, **xN**, **x**) can be *annotated* with elements e.g. **xN{U}** (or **{U}xN**, again, a question of convention) meaning a nuclear head containing element **U**. This is a very important innovation, because it abolishes autosegmental spreading. Slots and their content mean phonological objects combined, while an element cannot belong to multiple terminals at the same time.

GP 2.0 - as other frameworks built on Government Phonology – uses melodic primes called privative elements (commonly referred to simply as *elements*) to indicate the quality of sounds. Elements were introduced in KLV85 as a substitute for equipollent and privative features. Similarly to features, privative elements indicate a salient property of a speech sound, but unlike features, elements have an independent phonetic realisation without a need to be combined with other properties. The phonetic realisation of an element depends on the phonological position it is attached to. For example, element **U** can yield an /u/ when it is in

¹ Indication of “bar levels” of projections is only a question of convention, e.g. someone indicates maximal projections as phrases: NP for nuclear phrases, and OP for onset phrases, while others stick with indicating bar levels in all cases. The number of times a head projects depends on the type of onsets, and the underlying length of vowels. Projections are explained in detail in 2.3 and 2.4.

nuclear position, but a /w/ when it is non-nuclear. In GP 1.x elements can combine with each other in head-operator relationships, which also modifies the phonetic output. In GP 2.0, however, combination is a more complex issue due to the introduction of x-bar structures, which I will address later on.

2.2 Element Theory

GP 2.0 works with a seriously reduced set of elements, to be precise there is only three of them, namely **I**, **U**, and **L**. In this part I will provide a brief summary for the reasons why the other three of the most widely used elements (**H**, **ʔ**, and **A**) have been dropped out. First of all, a set of 6 elements can still overgenerate a lot. 6 elements can still generate 256 expressions, and this number is well above the number of phonologically relevant expressions a language needs. (Pöchtrager, 2006:14) With a set of 3 elements this number goes down to 20, which would be well below the number of expressions an average language contains, but as we will see, it is not an issue in GP 2.0 due to the various structural configurations it allows.

2.2.1 Abolishment of H

Based on the length trade-off relationships in New York City English (e.g. NYC English bid [bɪ:d] vs. bit [bɪt]), where we can observe a V:C_{LENIS}/VC_{FORTIS} distribution in which vowel length, which is decided by the fortis or lenis quality of the consonant. Pöchtrager (2006:28) claims that element **H** cannot be the reason for such a phenomenon, and he introduces the fortis-lenis hypothesis which claims that fortisness is not a melodic property, but a structural configuration. Fortisness means plus length compared to the lenis counterpart. This plus length is added or not added to the onset head through *m-command*. The definition of m-command is one of the most important issues of this paper. For the original definition and my proposed modifications see 2.5 and Chapter 4.

2.2.2 Abolishment of ʔ

Pöchtrager (2006:39) adopts Jensen's (1994) Configuration Hypothesis which proposes that stopness (**ʔ**) is a structural configuration, rather than a melodic prime. One of piece of evidence comes from Pulaar, a language where **ʔ** seems to emerge out from nothing. For example the plural of the noun *lewru* 'month' is *lebbi* 'months' instead of **lewwi*. The stem *lew* has /w/ with an underlying expression that lacks **ʔ**. When the suffix +Ci connects, where C is the copy of the last consonant of the stem, we will get a geminate plosive, which shows

that stopness is a structural configuration rather than melody.

2.2.3 Abolishment of A

Kaye and Pöchtager (2009, 2013) replace element **A** (standing for openness of vowels and coronality of consonants) with adjunction structure. Evidence for the idea that **A** is structural come from French (Ploch, 1995) and from the widely known distributional properties of English. In French, only nuclear expressions with **A** can undergo lengthening and nasalisation. In English, only before s+C clusters with C containing **A** does vowel length occur. (e.g. east, boost, easp*, boosk*) The same applies to nasal+plosive sequences. (e.g. count, coump*, counk*) In Southern British English long vowels can occur before s+C clusters without C containing **A** when the vowel itself contains **A** (e.g. task, draft). This evidence tells that **A** is not melodic, but structural property.

2.3 GP 2.0 Structure of Consonants

2.3.1 Approximants

Approximants have the smallest structure among consonants. They are nothing else but a single non-projecting onset head optionally annotated with melody. The situation is similar in GP 1.x, where approximants mostly consist of one element (e.g. [U.] for /w/). In the present paper I will argue that /h/ is an approximant, rather than a fricative. Of course, what counts as an approximant, and how they work can vary from language to language, for example in Hungarian and Icelandic /v/ can behave both as an approximant and a fricative depending on its distribution. This is why I give it as an example for both types of structures. Note that the structure I give for /r/ is of the same size as other approximants. The structure is non-projecting, xO does not merge with an x or take it as its complement. Head-adjunction increases complexity, but not size. Size of a structure depends on the number of projections, while complexity depends on both head-adjunction and projections. If the structurally highest element of an onset is a head (xO), we talk about an approximant.

Structures	$xO\{I\}$	$xO\{U\}$	$ \begin{array}{c} xO \\ \diagup \quad \diagdown \\ x \quad xO \end{array} $	xO
Possible values	/j/	/w/,/v/	/r/,/s/	/h/,/ʁ/

Figure 2a: Structures of approximants and possible values

2.3.2 Fricatives

Fricatives are an extended version of approximants. The onset heads merge with an x-slot and project to a bar-level (or a phrase level, there are multiple ways to call the maximal projection of a head, later I will also use OP instead of O'). This allows for an expression-internal m-command relationship which can distinguish pairs of different length and also fortis-lenis pairs. It also allows for annotation of the x-slot which can result in more complex phonological expressions.

Structures				
Possible values	/ç/,/j/,/ç/	/f/,/v/	/s/,/ð/,/θ/	/x/,/ɣ/

Figure 2b: Structures of fricatives and possible values

2.3.3 Plosives and Nasal Stops

Stops are an extended version of fricatives. The onset head merges with an x-slot, projects to a bar-level then the bar-level merges with another x-slot and projects to another bar-level. Stops have the biggest possible structure in GP 2.0. Nasals come to life with annotating the lower x-slot with the element of nasality: L. Stops have all the abilities of fricatives, but they are structurally bigger. It is worth mentioning here that even though stops have the biggest structure, they are the most primitive ones. For details see Úlfsbjörninn (2008a).

Structures				
Possible values	/c/,/c ^h /,/ɟ/	/p/,/p ^h /,/b/	/t/,/t ^h /,/d/	/k/,/k ^h /,/g/

Figure 2c: Structures of stops and possible values

2.4 GP 2.0 Structure of Vowels

Vowels are built in a similar fashion to consonants. The difference between them comes from the dependency relation of onsets and nuclei. As in GP 1.x onsets ultimately depend on nuclei, since nuclei license onsets' existence. There is no onset without a nucleus which can license it. The size of nuclei depends of language-specific parameters. In some languages, just as in NYC English, all nuclei (except for empty nuclei) are required to project to complete expansion (c-expansion), which means that the nuclear head projects twice, merging with two x-slots. In some languages nuclei are not required to project to c-expansion. C-expansion does not equal the notion of maximal projection when speaking about nuclei. Maximal projection (indicated as N''' in figure 2d) includes the γ (specifier) position, while c-expansion matches the N'' level in figure 2d. In this present paper I will refer to maximal projection of nuclear heads as NP standing for Nuclear Phrase or Nuclear Projection.

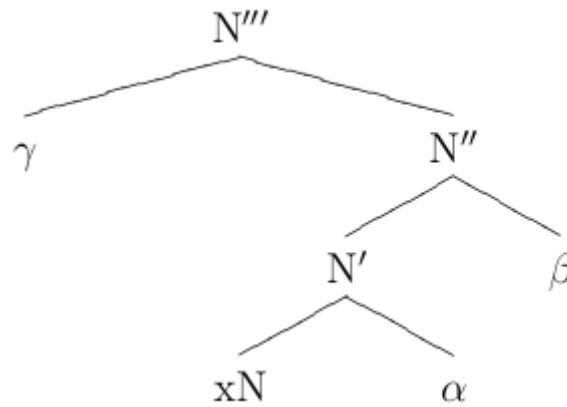


Figure 2d: The basic structure of a nuclear phrase (Pöchtrager, 2006:99)

Pöchtrager gives the possible content of the positions indicated with Greek letters in the following way: $\alpha \in \{x, O\}$, $\beta \in \{x, O, N\}$, $\gamma \in \{O\}$. Pöchtrager, however, does not take the dependency relation of onsets and nuclei that strictly. As we can see an onset can stand for β . As a consequence a tree can end with an onset, which allows us to have consonant-final domains. This is not entirely true, because the Final Empty Nucleus (FEN) exists in GP 2.0 just as in former GP frameworks, however, Pöchtrager (2006:119) assumes FEN to merge with the maximal projection, and project to another bar-level, in other words, the maximal projection takes FEN as a complement to the right as we can see it in figure 2e. I reject this idea, for reasons we will see later on, and adopt the idea of Úlfsson (2008b), and place the FEN at the end of the tree, so the final consonant can reside in the γ -position (specifier) of the empty nucleus. In a formal definition: $\beta \in \{x, N\}$.

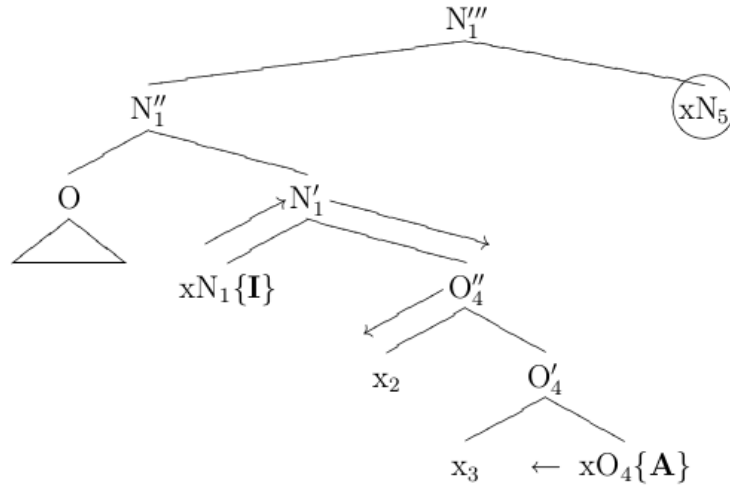


Figure 2e: The structure of NYC English *bid* [br:d] with the FEN circled according to Pöchtrager (2006:119)

2.4.1 The Types of Nuclear Heads

We can distinguish three types of nuclear heads in GP 2.0. These are namely the *i*-structure, the *ə*-structure, and the *a*-structure. (Živanović and Pöchtrager, 2010:362) The base of *i*-structures is a simple nuclear head (*xN*). This can project to higher levels, and can be annotated with melody. When it is unannotated, it either remains silent (the equivalent of an empty nucleus), or it can stand for /i/. When it is annotated with an element it stands for another non-open vowel.

Both *ə*-structure and *a*-structure are based on a head that is split in two (adjunction structure, see 2.2.3). The only difference is that while in *a*-structures there is a control relationship (see 2.5) holding between the lower head and the sister *x*-slot, in *ə*-structures there is none. This difference stands roughly for traditionally A-headed structures (open vowels like /a/ and open mid vowels like /ɔ/ and /ɛ/), and headless structures (mid vowels like /ə/ and closed mid vowels like /o/ and /e/). Of course there is no 100% correspondence between A-headedness and adjunction structures, but this is the easiest way to understand for someone who is new to the framework. Just like in the case of onsets, *m*-command delivers length from *x*-slots, when vowels are long.

Structures	<i>xN</i>	$\begin{array}{c} N' \\ \swarrow \quad \searrow \\ xN \quad x \end{array}$	$\begin{array}{c} xN \\ \swarrow \quad \searrow \\ xN \quad x \end{array}$	$\begin{array}{c} xN \\ \swarrow \quad \searrow \\ xN \rightarrow x \end{array}$
	<i>xN</i> { <i>I</i> }	$\begin{array}{c} N' \\ \swarrow \quad \searrow \\ xN\{I/U\} \quad x \end{array}$	$\begin{array}{c} xN \\ \swarrow \quad \searrow \\ xN\{I/U\} \quad x \end{array}$	$\begin{array}{c} xN \\ \swarrow \quad \searrow \\ xN\{I/U\} \rightarrow x \end{array}$
Possible values	/i:/; /i/; /I/; /u/; /ʊ/	/i:/; /i:/ or /u:/	/ə/; /e/ or /o/	/a/; /ɛ/ or /ɔ/

Figure 2f: Non-projecting *i*-structures, projecting *i*-structures, non-projecting *ə*-structures and non-projecting *a*-structures

2.4.2 The Structure of Domains

Based on what β stands for, Pöchtrager (2006:112) assumes the existence of three types of domains: the *bee* type, the *bid* type, and the *libby* type. We talk about *bee* type when $\beta=x$, *bid* type when $\beta=O$, and *libby* type when $\beta=N$. Because this present analysis rejects the existence of onsets in β position, we will not go into the *bid* type at all.

The *bee* type exists when there is a nucleus containing an onset in its specifier. This is the prototypical CV syllable. The difference opposed to sCV phonology is that no matter if we talk about syllables with short, long, or overlong vowels, we still assume only one CV sequence to exist instead of CV, CVCV, or CVCVCV (which is a major problem for sCV phonology, it cannot express overlong vowels within the boundaries of its own rules). Length is the question of domain-internal processes and the size of phrases. This is not so in sCV, because consonantal and vocalic positions serve as timing slots in the same time and no branching is allowed at all. The consonantal position can be empty in GP 2.0, in this case of course the syllable consists of a single vowel. Whether this emptiness comes with an empty position or a non-projecting onset head needs further research, but based on phenomena, like the French h-aspiré and Welsh h-insertion I assume the latter, even though I do not always indicate these in my trees (when they are not of interest).

Through the *libby* type, where β is equal to a nuclear phrase, we can connect as many syllables as we need, but this is not exactly a match for sCV either. Because α can be replaced by an onset, the coda position exists in this framework. However, coda position needs to be licensed by a more complex onset (so they can constitute coda-onset or RT clusters), just as in Standard Government Phonology, where coda is dominated by the rhyme.

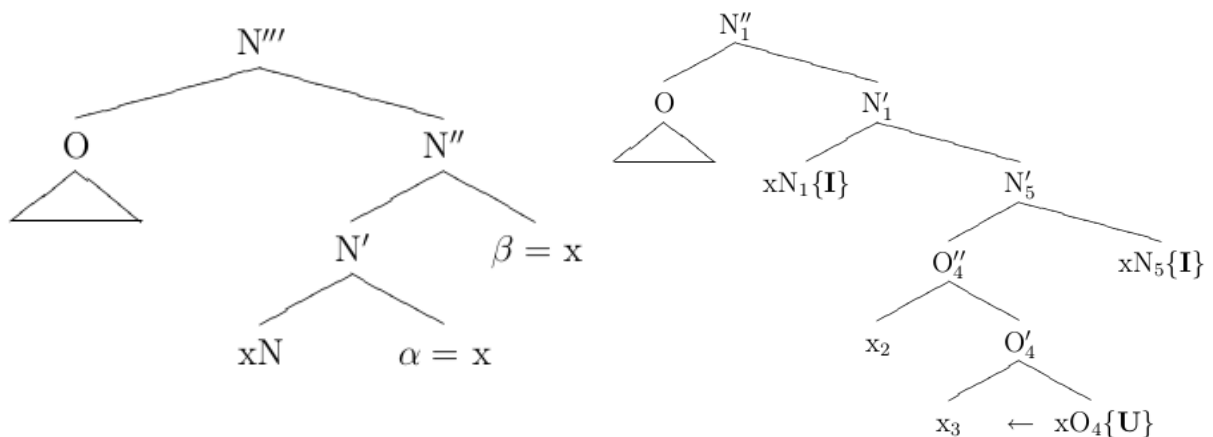


Figure 2g: *Bee* structure and *libby* structure from Pöchtrager (2006:112, 128)

2.5 Interterminal Relations

There are two relations which can hold between terminals, namely **control** and **m-command**.

Control: a licensing mechanism which can hold between a head and an x-slot which are sisters. Only heads can be controllers, and only non-head terminals (x-slots) can be controllees. A controlled x-slot cannot provide length through m-command (Pöchtrager, 2006:77; Kaye and Pöchtrager, 2009). Control relationship is obligatory between heads of stop structures and their sister x-slot, when the x-slot is not annotated. Control is also obligatory in a-structured vowels.

M-command: melodic command is a licensing mechanism which can hold between an x-slot and a head. M-command can be translated roughly to 'interpret the content of this terminal to the target'. When there is no annotation, m-command interprets empty space to the target head.

The rules of m-command, which is a major theme of the present paper, can be found in Chapter 4. Fortisness, after the abolishment of element **H**, is expressed by extra space interpreted to the head through m-command. The extra space delivered by m-command can also result in lengthening. We will see multiple cases for fortition, fortisation, and lengthening through m-command in the following chapters discussed in great detail.

Chapter 3: /h/, the "Large Portion of Voicelessness"

3.1 Previous Ideas about /h/

The sound /h/ has always been an object of interest in circles of phoneticians and phonologists. For phoneticians the unique stance of the vocalic chords, for phonologists its controversial mechanics, /h/ has always given something to think about. /h/ is traditionally classified as a voiceless glottal fricative, but this definition has been questioned by many, and today it is widely considered a pseudo-fricative, and it has got several different classifications for various reasons. One of these reasons is that /h/ does not share the same lenition trajectory with other fricatives. A lenition trajectory is a path a phonological object goes through while tending to zero. This idea is based on Vennemann's claim (Hyman 1975: 165): "a segment X is said to be weaker than a segment Y if Y goes through an X stage on its way to zero". A visualised model for lenition trajectories can be found in Lass (1984).

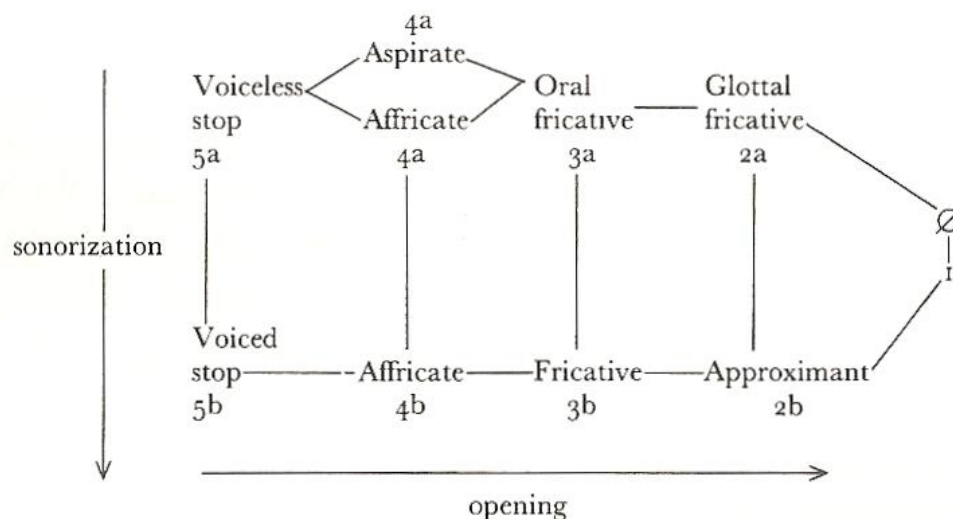


Figure 3a: Routes of lenition (Lass, 1984)

Of course stronger segments – including oral fricatives - go through a /h/ stage on the way to zero. The reason is when a fricative loses its oral place of articulation, in general the result is an /h/, which is indeed “only” a turbulent oral airflow, which – as I will argue later – yearns for an oral place of articulation, resulting in a unique interaction with its environment.

The same idea is captured by Government Phonology with the introduction of privative elements in lenition theories. The element **h** introduced in KLV85 was said to be included in every phonological expression including obstruction, including stops, affricates and fricatives. In other words, **h** is the source of obstruction in a phonological expression. For example, an expression /t/ consists of a set of elements {**R**, **h**, **H**, **I**} (coronal, obstruent, voiceless, stop), /s/ consists of {**R**, **h**, **H**} (coronal, obstruent, voiceless), while /h/ is of a

single {**h**} (obstruent). This approach also suggests the above mentioned two very important properties of /h/: 1. it can be easily subject to zero alternations due to its weak structure, 2. it is closely connected with obstruction, or in this model - as the name of element **h** suggests - /h/ itself **is** obstruction in some abstract way. I will argue later that my previous statement is partly true, but it requires serious refinement, for which GP 2.0 will be our tool. The structure of /h/ tells us it cannot be put in the same category as other fricatives due to its different structure.

The evolution of Element Theory brought a newer approach of the same idea. With some time, the existence of a large group of elements was disproved, and Element Theory remained with a seriously reduced set of privative elements. I will mention only the most important changes here.

- **R** (coronality) was melted into **A** (openness).
- **h** was considered redundant alongside **H** (high tone, voicelessness), because
 1. obstruction does not spread,
 2. the **H/L** (**L** for voicedness, low tone) distinction was considered relevant only in the case of obstruents, which frees us from indicating obstruction, and allows us remain with **H** and **L**.²
- **N** (nasality) became redundant alongside **L**. The presence or absence, or position of **H** itself can indicate voicelessness or voicedness and aspiration, while **L** “takes care of” indicating nasality and continues to indicate voicedness in L-voicing languages. There are two kinds of languages based on this difference. Aspirating languages in GP 1.x differentiate aspirated (fortis) and unaspirated (lenis) pairs by positioning **H** in head or operator position respectively (e.g. [**ʔA.H**] for [t^h] and [**ʔ.A**] for [t~d]). L-voicing languages differentiate voiceless and voiced pairs by the presence or absence of **L** (e.g. [**ʔ.A**] for [t] and [**ʔA.L**] for [d]). Nasality is the outcome of an operator positioned **L**. (e.g. [**ʔL.A**] for [n]). (Nasukawa, 2005)

The previously mentioned and other - for the current analysis less important - changes resulted in a set of elements reduced to six, three place or resonance elements and 3 manner elements namely: **A**, **I**, **U**, **H**, **L**, and **ʔ**. (Backley 2011, 2012) Therefore our previous example of /t/, /s/ and /h/ looks like this: [**ʔA.H**], [**A.H**] and [**H**] respectively. As we can see, one of the consequences of these changes is the change of the structure of /h/, which in very recent forms of GP looks like [**.H**], a headed **H** with no operator. It has no place element and it suggests

² We are talking about **H** and **L** responsible for voice configurations and not **H** and **L** in high or low tone vowels of course.

that /h/ is nothing else, but voicelessness. In this approach /h/ and other fricatives are only differentiated by the presence or absence of a place element, so we cannot fully decide whether /h/ is a full fledged fricative, or an approximant. Approximants or glides in GP 1.x are empty headed expressions with one element in the operator position while fricatives contain **H** either in their head or their operator position. Another problem of this approach is that /h/ and the velar fricative /x/ - since velarity is indicated by the lack of a place element - have the same structure, despite the fact that their behaviour and their distribution are largely different. I will argue later (in 3.2.1 and 3.2.4) that despite their complementary distribution in many languages, they cannot be the same phonological object due to the difference in their structures.

3.2 Proposal on the GP 2.0 Structure of /h/ and Aspiration

3.2.1 /h/ as a Non-branching Onset Head

In the present paper, I will model /h/ as a non-branching xO, with some really special abilities. Before seeing what these special abilities are, let us see what we profit from the structure I propose. At this point I have to mention that the idea of such an analysis for /h/ is not entirely new. Pöchtrager (2006:102) analyses the French word *haut* [o] 'high' in the following way.³

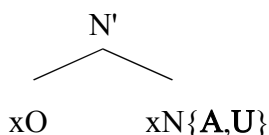


Figure 3b: The structure of *haut* /o/

The interesting point for us is xO, the onset head. In this case xO has no phonetic realisation. It contains no element, and it is not involved in any relations like m-command, which will be a crucial point. It is still present as a phonological object, but how can we know this exactly? How can we know that its structure is different from the structure of *eau* [o] 'water'? We will come back to this in a minute. Recurring to the original question, what do we profit from such an analysis? It shows that /h/ has a hyper-weak structure, it is a non-branching single head that is not a head of a government domain, so it can easily be subject to zero alternations. When we talk about /h/, it is right indeed, recall that it is always at the end

³ Elements and the system of annotation went through some changes since then, and tree 3b contains some obsolete ideas with the existence of element **A** and annotation of terminals with multiple elements, since both were abolished in Kaye and Pöchtrager (2009).

of lenition trajectories, it is often the final step before a lenition process reaches the point of zero. It also shows that in terms of structure /h/ is closer to an approximant than a fricative, which was the case in some earlier versions of GP, as we could see in 3.1.

At this point a question emerges, if there is no phonetic realisation of xO in the French word *haut*, how does it have a phonetic realisation elsewhere? Here come the special abilities I mentioned before. I propose the following:

(1) *The outcome [h] is always the phonetic realisation of a fortis structure.*

A fortis structure in GP 2.0 means that the head xO needs to be m-commanded by the structurally highest unannotated x. There are two options for an onset head to become fortis following the definition of Pöchtrager (2006) which I modify according to the revised definition of m-command in Živanović and Pöchtrager (2010).

- 1) It is either m-commanded by the highest unannotated x in its onset phrase **or**
- 2) it is m-commanded by an x of the preceding nucleus, taking length from the nucleus.

The first case is automatically ruled out, since a non-branching xO does not project and it cannot be m-commanded by anything in its phrase, but xO by itself which is not allowed. The second case is ruled out again when there is no preceding nucleus. Then how does the object xO become fortis and yield a /h/? Here comes my proposal: a non-branching xO can take away place from the nucleus of its own nuclear phrase, in other words, *xO can be m-commanded by the highest unannotated x of the following nucleus*. This seems to go counter to the original requirements of m-command, and we cannot be sure whether the problem is in the new idea or in the definition, so let us go through the behaviour of /h/ in different positions, in order to see if the new idea works.

3.2.2 /h/ in Initial Position

In order to make my previous statement visible, let us see the structure of the Hungarian word *hó* /ho:/ 'snow' in 3c. For indication of command relationships, instead of conventional arrows, I will use lower index notions, where [mcr] stands for m-commander and [mce] for m-commandee. The *path of m-command* always leads through nodes connecting m-commander and m-commandee.

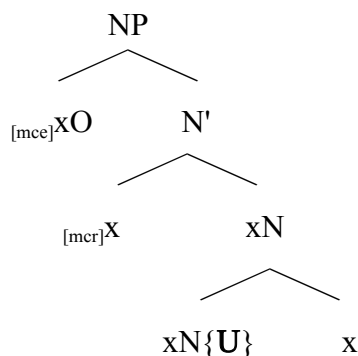


Figure 3c: The structure of *hó* /ho:/

First let us explain the tree from point to point. The structure of /h/ is as it is described above: a non-projecting nuclear head that is m-commanded by the highest unannotated slot in order to achieve fortis status and become realised as /h/. The structure of /o:/ is a projecting (long) adjunction structure with no control relationship holding between $xN\{U\}$ and x , because the rounded closed mid-vowel /o/ has a $\mathfrak{a}$ -structure.

What does this kind of analysis explain? Partial devoicing of the following vowel after /h/ is a well documented phenomenon. With Pöchtrager's interpretation of the fortis-lenis distinction in GP 2.0 we can easily come to a conclusion that this kind of devoicing is not only a phonetic phenomenon but it is also phonological. Also, I mentioned previously that /h/ “yearns” for an oral place of articulation: it does not have one so it is forced to assimilate with its environment. This environment is the nuclear phrase which contains the xO in its specifier. It is not only length that xO acquires through an m-command relationship resulting in partial devoicing of the vowel, but in addition the head of the domain gives xO an oral configuration. This trade-off relationship is now phonologically visible, giving a good reason for us to use x -bar instead of flat structures like sCV , where modelling this phenomenon would not be possible.

3.2.3 /h/ in Intervocalic Position

Of course, the mechanics of /h/ explained in the previous section apply only to syllable initial positions, and only when the underlying /h/ is not in an intervocalic position. Now we need to take other positions into account in order to get a picture of how /h/ works. Let us begin with the intervocalic position.

Intervocalic position is traditionally considered a weak position where lenition processes are likely to happen. As an example, the sCV model of the coda and coda mirror distinction (Ségéral and Scheer, 1999, 2008) categorises intervocalic (V_V) position to the group of naturally weak positions alongside the famous $_ \{C,\#\}$ disjunction. It is a well known phenomenon that an underlying /h/ realises itself as a voiced [ɦ] intervocalically in most

languages. It is a common view among phoneticians that this phenomenon has nothing to do with phonology, it is simply a spontaneous voicing process which is never distinctive. (Szigetvári, 1998) Why should we still deal with /h/ in intervocalic position then? As we could see previously, /h/ and its relationship with its environment can be actually modelled in GP 2.0 as opposed to other frameworks, and if we go through the possible environments of /h/ we can see a less surprising, but rather more interesting pattern.

We could see that /h/ can be modelled as a non-branching nuclear head (xO) which can be m-commanded and in order to achieve a fortis status. This will happen indeed word-initially in Hungarian, and a [h] is what we get. However, its likelihood to be m-commanded is not the same in every position. It appears that intervocalically /h/ (xO) will not be targeted by m-command, and will not be provided the extra space it needs to become fortis. What this results is a [ɦ]. As an illustration I will use the Hungarian word *kohó* /koho:/ 'smelter' in 3d. I will abbreviate the irrelevant part as a triangle.

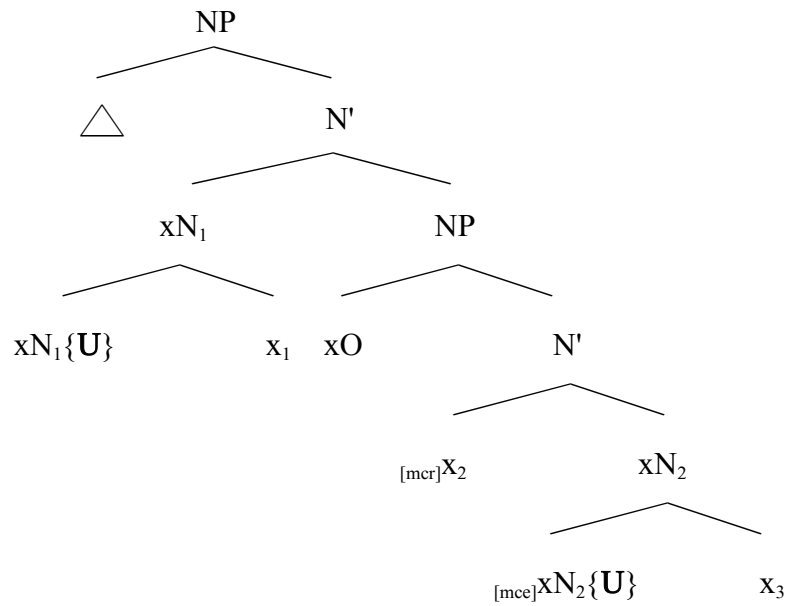


Figure 3d: The structure of *kohó* /koho:/

The main difference to spot compared to *hó* /ho:/ 'snow' is the lost m-command relationship between x_2 and xO. What we can see is an m-command relationship holding between x_2 and $xN_2\{U\}$. This is because the long /o:/ can fully realise itself by taking control over x_2 since it does not m-command anything else. Note that slots x_1 and x_3 are the products of adjunction and do not take part in m-command relationships.

One can realise we have met this object (non-projecting xO without m-command) before. It is indeed the same one as in French *haut* /o/ 'high'. But if non-m-commanded xO is a result of the intervocalic position, how does it appear word initially? It is not necessarily the

product of the intervocalic position. We could see that oral configuration of a non-branching xO depends on the nucleus. This is true in the case of *haut* too, it is not in connection with m-command relationships, the oral assimilation always happens when the onset and the nucleus are in the same phrase. What makes a difference is whether x-positions provide length for xO through m-command to become fortis. If not, xO is forced to remain lenis which results in a [h̥]. In French the same happens word-initially too, as opposed to Hungarian, where initial non-projecting xO is always m-commanded. It is clear that there may be some proper evidence for what blocks the m-command relationship intervocalically. This idea needs further research. For now I will go with the temporary conclusion that this seems to be a *language-specific parameter*. French does not allow xO to be m-commanded in any cases, which means no [h] is realised in any position.

The reader may have noticed a very strange point in my analysis that I have to address at this point. Why do I talk about fortis and lenis structures in L-voicing languages like French or Hungarian? In L-voicing languages the melodic prime **L** produces voicing instead of the loss of m-command (headness of element **H** in earlier forms of GP) and also there seems no regular trade-off relationship between onsets and nuclei depending on m-command relationships to exist. The explanation is simple. /h/ - at least in Hungarian – does not get voiced by regressive voice assimilation, but it does cause devoicing itself. The only position where /h/ gets voiced is the intersonorant position (including intervocalic). (Szigetvári, 1998) Considering these facts using the present framework can lead us to simple explanations. /h/ cannot include **L** because:

1. Its structure (non-branching xO) has no place to contain element **L**. We have not met a GP 2.0 structure containing **L** in head position and there is a high possibility that no such object exists.
2. The voicing of /h/ in intersonorant position cannot be originated from a structure containing **L**: *the intersonorant voicing it undergoes and the devoicing it causes progressively or regressively can only be structural*. This always depends on the presence or absence of m-command.

So we can conclude that it does not matter whether a language is of the L-voicing type or not, /h/ (non-branching xO) has the ability to require m-command and create a fortis structure, and its voicing is always caused by the absence of m-command.

3.2.4 /h/ in Final position

Another position which is considered weak is the word-final and syllable-final

position, which can be drawn up as the environment $_ \{C, \#\}$ for short. In this section we will take a closer look at the word-final mechanics of /h/ in Hungarian.

A hyper-weak structure like the one of /h/ (xO) is obviously extremely endangered in a weak position, and it would seem normal if it simply disappeared. In one case this is exactly what happens, but strangely we can see cases of fortition in word-final position, which is not something we would expect. I will take both cases into account. In Hungarian both variations can happen: /h/ in word final position either remains silent or fortition process takes place in which [x] is realised. My example is *méh* /me:/ or /me:x/ 'bee' for which I will give a basic structure assuming the existence of the word final xO. For my analysis, as I stated in Chapter 2, I will adopt the “*bid* structure” of Úlfsgbjörninn (2008b) (basically *libby* structure for consonant final domains) instead of the idea of Pöchtrager (2006), for reasons I will discuss in a minute.

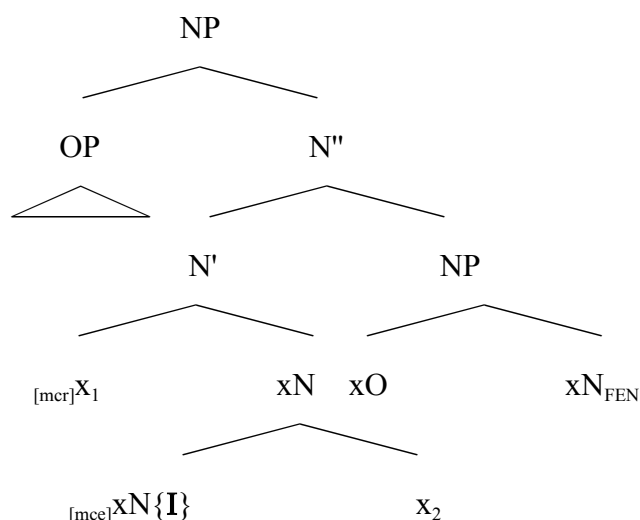


Figure 3e: The underlying structure of *méh* [me:] or [me:x]

Let us go through this tree to see what is going on. The irrelevant part for us ([m]) is abbreviated. We can see two nuclear nodes conjoined by N''. This is because the Final Empty Nucleus (xN_{FEN}) projects to a nuclear phrase in order to contain xO in its specifier. On the other side xN splits in two to create an adjunction structure which comes with the terminal x₂ and takes a complement x₁ and projects to N'. There is no control relationship between xN{I} and x₂ because the closed mid vowel /e/ has a ə-structure. There is an m-command relationship holding between xN{I} and x₁ because x₁ provides space for xN{I} to be realised as long. What we see at the end of the tree is something unusual: an empty onset head followed by an empty nuclear head. We have known for long that these kind of structures do not exist. Even in sCV phonology (Lowenstamm, 1996; Scheer, 2004) if an empty CV sequence occurs it gets deleted, or it is interpreted as word-boundary if it is sequence-initial.

sCV phonology is right to some extent, because this is one of the possible variations that can occur. The NP projection holding xO and the FEN gets deleted alongside with unary branching nodes due to the Principle of Structure Minimality (Pöchtrager, 2006:65). In this case what we get is the following tree:

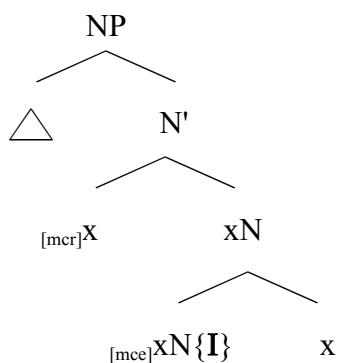


Figure 3f: The structure of [me:]

This is the structure of expectations, the empty ON (CV) sequence gets deleted⁴ which results in the output [me:]. But there is another variant [me:x]. How do we get this structure? I propose the following: the structure of the domain is the same as in 3e, *but the Final Empty Nucleus m-commands the onset head*, giving the structure of /x/. The illustration is in 3g.

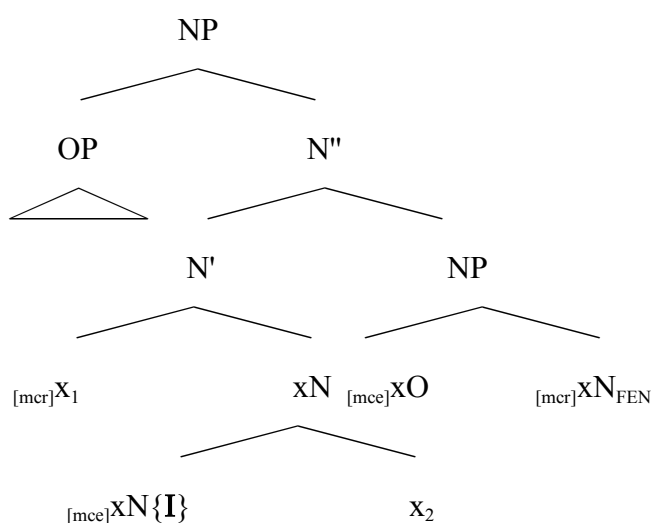
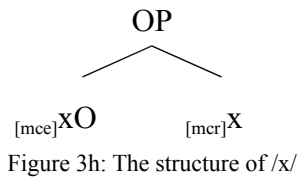


Figure 3g: The structure of [me:x]

For comparison 3h contains the structure of /x/. We can notice - if we accept that FEN can work as an unannotated x - that the structure is nothing different than the structure of a standalone /x/.⁵

4 Whether Structure Preservation Principle is valid or not in GP 2.0 is not entirely clear. Deletion can be interpreted here as “no phonetic realisation corresponds to this structure”.

5 Remember that the name of bar levels and phrases is a question of convention. Also the righthandedness or leftheadedness is not a contributing factor to the phonetic realisation of the structure, unless we talk about complex phrases like diphthongs or labialised and velarised consonants.



Again, what we are talking about right now is an allophonic variation of /h/, but still I find it important to take this kind of allophonic variations into account, because they are outputs of different phonological processes applying to a given structure, and these different outputs are phonologically modelable.

Turning back to the topic, it is easy to spot multiple strange ideas in my description. Firstly, xN works as an m-commander. Živanović-Pöchtrager (2010:366) states that only non-heads (x-slots) can be m-commanders and heads (xO, xN) can be m-commandees. I partly reject this idea, and propose that *FEN can work as a non-head terminal, and m-command the onset head in the specifier of its projection*. Secondly, a head xN m-commands another head xO. Since we concluded that FEN can work as an x this should not be a problem. However strange my idea might seem within the boundaries of GP 2.0, please do not forget that we are talking about a theoretical framework which is still in development. Later on in this paper I will bring another examples of the m-commanding FEN, like word-final aspirated plosives in Icelandic, and word-final fortition in German, which will prove it is not just a twisted idea, but it is part of a general pattern working in many languages.

At this point I need to stress how crucial it is to place the Final Empty Nucleus at the end of trees instead of conjoining it with the root node. Even in former versions of Government Phonology like sCV, FEN is something special, something that can make a difference with its presence or absence. I think that we should handle FEN in a special way in GP 2.0 too, and I see no point in conjoining it with the root node, because it hardly has any impact on the structure. The only exception is when it comes to analytic morphology, in that case this position comes in handy, and it can make a distinction from non-analytic morphology. Let me note that in some examples root node dominated FEN can make a real mess. It forces us to delete unary branching nodes because of the clash of multiple nuclei which need to be simplified. This can be avoided by using tree-final nuclei proposed by Úlfsson (2008b). I will not explain this any further, because it is well beyond the scope of the present paper, for details please see Pöchtrager (2006:204).

3.2.5 /h/ in Consonantal Environment

There are two positions left to explain, namely the post-consonantal (C_) and

preconsonantal (C) positions. While the first position is traditionally considered strong the second one is said to be weak. However, we will see that in neither of these two positions is /h/ able to realise itself segmentally. In this part I will not give a basic account of the representation of aspiration in GP 2.0, since everyone can look up the basic idea in Pöchtrager (2006). I will rather give the reasons why /h/ (aspiration) is not segmental in consonantal environment, not even in languages where there are no aspirated stops with phonemic value. (L-voicing languages, e.g. Hungarian) Then we will take a look at the interesting two-directional behaviour of aspiration in Icelandic, including the sonorant devoicing process, from which we will draw some not surprising, but rather interesting conclusions.

3.2.5.1 /h/ in Post-consonantal Environment: the Aspiration Process

/h/ as aspiration of course is not a new idea at all. In sCV phonology aspirated stops are H-headed expressions, meaning **H** (voicelessness/fortisness/aspiration) is their most salient property ([A**ʔ.H**] for t^h, [U**ʔ.H**] for p^h, [**ʔ.H**] for k^h), while /h/ itself is an H-headed expression with no operator ([.H]). This idea is something we cannot reject in GP 2.0 as we will see later on. The main question we can ask is whether /h/ is completely the same as aspiration or it can realise itself segmentally after a consonant. To put the same question in a GP 2.0 tone, whether an independent xO can appear before and after an onset phrase of a stop or not.

In GP 2.0 an aspirated stop is the phonetic realisation of a fortis structure as described in Pöchtrager (2006:70) modified by the polarity shift of m-command proposed in Živanović and Pöchtrager (2010:366) (the highest unannotated x in the structure m-commands xO). We can no longer talk about an element **H** in the structures, since it was eliminated with the introduction of structural layers and m-command. If we want to understand the mechanics of /h/ and aspiration in this framework, we need to take a few previously mentioned ideas into consideration. Firstly, let us recall what we have concluded about /h/ so far. /h/ is a non-branching nuclear head (xO) with a strong tendency to be m-commanded. The xO requires m-command from an unannotated x of its nuclear projection. When it is m-commanded we get a fortis [h]. When it fails to require m-command the result is a lenis [ɦ]. The lenis-fortis distinction is valid in L-voicing languages too. /h/ inherits the oral stance of the vowel containing it in its nuclear projection (the following vowel). When it fails to inherit oral stance, because /h/ is in the specifier of an empty nucleus ([_{NP}xO xN]), xO is able to require m-command from the sister nuclear head (working like an unannotated x) resulting in a fortition process and finally we will get a [x] in Hungarian. Secondly, we need to take a look at Pöchtrager (2006:247) and what it tells us about the requirements of coda-onset clusters.

“An onset O_n can only be licensed by an onset O_{n+1} iff O_{n+1} projects.” This – as Pöchtrager explains – aims to exclude coda-onset clusters with non-braching structures in the onset, like the ones of /r/, /w/, or /j/. Approximants own the weakest structures in GP 2.0 and they cannot license consonants in coda position.⁶ Again, we concluded that the structure of /h/ is also non-branching, and this means that it must be excluded from the onset position of coda-onset clusters too. And now we ask, what about the structure of words like *nátha* /na:thɔ/ ‘common cold’ in Hungarian? Of course, based on these circumstances, /th/ cannot form a coda-onset cluster. But where do we place /h/ then? One way is to analyse it as a regular bogus cluster⁷ and assume an empty nucleus between /t/ and /h/. However, this is not what I have in mind because the final short /ɔ/ could not provide length for xO, and the output could not be a [h]. I propose the following instead:

(2) /h/ after oral stops (in Hungarian):

- a) *An oral stop and a /h/ cannot form a cluster.*
- b) *In case of stop+/h/, /h/ is non-segmental, and it is only present in the form of m-command, which results in a fortis structure and therefore aspiration.*

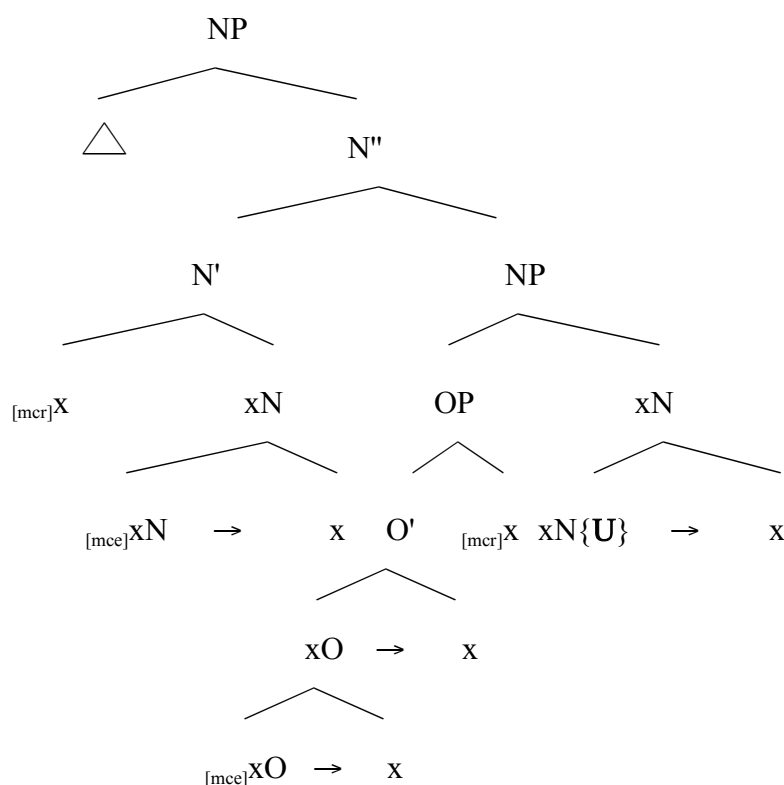


Figure 3i: The structure of *nátha* /na:thɔ/

6 Codas (or O for α) are in a similar fashion to Kaye (1990). Codas must be licensed by a following onset.

7 A bogus cluster is a set of two consonants which seem to constitute a coda-onset cluster, but they cannot do so due to structural restrictions.

Note that I put “in Hungarian” into brackets because my previous proposal is valid not only for Hungarian, but for other L-voicing languages too, but in the present paper I will not go into analysis for other languages of the same type. Also note that representation of the vocalic sound [ɔ] is something I am not sure about. In Hungarian [ɔ] and [a:] are in short-long opposition, so most likely [ɔ] does not contain an element U. The reason I represented it as containing U is a mere analogy drawn between the structure of the pairs [ɛ]-[e] and [ɔ]-[o], open and closed counterparts, which constitute an a-structure and ə-structure opposition in GP 2.0 containing element I and U respectively.

What does proposal (2) mean for us? First of all, we get aspirated stops even in L-voicing languages and a three-directional opposition: voiceless (plain) stops, voiced stops and aspirated stops. From this approach our previous example is better transcribed as /na:t^hɔ/. The voiceless-aspirated opposition rarely creates lexical distinction, but sometimes it does, for example *hátha* /ha:t^hɔ/ ‘~maybe it will be so’ (lexicalised compound of *hát*+*ha*) vs. *háta* /ha:tɔ/ ‘his/her back’ (*hát*+a_{POSS SING.3}), but I already expressed my opinion about the unnecessary of lexical distinction when distinguishing phonological structures.

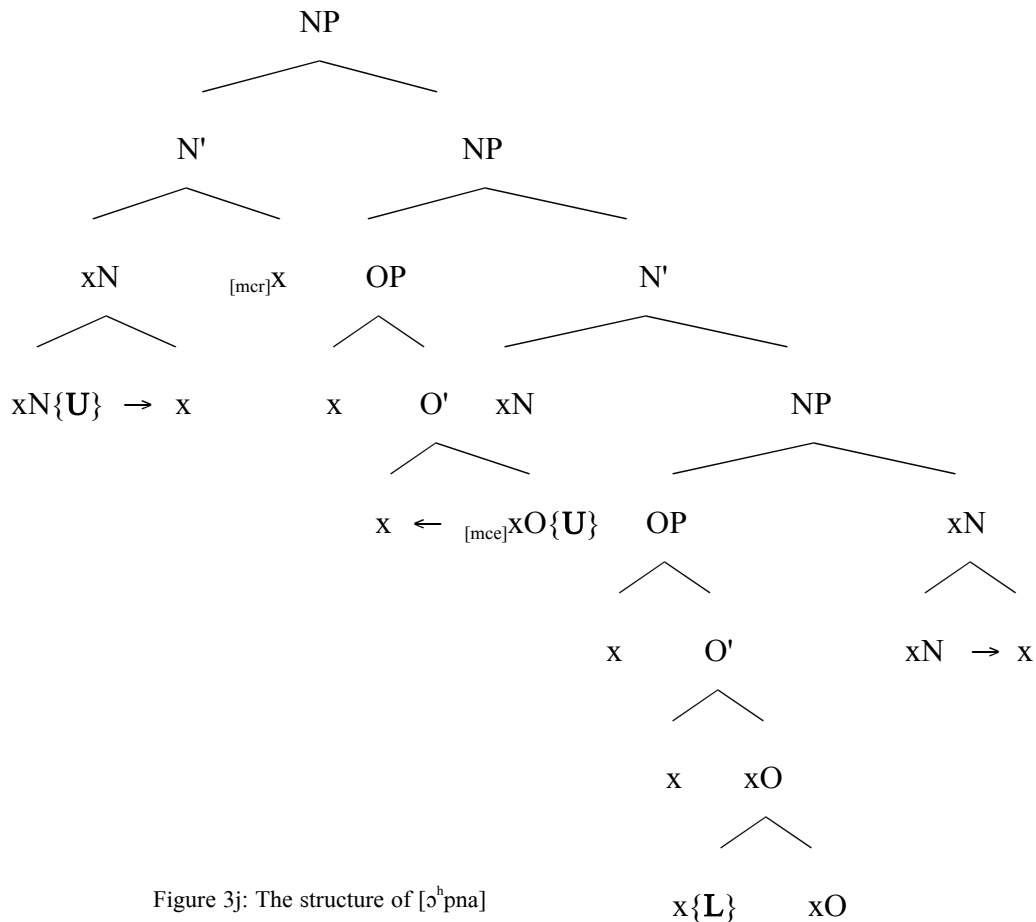
Proposal (2) also means that the phonological commonplace that /h/ equals aspiration has been proven in another framework. It is important that the onset head (xO) only appears when /h/ is segmental. When it is realised as aspiration, the xO of /h/ equals the head of the fortis structure. This can be roughly translated into H-headedness in GP 1.x. The present analysis is in the spirit of the radically non-segmental approach of GP 2.0, and this is what makes a real difference.

Why is it necessary to analyse /h/ in post-stop environment this way? We concluded that it cannot be a coda-onset cluster, because non-branching onset structures fail to license codas, therefore /t/ in /na:t^hɔ/ could not be in onset position dominated by the N' projection of /a:/. To begin a tree with two consonants could not work out, because a single specifier of a nuclear projection is not able to contain more than one onset projection at once. Another workaround could be to introduce an empty nucleus which could hold /t/ in its specifier, like we would do it in the case of bogus clusters, as I mentioned earlier. This could not work out because /h/ could not be m-commanded by the following short /ɔ/ due to lack of free x-slots it could provide. In addition /h/ seems to inherit the oral stance of /ɔ/ just like in the case of word-initial segmental xO. This suggests /h/ and /ɔ/ to be in the same nuclear projection. This leads us to a conclusion that stop+/h/ sequences in Hungarian can be analysed only as aspirated stops.

3.2.5.2 /h/ in Pre-consonantal Environment

To show the ways of /h/ in pre-consonantal environment is something that our regular test subject, Hungarian is not capable of. In Hungarian $_C$ environment groups with $_\#$ when it comes to /h/ and we cannot say anything new about it, but what we have already seen in 3.2.4. What can be really interesting to us in this topic is the preaspiration process for which our new test subject will be Icelandic. Icelandic preaspiration is a really complex issue and I will not be able to address all aspects of it. I will provide an analysis only of the most relevant part. The questions I will address in this part are the following: 1. Is pre-consonantal /h/ (preaspiration) segmental or not and how can we test it? 2. How does preaspiration work? To answer these questions I will have to address the case of the very special C_C (R_T) environment for /h/ in Icelandic, where sonorants devoice.

First of all, what is the obstacle for /h/ and an oral stop to constitute a coda-onset cluster based on the previous analysis? Nothing, because a stop has a two-layered structure, while /h/ is a non-braching onset head, so the stop is more complex, and technically nothing would prevent /h/ and an oral stop from constituting a coda-onset cluster. However, we will see that in Icelandic this is not exactly the case. When a sonorant occupies the coda position before an aspirated stop, the sonorant loses its voice. This phenomenon is quite telling, aspiration cannot be segmental, because it does not have a position to reside in. Aspiration of a plosive can cause devoicing in two way. Aspiration finds a way, no matter what environment it is in, and it does not need to be segmental. But then how does preaspiration work exactly compared to aspiration? Let us take a look at two structures and compare them based on what we already know. Our subjects in 3j and 3k are *opna* [ɔ^hpna] 'open_v' and *opinn* [ɔ:p^hin] 'open_{ADJ}'.



In the case of [ɔⁿpna] we can see an empty nucleus between /p/ and /n/, which needs some explanation. A nasal cannot license an oral stop in coda position, in other words, they cannot form a coda-onset cluster, they are a bogus cluster. It seems that we cannot derive this statement from the size of our structures, since both oral and nasal stops are twice-projecting (two layered) structures. The structure of /n/ can deceive our perception, because it is more complex thanks to head-adjunction, but do not forget that 'structurally complex' does not equal 'structurally bigger'. The structure of these two stops are equally “big”, the head projects twice in both cases. I will not give a formal definition of this licensing relationship, because it is irrelevant to us right now, and I will rely on analyses of GP 1.x which correctly predict (based on segmental complexity) that a nasal stop cannot license an oral stop as coda. The empty xN is there because a /pn/ cluster cannot exist, but /p/ needs a nuclear head to have a projection to reside in. At first glance this xN seems to be rather functional but it is not entirely true. If we consider this xN as the nucleus to license the onset, it is functional indeed. Former versions of GP also use empty nuclei for bogus clusters, and we can see that it is useful rather than harmful. But as we will see it is not entirely functional. This empty nuclear head is for example the reason why m-command cannot devoice post-stop sonorants (in TR

configurations), but it can devoice pre-stop sonorants (in RT clusters), see figures 3j and 3l. This shows us that adjacency is still a crucial factor in GP 2.0.

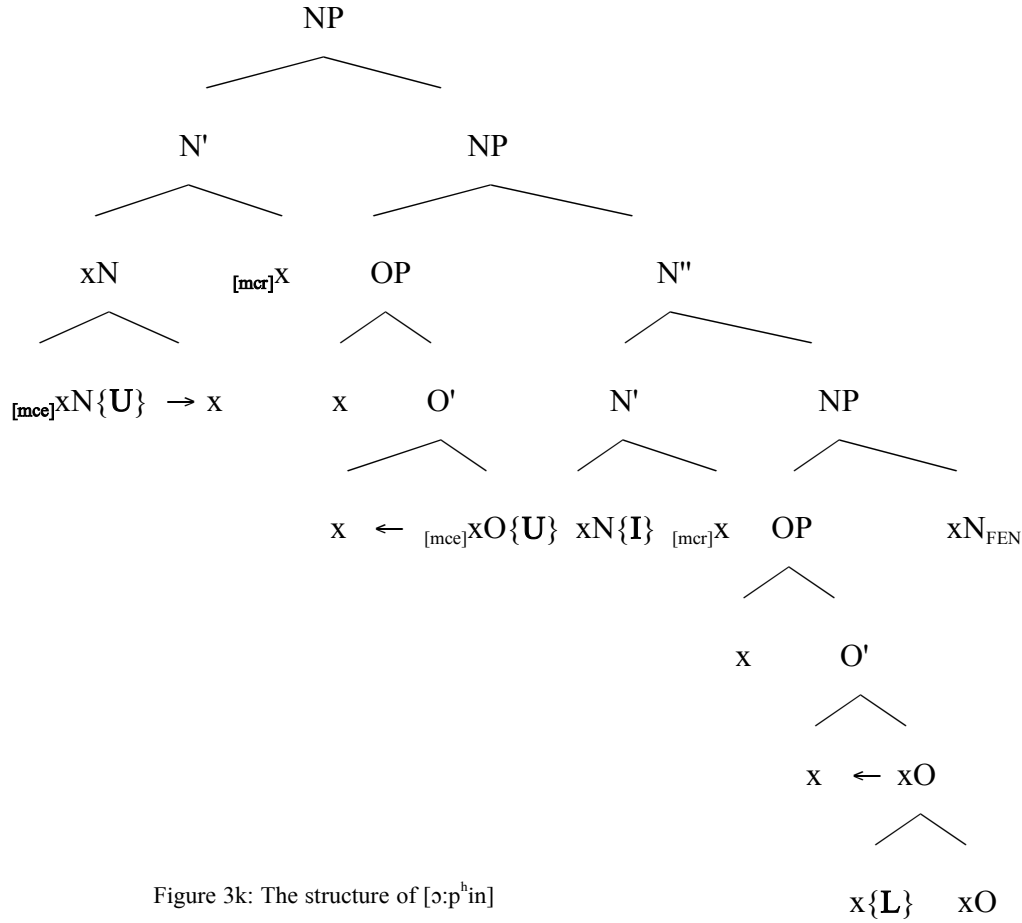


Figure 3k: The structure of [ɔ:pʰin]

Now let us continue analysing our trees. What is really striking is the opposition of [ɔ] and [ɔ:]. We have [ɔ] when there is preaspiration and [ɔ:] when there is postaspiration. Gussmann (2002:160) analyses this kind of phenomenon as vowel lengthening when particular conditions are met, namely the vowel stands before a [pʰ tʰ kʰ s]+[v j r] cluster. I reject this kind of vowel-centric analysis, and I will use a rather consonant-centric analysis where aspiration “pulls the strings”, similarly to Pöchtrager's solution to the vowels of New York City English. When we look at this phenomenon from this direction, length variation of vowels when it comes to post-nuclear plosives is not surprising at all. The same happens in NYC English, but it depends on whether the following stop is fortis or lenis (e.g. bid /bɪd/ vs. bit /bɪt/, for details see Pöchtrager (2006), Kaye-Pöchtrager (2009)). This case is different from the NYC trade-off relationship because *opna* and *opinn* both have a fortis /p/, but in one case we can see preaspiration and postaspiration in the other. It is more than obvious that preaspiration takes away place from the preceding nucleus, while postaspiration does the same with the following one. We can draw a conclusion that:

(3) Fortis stops of Icelandic

- a) *Fortis (aspirated) oral stops in Icelandic always take place from their environments.*
- b) *They achieve this by requiring m-command from the structurally highest unannotated x-slot of the projection of surrounding sonorants or vowels.*
- c) *When a vowel follows and no sonorant precedes, fortis stops require m-command from the following vowel by default, resulting in aspiration and a reduction of vowel length.*
- d) *When a sonorant consonant follows and a vowel precedes, the fortis stop requires m-command from the preceding vowel, resulting in preaspiration and a reduction of vowel length.*
- e) *When a sonorant consonant precedes in coda position and a vowel follows, the fortis stop requires m-command from the preceding sonorant which becomes devoiced . (We will see this later)*

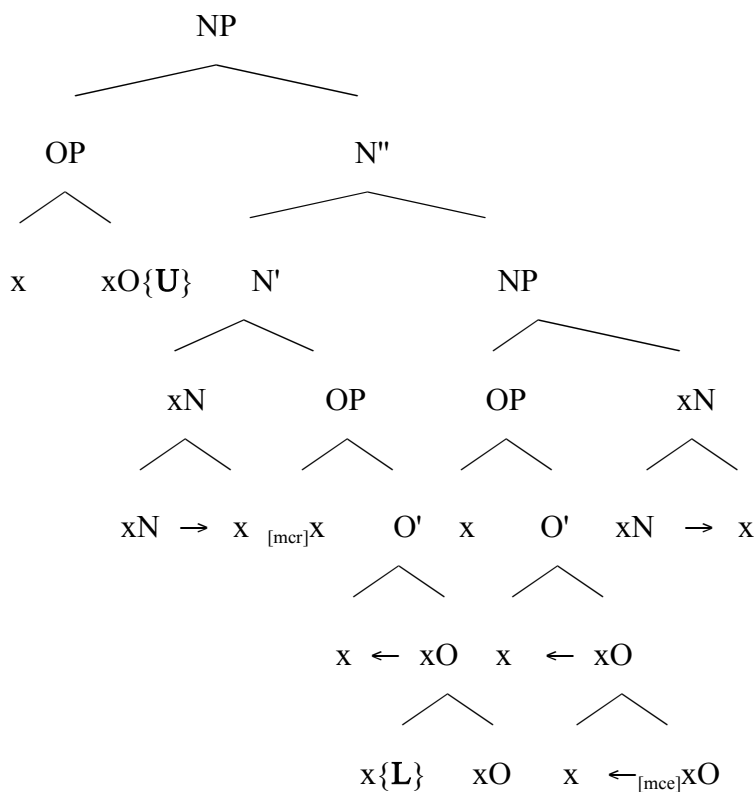
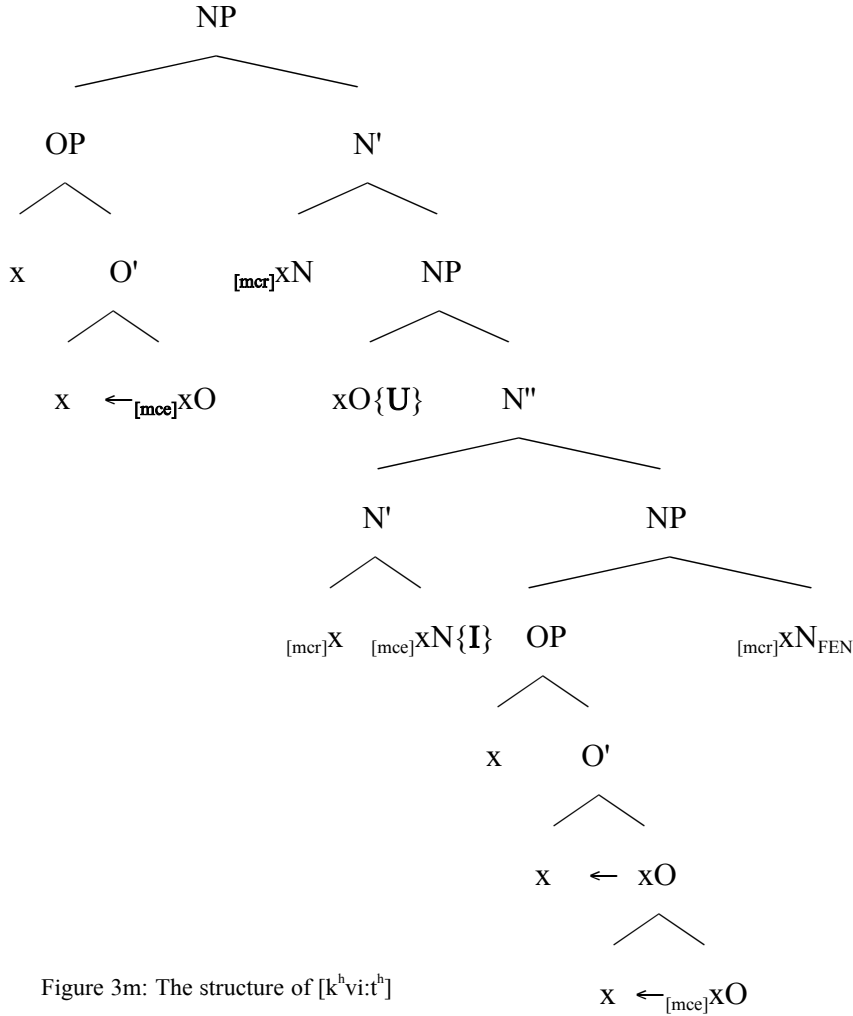


Figure 31: The structure of [vanta]

This was the first half of the story. Based on the previous analysis and conclusions, now we turn to the phenomenon of sonorant devoicing, and then we will take a look at the curious behaviour of word-final fortis plosives. As I mentioned before, in Icelandic sonorants

devoice by aspirated plosives in RT clusters. In order to visualise this phenomenon I give the structure of *vanta* [vaŋta] 'to need' in 3l. Sonorants in Icelandic devoice only if they are followed by an aspirated plosive, but they do not devoice when they are preceded by one. I stated previously that empty nuclei block sonorant devoicing in TR configurations which we can also see in figure 3j, where the aspirated plosive /p^h/ takes away place from the preceding vowel instead of sonorant devoicing. But what happens when there is no preceding vowel if a fortis plosive happens to meet a sonorant? We can see it in figure 3m, which gives the structure of *hvít* [k^hvi:t^h] 'white'. The empty nucleus prevents the sonorant from devoicing, but because there is no preceding vowel which could provide an m-commander x-slot, /k/ must require m-command from xN in order to get aspirated. This shows two important things. 1. Adjacency is crucial for m-command. It cannot go through an intervening object, be it empty or not. 2. The empty nucleus between a plosive and a sonorant is not only a necessity, but it has a very important function.

In order to formalise the need of adjacency I introduce three new notions: *skeleton*, *skeletal object*, and *non-skeletal object*. A *skeleton* is the chain of alternating NP-s and N-bars immediately dominating each other to the right of which the highest is the root node. Since we excluded onset-final domains, in every tree we will see a pattern of NPs and N-bars alternating, which works like the skeleton or the backbone of the structure. We call every NP or N-bar that is part of the skeleton a *skeletal object*. We call everything that is not the part of the skeleton, containing OP-s, O-bars, xO-s, and xN-s and N-bars which are not part of the skeleton *non-skeletal objects*. The *highest non-skeletal object* is the node immediately dominated by a skeletal object.



(4) Universal adjacency restriction for m-command

- a) *Highest non-skeletal phonological objects A and B are adjacent iff A and B mutually c++command each other.*
- b) *M-command relationship can hold between terminals C and D iff both C and D are terminals dominated by the same highest non-skeletal object **or** C and D are dominated by two separate adjacent highest non-skeletal objects.*

Less formally this means m-command can hold between two terminals of the same phonological expression or adjacent phonological expressions. Note that I am referring to the modified notion of c++command, instead of the original one. Both definitions and the reason for the modification can be seen in Chapter 4.

The reader may have noticed that I already stated that a FEN can work as an x-slot and it is able to m-command, but there has been no reference to non-final empty nuclei as m-commanders. I give the principles of empty nuclei in (5).

(5) Empty nuclei as m-commanders

- a) *Empty nuclei (xN) are able to behave as unannotated timing slots (x) and provide space to heads dominated adjacent highest non-skeletal nodes.*
- b) *The Final Empty Nucleus (FEN) has a universal ability to m-command, which can be parametrically regulated.*
- c) *Non-final empty nuclei m-command only if there is no other potential m-commander.*

Turning to 5b, there are cases in Icelandic when whether FEN m-commands or not is lexically encoded. For example when /t/-final stems - which are aspirated by default thanks to the space provided by FEN - get the suffix -t [t^h], which indicates the neuter gender of adjectives (Gussmann, 2002:55), they become m-commanded by the x-slots of the preceding vowels or sonorants. Consider the following examples: *hvít* [k^hvi:t^h] 'white_{FEM}' vs. *hvítt* [k^hvi:t^h] 'white_{NEUT}' and *tóm* [t^hou:m] 'empty_{FEM}' vs. *tómt* [thoumt] 'empty_{NEUT}'. In the first case we can see the vowel-shortening and preaspiration as output. We can see that both aspirated and preaspirated stops are possible word-finally, therefore whether one or the other will appear is fully lexical. In the second case, when the stem ends with a sonorant, we can see sonorant devoicing and also vowel shortening. Why is it so? In the stem, the final /m/ is an onset of the following empty nucleus, because no other onset follows to license it as a coda. But when the suffix -t is attached it licenses /m/ to appear in coda position. The consequence is that the projection of /m/ gets attached to the place of the x-slot in the original [ou:] and becomes the sister of the nuclear head. The shortening of the vowel happens simply because [ou:] loses an x-slot when /m/ gets attached in the place of it. The devoicing process goes through as it was explained before. However, at this point I am going to add some details to the explanation. Why does a sonorant get devoiced when its highest x-slot m-commands a plosive? We can roughly translate m-command to “interpret the content of this terminal to the target”. Of course when there is no content, what m-command interprets to the target is empty space. Let us look at the case of a nasal stop /n/ (its structure can be seen in 31). The content of the highest unannotated terminal gets interpreted to elsewhere. What do we remain with? We can see it in 3n.

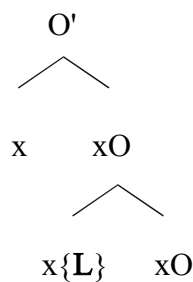


Figure 3n: The structure of [ŋ]

Basically we remain with the structure of some coronal fricative (one layered structure with adjunction) which contains the nasal element **L**. And this is what [ŋ] is, a coronal nasal fricative-like sound. This, of course, means that in this case we do not speak about a fortis-lenis opposition, but about a stop-fricative distinction. However, it should be noted that voiceless nasals seem to have two kinds of structures. In Modern Welsh, [ŋ̥] and [m̥] are either lexical, or the products of nasal or aspirate mutations. When nasal mutation takes place they are mutated forms of fortis stops [t] and [p], which suggests a fortis twice-projecting structure with **L** (patterning with [d] to [n] and [b] to [m]). When aspirate mutation takes place, they are mutated forms of [n] and [m], which can mean the loss of a layer more likely than fortition by m-command ([p] to [f], [t] to [θ], and [k] to [x] mutations show this pattern too). (King, 2003:14)

3.3 Word-final Fortisation in German

The word-final “devoicing” of obstruents is a very general phonological phenomenon, which is present in many languages. However general this phenomenon is, GP analyses have always had some difficulties with addressing it properly. Before attempting to model this phenomenon in the GP 2.0 framework, let us see an example for a GP 1.x analysis. Gussmann (2002:147) and Brockhaus (1995:171) state that the final empty nucleus in German cannot license voicing in the preceding onset and voice – which stays present as some kind of floating element – can be reattached to the others when the following nucleus is not empty anymore, so the obstruent can go through voice assimilation. According to Gussmann, obstruents in German are voiced only in voice-friendly environments, because it is an aspiration language with fortis and lenis obstruents, similarly to English. Gussmann and others who use this analysis are right that the FEN is behind the phenomenon as we will see, but otherwise there are serious problems with this kind of analysis. First of all voicedness is additional content from this perspective, which assumes voiced obstruents to be more complex than voiceless obstruents. I reject this analysis because our test subject for this

phenomenon – German – is not of the L-voicing type, but as other Germanic languages it is an aspiration language. Obviously we cannot apply an analysis to German where element **L** produces voicing, because the fortis-lenis distinction is generated by H-headedness in GP 1.x as we could see before. Voiced obstruents match unaspirated (plain) obstruents in this type of language, where voiced/unaspirated obstruents are unmarked, and voicelessness is the additional content. Secondly, in case we accept that the H-headedness is what distinguishes a fortis obstruent from a lenis one, then we come to another problem. The onset licensing of the FEN cannot be the cause for fortisation, for example it cannot convert /d/ [**L.A**] to /t/ [**A.L.H**]. If we take a model like the second version of Coda Mirror (Scheer and Ziková, 2010) into consideration, the situation is even worse, because the onset preceding the FEN is subject to government, which is the destructive one of the lateral relations that cannot cause fortisation. What we need is a model that can address this phenomenon using the fortis and lenis distinction instead of L-voicing.

In the model I propose we come back to 5b again. I state that in languages where word-final obstruent devoicing is active – like in German - FEN is parametrically encoded to m-command the heads of obstruents which results in fortisation due to the space extension of the preceding consonant. Let us see an example in figure 3o: *bunt* [bʊnt] 'colourful' vs. *Bund* [bʊnt] 'tie/alliance', and *buntes* [bʊntəs] 'colourful_{NOM NEUT}' vs. *Bundes* [bʊndəs] 'tie/alliance_{GEN}'. In [bʊnt] there is a compulsory, parametrically forced m-command relationship holding between the FEN and the preceding consonant. When a vowel follows, like in [bʊntəs] and [bʊndəs], FEN can no longer m-command the onset head of the plosives due to the locality rule of (4). The following schwa cannot provide space for the preceding onset and there is no sign of a length trade-off anyway, so the only object which can provide length for fortisation is the highest unannotated x-slot of the plosive, which either m-commands or not, yielding a [t] or a [d] respectively. As we can see m-commanding FEN is the cause of various independent phonological phenomena.

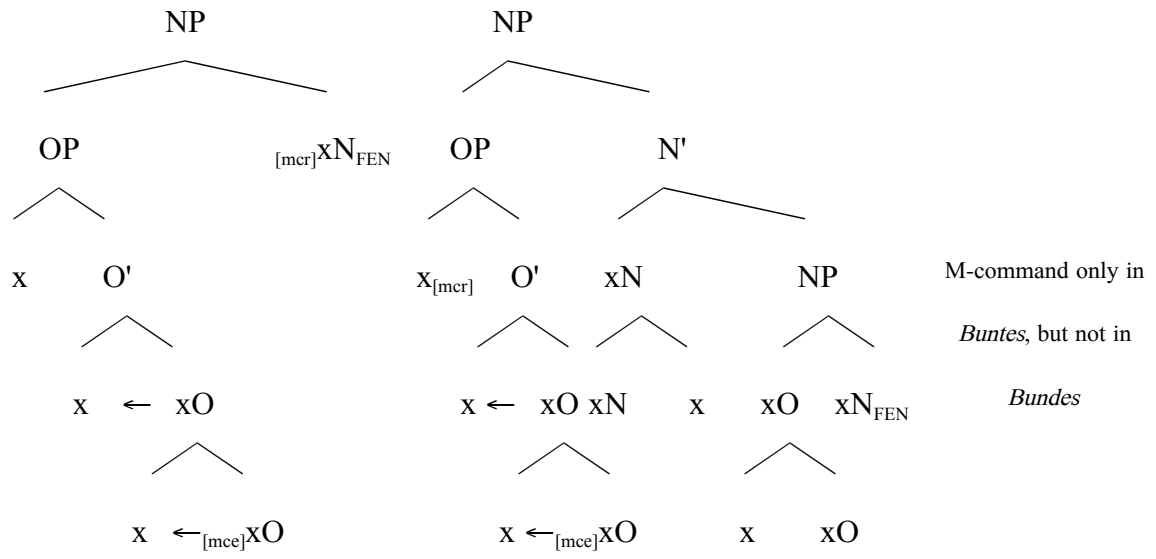


Figure 3o: [bönt] vs. [böntəs]/[bündəs] (only the relevant parts)

Chapter 4: On c++command

I am aware of the fact that my analysis on aspiration violates the c++command criterion (M4) for m-command, which can be found in Živanović and Pöchtrager (2010:366) along with the definition of c-command and c++command:

C-command: “Node α c-commands node β iff

(C1) β is α ’s sister, or

(C2) α ’s sister dominates β .”

C++command: “Node α c++commands node β iff

(C++1) α c-commands β , or

(C++2) α is the highest terminal in the maximal projection

immediately containing α and α ’s mother c-commands β .”

M-command: “(M1) M-command is a binary relationship between two terminals, an m-commander and an m-commandee.

(M2) Only non-heads can be m-commanders.

(M3) Only heads can be m-commandees.

(M4) The m-commander must c++command the m-commandee.

(M5) An m-commander can m-command only once.”

Figures 3k and 3l fail to meet the requirement that m-command relationship should only hold between two objects if one of them c-commands the other or the mother projection of the m-commander c-commands the other. It is easy to notice that both examples fail this requirement the same way: the highest unannotated x-slot is not contained directly in the highest non-skeletal node or a skeletal node. The notion of c++command was born without the consideration of such situations, and I think that the problem is in the definition itself. The definition of Živanović and Pöchtrager is based only on Putonghua rhymes, and it cannot address cases like aspiration in Icelandic. This, however, can be fixed in two steps. Firstly, the restriction on m-command needs to be based on adjacency (4) and not on the original definition of c++command. Secondly, to achieve this, we need a modification to c++command itself. I give the definitions in (6) and (7), which keep the crucial points of the basic definitions given by Živanović and Pöchtrager (2010:366), but also contain my proposed modifications based on the analysis in Chapter 3.

(6) C++command

Node A c++commands node B iff

- a) *A c-commands B*
- b) *A's mother c-commands B*

This modified definition is no longer based on terminals, it is true for any node be it terminal or not. Now we can address adjacency through the notion of c++command while previous analyses using this notion remain perfectly valid.

(7) M-command

- a) *M-command is a binary relationship between two terminals, an m-commander and an m-commandee.*
- b) *M-command relationship can hold either between terminals of adjacent phonological expressions or between two terminals of the same phonological expression.*
- c) *Non-heads (x) or non-projecting nuclei that are annotated with no element (xN) can be m-commanders.*
- d) *xN can behave as a non-head and m-command with specific conditions.*
- e) *Only heads can be m-commandees.*
- f) *An m-commander can m-command only once.*

In both 3k and 3l the conflict with c++command could be avoided with alternative analyses, however, I do not think that these alternative analyses are proper solutions. In 3l [vaŋta] we could avoid the conflict with assuming /n/ to be fortis, and make the onset head of /n/ the target of m-command. I did not choose this solution because I claim that fortis plosives always take away place from their environment in Icelandic and in this case it is not /n/ which is fortis, but it is /t/. R^hT sonorant-devoicing is not because of lexically fortis and lenis sonorants, but it is due to structural change caused by the m-command relationship. In 3k [ɔ:p^hin] the alternative solution is to say that the m-command relationship is phrase-internal in the OP of /p/. Some would also say [i] in [ɔ:p^hin] to be epenthetic, a product of the lack of proper government, so it should be non-branching and it should not provide space for /p/. It is a possibility I cannot reject but proper government in the GP 2.0 framework is a non-existing notion, however well it works in GP 1.x. To make such an analysis we first need to see whether phonotactic computations based on proper government are suitable for GP 2.0 or not.

Chapter 5: Conclusion

As we could see, GP 2.0 is an effective tool to model phonological phenomena surrounding aspiration. It is able to reflect the long known fact that the speech sound [h] is nothing different from aspiration, moreover, it provides us with an unusual, but consistent distribution of the segmental and non-segmental appearance of aspiration.

Segmental /h/ is modelable in this x-bar structure based framework as a non-projecting onset head which is able to require melodic command from the vowel of the nuclear projection holding the onset head in its specifier. When it manages to require m-command, and therefore take away place from the nucleus, the structure becomes fortis and the outcome we get is a [h]. When it does not manage to require m-command, the structure remains lenis and the result is a [ɦ]. This difference is always structural regardless of the fact that the language is aspirating or L-voicing. Whether an onset head is able to require m-command in certain positions depends on the parameters of a given language. /h/ always inherits the oral stance of the following nucleus, which is the consequence of the shared nuclear projection. In Hungarian, domain-final segmental /h/ is able to set up an m-command relationship with the final empty nucleus resulting in the appearance of the structure of /x/ and the phonetic realisation of [x]. When m-command relationship does not hold between them, the node containing the two heads gets deleted, and no phonetic realisation comes to life.

There is a large variation in non-segmental behaviour of aspiration among languages. However, we can make a generalisation that plosive+/h/ clusters are non-existent, and the result we get is aspirated plosives even in L-voicing languages. Moreover, Icelandic fortis plosives are able to aspirate in two ways. This is so, because they are bound to take away place from their environments by requiring m-command from one of the adjacent projections. We know that this is a case of two way aspiration and not a segmental /h/ because when a sonorant occupies the coda position in which /h/ could reside the sonorant becomes devoiced. A segmental /h/ cannot be the source of devoicing, since it does not have a position to exist in. This leads us to the conclusion that the fortis plosive can be the only cause of devoicing in Icelandic, which modifies the structure of the preceding sonorant by interpreting the empty space of the structurally highest timing slot to the head of the plosive via m-command, creating a fortis structure. However, this kind of m-command relationship violates c++command criterion in the original definition of m-command forcing us to re-evaluate the whole mechanism. This has been done by introducing the notion of adjacency, and by freeing the definition of c++command from being based on terminal nodes. We could also see that

based on our analysis German word-final “devoicing” has to be a fortisation process, triggered by the parametrically forced m-command relationship between the FEN and the preceding onset head.

There are two important modifications to Pöchtrager's ideas in the present analysis which are closely related to the redefinition of m-command. Firstly, the application of Úlfsson's FEN-final domains for consonant-final words. The effects of domain-final FEN can be noticed in various phonological phenomena, e.g. Hungarian [h] to [x] fortition, Icelandic word-final aspiration, and German word-final “devoicing”. Secondly, there are nuclear heads as m-commanders, which is inseparable from the previous modification. We can observe an interesting asymmetry here, as non-projecting nuclear heads seem to have a tendency to “lose their weight” by m-commanding, while onset heads tend to “get heavier” by requiring m-command.

What do we profit from this analysis? We discovered some weaknesses in the definition of m-command, which prevented us from understanding aspiration correctly. By defining the real capabilities of m-command, palatalisation and labialisation processes can be understood more easily, since segmental palatalisation and labialisation, /j/ and /w/ are differentiated from segmental aspiration only in the annotation of the non-projecting onset head. In addition, the introduction of skeleton might lead us closer to understand vowel harmony processes, since we might have discovered something that can be a coreference to the projection of nuclei in Standard Government Phonology. Through the chain of conjoined nuclear projections the connection of the nuclei of a phonological string becomes clear.

References

- Backley, Phillip 2011. *An Introduction to Element Theory*. Edinburgh: Edinburgh University Press.
- Backley, Phillip 2012. Variation in Element Theory. *Linguistic Variation*, 12, 57-102.
- Brockhaus, Wiebke 1995. *Final Devoicing in the Phonology of German*. Linguistische Arbeiten, 337. Berlin: Mouton de Guyter.
- Gussmann, Edmund 2002. *Phonology: Analysis and Theory*. Cambridge: CUP.
- Hyman, Larry M. 1975. *Phonology*. New York: Holt, Rinehart, and Winston.
- Jensen, Sean 1994. Is ʔ an Element? Towards a Non-segmental Phonology. *SOAS Working Papers in Linguistics & Phonetics*, 4, 71–78.
- Kaye, Jonathan 1990. ‘Coda’ Licensing. *Phonology Yearbook*, 7, 301–330.
- Kaye, Jonathan, Markus Alexander Pöchtrager 2009. *GP 2.0*. Paper presented at the GPRT6, Piliscsaba, Hungary, April 25, 2009.
- King, Gareth 2003. *Modern Welsh: A Comprehensive Grammar*. 2nd ed. London: Routledge
- KLV85 = Kaye, Jonathan, Jean Lowenstamm, Jean-Roger Vergnaud 1985. The internal structure of phonological representations: a theory of Charm and Government. *Phonology Yearbook*, 2, 305-328.
- KLV90 = Kaye, Jonathan, Jean Lowenstamm, Jean-Roger Vergnaud 1990. Constituent structure and government in phonology. *Phonology Yearbook*, 7, 193-231.
- Lass, Roger 1984. *Phonology*. Cambridge: CUP.
- Lowenstamm, Jean 1996. CV as the only syllable type. *Current trends in Phonology: Models and Methods*. Ed. Jacques Durand & Bernard Laks. Salford, Manchester: ESRI. 419-441.
- Nasukawa, Kuniya 2005. A unified approach to nasality and voicing. *Studies in generative grammar*, 65. Berlin: Mouton de Guyter.
- Ploch, Stefan 1995. French Nasal Vowels: A First Approach. *SOAS Working Papers in Linguistics & Phonetics*, 5, 91–106.
- Pöchtrager, Markus Alexander 2006. *The structure of length*. Doctoral dissertation, Universität Wien.
- Pöchtrager, Markus Alexander, Jonathan Kaye 2013. GP2.0. *SOAS Working Papers in Linguistics*, 16, 51-64.
- Scheer, Tobias 2004. *A Lateral Theory of Phonology. Vol.1: What is CVCV, and why should it be?*. Berlin: Mouton de Gruyter.

- Scheer, Tobias and Markéta Ziková 2010. The Coda Mirror v2. *Acta Linguistica Hungarica*, 57, 411-431.
- Ségéral, Philippe and Tobias Scheer 1999. *The Coda Mirror*. Ms., Université de Paris 7 and Université de Nice.
- Ségéral, Philippe and Tobias Scheer 2008. The Coda Mirror, stress and positional parameters. *Lenition and fortition*. Ed. J. Brandao de Carvalho et al. Berlin: Mouton de Gruyter. 483-518.
- Szigetvári, Péter 1998. Why [h] is not voiced. *Structure and interpretation: Studies in Phonology*. PASE Studies & Monographs 4. Ed. Eugeniusz Cyran. Lublin: Wydawnictwo Folium. 287-301.
- Úlfssbjörninn, Shanti 2008a. The formal dynamism of categories: Stops vs. fricatives, primitivity vs. simplicity. *Poznań Contemporary Studies in Linguistics*, 41, 121–146.
- Úlfssbjörninn, Shanti 2008b. *N''' = domain*. Paper presented at CUNY Phonology Forum on the Syllable, CUNY.
- Živanović, Sašo, Markus Alexander Pöchtrager 2010. GP 2.0 and Putonghua too. *Acta Linguistica Hungarica*, 57, 357–80.