DOKTORI (PHD) ÉRTEKEZÉS

The representation of voicing

A unified analysis of languages with two obstruent series as "aspirating" systems

A zönge ábrázolása

A két sor zörejhanggal rendelkező nyelvek egységes elemzése „aspiráló" rendszerekként

Őri Péter

2022

FACULTY OF HUMANITIES
EÖTVÖS LORÁND UNIVERSITY

Doctoral (PhD) Dissertation

Péter Őri

The representation of voicing

A unified analysis of languages with two obstruent series as “aspirating” systems

https://doi.org/10.15476/ELTE.2022.193

English Linguistics Doctoral Program
Head: Prof. Dr. Miklós Törkenczy, DSc

Doctoral School of Linguistics
Head: Prof. Dr. Gábor Tolcsvai Nagy, MHAS

Supervisor: Dr. Péter Szigetvári, PhD

Members of the Assessment Committee:
Chair: Prof. Dr. Ádám Nádasdy, CSc
Internal opponent: Dr. Zoltán G. Kiss, PhD
External opponent: Dr. Katalin Balogné Bérces, PhD
Secretary: Dr. Krisztina Polgárdi, PhD
Member: Prof. Dr. Miklós Törkenczy, DSc
Subsidiary member 1: Prof. Dr. Péter Siptár, DSc
Subsidiary member 2: Dr. Péter Rebrus, PhD

Budapest, 2022

Acknowledgements

First of all, special thanks go to my supervisor, Péter Szigetvári for his guidance over the past years, our discussions, his ideas inspiring me and his questions always challenging what I came up with. I am grateful for his feedback and also for his flexibility.

I would like to thank my opponents, Katalin Balogné Bérces and Zoltán G. Kiss for reading the previous version of this dissertation and for their questions and their invaluable comments and suggestions.

I am thankful to the members of the committee of my pre-defense for their contribution and the very useful discussion.

I am also indebted to my phonology and phonetics teachers at ELTE and at the Hungarian Research Centre for Linguistics, Ádám Nádasdy, Miklós Törkenczy, Attila Starčević, Péter Siptár and Péter Rebrus, and to all of my teachers who have taught me linguistics in general, for the wide range of things I have had a change to learn during my studies. Special thanks to Katalin Mády, too, for supervising my first experimental research.

There are many others who have helped me in some form during my studies—special thanks go to them as well.

And last but not least, a big thank you to my family for their continuous support and encouragement and for continuously reminding me of the deadlines—*köszönök mindent*!

Table of contents

Introduction

Languages with two obstruent series are the most typical laryngeal systems. In the vast majority of the cases, this two-way contrast can be defined with a VOT value. To encode laryngeal opposition, most current analyses assume two melodic elements (or distinctive features), |H| and |L| (or [spread glottis] and [voice]), and languages can be distinguished according to which one they apply. Based on this, we can differentiate between aspirating languages like English and true voicing languages like Hungarian. Whether a language belongs to one typological category or the other is usually determined by the phonetic realization of its obstruent categories and their phonological behavior.

In the present dissertation, I will attempt to illustrate that this idealized checklist cannot be taken too seriously as languages show a great deal of variation in both respects. I will therefore argue that one laryngeal element, namely |H|, is sufficient to represent the contrast in both aspirating and voicing languages. Consequently, the makeup of the two series of obstruents is going to be identical in the two language types. What binary systems may then differ in lies in the phonological processes operating on |H|: in what context it is licensed, whether it exhibits spreading, and if so, what its direction is. Furthermore, languages might show surface variation, i.e., implement the laryngeal categories with different physical forms.

Since abandoning |L| as a laryngeal element and thus recategorizing L-languages as H-systems does not require more stipulation than has always been necessary to assume—regarding both the possible phonological operations and the phonetic implementations—reducing the number of laryngeal elements available for two-way-contrast systems results in a simpler analysis, which, in turn, can provide more uniform accounts. Moreover, this move may contribute to the attempts made in the field of Element Theory at reducing the number of phonological primes.

The relationship between phonetics and phonology will also be discussed from the point of view of laryngeal phenomena, but the claims that will be made may also hold true in a broader sense. Working out an analysis which covers all kinds of attested laryngeal phenomena, and not only the most regular ones, either in a traditional model or in the one proposed here, seems to support the necessity of a substance-free view, according to which phonetic material is irrelevant to the phonological computation (although in a substance-free framework, establishing a model to uniformly account for cross-linguistically observed patterns may not be a goal). Furthermore, I argue that the mapping of phonetic content to phonological representation is also to a great extent arbitrary, an assumption of the Laryngeal Relativism view.

The dissertation is structured as follows: Chapter 1 provides an overview of Strict CV Phonology and Element Theory, the theoretical frameworks adopted in the dissertation, pointing out issues that will bear on the model to be proposed. Chapter 2 gives a phonetic background to laryngeal properties and summarizes how they have been treated in different phonological analyses. Chapter 3 briefly discusses different views regarding the role of phonetics in phonological processes and introduces the substance-free view, which the dissertation will advocate. After collecting arguments in support of an |H|-only laryngeal analysis for both aspirating and voicing languages, I work out the detail of the proposal in chapter 4. In what follows, I will aim to further support the new model. In chapter 5, I will attempt to show that cross-linguistic patterns of laryngeal dissimilation provide evidence for the markedness of the fortis obstruent series in languages traditionally regarded as voicing systems too. In chapter 6, languages displaying interactions between voicing and nasality, the two properties generally represented by |L|, will be examined, and it will be concluded that accounting for the relation between them does not necessitate the presence of |L| as a laryngeal element even in these systems. In chapter 7, further details of subsegmental representation will be discussed, namely the headed and nonheaded status of |H| and |L|.

Chapter 1

Theoretical background

Throughout the paper, the theoretical framework I will be assuming for the representation of phonological units and their relation to each other as well as the phonological processes applying to them is Strict CV Phonology (a.k.a. CVCV Phonology). Regularly tied to it is Element Theory (ET), developed for the representation of the makeup and of the internal structure of phonological segments. In this chapter, I am going to provide a brief overview of these two frameworks. Over the decades, both theories have undergone a number of modifications, resulting in more or less different versions, so the following summaries can only serve to give a general idea of the basic properties of the models.

1.1 Theories of lateral relations and Strict CV Phonology

Strict CV Phonology (or CVCV Phonology), originating from Lowenstamm (1996), is a theory which has emerged from Government Phonology (GP) (see Kaye, Lowenstamm & Vergnaud 1990, Kaye 1990, 1992a, Harris 1990, 1994 and Charette 1990 as well as Cyran 1997 and Kaye 2000).

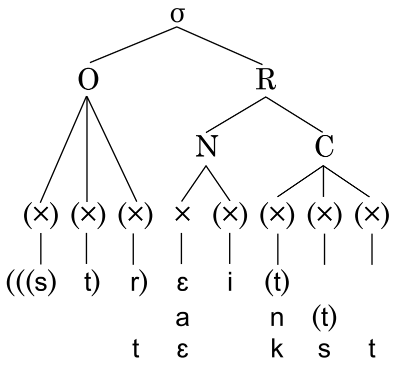
To begin with, earlier phonological analyses presumed that segments are ordered into larger prosodic units referred to as syllables. (1) illustrates a version of this hierarchical structure characterizing, for instance, English.[1] In this view, syllable formation is believed to be explicable with reference to the relative sonority of adjacent segments—put simply, syllable beginnings can be defined as the points from which sonority starts to rise (see, e.g., Harris 1994: 32–84).

---

[1] Throughout the dissertation, English words pronounced in current Standard Southern British English will be transcribed with the set of IPA symbols used in the CUBE transcription system (Lindsey & Szigetvári 2013–).

(1) The structure of English syllables in traditional analyses

O = onset, R = rhyme, N = nucleus, C = coda;
× = obligatory segment, (×) = optional segment[2]



The most striking feature of GP in which it differs from earlier approaches is that syllabic structures are replaced by binary and asymmetrical relations called government, which hold between skeletal positions. Government is possible only if the conditions defined in (2) are met (Kaye, Lowenstamm & Vergnaud 1990: 198–199).[3]

(2) a. Formal conditions of government in GP

- Strict Locality: the governor must be adjacent to the governee at the P_0 projection, which contains every skeletal point.
- Strict Directionality: syllabic constituents must be head-initial.

b. Substantive condition of government in GP

- The makeup of the segments in a given domain determines which one can govern, and which one can be governed.
  - ○ Complexity Condition: Let α and β be segments occupying the positions A and B, respectively. Then, if A governs B, β must be no more complex than α (Harris 1990: 273–275).[4]

---

[2] There is normally a restriction on the quantity of segmental material allowed in the rhyme. In English, it can be defined as follows: Content words must be minimally bimoraic (i.e., they minimally either contain a long vowel or a diphthong if they lack a coda or have a short vowel followed by at least one consonant). If a nucleus consists of a long vowel or a diphthong, the coda can contain two consonants only if they form a coronal cluster; noncoronal two- or three-member coda clusters can be preceded only by short vowels.

To exemplify some possible syllable types in English, the tree contains the following words (which we can get by beginning to peel off the parentheses from around the IPA symbols): *a* (definite article, stressed), *ray*, *tray*, *stray*, *eight*, *trait*, *straight*, *an* (definite article, stressed), *ant*, *text*.

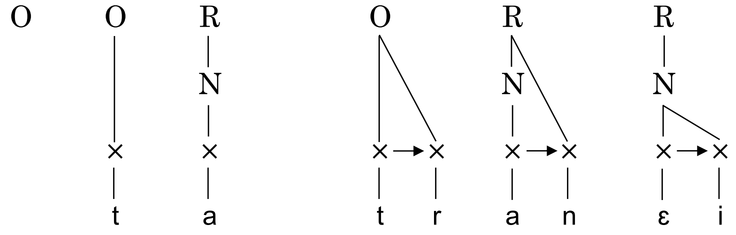
[3] Furthermore, according to the Projection Principle, government must be defined at the level of lexical representation; whether two objects contract this relation or not at this level cannot be altered in the course of phonological derivation (Kaye, Lowenstamm & Vergnaud 1990: 221).

[4] The issue of segmental makeup and complexity will be discussed in the second part of this chapter. In short, segment α is regarded as more complex than segment β if α consists of a greater number of primes than β. Originally, it was suggested that segments also be characterized as having a positive or negative value or being neutral in this respect, a

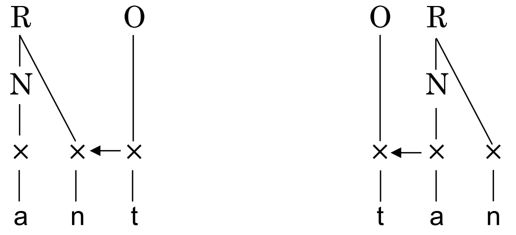
The possible syllabic constituents assumed in GP are onsets, rhymes and nuclei, to the exclusion of codas. The conditions in (2a) imply that syllabic constituents can be maximally binary; see the representations in (3), where the arrows mark government. Whether branching constituents are allowed is subject to parametric variation characteristic of the given language.

The relations between syllabic constituents are established via interconstituent (a.k.a. transconstituent) government, which also requires the conditions in (2) to be met; the only difference is that the directionality of the process in this case is the opposite, i.e., this type of government is head-final. Furthermore, only the head of a constituent may govern, and only a nucleus (or the projection thereof) can govern a constituent head. The possible governing relations between syllabic constituents are represented in (4).

(3) Syllabic constituents


a. Nonbranching[5]
b. Branching

(4) Interconstituent government


a.
b.

Furthermore, it is a requirement in GP that every position in the representation be licensed, i.e., sanctioned, by another position (Kaye 1990: 306):

(5) Licensing Principle

All phonological positions save one must be licensed within a domain. The unlicensed position is the head of this domain.

Constituent and interconstituent government represented in (3b) and (4) can thus be considered one type of licensing. Another sort of licensing is called

---

property referred to as charm, which was taken to play a role in its governing capacity of other segment (see Kaye, Lowenstamm & Vergnaud 1985, 1990: 202ff).

[5] Note that the nucleus, as a government licenser (see (5)), is required to dominate a skeletal point—as opposed to onsets.

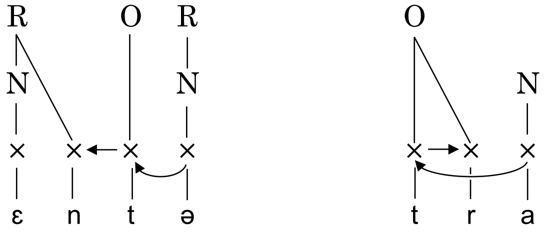
government-licensing, which is defined and represented in (6) and (7), where the curved arrows denote this relation (Charette 1990: 242):

(6) Government-licensing

For a governing relation to hold between a non-nuclear head A and its complement B, A must be licensed to govern by its nucleus at the licenser projection level.

(7) Government-licensing

a. b.

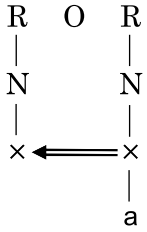


Finally, a further relation is needed which can be held responsible for vowel–zero alternations. This is called Proper Government, which is a special kind of government formalized and represented in (8) and (9), where the double arrow marks the relation (Kaye 1990: 313, Charette 1990: 236):

(8) Proper Government: A properly governs B iff

a. A and B are adjacent on the relevant projection,
b. A is not itself licensed, and
c. no governing domain separates A from B.

(9) Proper Government



The principle specifying that a properly governed position should be unpronounced is known as the phonological Empty Category Principle:

(10) Empty Category Principle

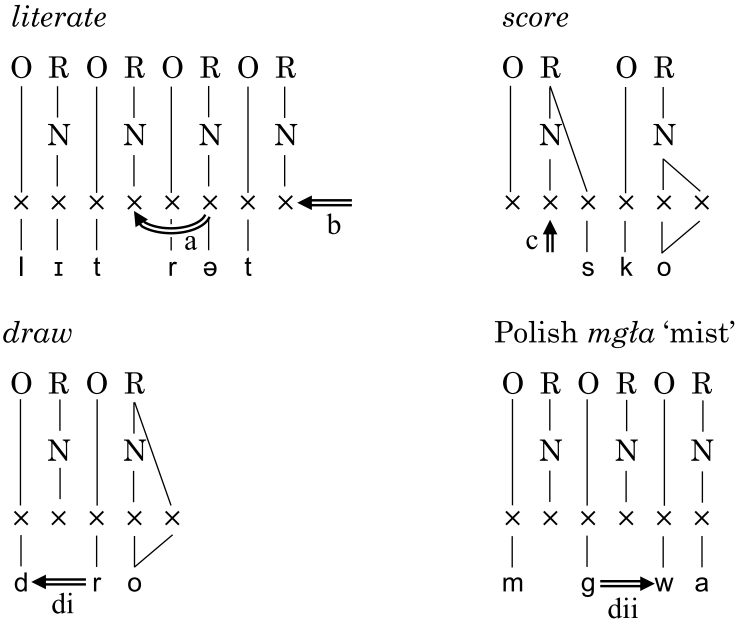
A properly governed position remains phonetically uninterpreted.

Besides Proper Government sites, there are three more positions that may receive no phonetic interpretation. The complete list of cases in which the Empty Category Principle may apply can be found in (11) (Kaye 1992a: 305, Gussmann & Kaye 1993: 451 and Scheer 2004: 35ff); the representations are provided in (12), where the double arrows indicate the licensing of phonetically null nuclear positions.

(11) Empty Category Principle supplemented

- a. properly governed nuclear positions (universal)
- b. domain-final nuclear positions (parametrized)
- c. nuclear positions preceding *s*+C sequences (parametrized)
- d.[6] i. nuclear positions enclosed in an Interonset Governing relation (parametrized)
  - ii. nuclear positions enclosed in an Infrasegmental Governing relation (parametrized)

(12)



As for Strict CV Phonology (see Lowenstamm 1996 as well as Scheer 2004), it takes the deconstruction of syllabic trees even further and claims that phonological skeletons in any language consist of strictly alternating consonantal and vocalic positions, i.e., CV sequences. An alternative proposal comes from Dienes & Szigetvári (1999) and Szigetvári (1999), who argue that phonological strings should rather be analyzed as VC sequences. In both versions, it is claimed that apparent consonant clusters and geminates span a vocalic position, while hiatuses, long vowels and heavy diphthongs span a consonantal position, which are silenced and therefore phonetically uninterpreted—these empty positions are denoted by lowercase “v” and “c.” It follows from the strict consecution of Cs and Vs that neither codas nor any branching constituents are assumed in this approach.[7] Furthermore, skeletal relations are limited to two types: government and licensing. We find some

---

[6] These two types of government have identical effects, although they assume reverse dependency relations and have been introduced to account for slightly different cases (for more details, see Scheer 2004: 111ff and footnote 8).

[7] Although it is the Strict CV framework that will be assumed throughout the dissertation, terms such as “syllable,” “branching onset” or “coda” will be often used for convenience, without any theoretical implications.

variation in the way these antagonistic forces are formalized in different varieties of the theory—see the assumptions of the theories dubbed “Coda Mirror” and “Coda Mirror Plus” in Ségéral & Scheer (1999) and Dienes & Szigetvári (1999: 8), respectively. In this dissertation, C and V will be regarded as two independent “unary features” in the sense of Dienes & Szigetvári (1999) and Szigetvári (1999), who define the two relations as follows (Dienes & Szigetvári 1999: 7):

(13) Government and licensing defined

a. Government spoils the inherent properties of its target.
b. Licensing supports the maintenance of melodic content in a position.

The authors describe the inherent properties of the consonants and vowels, referred to in the formalizations above, in the following way (Szigetvári 1999: 62):

(14) Inherent properties of Cs and Vs

a. Vocalicness is loud; V slots in the skeleton aim at being pronounced.
b. Consonantalness is mute; C slots in the skeleton remain silent if nothing intervenes.

A summary of the governing and licensing capacity of the two types of skeletal position is due. Vs are taken to be good governors and licensers unless they are governed, in which case they lose their inherent property including their ability to govern and license. Cs, on the other hand, have a limited capability of governing. The possible relations between Cs and Vs are summarized in (15) (Dienes & Szigetvári 1999: 8–10, Szigetvári 1999: 71–76).

(15) Governing and licensing relations between Cs and Vs

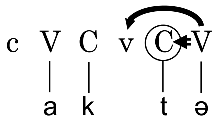
a. Licensing by V
   (i) A V position licenses the immediately preceding C position (V-to-C licensing, universal), or
   (ii) if the preceding C position is empty, it may also license the V position if that is nonempty (V-to-V licensing, parametrized, subject to melodic conditions).

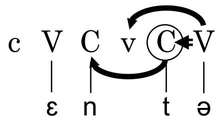
b. Government by V
   (i) A V position governs the immediately preceding C position (V-to-C government, universal) or
   (ii) the V position before it if that is empty, i.e., v (V-to-V government, universal).

c. Government by C
   A C-position may govern a preceding C position if the intervening V position is empty, i.e., v (C-to-C government, parametrized, subject to melodic conditions).

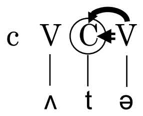
As for the combinatorial possibilities of what forces can influence consonantal positions in the skeleton, they can be either governed or not and either licensed or not; see (16), from Szigetvári (1999: 12–13).

(16) a. Licensed and not governed

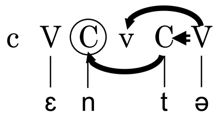


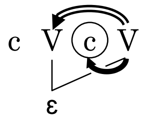


b. Licensed and governed

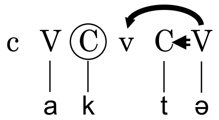


c. Not licensed and governed





d. Not licensed and not governed



Based on the influence of government or licensing, the lack thereof or the interaction of the two, phonologically strong and weak contexts can be distinguished, which is corroborated by empirical evidence too. These positions are listed in (17) (Dienes & Szigetvári 1999: 3–4).

(17) Strong and weak positions for Cs

a. Strong positions

those followed by a full V and preceded by an empty v (the full V licenses the C, but does not govern it because it governs the preceding empty v): C__V and #__V (note that there is an empty v between any two superficially adjacent C positions and that the word-initial # has been claimed to be an empty cv pair (see Scheer 2004))—see (16a)

b. Weak positions

i. those preceded and followed by a full V: V__V (the second V will not only license but also govern the intervening C)—see (16b)

ii. those followed by an empty v: __C and __# (the empty v does not govern, and neither does it license the C position)—see (16c–d)

A V position in the skeleton may remain phonetically unexpressed if it is governed or enclosed within a C-to-C government domain (buried) or domain-final (see Scheer (2004: 67), who includes in the Empty Category Principle silent v positions in branching onsets—see footnote 8 too; cf. Dienes & Szigetvári (1999: 10) for a reformulated version of the principle for the Strict VC model).

As can be seen from the representations in (16), government and licensing in Strict CV Phonology also meet the conditions in (2a) applying in GP: Strict Locality (a skeletal position can govern or license a C- or V-slot immediately preceding it, i.e., the target can be maximally two positions away from the source) and Strict Directionality (which is right-to-left).[8] Furthermore, the Complexity Condition of Harris (1990), according to which a governee should not contain more elements than its governor, is made use of in many versions of Strict CV approaches and will be assumed in the analysis proposed in the present dissertation as well.

Beyond the most noticeable way in which Strict CV theories differ from earlier generative models, namely the lack of syllabic constituents, there are other pivotal characteristics which set them apart from traditional approaches. Kaye, Lowenstamm & Vergnaud (1990: 194–195) pinpoint the following three "ground rules" right at the beginning of their article in which they elaborate on the idea of GP—they typify Strict CV Phonology as well:

(18) a. Nonarbitrariness

There is a direct relation between a phonological process and the context in which it occurs.

b. Universality

The set of available phonological processes behaves like a function mapping initial representations onto final representations.

Consequences:

- The same physical object will receive uniform interpretation across phonological systems.[9]
- Markedness conventions are universal.

c. Privativeness

Phonological oppositions that are privative at the level of lexical representation remain privative at all levels.

Consequences:

- No default rules to "fill in" missing features.

---

[8] It has been proposed by Scheer (2004) that branching onsets form a closed domain via what he calls Infrasegmental Government, in which the sonorant governs the preceding obstruent. This relation is believed to be conditioned by segmental complexity; as sonorants are claimed to be more complex than obstruents in Scheer's analysis, right-to-left directionality is predicted—in accordance with the principle of Strict Directionality. Furthermore, as the empty v between the obstruent and the sonorant in the closed domain does not absorb the governing capacity of the full V following the cluster, the V can govern and silence the v before the cluster without breaking the Strict Locality principle. For an alternative treatment of onset clusters, see Szigetvári (1999: 111–129).

[9] Kaye (1992a: 295–296) distinguishes a weaker and a stronger version of the Uniformity Principle: "sequences of contiguous positions that are in a governing relation and contain the same phonological material have the same constituent structure" within a given language vs. in all languages.

- Only univalent spreading (harmony) processes.
- "You can't spread something that isn't there."
- Unmarked values never spread directly.
- In Trubetzkoyan terms, privative oppositions do not get converted to equipollent ones in the course of derivation.

First of all, Strict CV Phonology assumes a set of universal principles common to all languages and a series of language-specific parameters delimiting the nature of phonological variation between linguistic systems (Cyran 1997: 1). One issue that the dissertation aims to tackle is the nonarbitrariness of phonological processes related to laryngeal phenomena in the sense defined in (18a). Another question concerns phonological markedness conventions, mentioned in (18b). Finally, according to the principle in (18c), all phonological contrasts are expressed in terms of unary primes in Strict CV models, more on which as well as on the properties of these primitives and the consequences of their application in the next section. Another objective of the dissertation is to investigate the characteristics of laryngeal elements regarding both their phonological behavior and their phonetic qualities as well as whether and how much the relationship between phonological representation and phonetic realization can be considered arbitrary—another sense of "arbitrariness" besides the one defined in (18a).

1.2 Phonological primes and Element Theory

Having provided a brief summary of intersegmental relations assumed in Strict CV Phonology, I will now turn to the subsegmental properties of speech sounds (for summaries, see, e.g., Lieberman 1970, Lass 1984: 75–124, Harris 1994: 90–97 and Mielke 2011). Few would disagree that phonological segments are decomposable into even smaller components. The claim that segments, or phonological expressions, are not atomic[10] units is supported by two considerations: sounds can be divided into groups, called natural classes, based on phonotactic restrictions applying to them and their involvement in phonological processes, either as triggers or as targets. That is, constraints and rules make reference to or manipulate certain properties of sounds independently of the others (see, e.g., Mielke 2011: 391 and Szigetvári 1999: 7)—differences in segmental qualities resulting in phonological oppositions are already investigated by Trubetzkoy (1939).

What does raise disagreement concerns the identity and general characteristics of the said segmental components, traditionally referred to as distinctive features. To begin with, even though phonological features belonging to a natural class are believed to share some phonetic property, it is not obvious in what way they should be rooted in physical reality—if they should at all. Jakobson, Fant & Halle propose that they be defined in acoustic terms on the basis that "[a]ny distinctive feature is normally recognized by the receiver if it belongs to the code common to him and to the sender, is accurately

---

[10] Ironically, the term "atomic" is still used as a synonym for indivisible, in spite of the fact that we have known for a while that atoms are actually reducible to subatomic particles. In this sense, phonological segments are, in fact, atomic.

transmitted and has reached the receiver" (1952: 8). This feature theory, referring to acoustic cues in the speech signal, is fairly unbiased toward either the speaker or the listener. Chomsky & Halle (1968), on the other hand, have established a set of features which describe articulatory maneuvers and has become more widespread than its predecessor. As a third alternative, suggested by Lieberman (1970), some features exist as a result of being clear articulatory categories targetable by the speech organs, while others are more clearly distinguishable perceptually; still others may belong to both groups. Therefore, he argues that "human phonologic features are 'linguistic' constructs that may be structured in terms of the properties of both the human vocal apparatus and the human perceptual system, ['matching'] the constraints of either or both of these physical systems" (Lieberman 1970: 161).

It has been questioned though whether the physical characteristics of speech sounds should have a direct relation to the segmental representation designed to account for the phonological phenomena the sounds participate in. Lass (1984) explains his objection to the axiomatic establishment of such a connection as follows:

> [T]here's no reason I can see … why features should be presumed to have [extralinguistic] reference [whether physical or mental], why their 'real existence' should lie anywhere outside linguistic theory. Is a feature theory, for instance, a theory of linguistic structure, or a theory of psychology? For linguists like Chomsky, for whom linguistics is 'a branch of cognitive psychology' …, the latter is the case; but for others for whom the equation of 'linguistic' with 'psychological' or 'mental' isn't self-evident, there's no obvious reason why a feature theory should be anything but a notational framework that yields satisfactory descriptions, and helps us understand the data we're interested in. (103)

Mielke (2011) has a similar stance on this issue. As a point of departure, the definition of natural class should be considered. Natural classes are taken to serve two purposes—defining lexical contrasts and determining involvement in phonological processes—which the twofold definition in (19) is based on.

(19) Natural class – traditional two-part definition

a. A group of sounds in an inventory that share one or more distinctive features, to the exclusion of all other sounds in the inventory.

b. A group of sounds in an inventory that may participate in an alternation or static distributional restriction, to the exclusion of all other sounds in the inventory.

Nevertheless, it is not obvious at all, as Mielke (2011) argues, whether the two versions necessarily identify the same group of segments. If they do not, then (19a) can be thought of as delimiting a phonetically natural class and (19b) as the definition of a phonologically active class. This claim as well as the theoretical reasoning of Lass (1984) seems to be supported by the findings of Mielke (2004: 162): about a quarter of the 6,077 phonologically active classes surveyed in the study cannot be defined by any phonetic feature or set of features. This mismatch, which may result from so-called crazy rules (Bach & Harms 1972), might make the issue of nonarbitrariness in (18a) more complex.

As has been noted, with the use of distinctive features, it can be expressed whether a certain property is characteristic of a sound or not, which can be done in two forms: via binary and unary features. Binary features (a.k.a. bivalent features or features defining equipollent oppositions) can take two values or coefficients, normally “plus” or “minus”: [+F] vs. [−F]. In the case of unary (a.k.a. monovalent or privative) features, an opposition is encoded as the presence vs. absence of a given prime: [F] vs. [∅]. The superiority of the latter is considered to lie in the fact that it is constrained already in the representation what properties can participate in phonological processes. Taking nasality as an example, in a binary model, theoretically, either of the equipollent values could trigger assimilation; however, [−nasal] does not seem to be phonologically active, so the approach predicts unattested phonological phenomena in this way. If nasality is encoded as the presence of the feature [nasal], and nonnasality as the absence thereof, then it follows from the representation that nasality may trigger assimilation, which is expressed in terms of feature spreading, while the absence of a prime is not something that phonological rules can have access to, meaning that nonnasality is necessarily phonologically inert.

In addition to these options, there are approaches which apply a combination of unary and binary features; terminal nodes in the feature geometrical trees of Sagey (1986: 273–281), for instance, occupy binary features, while class nodes are unary. It should be noted that besides unarity and binarity, a feature could possibly be scalar as well, capable of distinguishing more categories on a continuum than its two poles (see Lass 1984: 102–113). For example, in Beckman, Jessen & Ringen’s (2013) analysis, the laryngeal features [voice] and [spread glottis] are transformed into numerically specified scalar features before the phonetic level, which will interfere with how passive voicing affects the segment. Most commonly though, features, whether binary or unary, are converted into scalar ones at the level of phonetic implementation, which is characterized by gradience rather than categoricity (Harris 1994: 92).

Another issue regarding the makeup of segments concerns the degree to which they must be specified for distinctive features. The original idea is that the feature matrix of a segment contains all the features available for the linguistic systems together with a value for each feature, and two segments are said to be different if at least one feature has the opposite value in the two matrices. In later versions of feature theory, segments are lexically specified only for some features; only idiosyncratic information is stored in the underlying representation, and the rest, which is predictable, is added to the feature matrix via redundancy rules (see, e.g., Archangeli 1988). For example, in a binary model of underspecification theory, the voiced obstruent /d/ is specified as [+voice], its voiceless counterpart /t/ as [−voice], while /n/ is left unspecified for [±voice] even though it is phonetically a voiced sound. /n/ becomes a [+voice] segment in the course of derivation as this feature is predictable in the case of sonorants and is therefore filled in by the redundancy rule in (20). As a consequence, the feature [+voice] which /n/ is supplied with at a later stage is inaccessible to phonological processes, i.e., sonorants are considered not to participate in voice assimilation.

(20) [+sonorant] → [+voice]

As to what distinctive features exactly should be assumed in feature theories, the list is believed to consist of a limited number of features, approximately 20 (Clements 1985: 225), which form a universal set. The universality of the cross-linguistically recurring features may boil down to the characteristics of the human articulatory and auditory system, so it may be physiological and acoustic factors that constrain the number of dimensions available for contrasts in language. It has also been claimed that distinctive features are rather innate, i.e., they can be attributed to Universal Grammar (UG) (see, e.g., Mielke 2011: 393–397).

A new dimension in the representation of segments appears in frameworks where the relations between segmental components can be asymmetrical, with one or more primes functioning as heads and the rest being dependents or operators (see, e.g., Kaye, Lowenstamm & Vergnaud 1985 and Backley 2011). Generally speaking, a prime in head position plays a more decisive role in defining the phonetic as well as phonological identity of a segment than the same prime in operator position. As a result of hierarchical relations, the number of possible phonological expressions increases, risking overgeneration, a potential issue for the developer of a feature theory. As long as segments are represented as bundles of primes of equal status, the number of different segments which can be defined by n primes is 2^n, whether in a binary or unary framework, as exemplified in (21).

If, on the other hand, subsegmental relations are asymmetrical, and maximally one feature can function as the head of a phonological expression, binary models generate more contrasts than unary models as the number of primes rises: the formula for calculating the number of oppositions is $(n + 1) \times 2^n$ for binary models, as opposed to $(\frac{n}{2} + 1) \times 2^n$ for unary ones; see (22). For n=7 features, this means 1,024 vs. 576 contrasts, which needs to be further constrained so that the number will be decreased to a value approximating 100, which is a closer estimate of the number of contrastive sounds in a language (see Szigetvári 1999: 154–155).

(21) Possible contrasts expressible by n=2 primes in binary vs. unary frameworks

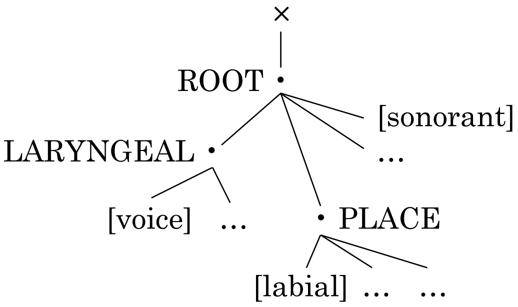
binary models: 4	unary models: 4
[+F] [+G],	[F] [G],
[+F] [−G],	[F],
[−F] [+G],	[G],
[−F] [−G]	[Ø]

(22) Possible contrasts expressible by n=2 primes in binary vs. unary frameworks with head–operator relations

binary models: 12			unary models: 8		
[+F] [+G],	[$\underline{+\text{F}}$] [+G],	[+F] [$\underline{+\text{G}}$],	[F] [G],	[$\underline{\text{F}}$] [G],	[F] [$\underline{\text{G}}$],
[+F] [−G],	[$\underline{+\text{F}}$] [−G],	[+F] [$\underline{-\text{G}}$],	[F],	[$\underline{\text{F}}$],	
[−F] [+G],	[$\underline{-\text{F}}$] [+G],	[−F] [$\underline{+\text{G}}$],	[G],	[$\underline{\text{G}}$],	
[−F] [−G],	[$\underline{-\text{F}}$] [−G],	[−F] [$\underline{-\text{G}}$]	[Ø]		

Furthermore, the primes of a segment have also been proposed to be organized into a structure instead of forming an unarranged bundle, an idea referred to as feature geometry (see, e.g., Clements 1985). In this way, features can be grouped based on the interdependence of their phonetic correlates as well as on the phonological patterns which they may participate in together (Mielke 2011: 399).

(23) A representation of subsegmental structure within feature geometry (see Harris 1994: 129)



As illustrated in (23), primes (indicated by terminal nodes) are organized under class nodes (e.g., the LARYNGEAL node) of the ROOT node, which itself is associated with a skeletal slot. Primes that are considered not to spread (e.g., [sonorant]) are directly attached to the ROOT node.

Different versions of GP and its descendants, as well as Particle Phonology (see Schane 1984), Dependency Phonology (see Anderson & Ewen 1987) and Radical CV Phonology (see van der Hulst 1994a), use unary phonological primes referred to as elements, particles or gestures. GP and Strict CV frameworks apply the melodic elements assumed in Element Theory (ET), which will be used in this dissertation as well (see Kaye, Lowenstamm & Vergnaud 1985, Harris 1990, 1994, Harris & Lindsey 1995, Kaye 2000 and Backley 2011, among others).

As unary primes encoding phonological contrasts as asymmetrical oppositions, melodic elements can be regarded as superior to binary features: an element is either present in or absent from a phonological expression, which makes one segment more marked with respect to a certain property, and thus more complex,[11] than another. In this way, it can follow right from the phonological representation which segments are accessible to a given phonological pattern—if something is not present, it cannot be phonologically active, as opposed to binary features, which come with two equal values.

The most significant way in which a melodic element differs from a unary feature is its being subject to autonomous phonetic interpretation. That is, an element such as |U|, the ET counterpart of the feature [labial], can be found in the representation of labial sounds like /b, p, m/ as well as /y/; however,

---

[11] The relative complexity of segments as well as its consequence may vary to a great extent from one theory to the other. Rice (1992), for instance, claims that the more sonorous a consonant, the more complex it is, contrary to mainstream government-based approaches. Scheer (2004) also proposes representations in which a sonorant consonant contains more elements than an obstruent. In these approaches, it is the more sonorous segments that can govern the less sonorous, i.e., more consonant-like, ones. In van der Hulst (1994b, 1995), the more prototypical a consonant or a vowel (i.e., the closer it is to voiceless plosives or /a/), the less complex it is.

it can be phonetically realized in isolation too, as /w/ or /u/. A feature like [labial], on the other hand, is unpronounceable on its own, without the support of the rest of the feature matrix (in which features are either lexically present or filled in by redundancy rules). A feature only leaves its mark on the identity of a segment that it is a component of.

(24) summarizes the primitives of ET. (24a) contains the elements, along with their phonetic attributes, that were proposed in earlier versions of the theory, which can be referred to as conservative ET (see Harris 1990: 262–264). These elements are assigned a positive, negative or neutral value called charm.[12] Charm was initially used by, e.g., Kaye, Lowenstamm & Vergnaud (1985, 1990) and Harris (1990) to determine the governing capacity of a segment. Over time, this set has been reduced to the six elements listed in (24b), which are normally utilized in most current, revised varieties of the theory, which can be regarded as standard ET (see Backley 2012: 66–67; cf. Kaye 2000).

(24) a. Melodic elements assumed originally in ET

E = {A^{+}, I^{0}, U^{0}, ɨ$^{+}$, v^{0}, R^{0}, ʔ^{0}, h^{0}, N^{+}, H^{-}, L^{-}}

Vocalic elements	
|A^{+}|	nonhigh
|I^{0}|	front
|U^{0}|	labial
|ɨ$^{+}$|	ATR
|v^{0}|	unmarked attributes

Consonantal elements	
|R^{0}|	coronal
|I^{0}|	palatal
|U^{0}|	labial
|ʔ^{0}|	occluded
|v^{0}|	unmarked attributes
|h^{0}|	noise
|N^{+}|	nasal
|H^{-}|	stiff vocal folds
|L^{-}|	slack vocal folds

b. The set of melodic elements assumed in standard ET

E = {A, I, U, ʔ, H, L}[13]

	Acoustic properties	Phonological categories
|A|	high F1 (F1–F2 converge)	pharyngeals, coronals, liquids, nonhigh vowels
|I|	high F2 (F2–F3 converge)	palatals, coronals, front vowels
|U|	lowering of all formants	labials, velars, uvulars, rounded vowels

---

[12] Roughly speaking, positive charm could be thought of as a marker of "voweliness," so a positively charmed element was associated with a resonating cavity (see Kaye, Lowenstamm & Vergnaud 1985: 311), while elements referring to the state of the vocal folds are claimed to be negatively charmed (Harris 1990: 216).

[13] Some authors assume |@|, a neutral element which can function as the head of an expression (Backley 2012: 65). Others claim that phonological expressions can be headless, which is marked with "__" in the head position (Kaye 2000: 1).

|ʔ|	sustained drop in amplitude	oral/nasal/glottal stops, laryngealized vowels
|H|	high-frequency energy	voiceless/aspirated obstruents, high tone vowels
|L|	low-frequency energy	fully voiced obstruents, nasals, low tone vowels

Melodic elements should be thought of as cognitive objects with the grammatical function of encoding phonological contrasts rather than simple articulatory and acoustic constructs. Nevertheless, as can be seen from the phonetic descriptions in (24b), elements are often defined in acoustic terms, in which respect they resemble Jakobson, Fant & Halle's (1952) features, rather than the articulatorily based ones proposed by, e.g., Chomsky & Halle (1968), the use of which has become the mainstream trend in feature theory. As the speech signal is a neutral ground shared by both the speaker or the hearer, ET can avoid to be biased toward either party of the communication—which is claimed to be a characteristic of generative grammar (Harris & Lindsey 1995: 47–48). The connection of the elements |H| and |L| and the phonetic forms associable with them will be one of the main issues dealt with in this dissertation.

As for the low number of primes assumed in government-based frameworks and ET, the contribution of the phonological skeleton to defining the identity of segments has made features encoding prosodic properties like [consonantal], [syllabic] or [long] unnecessary. For example, the interpretation of |U| as /w/ or /u/ does not depend on a further prime but on whether the element is linked to a C or V slot in the skeleton (see, e.g., Szigetvári 1999: 156). In addition, the reduction of the primes in (24a) to the set in (24b) was made possible by finding a relationship between the roles of two elements and assigning them to one element (e.g., in the case of the |A| and the |R| of conservative ET) and by distinguishing between head and operator position (see, e.g., Backley 2012). The present dissertation aims to contribute to rethinking the roles associated with the elements |H| and |L| as well as their headed and nonheaded appearance.

The melodic content of a segment, besides being lexically determined, can be influenced by the two forces targeting skeletal slots in Strict CV models: government and licensing—see (13)–(17). While licensing can be thought of as the sanctioning of the elements associated with a position, government leads to the delinking of elements, one of the two processes assumed in the theory. The other phonological operation is the linking of elements, which is usually achieved via spreading[14] (see, e.g., Harris & Lindsey 1995: 39–44). The terms "composition" and "decomposition" are often used as synonyms for linking and delinking.

The autonomous phonetic interpretability of melodic elements combined with the fact that phonological operations are limited to linking and delinking has significant consequences: Phonological derivation in government-based models is defined as a process turning phonological

---

[14] Another way in which the linking of an element can be brought about is through OCP-triggered coalescence, whereby adjacent identical elements are prohibited at the melodic level (see McCarthy 1986: 208).

representations into other phonological representations, and a phonological expression is phonetically interpretable at any stage of derivation. That is to say, mapping phonological forms onto phonetic categories falls outside the purview of phonology, while derivation is a component of the grammar. In other words, there is no systematic phonetic level in this theory (see, e.g., Harris & Lindsey 1995: 44–48). This aspect of Strict CV Phonology will be of great importance for the analysis proposed in the present dissertation—the relation between phonology and phonetics will be considered to be to a great extent arbitrary, which will be claimed to be supported by the phonological behaviors and the phonetic characteristics of laryngeal elements.

In this chapter, I have introduced and contextualized Strict CV Phonology and Element Theory, which I will be assuming throughout the dissertation. Also, I have pointed out aspects that will play an important role in the analysis proposed, for some of which (e.g., regarding the relation between a phonological element and its phonetic realization) modifications will be recommended.

Chapter 2

The phonetics and phonology of laryngeal properties

As one of the aims of the present dissertation is to investigate the connection between the phonological representation of laryngeal properties and their phonetic implementation, with the hope of contributing to the growing body of literature on the phonetics–phonology interface, this chapter will first discuss the phonetic characteristics of laryngeal contrasts. Following that, the second part of the chapter will provide an overview of how these oppositions as well as the related phenomena have been most commonly treated in different phonological theories.

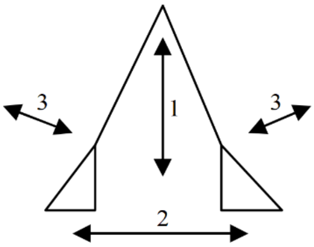
2.1 Phonetic background to laryngeal properties

During the production of most speech sounds, referred to as pulmonic sounds, air is pushed out of the lungs and passes through the vocal tract consisting of the trachea, the larynx above it and the supraglottal cavity made up of three resonating chambers, namely the pharyngeal, the oral and the nasal cavity. The airflow can be "transformed" into sound in either or both of the following two ways: a constriction somewhere in the vocal tract can be used to make a turbulent airflow perceived as a hissing noise, or the particles of the air can be set in vibration by the vocal folds. As for the former, the point at which the blockage of the air occurs and the degree to which the airway is closed are two major dimensions, referred to as the place and manner of articulation, which a consonant can be characterized and identified with. The third segmental quality that usually contrasts consonants is related to the states and actions of the vocal folds, which we can call the laryngeal properties of consonants. This latter characteristic is what this section aims to provide an articulatory and acoustic background to—for summaries, see, e.g., Chomsky & Halle (1968: 300–301, 315–316, 324–329), Halle & Stevens (1971: 198–202), Johnson (2003: 120–148), Raphael, Borden & Harris (2011: 69–81), Ladefoged & Disner (2012: 135–155) and Bárkányi & G. Kiss (2019: 59–63) as well as the references in these works.

The quality of a speech sound may vary depending on the tension, shape and position of the vocal folds (a.k.a. vocal cords, an anatomically less accurate term), which can result in phonologically contrastive segments. These parameters can be controlled through the musculature moving the two arytenoid cartilages, which the vocal fold are attached to at the back; see a schematized figure in (25), from van der Hulst (2015: 329), illustrating the said configuration along with the various states of the vocal folds, which will be presently discussed in detail.

(25) Possible changes in the state of the vocal folds

The little triangles represent the arytenoid cartilages, the lines connected to them the vocal folds, and the enclosed space the opening between the vocal folds called the glottis. Movements: 1—reduced stretching of the vocal folds; 2—adduction/abduction of the arytenoid cartilages; 3—in/outward rotation of the arytenoid cartilages (medial compression).



The articulation of (pulmonic) obstruents (stops, fricative and affricates) involves a constriction in the upper vocal tract, blocking the airflow. As a result, the air pressure in the supraglottal cavity swiftly rises above the subglottal pressure, making glottal pulsing impossible if the vocal folds are stiff and kept apart, as during quiet breathing. This is called passive voicelessness, a characteristic of obstruents like [p, t, k]—as virtually every human language has voiceless plosives, they can be thought of as the prototypical obstruent type. Acoustically speaking, the result of the chaotic turbulent stream characteristic of obstruents produced with this laryngeal setting is an aperiodic soundwave.

In their neutral state,[15] the vocal folds are only slightly held apart. When a vowel is produced, the air can pass through the supraglottal cavity freely (the differences in vowel quality can be typically attributed to the vertical and horizontal position of the back of the tongue, with which the shape of the supraglottal cavity can be changed), and the conditions are similar in the case of sonorant consonants (nasals,[16] approximants and glides) as well. Consequently, the pressure above the vocal folds is nearly identical to that outside the vocal tract, while the pressure under the glottis is higher due to the accumulation of the air coming out of the lungs. Therefore, the vocal folds are pushed apart by the airstream until the difference between the sub- and supraglottal pressure drops to the point when the glottis can no longer be forced open, and the vocal folds get sucked together. Then the subglottal pressure begins to build up again to reach a level at which the vocal folds are pushed apart, initiating another glottal cycle, followed by the equalization of the pressure around the glottis, closing it again. This is how the vocal folds are set in vibration during the articulation of vowels and sonorant consonants such as [a, i, j, r, m], insuring their default voicing, called spontaneous voicing. In acoustic terms, the glottal pulsing described above is reflected in the soundwave as periodicity.

Voicing (a.k.a. phonation) is possible in the case of obstruents as well, but this type of voicing normally requires an additional effort; this is called

---

[15] Prior to speech production, the vocal folds are generally set in a position in which the glottis is narrower than during breathing, and vibration is possible in case of unimpeded airflow, which is taken to be the neutral laryngeal setting in Chomsky & Halle (1968: 300).

[16] Although nasals are produced with a complete closure in the oral cavity, the supraglottal airflow is not impeded since air can freely escape through the nasal cavity.

active voicing. Compared to their neutral position and state, the vocal folds need to be adducted (or nearly so) by bringing the arytenoid cartilages together, plus they must be slackened by the reduction of their neutral stretching. Moreover, the unfavorable aerodynamic condition involving the production of obstruents needs to be overcome: as opposed to the articulation of sonorants, the constriction typifying obstruents eventually makes the supraglottal air pressure greater than the subglottal pressure, quenching voicing. The inhibition of vocal fold vibration can be actively delayed in one of or a combination of the following ways: lowering the larynx, raising the velum, broadening the pharynx and pushing the tongue root and the epiglottis forward. Obstruents pronounced in this way include [b, d, g]. If the speaker maintains vocal fold vibration by letting the exhaled air escape through their nose, the resulting plosives are prenasalized: e.g., [ᵐb, ⁿd, ᵑg].

It can also happen that an obstruent is produced with vocal fold vibration without the gesture being an articulatory target. In such cases, the obstruent is said to be passively voiced as a result of the environment. Spontaneous voicing can spread to an obstruent from a neighboring sonorant segment. Although intersonorant position is the most ideal context for an obstruent to undergo passive voicing, a single preceding or following sonorant may also suffice to cause vocal fold vibration.

Iverson & Salmons (2003: 49–53) claim that it is the voicing of a preceding sonorant that continues into an obstruent, which means that, for example, the initial obstruent of *bad* is (passively) voiceless, while the final one is passively voiced in isolation, i.e., it is pronounced [b̥ad]. The /d/ of *bad* is voiced because of the preceding sonorant even in *bad pay* [b̥ad pʰɛj], regardless of the voiceless segment following it in the next words. Due to the sensitivity of passive voicing to the left-hand context, the /b/ of *boy* in *bad boy* [b̥ad boj] is also predicted to be voiced because of the (passively) voiced segment before it. Based on research like that of Slowiaczek & Dinnsen (1985), it seems that the amount of passive voicing can be defined in terms of the voiced interval beginning at the onset of the obstruent, supporting the influence of the left-hand environment.

Although the proportion of voicing to the duration of the obstruent is a gradient phenomenon, it might be questionable whether a postpausal word-initial obstruent tends to fall into the passively voiceless category, whereas a prepausal word-final obstruent is consistently more likely to contain a greater voicing ratio, categorizing it as a passively voiced segment. Hunnicutt & Morris (2016: 216–217) mention several studies reporting results of word-initial obstruents in which the degree of voicing varies. These findings can be interpreted as passive voicing triggered by a following sonorant, i.e., the right-hand context. The assumption of presonorant position as the necessary condition of passive voicing is also built into the phonological analysis of Cyran (2011 *et seq.*). An actively and a passively voiced obstruent also tends to differ in terms of the amount of glottal pulsing in the segment: for instance, a study has found that in German, where a plosive can be passively voiced, only 62.5% of intervocalic plosives were phonated during more than 90% of their closure, while in Russian, a language with actively voiced obstruents, 97.5% of plosives in intervocalic position were entirely voiced (Beckman, Jessen & Ringen 2013).

Besides bringing the vocal folds together and slackening them in order to make their vibration possible, another type of adjustment of about the same complexity can be achieved by moving the arytenoid cartilages further apart than in the case of simple voiceless obstruents, and so spreading the glottis more widely open. Air can freely and relatively quickly pass through it, and, just like in the case of plain voiceless obstruents, the vibration of the vocal folds is not possible because they are stiff. Also, it will take the vocal folds longer to be brought together to start vibrating in a following sonorant, i.e., voicing will be delayed. The extension of the aperiodic noise after the release burst can be perceived as a short [h] after a plosive or the devoicing of a sonorant following it, e.g., [pʰ, tɹ̥]—this is called aspiration.

Plosives produced in one of the above laryngeal settings can be characterized and distinguished using a value referring to their voice onset time (VOT), measured in milliseconds, as suggested by Lisker & Abramson (1964). The VOT value of a plosive shows when vocal fold vibration begins relative to the release of the plosive. In the case of a voiced plosive like [b, d, ɡ], glottal pulsing starts before the release of the plosive, i.e., during the closure phase, and the VOT value will be negative (a.k.a. lead VOT), falling between −125 and −75 ms on average. If vocal fold vibration begins upon release or shortly afterward, normally within 25 ms, we talk of zero or short lag VOT, characteristic of [p, t, k], for instance. (The threshold of perceiving a plosive as aspirated is somewhere around 35 ms (G. Kiss 2017).) Finally, voicing can be considerably delayed, initiated typically 60–100 ms after the release of the plosive, so the VOT value is positive; the result is an aspirated sound like [pʰ, tʰ, kʰ] (Lisker & Abramson 1964: 403).

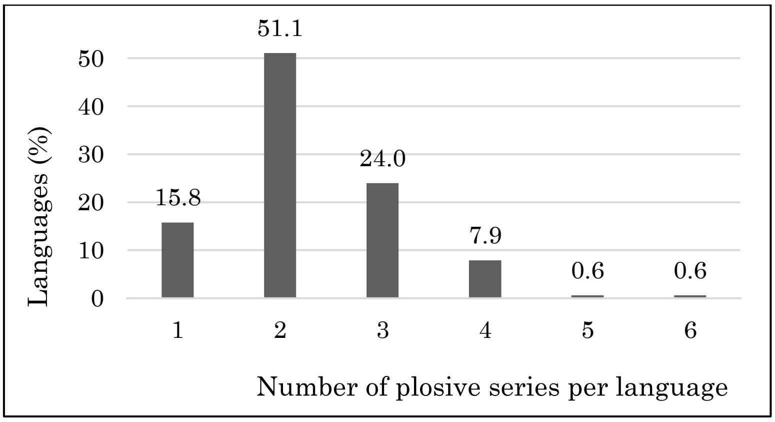
At his point, some facts are worth mentioning regarding the voicing and voicelessness of fricatives. As for voiceless fricatives, it has been shown that the glottal width characterizing aspirated plosives can be found in fricatives too, even though they might not be aspirated. In fact, this property of fricatives has been built in Iverson & Salmons's (1995: 370–371) analysis, in which they account for the fact that a plosive cannot be aspirated following a fricative in an initial cluster in English (e.g., *pin* [pʰɪn] vs. *spin* [spɪn]): The glottal opening has the same width and duration in the cluster /sp/ as in a singleton /p/. However, in the former case, the peak of the opening falls within the /s/ and narrows during the following /p/ to the point that vocal fold vibration can begin upon the release of the stop; in the latter case, the narrowing phase extends the duration of the stop, which is realized as aspiration.

The articulation of voiced fricatives is an interesting issue. As mentioned above, vocal fold vibration is inhibited if the difference between the sub- and supraglottal pressure drops, due to the constriction in the vocal tract, to the point at which the velocity of the airflow through the glottis reaches a critical value which is too low to insure vocal fold vibration. This explanation appears to imply that the narrower the constriction, the shorter it takes the air to accumulate, so the quenching of voicing will happen sooner. Based on this, a fricative is expected to be more prone to be pronounced voiced than a plosive (Recasens 2002: 333–334). Nevertheless, the picture may be more complex than that because the production of an ideal fricative and that of an ideal voiced sound involve aerodynamically conflicting gestures: frication requires high supraglottal air pressure insuring a stable airstream out of the vocal tract through the constriction, while for the maintenance of vocal fold vibration, the supraglottal air pressure should be relatively low (Ohala 1983: 201–202). This unfavorable situation leads to cross-linguistic variations arising from the difference in which property of a voiced fricative speakers maintain at the cost of the other (see, e.g., Bárkányi & Kiss (2012: 112–116) on the realization of /v/ in Hungarian and Slovak).

If we combine the laryngeal settings for both voicing and aspiration, i.e., slacken the vocal folds by the reduction of their length and also spread them, we get a voiced aspirated (a.k.a. breathy voiced) plosive, an even more complex type of obstruent: e.g., [bʱ, dʱ, gʱ]. There are two further laryngeally distinct obstruent types: ejectives (e.g., [p’, t’, k’]) and implosives (e.g., [ɓ, ɗ, ɠ]), which are nonpulmonic sounds produced with the constriction of the glottis as well as the raising and lowering of the vocal folds, respectively, before the oral release.

Of all the available laryngeal settings described above, as the figure in (26) shows, over half of the UPSID languages[17] exploit only one, in order to create a bipartite opposition in their plosive inventories. (For details on plosive categories in languages, see Maddieson (1984: 25–31).) Almost 90% of the binary laryngeal systems contrast plosive categories definable along the VOT continuum. Hungarian and English represent the two subtypes of these languages. In Hungarian, the opposition is between voiceless unaspirated and voiced unaspirated plosives, i.e., between plosives with short lag and negative VOT, e.g., [p] and [b]. In English, on the other hand, a word-initial plosive is either voiceless unaspirated or voiceless aspirated, i.e., has a short lag or a strongly positive VOT value, e.g., it is [p] or [pʰ].

(26) The distribution of the UPSID languages based on the number of their plosive series



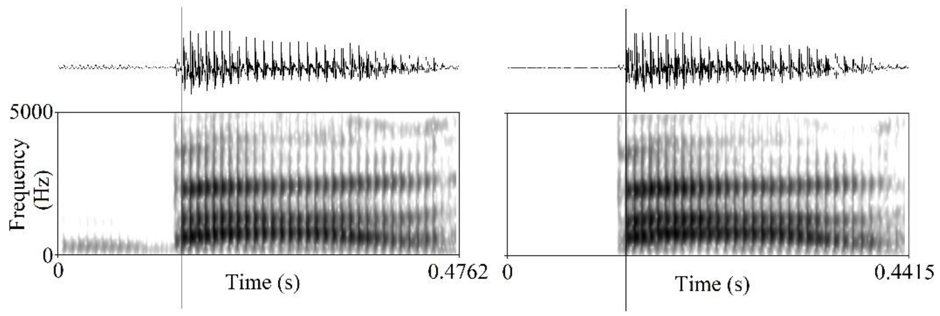
I have generated, using the software Praat, and show in (27) the oscillograms (waveforms) and spectrograms of four recordings in which a Hungarian native speaker pronounces the words *bál* and *Pál* and an English native speaker their English equivalents, *ball* and *Paul*. Although the orthographic conventions and phonemic transcriptions may suggest otherwise, the laryngeal contrast is indeed implemented differently in the two language types. The /b/ in Hun. *bál* is characterized by prevoicing, which appears as periodicity in the waveform already in the closure phase (though with a smaller amplitude than in the case of the following vowel as the obstruent is more silent due to the closed lips), and in the spectrogram, a striated darker area can be seen, referred to as the

---

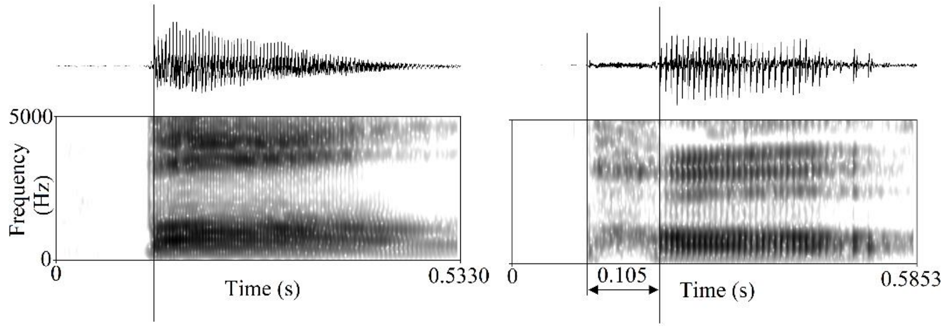
[17] The languages of the UCLA (University of California, Los Angeles) Phonological Segment Inventory Database (UPSID), which is a representative sample of the world’s languages (Maddieson 1984).

voice bar, indicating an increased amount of energy in the low frequency range; see (27a). If we compare the initial plosive of Hun. *Pál* in (27b) with that of Eng. *ball* in (27c), it is clear that they can be pronounced identically: the closure phase is silent, and vocal fold vibration begins upon release in both cases, i.e., they are voiceless unaspirated. Finally, Eng. *Paul* also begins with a voiceless plosive; moreover, glottal pulsing in the next vowel is delayed by 105 ms, i.e., the plosive is aspirated.

(27) Oscillograms and spectrograms of the two bilabial plosives in Hungarian and English



a. Hun. *bál*   b. Hun. *Pál*



c. Eng. *ball*   d. Eng. *Paul*

The present dissertation will focus on languages with two obstruent series belonging to either of the above subcategories. The remaining 10% of binary-contrast systems typically have a plain voiceless series contrasted with a set of (pre)nasalized plosives or voiceless ejectives/voiceless laryngealized plosives (examples of the latter category include /p̰, t̰, k̰/).

Besides binary systems, there are languages which do not feature laryngeal opposition at all. In most, if not all, such cases, the single obstruent series consists of plain voiceless members, requiring the simplest laryngeal setting and thus the least effort to produce. Hawaiian, for instance, has only the following obstruent phonemes: /p, k, ʔ/. A more common pattern though is when a language has three plosive categories. Although there is great variation in three-way-contrast systems, in the largest subtype, the oppositions are defined on the VOT scale, so these languages have voiceless unaspirated, voiceless aspirated and voiced unaspirated plosives. Thai, having near-minimal sets like /pâː/ 'aunt,' /pʰâaː/ 'cloth' and /bâː/ 'crazy,' exemplifies this subcategory (see Ladefoged & Disner 2012: 139–140). In the other cases, two of the three plosive series can be defined with a VOT value, while the third set tends to contain glottalic plosives (ejectives or implosives) or laryngealized plosives.

Less frequently, we can come across languages with four plosive series, a group which is even more heterogeneous regarding the combinations of the laryngeal properties their plosives may have. Hindi, for example, is a four-way-contrast system only using the laryngeal settings for voicing and aspiration as well as the combination of the two: it has voiceless unaspirated, voiceless aspirated, voiced unaspirated and voiced aspirated plosives; see, e.g., the minimal set /pal/ 'take care of,' /pʰal/ 'knife blade,' /bal/ 'hair' and /bʱal/ 'forehead' (see Ladefoged & Disner 2012: 142–144). Languages with five and even six series of plosive have also been attested; however, they are extremely rare. The Owerri dialect of Igbo, a language spoken in Nigeria, for instance, has six types of plosives: voiceless unaspirated, voiceless aspirated, voiced unaspirated and voiced aspirated plosives, plus a voiced implosive and voiceless implosives; e.g., in /ípa/ 'to carry,' /ípʰà/ 'to squeeze,' /íba/ 'to get rich,' /íbʱa/ 'to peel,' /íɓa/ 'to dance' and /íɓ̥a/ 'to gather,' respectively (see Ladefoged & Disner 2012: 152–155). Six seems to be the maximum number of plosive series differing in their laryngeal properties observed in human language.

2.2 The phonology of laryngeal properties

2.2.1 The phonological representation of laryngeal properties

As has been shown in the previous section, although both Hungarian and English are binary-contrast laryngeal systems, the opposition between their two obstruent series is implemented differently. Hungarian has voiceless obstruents with short-lag VOT and voiced ones with negative VOT, independently of the environment (e.g., in [p]*ál* 'Paul' vs. [b]*ál* 'ball'). Such languages use active voicing to create laryngeal contrast and can thus be labeled "voicing languages," further examples of which include Romance languages (e.g., French, Spanish and Romanian) and Slavic languages (e.g., Slovak, Russian and Serbo-Croatian). English, on the other hand, has aspirated plosives besides plain voiceless plosives in word-initial position, i.e., the opposition is between short-lag VOT and positive VOT (e.g., in *ball* [poːl(~b̥oːl~boːl)] vs. *Paul* [pʰoːl]). In case an obstruent is pronounced voiced, it is due to environmental effects, so they can only be passively voiced. English and most other Germanic languages—with the exception of Afrikaans, Dutch, Scots and Yiddish (see van Rooy & Wissing 2001: 296 and Abercrombie 1967: 136)—(e.g., German and Icelandic) and Mandarin are therefore often referred to as "aspirating languages" (see, e.g., Iverson & Salmons 1995: 369).

It has been common practice to refer to the two obstruent series in both language types as voiced and voiceless, probably originally due to the influence of orthographic conventions and for pedagogic reasons.[18] Nevertheless, it has been noted for long that in languages like English, the term “voiceless” does not sufficiently describe the phonemes like /p/, and “voiced” obstruents like /b/ are not necessarily voiced. Jones, for instance, provided the following detailed and accurate descriptions of these plosives a century ago:

> [W]hen **p** is followed by a stressed vowel …, it is pronounced with considerable force, and a noticeable puff of breath or ‘aspiration’, i. e. a slight **h**, is heard after the explosion of the **p** and before the beginning of the vowel. (1922: 24)
>
> [W]hen **b** … occur[s] initially …, [it is] partially devocalized in the pronunciation of most people, that is to say, voice is not heard during the whole of the stop but only during part of it, generally the latter part. With some speakers the voice disappears altogether, so that the [sound] become[s] **b̥** …. (1922: 35)

In voicing languages, the two obstruent series can be called voiced and voiceless without any problem. However, as these terms do not always describe the two types of obstruent in aspirating languages appropriately, they are often referred to in phonological analyses as lenis and fortis segments. Throughout the dissertation, I will use “lenis” and “fortis” as phonological descriptive terms referring to, e.g., /b, d, g, v, z/ and /p, t, k, f, s/, respectively, in both voicing and aspirating languages while words like “voiced,” “devoiced,” “voiceless,” “unaspirated” or “aspirated” will be applied to identify phonetic qualities.

It is indeed reasonable to call the obstruent series with the relatively higher VOT values fortes and the one with the lower VOT values lenes in both voicing and aspirating languages since they have similar phonetic correlates across the two types of system (see, e.g., Bárkányi & G. Kiss 2019: 62–63 and Strycharczuk 2012: 82). Besides the generalization that, for example, both an English /p/ and a Hungarian /p/ have a higher VOT value than an English /b/ and a Hungarian /b/, respectively (in onset position, at least), the following tendencies are also often observable: A fortis obstruent is generally longer than its lenis counterpart, and the vowel preceding the former tends to be shorter than if it occurs before the latter, a phenomenon also called prefortis clipping. In this way, the V-to-C length ratio is lower for fortes than for lenes. Furthermore, fortis plosives are usually released with a stronger and longer burst than lenis plosives. Also, the fundamental frequency (f_0) and the first formant (F_1) of a vowel following a fortis obstruent is relatively higher than after a lenis obstruent; this tendency applies to the preceding vowels as well, though with less prominence.

Now, let us take a look at what phonological representations have been proposed to encode laryngeal contrast in the two types of binary systems, along with the advantages and drawbacks of these models. For a brief overview, see, e.g., Mielke (2011). To begin with, Jakobson, Fant & Halle (1952: 26, 36–39) suggest two acoustically defined features relevant for the present topic:

---

[18] I have recently learned from an Austrian speaker that the plosives of German *Paul* and *Ball* are often referred to as *hartes p* ‘hard p’ and *weiches p* ‘soft p,’ respectively, especially in Austria. Interestingly, these terms are used by laypeople, too, from as early as elementary school.

[voiced/voiceless] and [tense/lax][19] for VOT-based binary systems (i.e., voicing and aspirating languages),[20] which are defined as follows:

> The voiced or "buzz" phonemes as /b d z v/ vs. the voiceless or "hiss" phonemes are characterized by the superposition of a harmonic sound source upon the noise source of the latter. For voiced consonants this means a joint presence of two sound sources. The spectrum of voiced consonants includes formants which are due to the harmonic source. The most striking manifestation of "voicing" is the appearance of a strong low component which is represented by the voice bar along the base line of the spectrogram. (26)
>
> In consonants, tenseness is manifested primarily by the length of their sounding period, and in stops, in addition by the greater strength of the explosion. (36)

This acoustic bias does not mean that distinctive features cannot be described in articulatory terms (Lieberman 1970: 158). Jakobson, Fant & Halle also mention that "[v]oiced phonemes are emitted with concomitant periodic vibration of the vocal bands and voiceless phonemes without such vibration," and that tense phonemes are articulated with greater tension than their lax counterparts (1952: 26, 38).

Chomsky & Halle (1968: 324–329) use laryngeal features referring to articulatory maneuvers: [±voice], [±tense] and [±heightened subglottal pressure] are the ones relevant for specifying categories along the VOT scale.[21] The articulation of voiceless unaspirated plosives does not involve any gestures represented by the said features, while voiced plosives are marked with the feature [+voice], aspirated plosives with the features [+tense] and [+heightened subglottal pressure], and in the case of voiced aspirated plosives, [+heightened subglottal pressure] is needed without tenseness in the supraglottal musculature.

Halle & Stevens (1971) introduce four features in order to express all possible states of the vocal folds and to represent every type of laryngeal opposition: [±stiff vocal cords] and [±slack vocal cords] plus [±spread glottis] and [±constricted glottis]:

---

[19] The authors apply the feature tense/lax to contrast vowels as well. This is the feature that distinguishes, for example, the two vowels of French *élève* /elɛv/ 'pupil.'

[20] A third feature, [checked/unchecked], is proposed to mark consonants that are produced with the compression or closure of the glottis, e.g., /pʾ/ (Jakobson, Fant & Halle 1952: 23).

[21] In order to distinguish laryngealized plosives, ejectives and implosives, the authors propose further features: [±glottal constriction], [±ejection] and [±implosion], respectively (Chomsky & Halle 1968: 315–316, 322–324).

(28) Laryngeal specifications and the resulting sounds in Halle & Stevens (1971)

	+stiff, −slack	−stiff, −slack	−stiff, +slack
+spread, −constricted	voiceless aspirated plosive [pʰ]	voiceless partially aspirated plosive [p$_{k}$]	voiced (breathy) aspirated plosive [bʱ]
−spread, −constricted	voiceless unaspirated plosive [p]	lax voiceless plosive [b$_{l}$]	voiced unaspirated plosive [b]
−spread, +constricted	ejective [p’]	implosive [ɓ]	(pre)glottalized or laryngealized obstruent [ʔb], [b̰]

As can be seen in the table in (28), summarized in Szigetvári (1996: 99), unaspirated voiceless plosives, for instance, are specified as [+stiff, −slack, −spread, −constricted], aspirated plosives as [+stiff, −slack, +spread, −constricted], voiced plosives as [−stiff, +slack, −spread, −constricted], and voiced aspirated plosives as [−stiff, +slack, +spread, −constricted]. As [+stiff, +slack] and [+spread, +constricted] specify physiologically impossible vocal fold settings, these combinations can be ruled out, so a maximally nine-way opposition can be expressed in the model. To further constrain the number of contrasts, since nine seems to be unnecessarily too many, Kenstowicz (1994: 40–41) replaces [±stiff vocal cords] and [±slack vocal cords] with [±voice]. As a result, the features [±voice], [±spread glottis] and [±constricted glottis] are capable of expressing a six-way opposition, avoiding overgeneration.

In contrast with the models mentioned above, in which the underlying representations manage to faithfully reflect phonetic reality, the approach which is considered the traditional view in laryngeal analysis is the one that uses only the feature [(±)voice][22] to encode laryngeal contrast in both voicing and aspirating languages (Beckman, Jessen & Ringen 2013: 259). That is, for example, the plosives in both Hun. *bál* and Eng. *ball* are marked as [+voice] while the ones in both Hun. *Pál* and Eng. *Paul* as [−voice]—or, in a unary framework, the former two are specified for the feature [voice] while the latter two lack it.

What requires an explanation in a [voice]-only theory concerns the possible mismatch between the phonological representation of an obstruent and its phonetic realization as a voiced, plain voiceless and voiceless aspirated segment. In SPE-based models, the relationship between the two levels of representation in a voicing language is straightforward: the articulation of obstruents marked as [+voice] involves vocal fold vibration, while the ones

---

[22] For analyses assuming binary features, see, e.g., Lieberman (1970), Keating (1984) and Wetzels & Mascaró (2001), while examples of accounts in unary models include Lombardi (1995, 1999).

specified as [−voice] are produced without this gesture. As for the realization of fortis obstruents in an aspirating language, on the other hand, aspiration can be assigned to the [−voice] segments by a redundancy rule (see Chomsky & Halle 1968: 164–171). The application of this rule may be context-dependent; this is the case, for example, in English, where [−voice] obstruents are aspirated foot-initially and unaspirated elsewhere. The possible voicelessness of lenis obstruents with an underlying [+voice] specification in this language type may be resolved by mapping the feature to a low voice value on the VOT scale at the phonetic level, which is characterized by gradience. In English, nonintersonorant obstruents tend to receive a lower value than if they occur between sonorant segments.

It is indeed necessary in a framework marking the obstruent series in voicing and aspirating languages identically to assume, like Lieberman (as cited in Keating 1984: 290) does, that "[±voice] … as a binary phonological feature can be implemented differently in different languages along the continuous dimension of [voice onset time]." Keating (1984) complements this proposal and formalizes it by introducing an intermediate categorical phonetic level between the phonological level and the level of actual phonetic implementation continuous in time. The phonological level has the specifications [+voice] and [−voice]; the newly introduced level contains three discreet, and thus abstract, phonetic categories: {voiced}, {voiceless unaspirated} and {voiceless aspirated}; and at the level of phonetic implementation, feature values are gradient and defined along the VOT scale. The feature [±voice] serves to encode phonological contrast uniformly in voicing and aspirating languages. The two values of the phonological [±voice] are mapped to two of the three phonetic categories. Which two phonetic properties will be assigned to [+voice] and [−voice] is language-dependent. In fact, this is the point at which voicing and aspirating languages differ: in Hungarian, [+voice] is mapped to {voiced}, and [−voice] to {voiceless unaspirated}, whereas in English, [+voice] will be implemented by {voiceless unaspirated}, and [−voice] by {voiceless aspirated}. Finally, the still abstract phonetic categories will be mapped to values along the VOT continuum as well as other to values of other parameters defining their concrete physical realizations.

By separating a systematic phonetic level from the phonological level, Keating's (1984) proposal actually relieves the distinctive feature [±voice] of the burden of encoding physical properties. The function of the features of the phonological level is then to define phonological contrasts and natural classes. This model is in harmony with Lass's (1984) and Mielke's (2004, 2011) questioning the necessity and plausibility of charging phonological features with both phonological and phonetic duties, summarized in section 1.2. The main consequence of gaining a phonetic content–free distinctive feature is as follows:

> [s]ince phonological rules apply to binary feature values, before phonetic category implementation, they cannot anticipate the phonetic values onto which those binary values are mapped … A curious consequence of this lack of look-ahead is that it should be possible for such a rule to occur with EITHER sort of phonetic category implementation. That is, the occurrence of a phonological rule in a language should not depend on, or be correlated with, the phonetic details of the language. (Keating 1984: 292, emphasis in original)

As a result, in this model, the same phonological rules can be assumed to uniformly apply to the values of the same distinctive feature in both language types. As an advantage of rule equivalence, cross-linguistic phonological generalizations can be captured, namely (i) vowel duration tends to be shorter before an obstruent specified as [−voice] than before a [+voice] one (although the vowel-to-consonant length ratios may significantly differ across language types), and (ii) the fundamental frequency of vowels following an obstruent specified as [−voice] is normally higher than after [+voice] segments. Although the model argued for in the present dissertation is different from the one proposed by Keating in ways discussed in subsequent sections, it agrees with this major assumption.

The role of the three phonetic categories is to encode the maximum number and the identity of well-separable areas on the VOT scale available for implementing phonological contrast. These are cross-linguistically recurring categories, which result from physiological constraints. It is at the level of systematic phonetic categories that the laryngeal markedness relations of obstruents can be expressed; i.e., in a voicing language, {voiced} is more marked than {voiceless unaspirated}, and in an aspirating language, {voiceless aspirated} is more marked than {voiceless unaspirated}. Processes such as neutralization can thus be accounted for at this level of analysis. Finally, the level of concrete phonetic implementation contains all the low-level phonetic details that might be required, for instance, to differentiate between a native and non-native accent.

Hall calls this "traditional" [voice]-only approach "the broad interpretation of the feature [voice]" (2001: 31–32) since in such models, it must be allowed that the two values of the laryngeal feature be mapped to a broader range of phonetic values given that it is assumed in both voicing and aspirating languages. Examples of analyses provided in this approach include Lieberman (1970), Keating (1984), Lombardi (1995, 1999) and Wetzels & Mascaró (2001). In the "nontraditional" view (see Beckman, Jessen & Ringen 2013: 259), referred to as the "narrow interpretation of the feature [voice]" by Hall, two distinctive features are employed, namely [(±)voice] and [(±)spread glottis], or, more simply, [(±)aspiration], for the representation of laryngeal contrast. In this approach, voicing and aspirating languages are typologically separated right at the phonological level as their two obstruent series receive different phonological representations. For example, the /b/ of Hun. *bál* 'ball' is marked with the feature [voice] while the /p/ of Hun. *Pál* 'Paul' is unmarked (or, in a binary model, the former is specified as [+voice], and the latter as [−voice]); whereas in English, it is the /p/ of *Paul* that is marked, containing the feature [spread glottis], while the /b/ of *ball* is laryngeally unmarked (or the former is specified as [+spread glottis], and the latter as [−spread glottis]). This approach is also known as Laryngeal Realism, a label used by Honeybone (2005: 345). Proponents of this nontraditional view of phonological analysis include Halle & Stevens (1971), Clements (1985), Iverson & Salmons (1995) and Beckman, Jessen & Ringen (2013).

It seems an advantageous step to assume both [voice] and [spread glottis] in laryngeal analysis for two main reasons. First of all, the phonological representation faithfully reflects phonetic reality. Lenis obstruents in a voicing language such as /b, d, g/, which are marked with the feature [voice], are articulated with active voicing (i.e., pronounced [b, d, g]), while the same lenis obstruents in an aspirating language, being laryngeally unmarked, are normally pronounced without glottal pulsing (i.e., pronounced [p, t, k]) and can only undergo passive voicing in a voicing environment. Fortis obstruents like /p, t, k/ are unmarked and articulated as plain voiceless sounds ([p, t, k]) in a voicing language, whereas in an aspirating language, they are specified for the feature [spread glottis] and are normally produced with larger energy, which tends to be implemented as aspiration ([pʰ, tʰ, kʰ]).

Secondly, as Kaye (2005: 283) argues, “the only source of phonological knowledge is phonological behaviour.” Based on this, the different phonological behaviors of obstruents in the two language types also appear to support their having different phonological representations. The loanword *notebook* in Hungarian contains the cluster /db/ as the result of regressive voice assimilation: Phonetically speaking, in anticipation to the active voicing characteristic of the articulation of the second obstruent, the first member of the cluster is also pronounced voiced. This process can be analyzed phonologically as the spreading of the feature [voice] from the /b/ to the /t/, turning it into its voiced counterpart (see, e.g., van Rooy & Wissing 2001). In English, on the other hand, *notebook* has the cluster /tb/. This is, in fact, predicted by the phonological representation of the obstruents: the /b/ is laryngeally unmarked, so it cannot trigger voice assimilation, and the /t/, being marked with the feature [spread glottis], will resist undergoing voicing of any degree (see, e.g., Beckman, Jessen & Ringen 2013). Fortis obstruents, on the other hand, do trigger a process in an aspirating language that many authors believe should be accounted for in the phonological component. Sonorants after fortis obstruents undergo devoicing in words like Eng. [pl̥]*ay*, [tɹ̥]*ay* and [sl̥]*eigh*, which can be analyzed as the spreading of [spread glottis] from the fortis obstruent onto the sonorant, making it voiceless (see, e.g., Iverson & Salmons 1995).

Authors such as Harris (1994) and Backley (2011) are also proponents of this “nontraditional” view of laryngeal analysis, although they work within the framework of Element Theory and assume the melodic elements |L| and |H| instead of the distinctive features [voice] and [spread glottis]. The way in which they group VOT-based binary systems into typologically different categories, however, remains the same.[23] In the analysis of the present dissertation too, the melodic elements of ET will be assumed; however, I will argue that, similarly to the traditional view of laryngeal analysis summarized above, one and the same element should be applied to encode laryngeal contrast in both voicing and aspirating languages. I will propose that this element be |H|, making the fortis obstruents the marked series. It will also be discussed how this analysis is compatible with a substance-free approach to phonology, a view summarized in the next chapter.

---

[23] It is worth mentioning Brockhaus’s (1995: 250–251) analysis at this point, in which both |L| and |H| are assumed in the same binary-contrast system, meaning that the language has no unmarked obstruent series. With this proposal, the author aims to account for incomplete final neutralization in languages like German.

2.2.2 Laryngeal assimilation and its phonological representation

In connected speech, it often happens that the movement of an articulator involved in the production of a speech sound is altered to a certain extent when the production of a neighboring sound requires a different movement of the same articulator, in which case, the articulator may take a shortcut (see, e.g., Raphael, Borden & Harris 2011: 137–139). Such assimilatory processes can be observed on the voicing properties of obstruents as well. In a voicing language like Hungarian, if two or more obstruents occur next to each other, either all or none of them should be articulated with vocal fold vibration, and it is the rightmost member of the cluster that determines the voicing property of the whole cluster; see (29).

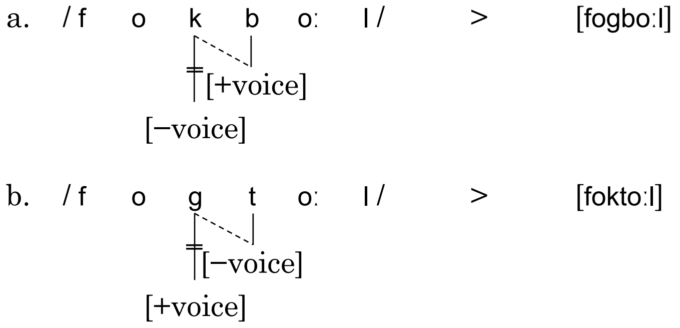
(29)	fo/k-b/ól	–	fo[g-b]ól	'degree-ELA'
	fo/g-b/ól	–	fo[g-b]ól	'tooth-ELA'
	fo/k-t/ól	–	fo[k-t]ól	'degree-ABL'
	fo/g-t/ól	–	fo[k-t]ól	'tooth-ABL'

This section will summarize how this phenomenon has been analyzed in different phonological theories. To begin with, in SPE-based models, a simple feature-changing rule can be used to describe voice assimilation, in which an obstruent is required to have the same voice specification as the following obstruent (see, e.g., Chomsky & Halle 1968: 178):

(30) $$[-\text{son}] \rightarrow [\alpha\text{voice}] \,/\, \_\_ \begin{bmatrix} -\text{son} \\ \alpha\text{voice} \end{bmatrix}$$

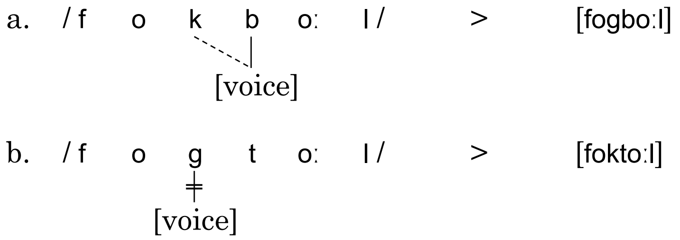
SPE-type arbitrary rules are not constrained enough with regard to the possible inputs and outputs of phonological processes as well as the contexts in which they may occur, which is generally considered to be a disadvantage. In autosegmental models (see Goldsmith 1976), voice assimilation can be analyzed as modifications in the associations between skeletal slots and autosegments. This is illustrated in (31), where binary features are assumed. In both cases, the obstruents not followed and licensed by a sonorant segment lose their voice specifications, represented as the delinking of the distinctive features. They will not remain unspecified though since the feature of the following obstruent will spread onto them (see, e.g., Cyran 2016).

(31)

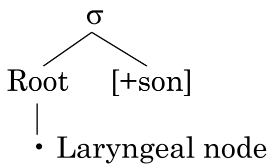


In (32), the representation of the same assimilatory processes can be seen, but in a unary model. As phonological contrasts are not equipollent in this approach, the assimilation of voicing and voicelessness has to be analyzed as two asymmetrical processes. In (32a), the first obstruent of the cluster is laryngeally unmarked, while the second is specified for the feature [voice], which will spread onto the one before it. In (32b), the first member of the obstruent cluster is the one that is laryngeally marked, but the feature will be delinked from the segment as it is not licensed by a following sonorant segment, and the resulting unmarked obstruent will be phonetically realized voiceless. The condition under which the laryngeal specification of an obstruent can be sanctioned is formalized by Lombardi (1995) as shown in (33): the Laryngeal node is licensed and thus remains linked to the Root node of a segment if it is followed by a sonorant (consonant or vowel) in the same syllable.[24] So, in sum, the spreading of voicing can be phonologically analyzed as feature spreading, while the spreading of voicelessness as feature delinking.

(32)

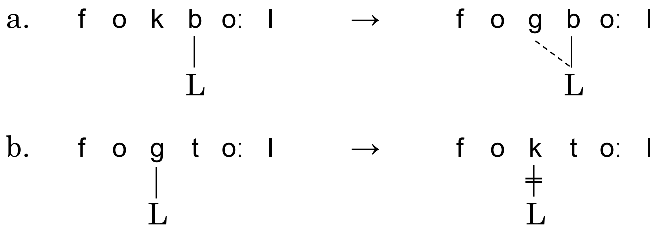


(33) Laryngeal Constraint (Lombardi 1995)



Finally, the representations in (32) can be transformed into the ones given in (34) where melodic elements are used, with the same processes operating on them.

(34)



As for the Laryngeal Constraint in (33), it can be expressed in terms of lateral relations assumed in Strict CV approaches, which is illustrated in (35).[25] A

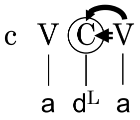
---

[24] At this point, the constraint in its present form is displayed for illustrative purposes only. It suffices for the time being but will need to be modified for certain languages in order to accurately account for the data.

[25] Throughout the dissertation, “H” or “L” in superscript indicates that the given segment is laryngeally marked, while a superscript “0” denotes laryngeal unmarkedness.

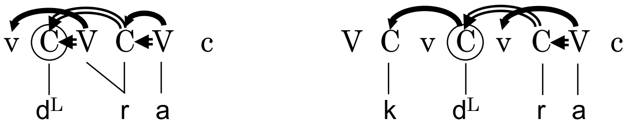
laryngeal element remains linked to a skeletal position if it is licensed by a following vowel, whether it is governed, as in (35a), or not, as in (35b). In the case of a tautosyllabic obstruent+sonorant cluster, the obstruent can keep its laryngeal specification due to the following sonorant consonant, which can be explained in Szigetvári's Coda Mirror Plus model as the result of the C-to-C licensing formed between the sonorant and the obstruent (1999: 111–149); see (35ci). Scheer (2004: 35ff) suggests that such onset clusters be assumed to contract a special relation, which he calls Infrasegmental Government, creating a closed domain, across which government can apply without violating the Strict Locality condition. Infrasegmental Government can be considered to be responsible for the licensing of the laryngeal element; see (35cii).

(35) a. Licensed and governed by a following V



b. Licensed and not governed by a following V

c. i. Licensed via C-to-C licensing (and by a following V in the case of initial onsets) and not governed



ii. Subject to Infrasegmental Government

It appears that voice assimilation, like other phonological phenomena, can be accounted for in a Strict CV model, using the primitives of Element Theory, in a nonarbitrary way as there is a direct relation between the phonological operations and the contexts in which they occur. Instead of arbitrary rules, the theory assumes a set of universal principles common to linguistic systems (such as government and licensing as the possible phonological relations, a universal set of unary elements, the linking and delinking of these elements as possible phonological operations); while cross-linguistic variation can be attributed to language-specific parameters (see, e.g., Cyran 1997: 1). One of the questions the dissertation attempts to deal with is to what extent laryngeal processes—and phonological processes in general—can be considered nonarbitrary. In chapter 4, after looking into samples of the phonetic qualities and the behaviors of obstruents in different laryngeal systems, I will propose an alternative model for a more uniform phonological analysis of laryngeal phenomena, positing |H| for encoding the contrast and participating in phonological processes in both aspirating and voicing languages. For this, no more stipulation will be required in the phonology than has always been necessary.

Chapter 3

Studying speech sounds

A clear distinction between the two aspects of the study of speech sounds, the phonetic and the phonological, can be traced back to as early as 1870, when Baudouin de Courtenay defined the scope of the two domains (see, e.g., Siptár 2006).[26] The debate concerning their exact objects of study and methodologies of investigation as well as their relationship has not been settled ever since though.

In brief, the two fields can be described as follows:

> [B]ased on the core properties of which sound patterns belong to phonology and which to phonetics, the modules of the two conceptual domains can be distinguished along two dimensions: the first dimension is based on the dichotomy of "physical" vs. "cognitive". Along this dimension, phonetics is substantive: it is anchored in the physical, physiological, acoustic, etc. domains of speech, whereas phonology is substance-free, cognitive, "formal", psychological, mentalistic etc. The other dimension divides phonetics and phonology along the notion "concreteness": along this dimension phonology is about contrast, discrete categories, abstract symbols, while phonetics is about detail, redundancy, gradience. These two dimensions are most often treated together, they are collapsed into a single, composite dimension. (Kiss 2007: 98–99)

Kingston (2007: 401) lists three possible ways in which these domains can interface: phonetics can define distinctive features, it can explain a number of phonological patterns, and it can implement phonological representations. He also points out that the answers to questions regarding the autonomy of the two disciplines "could not differ more." On one end of the scale, we can find scholars who argue that they are not separable, so much so that phonetics should be integrated into phonology as the latter is reducible to the former—this allows more comprehensive accounts for phonological phenomena. According to the opposite stance, phonological analysis should be entirely substance-free, that is, no reference should be made to phonetic considerations. These two extremes flank an array of theories along the scale. Section 3.1 briefly discusses approaches in which phonetic substance plays a role in phonological analysis, while the substance-free view, which will be advocated in the present dissertation, is discussed in section 3.2.

---

[26] For a discussion supporting the distinctness of the two fields and the modularity of the two systems in the brain, see, e.g., Cohn (1998) and Blaho (2008: 5–7), respectively.

3.1 Functionalist approaches to phonology

The functionalist end of the above-mentioned scale of views concerning the phonetics–phonology interface is represented by Ohala, who argues that "there is an intimate interaction between [phonology and phonetics]; viewing them as autonomous is artificial and unnecessarily complicates the study of speech" (1990: 156). He believes that the two should be integrated, which would "allow us to explain sound patterns in language in terms that have greater simplicity, generality, empirical verifiability, fruitfulness and convergence" (1990: 153).

It was mainly from the 1990s that experimental finding began to be built into phonological models, in a framework usually referred to as laboratory phonology—for a brief summary of phonetically based functionalist approaches, see, e.g., Szigetvári, Rebrus & Kiss (2008); a detailed overview can be found in Kiss (2007). The general view of phonologists working within this framework on the relationship between the two disciplines is summarized by the editors of the fifth volume of the Papers in Laboratory Phonology as follows:

> [P]honology is not a purely formal system whose structure and behavior is divorced from its substance instantiation. Rather, phonology reflects phonetic substance at all levels of description. It is built on the dimensions of contrast which are made available by articulation and psychoacoustics. The linguistically available combinations of values along these dimensions are constrained by their actual physical interactions. The natural classes of phonological elements, as revealed by allophony, phonotactics and morphophonemic alternations, are all heavily shaped by their phonetic similarity. (Broe & Pierrehumbert 2000: 4)

We can find several terms in the literature reflecting the role of phonetic substance in phonological theory, e.g., "grounded phonology" (Archangeli & Pulleyblank 1994), "phonetically-driven phonology" (Hayes 1999) and "phonetically based phonology" (Hayes, Kirchner & Steriade 2004).

To name but a few examples of phonological investigation within this framework, we can the following: Authors studying the articulatory aspects of speech as factors shaping sound patterns include Ohala (1983). In line with this approach, Browman & Goldstein's (1986, 1995) model provides phonological explanations via defining "constellations of dynamically defined articulatory gestures"; their approach is dubbed "articulatory phonology." Kingston (2007), on the other hand, focuses on perceptual considerations, drawing the conclusion that the speaker's aim is to produce particular acoustic or auditory effects. Examining the relationship between phonology and perception, Martin & Peperkamp (2011) report that while the phonemic categories and the phonotactics of one's native language affect perception, this influence is actually bidirectional, which may explain diachronic sound changes. Steriade (1997), for example, examines how the maintenance of phonological contrasts depends on the licensing of their phonetic cues in different positions, considering articulatory and perceptual factors as well. As for Blevins, working within the framework of Evolutionary Phonology, she argues that "principled *extra-phonological* explanations for sound patterns have priority over competing *phonological* explanations unless independent evidence demonstrates that a purely phonological account is warranted" (2006: 124, emphasis in original) and considers the diachrony of languages to account for the patterns.

Looking into phonological theories, we can see differences in the degree of the presence of substance in them and its role (see, e.g., the summary in Reiss 2018: 426–429). In traditional generative theories, distinctive features are articulatorily or acoustically grounded; however, due to the formal nature of the approach, phonological rules do not treat their operands based on their phonetic content. In Optimality Theory (OT), on the other hand, phonetically and physically grounded markedness constraints are built into the models, so substance plays an important role in them. Element Theory (ET) has undergone some significant changes in this respect since its foundation. In the beginning, the elements represented acoustic properties; however, by now, their nature has been somewhat reconsidered, and it is rather their cognitive mental category aspect that is emphasized nowadays. By this move, the importance of substance in ET has been reduced. In the next chapter, we will see a radical extension of this practice within a view called Laryngeal Relativism, which will be used as a point of departure for the model to be proposed.

3.2 Substance-free approaches to phonology

3.2.1 Background and the basic idea

Proponents of radical formalism in phonology argue that phonetic substance should be completely disregarded in phonological analysis. A strict dichotomy between abstract form and substance is far from being a novel idea in linguistic theory. Saussure (as cited in Volenec & Reiss 2020: 59–60, emphasis in original) stated the following more than a century ago:

> *Language is a form and not a substance.* This truth could not be overstressed, for all the mistakes in our terminology, all our incorrect ways of naming things that pertain to language, stem from the involuntary supposition that the linguistic phenomenon must have substance.

Strict formalism is characteristic of traditional generative theories. After considering a need for integrating principles of markedness into their theory of grammar, Chomsky & Halle (as cited in Reiss 2018: 427) indeed conclude that "[i]t does not seem likely that an elaboration of the theory along the lines just reviewed will allow us to dispense with phonological processes that change features fairly freely" as "the phonological component requires wide latitude in freedom to change features." In Optimality Theory (OT), on the other hand, as has been mentioned, substance is taken to be a defining factor, since the markedness constraints it employs to generate the desired surface forms are justified on physiological or physical grounds. Later, however, even one of the founders of the theory, Prince (as cited in Reiss 2018: 428) suggested a more moderate view on the substance-based nature of these constraints:

> A constraint, in the intended sense, is a principle within a theory and, like any other principle in any other theory, is justified by its contribution to the consequences of that theory. Since OT is a theory of grammar, the consequences are displayed in the grammars predicted and disallowed—'typological evidence'. A constraint which cannot be justified on those grounds cannot be justified. Further, justifying a constraint functionally (or in any other extrinsic way) can have no effect whatever on its role within the theory. A constraint, viewed locally, can appear wonderfully concordant with some function, but this cannot supplant the theory's logic or compel the global outcome ('efficiency') that is imagined to follow from the constraint's presence, or even make it more likely.

Hale & Reiss (2000), Reiss (2018) and Volenec & Reiss (2020), for instance, claim that phonetic substance should always be considered irrelevant to phonology—they dub their theoretical framework Substance Free Phonology (SFP). They argue that as phonology is a branch of cognitive science, it should study the competence of the speaker. Phonological competence is part of I(nternalized)-language, i.e., it is a mental object, a module internal to the human mind. This phonological submodule is assumed to consist of "a finite set of primitive, atomic symbols (basic representations) and a finite set of functions that manipulate those symbols (basic computations)" (Volenec & Reiss 2020: 11). As mental representations, these primitives are neural symbols and thus necessarily free of substance. Consequently, they are treated by the computational system independently of their physical realizations.

As far as speech is concerned, it results from the externalization of I-language. It is the performance of the speaker, which has articulatory, acoustic and auditory aspects. There is, of course, a relation between I-language and speech; however, it is a highly complex and indirect connection. It is therefore important to treat them separately, bearing in mind that "phonology is not the study of speech, but speech provides evidence for the study of phonological competence" (Volenec & Reiss 2020: 7).

A phonologist should thus aim to explore the computational system of the phonological module provided and biologically determined by Universal Grammar (UG). Ideally, this enterprise results in the identification of what a possible human language is. Predicting which formally possible linguistic system is attested and accounting for the observed frequency of a pattern should not be the task of a phonologist. Incidental facts about specific languages and cross-linguistic tendencies are epiphenomena of phonetic factors (articulation and perception) and of sound change (Reiss 2018: 429), which should fall outside the purview of a theory of grammar.

3.2.2 Substance Free Phonology (SFP)

The figure in (36) illustrates how we get from I-language to speech as well as the dichotomy between phonology and phonetics. For a detailed description of the process and arguments for the theory, see Volenec & Reiss (2020) and references therein.

(36) From I-language to utterance: the phonological and the phonetic part of the process

underlying phonological representation
↓ operational part of phonology } phonological competence
surface phonological representation
↓ transduction algorithms
phonetic representation
↓ the sensimotor system
actual physical form

What happens in the phonological module is that an underlying representation, consisting of cognitive abstract primitives, is manipulated and turned into a surface phonological representation by the computational system via the application of functions such as deletion, addition or regrouping. The next step is the conversion of the resulting abstract units into phonetic representations. Two algorithms are assumed to carry out the transduction, which do not form part of the phonological competence. One of them is responsible for providing a schema for the muscles specifying the movements required to realize the primitives in each segment. The phonetic forms mapped to the primitives within a segment impact each other, which will lead to intrasegmental coarticulation. The other algorithm drives the temporal extension of the phonetic forms and may cause intersegmental coarticulation. This explains subtle and systematic phonetic variations. Eventually, these phonetic representations are fed to the sensimotor systems, through which they will be made an actual utterance.

3.2.3 Characteristics and some implications of SFP

3.2.3.1 The relation between phonology and phonetics

Again, proponents of SFP argue "the best way to gain an understanding of the computational system of phonology is to assume that the substance of phonological entities is *never* relevant to how they are treated by the computational system, except in *arbitrary*, *stipulative* ways"; and it is claimed that the goal of generative linguists is therefore solely "to define the set of *computationally possible* human grammars" (Hale & Reiss 2000: 162, emphases in original). It might be tempting to build phonetic factors into a phonological model in order to be able to explain attested, attestable and unattested patterns as well as universal tendencies. However, as these are epiphenomena of the articulatory and perceptual characteristics of speech as well as of historical sound changes (which probably had a phonetic motivation once), they should be explained, for example, in the field of phonetics. The choice of building these considerations into a synchronic model of grammar would result in duplication and thus would violate Occam's razor. Volenec & Reiss (2020: 15) explain the distinction between the phonological and the phonetic in the following way, a view on phonological processes adopted in this dissertation too:

> If a featural assimilation rule correctly models a part of a speaker's phonological competence, a phonetician can then posit hypotheses as to why such a pattern exists, why there is variability in externalization of this knowledge, what are the limits of its variation, whether the variation is purely biomechanical or partly/mostly/solely cognitive, and so on. Adopting such a perspective not only preserves a clear distinction between competence and performance, a necessity on many different grounds, but it also facilitates disentangling phonological conclusions from phonetic conclusions even though both are drawn from the same data.

This is in harmony with earlier views like that of Anderson (1981), according to whom phonology is not "natural" in the sense that it cannot be reduced to extralinguistic factors specific to other domains such as physiology, acoustics, perceptual psychology or social considerations. This, however, should not mean

> that the content of linguistic systems is intrinsically arbitrary, or that the study of other domains (such as phonetics) is irrelevant to an understanding of Language (specifically, phonology). … [A]lthough the language faculty is an intrinsically autonomous aspect of human mental organization (at least, so far as we know at present), the specific content of particular linguistic systems is heavily based on other considerations. (Anderson 1981: 535)

In other words, the cooperation of phonologists and scientists of other fields such as phoneticians is necessary for gaining a complex insight into the sound patterns of particular languages; nevertheless, this does not contradict the claim that studying the phonological faculty of the human mind determined by UG does not require phonologists to take extralinguistic aspects into account.

3.2.3.2 Markedness

The liberation of phonology from substance has implications regarding markedness. This term has been used in the literature in a number if different senses. Haspelmath (2006) distinguishes twelve meanings (which he groups into four categories). Out of these, three might be relevant for us. To begin with, markedness can be understood as phonetic difficulty. This idea of the term is regarded by Reiss as a useless notion for understanding grammar (2018: 429–434): for instance, the fact that an implosive is more difficult to produce than a plain pulmonic plosive does not imply that its mental representation is also necessarily more complex (just as the mental representation of an elephant is not bigger than that of a mouse, to cite his example). Therefore, although markedness can be used as a phonetic descriptive term, it should not be taken to imply anything for the phonological grammar of the language. In other words, as has been suggested by Reiss, this concept should be abandoned in phonological analysis. Throughout the dissertation, unless stated otherwise, I will be using the term in the Trubetzkoyan sense, i.e., for the phonological specification of a segment for a given property, which is to be defined as the presence of a unary prime in the phonological makeup of the segment. As a synonym for specification, the use of the term in this sense is not incompatible with the substance-free approach.

The third type of markedness, which denotes typological implication or cross-linguistic rarity, refers to generalizations about human languages like "the syllable coda position is marked compared to the onset position." Although this and similar characteristics of languages might have to do with the phonetic aspects of speech, having the means to account for them in a phonological theory does not seem to be incompatible with the substance-free view. For example, the above prediction can be reached in Strict CV analyses, following from the assumption of strictly alternating CV sequences, the application of the antagonistic forces government and licensing, the processes linking and delinking as well as the phonological makeup of segments, which are not necessarily related to phonetic substance. Volenec & Reiss (2020: 18–19) write the following about the relation of phonetic content to consonantalness or vocalicness, based on which they seem to regard them as cognitive categories:

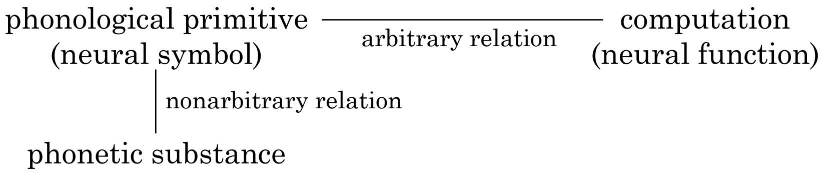
> there are no obvious physical properties that correspond to the set of speech sounds [s, p, g, r, m, l] but not [i, u, a] …: a completely unbiased scientist would not be able to derive the category 'consonant' from the signal. The degree of constriction in the vocal tract might be invoked as the relevant criterion here, but the cut-off point between the categories 'consonant' and 'vowel' is arbitrary and must be predetermined for the parsing to begin. For a human speaker, the innate category is applied to a certain input, thus determining that consonants constitute a 'natural class'.

Thus, cross-linguistic tendencies which can be accounted for with reference to the interactions of the said cognitive categories may be relevant for SFP. Exploring this issue in more depth would fall beyond the scope of this dissertation though. This sense of markedness will not be applied in the dissertation.

3.2.3.3 Phonological primitives and their phonetic content

Advocates of the substance-free approach do not form a homogeneous group—for a brief overview of the different schools, see, e.g., Blaho (2008: 1–44). One of the major differences between these varieties concerns the relationship between phonological primitives and their phonetic substance. According to Reiss and his collaborators Hale, Bale and Volenec, representing SFP, the computational system does not access phonetic content when manipulating phonological primitives, as was mentioned above. However, they argue that the relation of these cognitive objects with substance is not arbitrary—the natures of these relations are summarized in (37). These authors believe that set mental representations must be provided by UG since learning cannot even begin without innate categories, which the input can be parsed with (see, e.g., Volenec & Reiss 2020: 16, also citing Jackendoff and Fodor).

(37) The relations of phonological primitives and their natures



The assumption that phonological primitives are innate might have a further consequence: one could argue against the need for a language-specific phonetic module. In addition to the fixed set of primes in the phonological faculty, the transduction algorithms are also biologically determined in humans, so they always assign the same neuromuscular schema to each prime when they are converted. Therefore, lack of invariance cannot be attributed to the transduction process. This must then mean that cross-linguistic variation can be traced back to different phonological primes. (The set of primes that a speaker possesses in their competence arises through the reduction of the original (complete) set as a result of a lack of positive evidence for certain contrasts in the system requiring certain primes.)

Other substance-free theorists argue that phonological primitives are not innate but emergent. Chabot claims, for instance, in Volenec & Reiss (2020: 90ff) in response to the above reasoning, that phonological primitives are substance-free and emergent. He points out that there are many things that humans are capable of learning although they do not have innate knowledge of; they can learn them through their experience. By the same token, innate phonological primitives are not necessary for a speaker to be able to start processing the ambient data and establishing categories for them. He also argues that we do not have to assume different phonological representations underlying phonetically distinct forms. He illustrates it with the case of rhotics, which are subject to a great deal of phonetic variation, still constituting a phonologically stable category. He also mentions sign languages, which would then require a separate set of innate primitives, lying dormant in speakers of spoken languages.

Blaho, for example, works within a framework called Radical Substance Free Phonology (RSFP), assuming the following relation between phonological representation and phonetic substance (2008: 22–23):

> [F]eatures are indicators of the way members of an inventory behave, but they don't necessarily have any consistent phonetic characteristics even within the same system. If phonology is really separate from phonetics, and phonological features are assigned based on the patterning of segments, there is no reason *a priori* why phonological features have to correspond to phonetic properties.

In her view, it is not the phonological primitives that are innate but the capability of making generalizations regarding the data we are exposed to and of creating categories for them (see Blaho 2008: 11, 40 and references therein). As to what can support the presence of a primitive in a given linguistic system, she believes that

> learners may posit a feature that is required to uniquely specify every segment in the inventory but does not show activity in any phonological process, and, conversely, they may posit a feature that is not contrastive but that is supported by evidence from phonological processes. (Blaho 2008: 40)

3.3 Assumptions for the analysis to be proposed

It will be shown in chapter 4 that whether we posit two laryngeal primes (the melodic elements |L| and |H|) or only one (|H|) to encode laryngeal oppositions in VOT-based two-way-contrast systems, the way the computational system treats them does not regularly follow from their phonetic content, which supports the substance-free approach.

Furthermore, I will be assuming a language-specific phonetic module, which is part of the speaker's knowledge but separate from their phonological competence. Taking rhotics as an example again, bypassing the fact that they have a stable phonological identity despite the considerable variation in their physical implementation, we could argue that an alveolar trill, an alveolar approximants and a uvular trill, representing well-distinguishable phonetic categories, have different underlying representations, so language-specific phonetics in not justified. However, in order to account for tendencies of subtle and gradient cross-linguistic variations such as passive voicing in English obstruents in comparison with a lesser degree of the same phenomenon occurring in German osbtruents, we would need to posit a great number of phonological primitives if we hold them responsible for the variation. However, then, as Chabot puts it,

> why is there such a cognitive over-abundance in phonological features when so many features are destined to go unused in the brains/mind of speakers? This seems to be contrary to the minimalist program, and not a likely evolutionary path, given that cognitive resources are metabolically expensive. Using features to account for variation also means we are faced with another conundrum: gradience is infinite but features are finite, meaning that not all gradient effects can be reduced to feature specification. One possible solution to this is by invoking performance factors, but doing so means feature-based gradience (phonology) and performance-based gradience (phonetics) become indistinguishable. (Volenec & Reiss 2020: 96)

Two possible consequence may follow from the existence of language-specific phonetics. On the one hand, it might mean that phonological primitives are not innate but emergent, in which case their phonetic variation would not be surprising either. On the other hand, if the speaker's phonological faculty does indeed contain an innate set of primitives, the transduction process might still be more complex than have been thought and might be affected by learned language-specific phonetic patterns.

Whether phonological primitives are innate or emergent may have different implications for the analysis. Cyran (2014: 198–201, 2016), explains the idea of a substance-free phonological analysis of laryngeal processes and illustrates it, assuming emergent primes. In brief, he argues that speakers of a voicing language take the lenis obstruent series, and speakers of an aspirating language take the fortis series to be the marked obstruent type based on the behavior of the segments in the given linguistic system. As phonological elements are "cognitive categories with an established systemic interpretational link to a phonetic category," and as |L| and |H| are in complementary distribution across the two types of laryngeal system, they can be regarded as the same item marking reverse obstruent series. This analysis differs from the one proposed in chapter 4 in that the former keeps the markedness relations in voicing and aspirating languages without the necessity of positing two elements, while I will suggest treating all two-way contrast systems as having their fortes marked. Although the analysis summarized above is well acceptable, I believe that we have no particular reason to assume that in a voicing language like Hungarian, lenes form the marked series since assimilatory processes are symmetrical (apart from a few peculiar cases). Also, we will see from the laryngeal typology presented in chapter 4 that positing |H| fares better cross-linguistically. Therefore, an |H|-only analysis in which the fortis series is marked in every binary-contrast system does not seem to be incompatible with a substance-free view assuming emergent primes—it may just not call for this particular analysis.

If, on the other hand, phonological primitives are innate, then it follows straightforwardly what phonetic representation a given element is transduced into. That is to say, if |H| can be found in a laryngeal system, it should be necessarily associated with the lower VOT values, which is in line with the analysis proposed. However, only one fortis element will be applied. In this respect, it is different from Volenec & Reiss's (2020) theory, where cross-linguistic variation can be accounted for if we assume that the different forms are the implementations of an array of primes from which a speaker of a given language has unlearned the ones that have not been evidenced by the ambient data. Avoiding the "cognitive over-abundance in phonological features" by assuming only |H| implies that the cross-linguistic differences will be added in the course of transduction.

Arguing for one or the other view would require more psychological and biological investigation, which would fall beyond the scope of this study. Suffice it to say at this point, I believe, that the analysis in the present dissertation is fairly compatible with either view. It should be noted that substance-freeness does not mean that phonological primitives do not have a relation with substance—either they emerge through perception and will then be associated with phonetic forms, or their relation with phonetic correlates is determined. Either way, phonetic substance is considered not to play a role in the way they are manipulated by the computational system.

As for what should be regarded as a phonological matter, I will be assuming the following: Contrasts[27] and the primitives via which they are encoded in a linguistic system as well as the processes which they participate in should form the object of phonological investigation. Issues concerning the way they are physically realized, however, is to be examined from a phonetic point of view. Trivial examples of the latter include the amount of voicing in a

---

[27] For arguments against the inclusion of contrast in phonology, see Reiss (2018: 434–435).

passively voiced obstruent, a scalar property. Nevertheless, I argue that, for example, flapping and aspiration in General American English are two phenomena to be distinguished in this respect, although both are examples of allophonic alternations: Flapping tends to be a neutralizing process (see *wri*/t/*er* and *ri*/d/*er*, potentially pronounced the same, [rajɾɚ]), where the loss of the contrast can be analyzed in Strict CV- and ET-terms as the delinking of the occlusion element |ʔ| (and the laryngeal element |H|) responsible for stopness (and fortisness). Aspiration, on the other hand, will be treated as a phonetic correlate of fortisness, which will be phonologically irrelevant. The presence or absence (or the different degrees) of aspiration in, say, /t/*érm* and *wrí*/t/*er* can, of course, be the subject of examination, along with cross-linguistic variations—for instance, in Icelandic, aspiration would be found in both environments. However, as the phonological representations of the /t/'s in the two English examples and that of an Icelandic /t/ will be assumed to be identical,[28] the differences in how they actually surface, systematic as they may be, will be considered phonetic in nature.

Furthermore, it has been observed that it is aspiration in languages like English but voicing in languages such as Hungarian that normally changes in proportion to the speaking rate: these properties tend to be enhanced in slower speech. The fact that a speaker has control over the physical correlates of one or the other obstruent category could be taken as evidence for laryngeal markedness in the phonology as well. This criterion for positing a phonological prime in a linguistic system might be misguided. Data from Swedish (see, e.g, Beckman, Helgason, McMurray & Ringen 2011) also support this idea: In this binary-contrast laryngeal system, obstruents are either prevoiced or aspirated, and based on the experimental result, speakers of the language control both correlates. However, voicing in obstruents is phonologically inactive, not playing a role in assimilatory processes. I argue that it is rather this behavior of the obstruents that should inform the phonological grammar, which means that prevoiced obstruents are phonologically unspecified for voicing (for analyses positing the same markedness relations in Swedish, see, e.g., Cyran 2017: 501–502 and Balogné Bérces & Huszthy 2018: 163–164; this issue is also touched upon in chapter 4). I argue that the said tendency only supports the assumption of language-specific phonetics—along with cross-linguistic variation in the amount of passive voicing in obstruents.

As part of the proposed analysis, I will treat the realization of laryngeally neutral obstruents as a phonetic issue. From a phonological point of view, linguistic systems may differ, for example, in whether or not their final obstruents undergo delaryngealization. However, the way they are phonetically realized in a position where the laryngeal contrast is not preserved is determined in the phonetic module. These surface forms can often be explained with reference to physical and physiological factors, but as will be shown, other extralinguistic considerations may also play a role. The details will be discussed on in section 4.3.2.

---

[28] For an ET analysis in which these two instances of /t/ have different phonological representations, see Backley (2011: 141), discussed in section 7.2.2.

Chapter 4

The proposal: an |H|-only analysis[29]

In the present dissertation, I propose a unified representation for laryngeal contrast in both voicing and aspirating languages. More precisely, it will be suggested that instead of the mainstream representation of the opposition summarized in (38), where the lenis obstruents form the marked series in a voicing language, containing |L|, while the laryngeally specified set consists of the fortis obstruents with |H| present in them in an aspirating language, it is the fortes in *both* language types that should be laryngeally marked and it is the element |H| that they should be specified for, while the lenes should be the unmarked category; see (39).[30]

(38) The mainstream representation of laryngeal contrast and their phonetic realization in word-initial plosives in Hungarian and English

	|L|	∅	|H|
Hungarian	/b, d, g/ [b, d, g]	/p, t, k/ [p, t, k]	
English		/b, d, g/ [p, t, k]	/p, t, k/ [pʰ, tʰ, kʰ]

(39) An alternative representation of laryngeal contrast and their phonetic realization in word-initial plosives in Hungarian and English

	∅	|H|
Hungarian	/b, d, g/ [b, d, g]	/p, t, k/ [p, t, k]
English	/b, d, g/ [p, t, k]	/p, t, k/ [pʰ, tʰ, kʰ]

The result is a simpler analysis for VOT-based two-way laryngeal systems. I argue that phonologically speaking, these binary systems differ only in the processes operating on |H|. As for the variance across languages in the physical characteristics of the two sets of obstruents, it should be regarded only as the result of the different phonetic realizations of |H| and the lack thereof. The typology of languages with two obstruent series that can be established in the present Same-Element-Different-Processes approach will also be discussed.

---

[29] The present chapter draws heavily on Őri (2020a) and Őri (2020b).

[30] Throughout the dissertation, I use the word "markedness" in the sense of phonological specification for a given property, i.e., the presence of a unary prime in a given segment—for a discussion on the different meanings of markedness, see section 3.2.3.2. The term "fortis" denotes the obstruent type associated with the higher VOT values, while "lenis" refers to the obstruents having the lower VOT values in a binary system, whether it is traditionally categorized as an aspirating or voicing language. "Voiced," "voiceless," "devoiced" or "aspirated" name phonetic qualities.

4.1 The elements |ʔ|, |H| and |L| in standard ET

Let us begin with a quick overview of the melodic elements of standard versions of Element Theory, as they are defined and applied within the theory, with special focus on the ones that are relevant for laryngeal oppositions.

As, for instance, Backley (2012) summarizes, there are three resonance elements, namely |A|, |I| and |U|, employed in ET which are typically associated with vocalic positions, but they can also define consonantal places of articulation, as described in section 1.2. The nonresonance elements |ʔ|, |H| and |L| can be normally found in consonants; nevertheless, they can occur in vowels as well. The general phonetic correlate of the stop/occlusion element |ʔ| is a sudden drop in acoustic energy, which, in articulatory terms, is achieved by the blockage of the airflow somewhere in the oral cavity or at the glottis. That is, this prime is present in oral stops, including ejectives and implosives, in the glottal stop, in affricates and potentially in nasal stops and laterals as well as in laryngealized/creaky voiced vowels. |H| and |L|, often referred to as the laryngeal source elements, are regularly associated with high- and low-frequency energy, respectively, in the speech signal.

As for the |H| of standard ET, which is taken to represent the presence of energy distributed in the high frequency range of speech sounds, this element has been brought about by merging the |H| and the |h| of conservative ET. Originally, the noise element |h| was applied to represent frication or obstruency, or the absence of [sonorant] in feature theoretical terms, and thus, it was assumed to be present in released plosives, fricatives and affricates. "Old" |H|, on the other hand, indicated the category fortisness, or [spread glottis] in feature theories, mainly in obstruents, the common manifestation of which is aspiration, i.e., voicelessness of prolonged duration. In most versions of standard ET, "new" |H| is taken to represent both obstruency and fortisness, a dual role which it is capable of fulfilling by being either the head or a dependent in a phonological expression. The issue of headedness vs. nonheadedness will be investigated in chapter 7. In the present dissertation, |H| will not mark obstruency—the details of which, again, will be discussed in chapter 7—so "new" |H| is liberated from one of its roles and thus allowed to function again as "old" |H|, responsible for expressing fortisness alone. Furthermore, if |H| is present in a vowel, it marks high tone in tonal languages like Mandarin.

The other source element, |L|, whose equivalent in feature theories is [voice], marks active voicing in the voiced series of obstruents in laryngeal systems such as Hungarian and French. It is also employed to indicate nasality in segments like /m, n, ŋ/, which was originally the responsibility of the element |N| in conservative ET. What voicing and nasality have in common from an acoustic point of view is the accumulation of energy in the low frequency range of segments. The basis for positing the same prime for both voicing and nasality, other than a phonetic relation, will be examined in chapter 6, and the question of how the two properties can be phonologically represented using the same element with the assumption of a difference in headedness will be tackled in chapter 7. Besides voicing in obstruents and nasality in consonants or vowels, |L| can also represent low tone in vowels.

In this chapter, it will be claimed that the laryngeal element |L| can be generally abandoned and replaced by |H| in true voicing languages. I will attempt to illustrate in the next section (4.2) that both the phonetic realization and the phonological behavior of laryngeal elements show greater complexity and therefore less uniformity than is usually reported in phonological works, which may be taken to point toward the necessity for the alternative analysis presented in the following section (4.3). In the next chapter (chapter 5), it will be shown how laryngeal dissimilation also supports this decision cross-linguistically. Following that, in chapter 6, I will argue that |L| should not necessarily be assumed even in such binary laryngeal systems where nasality and voicing seem to interact, and it will also be shown that this move may not result in the loss of generalizations concerning the relation between voicing and nasality.

4.2 Almost anything is possible

Observing laryngeal properties and phenomena in voicing and aspirating languages, we might have the impression that the melodic elements regularly assumed in them, |L| and |H|, have some particular and well-definable characteristics which result in the uniform behavior of the respective obstruent series of languages of the same type and lead to systematic differences between the two kinds of laryngeal system. As for |L|, the two main indicators of its presence in a language seem to be the complete voicedness of one of the obstruent series and regressive voice assimilation, which is regarded by Westbury (as cited in van Rooy & Wissing 2001: 310) as "not just a 'rule' that should be stipulated [but] an inherent consequence, even property, of the distinctive feature [voice]," or the melodic element |L|. That is, not only the obligatoriness of the process but also its direction appears to be carved in stone. Similarly, there are particular patterns that are related to |H| as well: although regressive laryngeal assimilation cannot be found in languages like standard dialects of English (Lombardi (1999: 299), for example, considers the assimilation of aspiration rare or nonexistent), progressive sonorant devoicing is often cited as an evidence of |H| being the active laryngeal element in these languages (see, e.g., Backley 2011: 137). All in all, based on the regularities described above, it could be concluded, on the one hand, that both |L| and |H| must be associated with some specific phonetic properties, and, on the other hand, that the spreading of each element has characteristics that are necessarily and unambiguously related to it. In this section, we are going to see that this is, in fact, not the case. The mentioned "inherent properties" are tendencies only, while other patterns also exist, making the picture much more complex than it might seem at first glance.

4.2.1 Phonetic qualities

Although full voicedness in obstruents and aspiration are generally indicators of the presence of |L| and |H|, respectively, and the laryngeally unmarked obstruent series, which lack either element, tends to be pronounced as simple voiceless segments (Backley 2011: 124–162), there are serious variations in the realization of the different categories.

Observing obstruents in Icelandic and English, regarded as representatives of the same laryngeal system, we can see the following difference in the realization of |H|: in some dialects of Icelandic, marked plosives are regularly aspirated even in unstressed syllables and in coda position (see Árnason 1980: 9 and Thráinsson 1994: 147–148, 150–151), while in English, aspiration is context-dependent, reported to occur mainly in foot-initial plosives, and its amount is a function of the degree of stress of the vowel following it (Iverson & Salmons 1995: 372–376). In a broader sense, the implementation of fortisness generally involves longer obstruent duration than lenisness; however, the exact manifestation of this relative robustness may display further differences in noninitial positions, especially where the contrast is worst cued (see, e.g., Steriade 1997). In Swedish, for instance, preaspiration can be applied in words like *dä*[ʰk] 'deck' (Ringen & Helgason 2004: 56). In English, final fortis obstruents in words like *deck* are usually realized with a smaller length ratio of the (sonorant+)vowel and the obstruent than in the case of lenes (Kaye 2014: 258–259, 265–266),[31] plus the fortisness of noncontinuant obstruents can also be reinforced by preglottalization.

As for the laryngeally unspecified obstruents, their realization is to a great extent determined by which type of language they occur in. In aspirating languages, such unmarked obstruents, not having an articulatory target, frequently undergo passive voicing in a voicing environment. This process, however, is normally absent from voicing languages, in which unmarked obstruents are actively voiceless—if they were subject to passive voicing, they would become perceptually indistinguishable from their underlyingly voiced counterparts (Cyran 2011: 56).[32] At the same time, it should be noted that, for example, Icelandic is an exception to this systematic difference: unmarked

---

[31] We can find works in the literature in which particular allophonic alternations related to fortisness are incorporated into the phonological representation; see, e.g., Backley (2011: 140–142) or Huber & Balogné Bérces (2010: 454–455), who analyze postfortis sonorant devoicing as the spreading of the element encoding the fortisness of the obstruent to the following sonorant, or Pöchtrager (2006), who accounts for prefortis clipping in English by assuming that the phonological representation of a segment has a structure, a theory in which |H| is no longer a melodic element but an empty slot in the structure of obstruents licensed within the obstruent itself in case of fortes and by the preceding vowel in the case of lenes, which explains the different vowel–obstruent length ratios across the two final vowel+obstruent sequence types. I will, however, not consider the details of the phonetic realization of phonological contrasts to be relevant in the phonology (similarly to Balogné Bérces & Huszthy's (2018: n. 6) stance on sonorant devoicing after fortis obstruents). This is in agreement with Cyran's (2019: 154–155) view suggesting that, together with the passive voicing of obstruents, aspiration as an implementation of fortisness does not belong to the phonological component—along with all of the allophonic phenomena accompanying it such as sonorant devoicing, I suppose.

Furthermore, sonorant devoicing can actually occur in voicing languages too, and we have no reason to attribute it to |H|-spreading. One relevant example is French, in which a sonorant in a word-initial or -final cluster consisting of a voiceless obstruent and the sonorant normally becomes voiceless (e.g., in *créer* [kʁ̥ee] 'to create,' *quatre* [katʁ̥] 'four' and *carte* [kaʁ̥t] 'map') (see Fagyal, Jenkins & Kibbee 2006: 48). This phenomenon has been found in Hungarian word-initial voiceless plosive+sonorant sequences as well (Lehnert-LeHouillier 2009: 65) and has been categorized as phonetic in nature since its amount does not vary in proportion to speaking rate, neither is it sensitive to morpheme boundaries (for details on these criteria, see Lehnert-LeHouillier 2009: 51–55 and footnote 33).

For a discussion on what should count as phonological and phonetic, see section 3.3.

[32] Actually, passive voicing is not precluded in all voicing languages: it can be found in, e.g., Rome Italian and Iberian Spanish (see Hualde & Nadeu 2011).

plosives in this H-language tend not to become voiced in any environment, in which respect they behave exactly as if Icelandic were an L-language. Moreover, we can find significant phonetic variations in the realization of unmarked obstruents across other aspirating languages as well. On the one hand, these differences may lie in what counts as a sufficiently strong environment capable of triggering passive voicing in the given systems—for different descriptions of passive voicing induction, see section 2.1. Icelandic seems to represent one extremity on this scale as it tends to completely block the process, not allowing passive voicing to occur at all (Árnason 1980: 9); in German, intervocalic position appears to be enough in many cases to cause unmarked obstruents to undergo voicing (see Beckman, Jessen & Ringen 2013); and, finally, in English, even word-initial lenis obstruents may become partially voiced, showing that presonorant position can already function as a voice-inducing environment (see the results of the studies cited in Hunnicutt & Morris 2016: 217). On the other hand, the degree of voicedness in lenis obstruents also varies cross-linguistically. In the research of Jacewicz, Fox & Lyle (as cited in Hunnicutt & Morris 2016: 217), in Wisconsin English, which can be taken to represent General American English, word-initial, utterance-medial lenes following a liquid were found to be voiced throughout only about 67% of their closure on average. In the case of Alabama and Mississippi (referred to as Southern American) English speakers, this number was around 90.5% for morpheme-initial, utterance-medial lenes following another lenis obstruent (Hunnicutt & Morris 2016: 220–221), which is reminiscent of obstruent voicedness in languages such as Russian (see Beckman, Jessen & Ringen 2013), where full voicing in obstruents is believed to be an indicator of active articulatory gestures.[33]

Furthermore, as far as the realization of unmarked obstruents in voicing languages is concerned, again, these segments are supposed to be

---

[33] If we take the presence of |L| as a laryngeal element in a language to imply voice assimilation, following van Rooy & Wissing (2001), it would be ungrounded to assume both |H| and |L| in Southern American English or Swedish, in which fortis obstruents can be aspirated, and lenis obstruents are strongly voiced but do not trigger voicing. The analysis of such languages as regular H-systems will be discussed and argued for in section 4.3.3. It should be noted though that there are authors such as Hunnicutt & Morris (2016) and Beckman & Ringen (2004) who suggest that both [voice] and [spread glottis] be used in the phonological representation in these languages. This idea can be supported by two arguments. First, according to some phonologists (e.g., Beckman, Helgason, McMurray & Ringen 2011 and Lehnert-LeHouillier 2009), if the amount of aspiration or voicing varies in proportion to speaking rate, i.e., the phonological contrast becomes more salient in slower speech due to the enhancement of the phonetic cues, which indicates that these properties originate at the level of speech planning, we should consider these segmental characteristics phonological in nature—actually, this applies to Swedish. In this paper, however, I take the different physical properties of the realization of a given laryngeal contrast as a purely phonetic issue, whether they are the results of active planning or defined by universal phonetics. As for the second argument, if one works in the framework of Optimality Theory (OT), two theory-specific principles (namely Richness of the Base and Lexicon Optimization) appear to be right at hand to justify the need for the two phonological features (for details, see Beckman & Ringen 2004). Nevertheless, the necessity for two laryngeal elements on such a basis seems to be questionable at best for reasons summarized in section 4.3.3.2 along with a possible [aspiration]-only OT analysis for Swedish. In sum, along with authors like Cyran (2017: 484, 501–502) and Balogné Bérces & Huszthy (2018: 163–164), I argue that full voicedness in one of the obstruent categories in languages like Swedish is, in fact, just a phonetic laryngeal property of the phonologically unmarked set—in this respect, the analysis proposed in the present study is similar to that of Keating (1984).

pronounced voiceless unaspirated, a tendency slightly contradicted by the Hungarian data in Gósy (2000: 20, 24): in her research, the average VOT value of the voiceless velar stop is 50.2 ms when pronounced in isolated words and as high as 35.3 ms even in spontaneous speech, which exceeds 35 ms, the threshold of perceiving a plosive as aspirated (G. Kiss 2017). Similarly, Lehnert-LeHouillier (2009: 65) also points out the tendency of Hungarian voiceless plosives across places of articulation to be considerably more aspirated than expected in the case of a typical L-language—even if their VOT values are much lower than those of aspirated plosives in English.

Finally, laryngeal systems like Kashmiri (spoken in India), which contrast aspirated and unaspirated plosives and display word-final neutralization, mean an even greater puzzle since the difference between them and a typical H-system is more essential than a slight cross-linguistic variance in the interpretation of |H| and its absence. The surprising feature of laryngeal neutralization in these languages is that it is the aspirated series that the two sets of plosives are neutralized to (Vaux & Samuels 2005: 418–419)—the obstruents that are taken by most phonologists as the marked category.[34] This laryngeal pattern leaves us with two options: we either accept a marked segment as the result of neutralization or expand more drastically the limits on what physical realizations phonological specifications may be mapped to (for hypothetical representations that could be assumed in such languages, see Balogné Bérces & Huszthy 2018: 166).

In sum, on the one hand, we can observe an unsurprising degree of cross-linguistic variation exemplifying the basic idea that phonetics is concerned with gradient phenomena.[35] On the other hand, we can also find languages in which the phonetic realization of |L|, |H| or |Ø| falls outside the normal range associated with the given phonological category, making it phonetically identical, or at least very similar, to another phonological category. For instance, the lenis obstruents of Southern American English are voiced so much that if we only take the phonetic criterion into account, they could be analyzed as possessing |L|, whereas the laryngeally unspecified obstruents in languages like Hungarian tend to be aspirated more significantly than would be necessary or expected, supporting a suspicion that |H| might play a role in the phonological representation of such a language. As we are going to see, the physical characteristics of obstruents often suggest quite a different laryngeal representation in the phonology than their behavior in the system. Therefore, using the phonetic realization of obstruents as a basis for determining their phonological markedness, I argue, is misguided.

---

[34] If aspiration is defined in terms of VOT, i.e., as a delay in voicing in the following sonorant, it is not possible to identify word-final obstruents as aspirated segments, which is the case in Kashmiri as well. The considerable release burst though, which some authors interpret as aspiration (see, e.g., Iverson & Salmons 2007), might be understood as neutralization to the phonetically, and perhaps phonologically, marked category.

German may also appear to display final neutralization to the fortis (i.e., the marked) category, which is what the voicelessness and optional aspiration of plosives in word-final position suggests (see Vaux & Samuels 2005: 418); however, these final obstruents can also be analyzed as delaryngealized (i.e., unspecified) segments, which are pronounced voiceless by default (Backley 2011: 192–193).

[35] Cross-linguistic variation, for example, in the degree of passive voicing in the same environment may support the existence of language-specific phonetics discussed in section 3.3.

4.2.2 Spreading

Current phonological analyses usually consider both laryngeal elements to be tied to very specific processes with regard to the obligatoriness of their spreading as well as its direction. Frequent as they might be, these are only properties of great probability at most.

As for the assimilation of aspiration targeting obstruents, it is less than typical (see Lombardi 1999: 299). Examples of laryngeal systems in which fortisness does not spread include standard dialects of English, where lenis+fortis sequences may freely occur, e.g., in *sai*/d s/*omething*. There exist, however, laryngeal systems like Yorkshire English, in which fortisness does cause regressive assimilation, e.g., the phrase *said something* becomes homophonous with *set something* (see, e.g., Wells 1982: 366–367 and Hughes, Trudgill & Watt 2012: 105–107 as well as the experimental findings of Whisker-Taylor & Clark 2019).[36] We also find languages which exhibit bidirectional spreading of fortisness. The most commonly cited example in the literature is Swedish (see Ringen & Helgason 2004: 60 and Riad 2014: 102ff), in which the left- and rightward directionality of laryngeal assimilation can be illustrated with words like *vä*/g-t/ 'weigh-SUP' and *kö*/p-d/*e* 'buy-PAST,' realized as *vä*[$^{(h)}$kt] and *kö*[$^{(h)}$pt]*e*, where the laryngeal element systematically spreads from affix to stem and vice versa, but the same phenomenon can be observed in lexicalized compounds like *hö*/g-t/*id* 'festival' and *ti*/s-d/*ag* 'Tuesday' as well (Lombardi 1999: 285).

It could be argued (in line with analyses like that of Cyran (2017: 493–494)) that such bidirectional devoicing is not the result of phonological spreading but a phonetic (i.e., coarticulatory) phenomenon, in which the lenis obstruents of the clusters simply do not undergo passive voicing due to the lack of a voicing environment. This is what happens in English, in compounds like *cheesecake* ([-z̥k-]) and *matchbox* ([-ʧb̥-]) (Balogné Bérces & Huszthy 2018: 158); moreover, Szigetvári (2020a: 48) argues that fortis+fortis clusters are actually absent from the language, suggesting that the underlying representations of, e.g., *tract* [trakt] and *tracked* [trakt] are /tragt/ and /trakd/, respectively—see footnote 64 too. The lenis obstruents in the compounds undoubtedly keep their laryngeal identities, which is what the absence of prefortis clipping in *cheese* and the lack of aspiration in *box* indicate. Also, there is no evidence that *tract* or *tracked* contains two fortes: Whether we assume /kt/, /gt/ or /kd/ in them, once the cluster contains a fortis, it will make the other member voiceless. Further, prefortis clipping can be claimed to apply if the cluster contains a fortis, i.e., in

---

[36] In standard dialects of English, even though a lenis obstruent in lenis+fortis sequences normally "devoices," or, simply, does not undergo passive voicing (e.g., *sai*[d̥ s]*omething*), the contrast between a voiceless lenis and its fortis counterpart is still maintained (see, e.g., Balogné Bérces 2017: 152–153), primarily by the length of the preceding vowel. In Yorkshire English, on the other hand, what happens "is not mere allophonic devoicing, such as is very widespread in English: it involves the complete neutralization of the voicing (fortis/lenis) opposition," resulting in perfect homophones, e.g., in the case of *said/set something* (Wells 1982: 367). Although in their experiment, Whisker-Taylor & Clark (2019) did not actually measure voicing and other correlates of the fortis–lenis distinction, the fact that the assimilated /d/ of *said* can be glottalized still supports the claim that fortisness exhibits spreading. While this phenomenon is getting less detectable among younger speakers of this dialect, and nowadays, its occurrence is fairly limited, Meccan Arabic can also be mentioned as another example this pattern—for details, see section 4.3.4.

all three cases. As for the second member, aspiration does not cue laryngeal contrast in final position; therefore, we have no means to prove if it is a fortis.

This scenario, however, seems rather unlikely in a language like Swedish. First, in *vä*/g-t/ > *vä*[⁽ʰ⁾kt], the possibility of the preaspiration, a segmental property, appearing right before the /g/ suggests that it has actually become a fortis obstruent. As for the /d/ in *kö*/p-d/*e* > *kö*[⁽ʰ⁾pt]*e*, assuming a complete absence of passive voicing as a result of the postfortis environment may not be justified in a language whose lenis obstruents are fully voiced even in word-initial position, which is not the most ideal voicing environment either. Further evidence in support of the phonological spreading of fortisness in the above cases comes from Swedish word-medial clusters and clusters across word boundaries in compounds, in which voiceless assimilation is reported not to be mandatory. For example, speakers pronounce [d̥k~dk] in *vodka* and [kd̥] in *anekdot*, and the same characterizes the clusters in *grä*/d-k/*ola* 'toffee' and *i*/s-g/*lass* 'ice-cream' too (cf. the lexicalized *hö*/g-t/*id* 'festival,' pronounced with [ktʰ]). This phenomenon can indeed be regarded as nonphonological, coarticulatory devoicing, while the processes related to the inflectional suffixes exemplify the bidirectional spreading of the laryngeal element.

As for voicing languages, it is precisely the compulsory leftward spreading of voicing that is considered to characterize this type of laryngeal system (e.g., French or Hungarian) (see van Rooy & Wissing 2001).[37] But does voice assimilation necessarily take place, and is its direction fixed? Ringen & Helgason (2004) and Hunnicutt & Morris (2016) hold the feature [voice], or, alternatively, the element |L|, responsible for the full voicedness of the lenis obstruents in Swedish and Southern American English, which does not trigger voice assimilation (see footnote 33). These laryngeal systems can also be analyzed as ordinary aspirating languages, and the voicing of their lenes simply as the result of "go[ing] for maximal dispersion rather than for sufficient phonetic distance," as suggested by Cyran (2017: 484, 501–502) and Balogné Bérces (2017: 153–154, 159). This decision can be further supported in the case of Swedish by the fact that whereas voicing is phonologically inactive in the language, fortisness exhibits spreading. At this point, we should also mention Italian, which might be more challenging to analyze because one of its obstruent series is fully voiced independently of the context, without systematically triggering voice assimilation, and, at the same time, its voiceless obstruents are only mildly aspirated (see Huszthy 2019: 74–78, 2020).[38] Regardless of how this language is analyzed phonologically, it provides evidence for the existence of laryngeal systems with phonetic voicing and no

---

[37] It seems reasonable to expect regressive voice assimilation before a fully voiced obstruent: if the rightmost member of an obstruent cluster has voicing throughout more than 90% of its duration, we could assume that it is the result of active articulatory gestures—as opposed to the way sonorants are voiced (for a description, see section 2.1). Then, from an articulatory point of view, it is easier to use active voicing in all members of the cluster (or, alternatively, to pronounce them voiceless) than to switch between articulatory gestures in the middle of the cluster.

[38] Phonologically speaking, Italian can also be categorized as an aspirating language like English or Swedish, with the assumption that the difference only lies in how the two obstruent series are phonetically realized (see Balogné Bérces & Huszthy 2018 and Huszthy 2019, 2020). This can account for why laryngeal behavior in this language does not conform to the pattern that characterizes the other Romance languages, regarded as typical L-systems.

aspiration where voicing does not spread. Finally, Oromo, a language spoken in Eastern Africa—although not a two-way laryngeal system as its consonant inventory contains ejectives and an implosive besides plain voiceless and voiced obstruents—seems to prove that progressive voice assimilation might not be impossible either, although this consonant harmony is an instance of allomorphic alternation and limited to the interaction of /b, d, g/ and /t/: for example, /ʧʼab-t-e/ 'break-3SG.F/2SG-PRF' and /fiig-t-e/ 'run-3SG.F/2SG-PRF' become [ʧʼabde] and [fiigde] (Geshe & Devardhi 2013: 335–336).[39] Such allomorphic alternations can be found in Norwegian as well: e.g., in /byg-t/ > [bygd] 'build-PAST' and /byg-tə/ > [bygdə] 'build-PRET' (cf. /døm-t/ > [dœmt] 'judge-PAST' and /brʉk-t/ > [brʉkt] 'use-PAST') (see Brown 2006 and Kristoffersen 2000: 72ff).

In sum, we have seen that both the nonspreading and the spreading of both aspiration and voicing have been attested, and in the latter case, the process can be regressive as well as progressive. This means that even though we can differentiate between more or less typical patterns, a laryngeal property can possibly exhibit any behavior, depending on the given linguistic system.

4.3 An alternative laryngeal analysis

4.3.1 Laryngeal Relativism and its consequences

In the previous section, it was shown that the physical realization of obstruents specified for |L| or |H| as well as of their unmarked counterparts may vary along a relatively large scale. Such phonetic differences between identical laryngeal systems and potentially the phonetic equivalence of different laryngeal systems can be accounted for if we accept Cyran's (2011, 2014, 2017) Laryngeal Relativism.

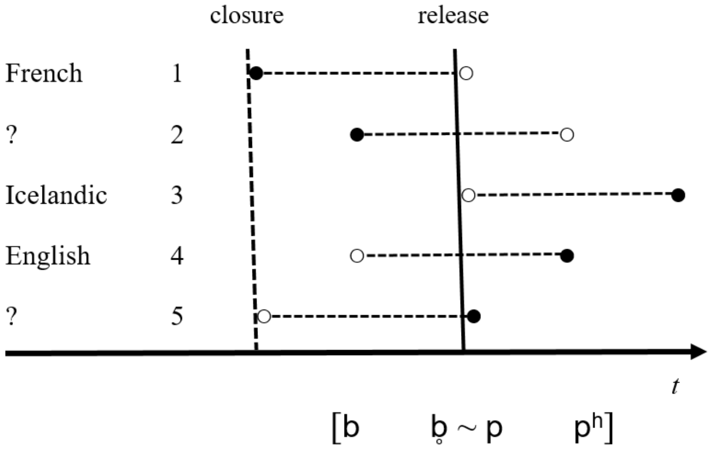
The label "Laryngeal Relativism" indicates the position of the approach relative to the "narrow interpretation of [voice]" dubbed "Laryngeal Realism" by Honeybone (2005: n. 13): whereas in Laryngeal Realism, the presence of |L| and |H| in the phonological representation of obstruents is necessarily accompanied by vocal fold vibration and spread glottis, respectively, the Laryngeal Relativism view states that the phonetic form of an obstruent does not reveal its laryngeal specification in the phonology because the relationship

---

[39] Hansson (as cited in Finley 2017: 4) states that "[c]onsonant harmony shows a relatively strong bias towards right-to-left directionality, which has been explained in terms of speech planning, as the speaker harmonizes in anticipation of an upcoming segment." That is, the rightward spreading of aspiration or voicing is expected to be less common across languages. As for the relative frequency of the two, progressive voice assimilation has been attested but is a rarer phenomenon than the rightward spreading of fortisness, which might have phonetic bases. I hypothesize that one reason might be that a prototypical obstruent is a voiceless segment (this is what the fact that most languages have obstruents of this type suggests (Szigetvári 1996: 98)), which is why it might be easier for a fortis obstruent to turn another obstruent following it into a fortis than for a voiced obstruent to trigger voicing in a following voiceless one. In addition to that, the implementation of fortisness often involves some degree of postaspiration, i.e., the offset of the laryngeal gesture (the abduction of the glottis) follows that of the oral constriction, as opposed to voicing, which normally takes place during the constriction phase of the obstruent (cf. Steriade 1997: 61–63). Consequently, a fortis obstruent might be more likely to influence the laryngeal property of another segment following it.

between the two should be considered arbitrary. It is, in fact, only through the behavior of the segments in a given linguistic system that their phonological makeup can be identified.[40] The figure in (40) illustrates this loose relationship between phonology and phonetics. The filled circles denote the phonologically marked plosives, and the empty circles their unmarked counterparts. The position of the circles along the horizontal dimension represents when vocal fold vibration begins relative to the release of the plosive.

(40) The phonological markedness of plosives and their phonetic realization in terms of VOT in two-way-contrast systems (Cyran 2011: 60)



If we compare, say, language types 1 and 5, we can see that their two plosive categories have the same phonetic characteristics but their phonological specification is just the opposite in the two laryngeal systems. Furthermore, an important principle regarding the physical realization of plosives is that a sufficient phonetic distance should be kept between the two categories so that they can be distinguished. This general distance is marked by the horizontal dashed lines.[41]

Now, let us examine a specific case, which Cyran uses to support the Laryngeal Relativism view: Warsaw Polish (WP) and Cracow Polish (CP), the

---

[40] The role of phonetics in the sense that it is from acoustic signals that a speaker can gain information based on which to identify phonological representations (and perhaps to establish them in the course of language acquisition) is not necessarily incompatible with a substance-free approach. This view does not deny the existence of relations between phonological elements and phonetic correlates; however, it considers the phonetic substance irrelevant to the phonological computation (see section 3.2). This means, for example, that the phonological faculty may not contain rules targeting perceptually less salient or articulatorily more challenging categories. Of course, "the nature of speech perception and sound change drive to a great extent the distribution of patterns we find in the languages of the world, but these distributions are facts about particular phonological systems; they are not facts about phonological UG" (Reiss 2018: 429). For an example of how categories resulting from the way incomplete laryngeal neutralization is perceived can be represented, see section 7.2.1.

[41] Although VOT is the primary cue to laryngeal contrast in the case of plosives, the general idea of arbitrariness in the relationship between phonological representation and phonetic realization should extend to other correlates too as well as to other types of obstruent, i.e., fricatives and affricates.

two main dialects of the language. The words in (41), from Cyran (2011), show how plosives are pronounced and how they behave in both Polish dialects.

(41) a.

[pʲ]ić	‘to drink’
[bʲ]ić	‘to hit’
o[k]nie	‘window-LOC’
o[g]nie	‘fire-PL’
by[k]a~by[k]	‘bull-GEN-SG~bull-NOM-SG’
wa[g]a~wa[k]	‘scale-NOM-SG~scale-GEN-PL’
ka[d]ra~ka[t]r	‘personnel-NOM-SG~personnel-GEN-PL’

b.

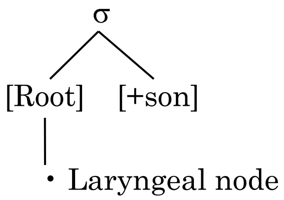
rzu/t b/agnetem	[d b]	‘bayonet throw’
ra/d g/łupich	[d g]	‘silly advice-GEN-PL’
rzu/t p/oziomy	[t p]	‘horizontal plan’
ra/d p/rzyjacielskich	[t p]	‘friendly advice-GEN-PL’

We can see in (41a) that, phonetically speaking, both dialects contrast plain voiceless plosives with voiced ones before (a sonorant plus) a vowel and display word-final laryngeal neutralization. If we also consider the regressive voice assimilation observable in (41b), it seems reasonable to take Polish to be an L-system.

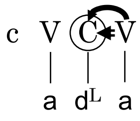
Actually, voice assimilation is symmetrical in Polish, that is, both voicing and voicelessness can exhibit spreading. From a phonological point of view, however, it has to be modeled as an asymmetrical phenomenon in a framework applying privative elements, in which the laryngeal contrast is not encoded as the specification of a segment for the opposite values of the same feature but as the presence vs. absence of a melodic element. The two processes that need to be assumed for accounting for voice assimilation in a privative model are delaryngealization and spreading.

An obstruent is considered to undergo delaryngealization if it occurs in an environment in which its laryngeal element is not licensed. According to Lombardi (1995, 1999), the licensed position in a number of languages is the one shown in (42), i.e., the laryngeal element of an obstruent is delinked, so neutralization takes place unless the obstruent is immediately followed by a sonorant in the same syllable; see section 2.2.2, where you can find the same constraint expressed in Strict CV terms too along with an explanation. The representations are repeated in (43) for convenience.

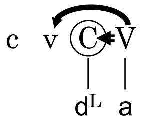
(42) Laryngeal Constraint

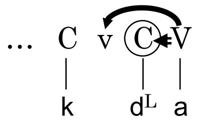


(43) a. Licensed and governed by a following V

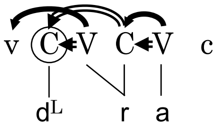


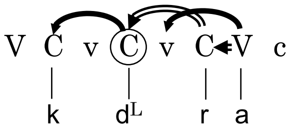
b. Licensed and not governed by a following V



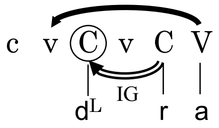


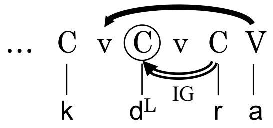
c. i. Licensed via C-to-C licensing (and by a following V in the case of initial onsets) and not governed (Szigetvári 1999)





ii. Subject to Infrasegmental Government (Scheer 2004)





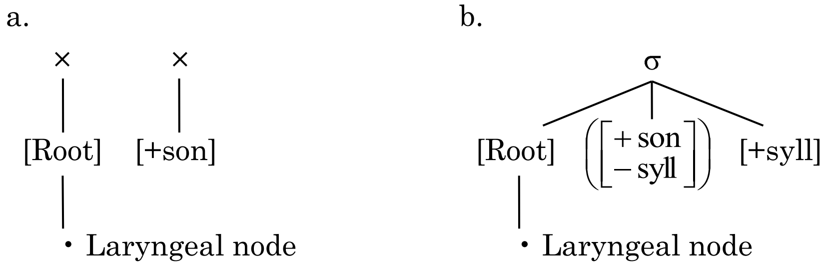
It seems that this constraint needs to be slightly modified in some cases in order to fit the data in other languages. For instance, the words *ha*[ɟm]*a* 'onion' and *fi*[cm]*ál* 'sneer at' indicate that the constraint in Hungarian is less restrictive since to maintain its laryngeal identity, it is enough for an obstruent to be simply followed by a sonorant segment, which does not need to form a syllable with it (see Siptár & Törkenczy 2000: 201). The Laryngeal Constraint applying in Hungarian is, therefore, the one represented in (44a). In a Strict CV account, it appears that we must assume either that the relations represented in (43ci–ii) are contracted in the case of words like *ha*[ɟm]*a* too or that the licensing of the laryngeal element in the obstruent is not dependent on lateral relations in such languages but on the makeup of the following consonant if the vocalic position between them is silenced, i.e., is incapable of licensing.

In Polish, on the other hand, as the delaryngealization in the word *kadr* and the lack of laryngeal neutralization in *waga* and *ognie* (see (41a)) suggest, a laryngeal element of an obstruent can be licensed only by a vowel following it in the same syllable (with the possibility of an intervening sonorant consonant) (also see Cyran 2014: 142–145). These conditions are represented in (44b). In Strict CV Phonology, in words like *kadr*, no C-to-C licensing can be formed between the sonorant and the obstruent because the sonorant is not licensed by a following vowel (cf. the representation in (43ci)); or no Infrasegmental Government is contracted while the vowel enclosed by the obstruent and the sonorant is silenced by the final empty v (cf. the representation in (43cii)).[42]

---

[42] In languages like French, laryngeal contrast is preserved in this position (e.g., in *cadre* [kadʁ] 'frame' vs. *quatre* [katʁ] 'four'). In Strict CV terms, it means that final empty v's are parametrically set to be able to license the sonorant, which in (43ci), can in turn license the laryngeal element of the obstruent preceding it, and in (43cii), can establish Intrasegmental Government with the obstruent.

(44) Laryngeal Constraint, modified versions



Although, as we have just seen, the environments in which a laryngeal element can be licensed may vary to some extent cross-linguistically, we are going to refer to these contexts uniformly as presonorant position for the sake of simplicity. More important is the divide between languages in which the Laryngeal Constraint is active and those in which laryngeal licensing is independent of the context. This characteristic of languages will be discussed in detail in the subsequent sections and will serve as a basis for the establishment of the alternative laryngeal typology proposed in section 4.3.4.[43]

Based on the data in (41b), regressive voice assimilation in the two Polish dialects could be analyzed with reference to delaryngealization in unlicensed positions and the spreading of the laryngeal element in the following way: The final obstruent of both *rzu*/t^0/ and *ra*/d^0/ will be pronounced voiceless because they are unmarked, lacking the element |L|—either originally (*rzu*/t^0/) or as the result of delaryngealization in final position (*ra*/d^L/ → *ra*/d^0/).[44] If these segments are followed by a word beginning with a voiced, i.e., laryngeally marked, obstruent, |L| can spread to them and make them voiced. As for what we can perceive as the spreading of voicelessness in the other cases, it will not be analyzed as phonological spreading but simply as the final obstruent remaining laryngeally unmarked and thus pronounced voiceless.

---

[43] Languages in which the Laryngeal Constraint is active can be further divided: we can distinguish Polish-type languages with systematic final neutralization and laryngeal systems in which obstruents undergo delaryngealization in word-internal unlicensed positions but not word-finally. Lombardi (1995: 64–66) accounts for the latter language type, which includes Yiddish, Serbo-Croatian and Romanian, using the constraint Final Exceptionality, which allows obstruents to maintain their laryngeal specification at the end of a word:

Lar]$_{W}$

Actually, the Hungarian data show that some languages may require us to modify the constraint. Cross-word voice assimilations (e.g., *fo*/g#h/*ívni* > *fo*[k h]*ívni* ‘will call’) show that it is, in fact, only in utterance-final position that the laryngeal identity of an obstruent is protected (see Siptár & Törkenczy 2000: 201):

Lar]$_{U}$

In a Strict CV account, Final Exceptionality is equivalent to the parametric choice of the language regarding whether it allows final empty v’s to license or not.

[44] According to the Minimality Hypothesis, “processes apply whenever the conditions that trigger them are satisfied” (Kaye 1992b: 141), and it excludes the possibility of rule ordering. In the present case, both final delaryngealization and the leftward spreading of the laryngeal element are phonological processes of the system, and when operating together, the conditions of both are met.

So far, the two Polish dialects, WP and CP, have shown the same pattern. The difference that sets apart the two varieties is how the word-final and thus laryngeally unmarked obstruents behave before a sonorant in the next word: CP displays cross-word (sandhi) presonorant voicing, whereas WP does not:[45]

(45)

	WP	CP	
rzu/t ɔ/ka	[t ɔ]	[d ɔ]	‘glimpse’
ra/d ɔ/jcowskich	[t ɔ]	[d ɔ]	‘fatherly advice-GEN-PL’

This difference has led Cyran to reanalyze CP as an H-system while continuing to consider WP an L-system. Even though the two series of obstruents have exactly the same phonetic properties in the two dialects, their phonological representations do not need to be identical according to the Laryngeal Relativism view. It is, in fact, the behavior of the obstruents that can inform us (e.g., during language acquisition) about their phonological makeup. If we only take phonological behavior into account, things appear to fall into place if CP is taken as an H-language, in which voiceless obstruents form the marked series, containing |H|, and the voiced ones constitute the laryngeally unspecified set.

Unlike in regular H-languages such as English, the presence of the element |H| in the phonological representation does not involve phonetic aspiration, only stable voicelessness. So the phonetic realization of /p^{jH}/*ić* and *o*/k^{H}/*nie* will be [pʲ]*ić* and *o*[k]*nie*. As for voicing in obstruents, the laryngeally unspecified ones will undergo passive voicing if they occur in a voicing environment, i.e., in presonorant position.[46] Of course, we can talk of passive voicing only in a phonological sense as its occurrence can be accounted for with reference to a phonological environment, just like in English. However, unlike in English, it results from active articulatory gestures and is phonetically manifested as the full voicedness of the obstruent, which is why Cyran labels it as “enhanced passive voicing.” So, the final obstruents of *rzu*/t^{0}ǁ/, *ra*/d^{0}ǁ/ and *ka*/d^{0}rǁ/ will be voiceless because they are not subject to enhanced passive voicing,[47] but the ones in /b^{j0}/*ić* and *o*/g^{0}/*nie*, will be voiced due to the following sonorant. So will the obstruent clusters in *rzu*/t^{0} b^{0}/*agnetem* and *ra*/d^{0} g^{0}/*łupich*, where the voicing of /t^{0}/ and /d^{0}/ can be considered to be the result of coarticulation triggered by the actively voiced [b] and [g] following them in the next word. Similarly, the originally unmarked or delaryngealized final obstruents in the phrases *rzu*/t^{0} ɔ/*ka* and *ra*/d^{0} ɔ/*jcowskich* also become voiced.

---

[45] It should be noted here that word-final devoicing in Polish has been reported to be an incomplete process (see Cyran 2017: 485 and references therein as well as section 7.2.1 for a possible analysis of incomplete neutralization). Strycharczuk, however, has found that in CP, final neutralization before sonorants in the sandhi context is optional rather than gradual (2012: 71ff). What this means to the phonological analysis is simply that speakers who do not neutralize the laryngeal contrast in word-final obstruents before a sonorant in the next word apply the Laryngeal Constraint in (44a) instead of the one in (44b).

[46] For a discussion on what can be considered a voicing environment, see section 2.1.

[47] The voicelessness of the /t^{0}/ and /d^{0}/ in *rzu*/t^{0} p^{H}/*oziomy* and *ra*/d^{0} p^{H}/*rzyjacielskich* may be explained in two ways. First, it can be the result of the lack of enhanced passive voicing—as unmarked obstruents occurring in a nonvoicing environment, they will be phonetically voiceless (Cyran 2017: 493–494). The alternative analysis is a phonological one, in which |H| can be assumed to spread to the unmarked obstruents from the /p^{H}/ (Cyran 2011: 73–74).

That is, sandhi voicing before sonorants in CP is a direct consequence of analyzing the dialect as an H-system: it is the phonetic interpretation of an unmarked obstruent as a voiced segment due to the voicing environment and not the result of phonological spreading. Cyran notes that in WP, and other L-systems in general, a final laryngeally unspecified obstruent cannot be voiced; passive voicing is not characteristic of this language type so that the sufficient phonetic distance can be kept between voiced obstruents possessing |L| and their unmarked counterparts.

By categorizing WP as an L-system and CP as an H-system representing language types 1 and 5, respectively, in the figure in (40) and by assuming the same phonological processes, namely delaryngealization and spreading, in both systems, Cyran can explain the different behavior of final obstruents in the two dialects. As for the phonetic equivalence between WP and CP, whose obstruents have different phonological representations, and the phonetic difference between phonologically identical laryngeal systems like CP and English, such variances are expected in the Laryngeal Relativism view, whose main principle is that the relationship between the phonological representation and its phonetic realization should be regarded as arbitrary; the only criterion that needs to be met is the maintenance of a phonetic distance great enough for the contrast to be perceived.

4.3.2 A reanalysis of Warsaw Polish and other L-systems

Now, let us examine the possibility of reanalyzing the Warsaw dialect too as an H-system, a step toward reconsidering the way we treat many other languages traditionally categorized as L-systems. If WP is also taken as an H-language, then the laryngeally specified obstruents (e.g., in /p^{jH}/*ić* and *o*/k^{H}/*nie*) are pronounced voiceless, just like the unmarked ones occurring in nonvoicing environments (e.g., in *rzu*/t^{0}‖/, *ra*/d^{0}‖/ and *ka*/d^{0}r‖/ and also in *rzu*/t^{0} p^{H}/*oziomy* and *ra*/d^{0} p^{H}/*rzyjacielskich*). The |H|-less obstruents in /b^{j0}/*ić* and *o*/g^{0}/*nie* as well as in *rzu*/t^{0} b^{0}/*agnetem* and *ra*/d^{0} g^{0}/*łupich* will be subject to enhanced passive voicing. However, unlike in CP, the word-final unmarked obstruents in *rzu*/t^{0} ɔ/*ka* and *ra*/d^{0} ɔ/*jcowskich* will fail to be interpreted as voiced segments. I argue that this dialectal difference is phonetic in nature, and that the two varieties are phonologically identical systems.

It appears that in WP, a sonorant cannot cause sandhi voicing in an unmarked obstruent while a voiced obstruent can, suggesting that the latter provides a stronger voicing context. This is not surprising if we think of the fact that a sonorant is a spontaneously voiced sound whereas the voicing of an obstruent, which is voiceless by default, can be achieved through the application of active articulatory gestures (if its voicing is not the result of the context, in which case its quantity tends to be smaller)—for details, see section 2.1. In fact, the difference in the voicing capacity of actively voiced obstruents and spontaneously voiced sonorants is detectable in CP as well: Strycharczuk's research into laryngeal assimilation in CP has shown that a word-final obstruent tends to be more prone to undergo voicing before a voiced obstruent than before a sonorant in the next word (2012: 71ff)[48]—more on which later in this section. So the claim that a voiced obstruent has a stronger voicing capacity than a sonorant is supported by phonetic facts in terms of the physiological characteristics of the triggers on the one hand, and their cross-dialectally observable different effects on a preceding obstruent on the other. The varying impacts of voicing environments of different strengths can be found in other languages too—see paragraph 3 of section 4.2.1.

As to the question why the /d^0/ remains voiceless in *ra*/d^0 ɔ/*jcowskich* in WP when the /bʲ^0/ in /bʲ^0/*ić* and the /d^0/ in *ka*/d^0/*ra* are voiced via enhanced passive voicing, the difference between the two cases may be explained with reference to phonetic analogy. /bʲ^0/*ić* and *ka*/d^0/*ra* are lexical items which only exist in the phonetic forms [bʲ]*ić* and *ka*[d]*ra*, but the normal realization of *ra*/d^0/ in isolation is *ra*[t], a form whose final voiceless obstruent seems to require a stronger effect, namely that of an actively voiced obstruent, to override its tendency to preserve its voiceless quality so that it will change to [d] (cf. Steriade 2000).[49] That is, we could assume coarticulatory effects causing phonetic assimilations in both CP and WP, but in WP, the phenomenon starts to occur in a stronger voicing environment due to the phonetic analogy effects.

German data supporting the role of phonetic analogy

German data may lend support to the analysis proposed here for WP since they exemplify phonetic analogy leading to precisely the same kind of result as in WP. First, consider the words in (46). They illustrate that in word-final

---

[48] In order to account for the difference between the two cases of voicing, one might want to distinguish between these phenomena by assigning them to different levels of analysis: the stable voicing before voiced obstruents could be thought of as a proper phonological process, i.e., the spreading of |L|, while the unstable voicing before sonorants could be treated as the result of coarticulatory effects, so a purely phonetic process. Nevertheless, besides the fact that this would be incompatible with the principle of Laryngeal Relativism stating that passive voicing does not occur in L-systems, we should bear in mind that the degree of voicing in an obstruent might not necessarily be an indicator of the presence or absence of |L| in the segment—think of the different phonetic qualities of lenis obstruents in the same environment in the languages mentioned in paragraph 3 of section 4.2.1.

[49] The same effect is held responsible, for example, for the sound qualities in the following French case: The coda-/ʁ/ in *bar trouvé* [baʁtʁuve] 'bar found' is weaker than the onset-initial-/ʁ/ in *bas retrouvé* [baʁətʁuve] 'stocking found again' and also tends to double the length of the vowel preceding it. The schwa in *bas retrouvé* [baʁətʁuve] can be dropped, and the new form, *bas r'trouvé* [baʁtʁuve], appears to become homophonous with *bar trouvé* [baʁtʁuve]. However, the phonetic qualities of the /ʁ/ and the vowel preceding it are carried over to the new form (see Steriade 2000). I assume that phonetic analogy causes the /d^0/ in *ra*/d^0 ɔ/*jcowskich* in WP to retain the characteristics it has when *ra*/d^0/ is pronounced in isolation, an effect that seems not to play a role in CP.

A somewhat similar case can be observed in General American English, where the first /t/ in *militaristic* [mɪ́lətəɹɪ́stɪk] fails to undergo flapping, as opposed to the one in *capitalistic* [kʰǽpərəlɪ́stɪk]. Even though all the conditions are met in both derivatives for the /t/'s to turn into [ɾ], they tend to preserve the phonetic properties they have in the roots [mɪ́lətʰɛɹi] and [kʰǽpərəl], making the phonetic forms of the members of the paradigm more uniform. In Steriade (2000), this analogy is also labeled as phonetic in nature since in the analysis she advocates, the segmental property involved, namely the durational difference between [t]/[d] and [ɾ], is noncontrastive. However, in most analyses, this case appears to be different from the phonetic analogy assumed in WP and the one displayed in French in the sense that this lenition is not only a question of phonetic realization but is also regularly indicated in the segmental representation.

position, obstruents undergo neutralization and are realized voiceless whether they were originally lenis, as in (46a), or fortis, as in (46b).

(46)	a.	Hand [hant] ~ Hände [hɛn.də]	‘hand ~ hands’
		Tag [taːk] ~ Tage [taː.gə]	‘day ~ days’
	b.	bunt [bʊnt] ~ bunter [bʊn.tɐ]	‘colorful ~ more colorful’
		krank [kʀaŋk] ~ kränker [kʀɛŋ.kɐ]	‘sick ~ sicker’

Iverson & Salmons (2007) suggest the following analysis in light of the data in (47)–(51), collected from Hall (2005): In German, an obstruent undergoes laryngeal neutralization if it is in both syllable- and morpheme-final position, exemplifying the preference of languages for prosodic edges to line up with each other. According to the authors, working within the framework of Evolutionary Phonology, a further characteristic of the process is that it is manifested as final fortition—a process involving the addition of a melodic prime *ex nihilo*, which would be problematic for theories of Autosegmental Phonology; for details regarding edge marking as motivation for final fortition, see Iverson & Salmons (2007: 127–129).[50] In this analysis, the obstruents in the words in (47) are underlyingly fortes while the ones in (48), being syllable- and morpheme-final, undergo fortition. As for the loan words in (49), their word-internal coda obstruents are taken to be underlyingly fortis in their synchronic representation, probably due to German speakers once failing to perceive the unreleased obstruents in the donor language as lenis (see Iverson & Salmons 2007: 133–134). In (50) and (51), the coda obstruents remain lenis, and are therefore pronounced somewhat voiced, since they are not morpheme-final.

(47)	Atlas	[at.las]
	Athlet	[at.leːt]
	ethnisch	[ɛt.nɪʃ]
	Atmosphäre	[at.mo.sfɛː.ʀə]
	Technik	[tɛç.niːk]

(48)	a.	Han/d/	[hant]	‘hand’
		Ta/g/	[taːk]	‘day’
	b.	han/d/lich	[hant.lɪç]	‘handy’
		le/z/bar	[leːs.baɐ]	‘readable’

(49)	Admiral	[at.mi.ʀaːl]
	Badminton	[bɛt.mɪn.tən]
	Kadmium	[kat.mi.ʊm]
	Charisma	[ka.ʀɪs.ma]

---

[50] While fortition *qua* the addition of a phonological prime can serve as a means of marking prosodic edges more effectively, I believe it is not obvious that it should be a phonological process. The potential voiceless noise burst accompanying the release of neutralized German plosives, along with their possibly prolonged duration in phrase-final position, does not necessarily mean that they are fortes; they can be considered plain obstruents (for arguments, see Harris 2009) characterized by some degree of phonetic enhancement to mark prosodic edges.

(50)	Siedl-ung	[ziːd.lʊŋ]	‘settlement’
	Siedl-er	[ziːd.lɐ]	‘settler’
	siedel-n	[ziː.dəln]	‘to settle’
	ordn-en	[ɔɐd.nən]	‘to put in order’
	Ordn-ung	[ɔɐd.nʊŋ]	‘order’
	orden-t-lich	[ɔɐ.dənt.lɪç]	‘orderly’
	Pendl-er	[pɛnd.lɐ]	‘commuter’
	pendel-n	[pɛn.dəln]	‘to commute’
	Basl-er	[baːz.lɐ]	‘one from Basel’
	Basel	[baː.zəl]	‘Basel’

(51)	a.	Adler	[aːd.lɐ]	‘eagle’
	b.	Magma	[mag.ma]	
		Segment	[zɛg.mɛnt]	
		Dogma	[dɔg.ma]	
		Stalagmit	[ʃta.lag.miːt]	

Hall (2005) opts for another approach to account for the data above, assuming the interference of paradigm uniformity effects. In his analysis, lenis obstruents form the laryngeally marked series, and final neutralization is expected to occur in coda position. That is, nothing happens in the words in (47) as they contain underlyingly unmarked obstruents, which are realized voiceless. In (48) and (49), the coda obstruents undergo delaryngealization and become voiceless. Nevertheless, in (50), the obstruents which are also in coda position do not lose their laryngeal specification due to paradigm uniformity effects: in each case, there exists a morphologically related word form whose obstruent is predicted to be voiced (as it is in onset position); this form will let the one with the obstruent in coda position retain the laryngeal markedness of the segment, leaving it voiced and thus making the two word forms more similar.

In this analysis, the words in (51) are not expected to contain voiced obstruents, which is why they should be treated as exceptions. This, however, does not seem to be a shortcoming of this approach because this group does indeed show peculiarity: the failure of coda obstruents in monomorphemic words to undergo devoicing is limited to /gm/ clusters and /dl/ only in the word *Adler* (it can happen in proper nouns too, but such words may not be representative of canonical phonological patterns (see Hall 2005: n. 18)). As Hall points out, an analysis referring to paradigm uniformity effects can explain why the non-exceptional cases of coda obstruent voicing can only be found in heteromorphemic words. As a further advantage of Hall’s approach, it falls out of the analysis that in loanwords like *Admiral*, the coda obstruent which was originally lenis in the donor language has become voiceless, just as expected in accordance with the German pattern, since no paradigm uniformity effect blocked its delaryngealization (see Hall 2005: 258–259). Iverson & Salmons (2007) owe it to the fact that the word *admiral* contained an unreleased [d̚] in the source language, which was perceived and recategorized as a voiceless segment when entering German. However, it should not be forgotten that the original specification of lenis coda obstruents has been systematically altered in other loanwords too (see (49)), and even in the case of fricatives, like in *Chari*[s]*ma*, where their perception as lenes does not rely on their release. Therefore, we may talk of a proper repair strategy here rather than of the consequence of insufficient perceptual salience.[51]

I suggest the application of Hall's (2005) approach of referring to paradigm uniformity but consider the fortis series to be the marked obstruent type, as has been most commonly assumed in recent phonological works. Unlike Iverson & Salmons (2007) and in accordance with Harris (2009), among others, I take final neutralization to be realized as delaryngealization, i.e., the loss of the laryngeal element, |H|. Furthermore, based on the data in (46)–(48), it seems that German can be analyzed similarly to Polish, i.e., obstuents undergo delaryngealization in word-final position, which implies that the process occurs at the end of word-internal syllables too (see Lombardi 1995: 68), unless the following segment is a sonorant (see Beckman, Jessen & Ringen 2009). That is, in (46), the alternation in *Han*[t]~*Hän*[d]*e* shows that the stem contains a lenis /d^0/, which is passively voiced before a vowel and remains voiceless in word-final position. In *bun*[t]*er*, the alveolar plosive is a marked /t^H/, which loses its laryngeal specification in *bun*[t] and is also pronounced voiceless at the end of a phonological word. The stably voiceless obstruent followed by a sonorant in words like *A*/t^H/*las* (see (47)) can be considered to be underlyingly fortis and to keep its laryngeal element in this position.

Interesting are the alternations in (52):

(52) a. Han[t] ~ Hän[d]e ~ han[t]lich 'hand ~ hands ~ handy'

b. han[d]eln ~ Han[d]lung 'to act ~ act (noun)'

The [t] pronounced in *han*/d^0/*lich*, a derivative of *Han*/d^0/, must be a lenis obstruent, and the voiced [d]'s in *han*/d^0/*eln* and *Han*/d^0/*lung* are obviously lenes too. Nevertheless, we can see that while the plosives in *han*[t]*lich* and *Han*[d]*lung* must be phonologically identical, i.e., /d^0/, they are phonetically realized in different ways. German consonant-initial suffixes like *-lich* are normally regarded as separate phonological words as opposed to vowel-initial suffixes like *-ung*, which are considered to form one phonological word with the stems they are attached to (e.g., /hand^0#lɪç/ vs. /hand^0.lʊŋ/). If the issue at hand were about phonological licensing and delaryngealization, the relevance of a prosodic boundary could be more straightforward.

However, in the case of the phonetic process of passive voicing, the target obstruent is underspecified for voicing and thus believed to lack an articulatory target along this dimension (see, e.g., Keating 1988: 284–285).

---

[51] Although using a different framework, Kumashiro (2000) also assumes paradigm uniformity effects in High German to account for a similar phenomenon: When loanwords containing [gm] or [gn] in the donor language are borrowed into High German, the voicing of [g] is retained, e.g., in *Fra*[gm]*ent* or *Ma*[gn]*et*, as such a cluster has its counterpart in the native vocabulary, e.g., in *Se*[gn]*ung* 'blessing.' The [g] of *Se*[gn]*ung*, in turn, remains voiced in order to keep the interlexical relations with *Se*[g]*en* 'blessing' stronger. (Actually, [gn] is also a possible onset cluster, in which we may not expect neutralization.) In the case of words like *Chari*[sm]*a*, on the other hand, we find obstruent devoicing due to the lack of the [zm] cluster in the native words of the language. This situation is different in Northern Standard German, where obstruents have undergone devoicing in *Se*[kn]*ung* as well as in *Fra*[km]*ent* and *Ma*[kn]*et* too, meaning that paradigm uniformity effects are absent from this variety.

This being so, one may expect that the targetless /d^0/ of both German words will be affected in the same way by the /l/ following it in the same intonational phrase. For example, in Slovak, a voicing language, which displays final obstruent devoicing and presonorant sandhi voicing, “the presence of the target and the trigger in the same or different syntactic phrases does not seem to make a difference … with regard to P[re-]S[onorant]V[oicing] as long as they belong to the same intonational phrase” (Bárkányi & Beňuš 2015: 2). It can be the case though that an unmarked obstruent in presonorant position normally undergoes passive voicing in German, a process counteracted morpheme-finally in order to mark the boundary. However, this would not explain why the coda obstruents in words like *admiral* and *badminton* (see (49)) also become voiceless when entering German, which seems a rather productive process.

If, on the other hand, we assume that syllable-final lenis obstruents are less prone to undergo passive voicing in German than in English, we can consider voicelessness in *Han*/d^0/ and *han*/d^0/*lich* as well as in *A*/d^0/*miral* or *Ba*/d^0/*minton* to be their default realization in this position. As for words like *Han*/d^0/*lung* (see (50)), the voicing of their coda obstruents can be the result of phonetic analogy, making the physical forms of the members of the paradigm more uniform (i.e., [han.dəln] → [hand.lʊŋ]). With this in mind, it is not surprising that the words within which lenis coda obstruents in presonorant position are pronounced voiced without paradigm uniformity effects form a peculiar group (see (51)): it consists of proper nouns and only words containing [gm], with one exception, *A*[dl]*er*.

It is worth noting the results of Jessen & Ringen’s (2002) and Beckman, Jessen & Ringen’s (2009) experiments, which support the idea that the difference between the plosives in *handlich* and *Handlung* should be considered a phonetic issue. The authors have found that although the lenis fricative or plosive in presonorant position in words like *fa*/z/*rig* ‘fibrous’—a derivative of *Fa*/z/*er* ‘fiber’—and *Han*/d/*lung* tend to be voiced, there is some variation in their realization as voiced or voiceless segments. This even applies to *ne*/b/*lig* ‘foggy’—derived from *Ne*/b/*el* ‘fog’—where /b/ occurs in onset position. These data show the strong tendency of syllable-final lenis obstruents in Standard German to be realized voiceless. This default realization seems to be overwritten (with some variation) by paradigm uniformity effects in words like *Handlung* to make them more similar to their phonetic forms in the base words they have been derived from (in this case, *handel*).

Whether phonetic analogy plays a role in the voicing of lenis obstruents is a dialect-specific factor, an idiosyncratic property of High German. In the North German variety, besides lenes undergoing devoicing in the same environments as in High German, the alternations in (53) can also be found (see, e.g., Hall 2005). This means that obstruents in coda position are pronounced voiceless without paradigm uniformity effects modifying their realization.

(53)	handeln [han.dəln] ~ Handlung [hant.lʊŋ]	‘act (noun) ~ to act’
	siedeln [ziː.dəln] ~ Siedler [ziːt.lɐ]	‘to settle ~ settler’
	ordentlich [ɔɐ.dənt.lɪç] ~ ordnen [ɔɐt.nən]	‘orderly ~ to order’

In sum, if we do not want to assume final fortition in German, i.e., the addition of a phonological prime (like Iverson & Salmons (2007) do), and if we do not mark the lenis obstruent series with the element |L| or the feature [voice] (like Hall (2005) does), the different realizations of /d/ in *han*/d/*lich* and *Han*/d/*lung* must be taken to be a phonetic issue (as suggested by Beckman, Jessen & Ringen 2009). Besides, the following should be considered: the pattern of borrowing words into the language, e.g., *admiral* → [at.mi.ʀaːl] or *charisma* → [ka.ʀɪs.ma]; the fact that *Adler* [aːd.lɐ], words with the [gm] cluster (like *Magma* [mag.ma]) and proper nouns are the only monomorphemic words in which coda obstruents are voiced, a rather peculiar group; and the fact that voicing in coda position regularly occurs in words like *Handlung* [hand.lʊŋ] and *ordnen* [ɔɐd.nən], which have a morphologically related word in which the given obstruent realized voiced, being in onset position (in this case, they are *handeln* [han.dəln] and *ordentlich* [ɔɐ.dənt.lɪç]). We can account for these data with reference to paradigm uniformity effects on the phonetic forms of lenis obstruents.

In WP too, phonetic analogy can be considered to play a role just like in German. Again, the laryngeally unmarked obstruents in /b^{j0}/*ić* and *ka*/d^0/*ra* are realized as voiced [b] and [d] since they are in presonorant position. This should apply to *rzu*/t^0 ɔ/*ka* as well as to *ra*/d^0 ɔ/*jcowskich* too, just like in CP. However, it is the phonetic forms *rzu*[t] and *ra*[t], which is how the words are pronounced in isolation, that will surface in this context.[52] This effect will only be overwritten by an actively voiced segment, i.e., a voiced obstruent, e.g., in *rzu*/t^0 b^0/*agnetem* and *ra*/d^0 g^0/*łupich*.

Now, if the two Polish dialects are regarded as phonologically identical laryngeal systems, and thus the different behavior of their final obstruents does not fall out from CP being considered an H-language and WP an L-language as in Cyran's analysis, the occurrence of presonorant sandhi voicing in CP but not in WP might seem to result from the presence vs. absence of an SPE-type arbitrary phonological rule (see Chomsky & Halle 1968). However, in the present analysis, this dialectal variation has nothing to do with the phonological component of the grammar. The difference between CP and WP is of the same nature as the one between, say, standard English and Icelandic—although there is little disagreement about their representing phonologically the same laryngeal system, in the former, intersonorant position provides a strong enough environment for a plosive to undergo phonetic voicing, whereas in the latter, they systematically resist passive voicing in the same environment. As for the role of phonetic analogy, like in the French case mentioned in footnote 49, it also falls outside the scope of phonological rules and phonological representation.

A further consideration which may suggest that the presence or absence of presonorant sandhi voicing in a given dialect is more relevant to the phonetics of the system than to its phonology is that it only concerns the physical realization of a segment in a neutralizing context. As the trigger of the process is laryngeally unspecified, no phonological prime can be involved in it. Therefore, the neutralization of the contrast between voiced and voiceless obstruents in this case is unlike that between, say, /m/ and /n/ before /p/ and /b/, which can be analyzed as a phonological process with the involvement of the place element (|U|). It is rather like variability in the realization of the final neutralized obstruents in German, for which we might want to distinguish

---

[52] In the case of *rzu*/t^0/, the underlying fortisness of the final obstruent may also contribute to it being pronounced voiceless even when followed by a sonorant segment in the next word.

dialect A where these segments are generally pronounced plain voiceless without a significant release burst and dialect B where they tend to be strongly aspirated, whether or not these realizations are context-dependent.[53] If such varieties can be found, we can categorize them as different dialects; however, this will only be a phonetic description—the two systems should be considered phonologically identical.

Another way in which the presence vs. absence of presonorant sandhi voicing can be phonological is that not the segments in question but the laryngeal systems are different, as proposed by Cyran (2011 *et seq.*). In this case, the different phonetic realizations systematically follow from whether the language is an H-system, in which (enhanced) passive voicing is possible, or an L-system, from which it is absent. Although it is an elegant way of accounting for the data, there are two facts that can be brought up in support of treating the two varieties as identical phonological systems and the variation in the segmental realizations as a purely phonetic issue. First, as noted in Schwartz (2016: 119) and Cyran (2017: 489), contrary to the prediction of Laryngeal Relativism, passive voicing is not necessarily precluded in L-languages; it occurs in, e.g., Rome Italian and Iberian Spanish (see Hualde & Nadeu 2011). That is, the assumption of some idiosyncrasy governing passive voicing is inevitable even in this analysis.

Furthermore, and perhaps more importantly, if we take a closer look at the CP data and want to account for them, we find ourselves in exactly the same situation as when we attempt to explain the difference between CP and WP. Strycharczuk's (2012: 71ff) experimental data prove that in general, more voicing can be observed in word-final obstruents followed by sonorants in the sandhi context in CP than in WP. It has also been found that the neutralization of the voicing contrast in these obstruents is optional in CP. This means that whether the sonorant in the next word can license the laryngeal element can vary (i.e., the speaker can apply the Laryngeal Constraint in (44a) or the version in (44b)). What is more relevant though is that if the word-final plosives end up laryngeally neutralized, their phonetic voicing before sonorants in the sandhi context is not gradual but categorical and *optional*. That is, speakers within the CP dialect are observed to either voice or not these plosives. Moreover, considerable intraspeaker variation characterizes this phenomenon (Patrycja Strycharczuk, personal communication). It is therefore more reasonable to regard it as an arbitrary decision rather than to assume the existence of two parallel phonological systems (an H-system and an L-system) constituting the dialect plus a continuous switch between them in the same speaker. All in all, I believe that the physical realization of final obstruents is not systematic enough for us to be able to account for the different phonetic forms as the direct consequence of different phonological systems.

---

[53] For example, Wagner (2002: 377–378) has found that in German compounds where the first member ends in an obstruent and the second begins with a sonorant consonant, the final obstruent induced devoicing in the following sonorant for some speakers, while for others, this effect seems to be absent.

Catalan data further supporting the phonetic nature of voicing/voicelessness in word-final obstruents

Catalan, a language also exhibiting final devoicing, displays an even more complex picture of voicing phenomena in the sandhi context. Strycharczuk (2012: 107ff) reports that in Central Catalan, before a sonorant consonant, all word-final obstruents undergo voicing, whereas before a vowel, only sibilants and plosive+sibilant clusters do so, to the exclusion of singleton plosives. Also, the Catalan dialects form a continuum regarding the range of obstruent types that become voiced in prevocalic position in the sandhi context (see Jiménez & Lloret 2008: 82–86 and Strycharczuk 2012: 111): in the Alicante dialect, all obstruents undergo voicing; in Central Catalan, all obstruents except for plosives and variably the labial fricative; in a Valencian dialect, only sibilant fricatives (i.e., not plosives, the labial fricative and affricates); while in Central Valencian, prevocalic sandhi voicing is absent.

This remarkable variability in the case of both the triggers and the targets provide evidence, I argue, that assuming a certain degree of idiosyncrasy in the physical realization of delaryngealized obstruents is necessary. As far as I can see, these phonetic forms cannot follow from different phonological representations, systems or processes in autosegmental frameworks. For one thing, as Strycharczuk (2012: 132) points out, "there are no factors that could motivate a representational asymmetry between sonorants and vowels independently of the aim to capture the pattern formally." She summarizes the phonological analyses proposed to account for the Central Catalan data by means of some combination of the following tools: referring to different levels of analysis (word level and phrase level) to explain the trigger asymmetry between sonorant consonants and vowels; making use of the phonological specification of vowels and sonorant consonants as [voice]; and applying OT constraints to generate the desirable outcome (e.g., *CONTVOILAG requiring the leftward spreading of [voice] from a vowel to the preceding fricative so that voicing will not lag behind the onset of the continuant fricative+vowel cluster, which does not affect plosives) (see Strycharczuk 2012: 109–110). The most striking problem with all of these accounts is perhaps that they must assume laryngeally specified sonorant segments although this property is noncontrastive in them. So it can be concluded that a "successful representational solution to this problem is not readily available" (Strycharczuk 2012: 132).

What further complicates this already complex picture in Central Catalan is that voicing before sonorant consonants show a great degree of inter- and intraspeaker variation, which makes the phenomenon more likely to be phonetic in nature. Moreover, if the laryngeal contrast in final obstruents is neutralized, the exact quality of these unmarked segments along the voicing continuum, which plays a contrastive role elsewhere, does not serve any linguistic function here. Therefore, I suggest regarding the assignment of VOT values to final unmarked obstruents as a nonphonological issue. In other words, phonologically speaking, all of the Catalan dialects mentioned above represent the same laryngeal system (they are all two-way-contrast languages with final neutralization); they can only be distinguished based on the phonetic description of their obstruents in neutralizing positions.

As for what these realizational differences arise from, several factors can play a role. First of all, we may find forms which can be considered phonetically natural as they can be explained with reference to ease of articulation. For instance, if a laryngeally neutralized postvocalic word-final obstruent is followed by a sonorant in the next word, it is in a voicing environment. As it has no articulatory target along the voicing dimension, the spontaneous voicing of the flanking segments spread to it.[54,55] In the case of an unexpected phonetic form, its reason is to be explored. For example, for the presence or absence of passive voicing in German obstruents in an environment where we would not predict it, paradigm uniformity effects may provide an explanation. However, it can also happen that no reasonable phonetic basis can be identified for a particular phonetic form. Very often, the Evolutionary Phonology approach can shed light on how a phonetically unnatural form has come into existence, summarized in Strycharczuk (2012: 130) as follows:

> [S]ound patterns are most accurately explained in the context of diachronic processes that led to their development coupled with the abstract mechanism used by learners to generalise over the perceived variation, where markedness effects may emerge from the system, but they are not a primary driving force.

That is, the phonetic motivation which brings about a given sound pattern may disappear over time, and the remaining forms will be synchronically unjustifiable, i.e., arbitrary. However, even phonetically unnatural forms are acquirable by the speaker and the perceived pattern will be learned. I argue that in the different Catalan dialects too, which should be regarded as phonologically identical laryngeal systems, the laryngeally neutral word-final obstruents are assigned a variety of phonetic qualities, which are learned by the speakers based on the perceived patterns. (For a hypothesis on how the now arbitrary forms have evolved diachronically, see Strycharczuk (2012: 127–132).) These mappings constitute the language-specific implementation rules of the phonetics.[56]

---

[54] For a discussion on the assumption that the unmarked lenis obstruents in an aspirating language like English is not a result of a (weakly) voiced phonetic target but of passive voicing, see Jansen (2004: 43). For different views on what can qualify as a voicing environment, see section 2.1.

[55] Regarding what can be considered a phonetically natural phenomenon, sometimes either of two opposite scenarios seems to be explicable. For example, if fricatives undergo passive voicing while plosive do not, as is the case in Central Catalan, the fact that certain acoustic cues to voicing in plosives are missing from fricatives can support the idea that it is easier to reach a voicing percept in fricatives (see Strycharczuk 2012: 65–69). If, on the other hand, it is the fricatives that are less prone to become voiced, the answer may lie in the complexity of the articulatory gestures required for the maintenance of voicing in fricatives, as described in section 2.1 (see Ohala 1983: 201–202).

[56] Such language-specific phonetic rules can also be take to be responsible for the difference in the concrete realizations of word-final obstruents in German dialects which preserve the laryngeal contrast in this position: in one variety, the opposition is physically encoded in the vowels preceding the obstruents while in another, the opposition is cued on the obstruents themselves (see Iverson & Salmons 2007: 138).

In conclusion, I believe that both CP and WP can be analyzed as H-languages if we consider the relationship between the phonological representations and the phonetic realizations of laryngeal properties to be arbitrary and accept the claim that the different behaviors of final obstruents in the two dialects do not have to be treated as a phonological issue but can be accounted for at the phonetic level.[57] In the rest of the paper, I will aim to show that other L-languages can also be recategorized and discuss the details of the alternative analysis proposed.

4.3.3 All we need is |H|

4.3.3.1 Phonetic and phonological considerations

I argue that one laryngeal element, namely |H|, is enough to represent the binary opposition in both aspirating and voicing languages, which, in turn, will no longer be regarded as two separate phonological systems. I propose instead that the typology of these two-way-contrast systems be established based on the phonological processes operating on |H|. The phonetic differences in the realization of the obstruent series across languages should not concern us as the relationship between phonological representation and its physical implementation will be considered arbitrary, just as is assumed in Laryngeal Relativism.

First, let us examine what can justify and seem to even call for such an analysis. Let us look into the issues discussed in section 4.2—the phonetic realization and the spreading of the laryngeal elements. Even if we do not rush to adopt the principle of Laryngeal Relativism regarding the relationship between phonology and phonetics, if we take into account the examples provided in section 4.2, we have to realize that a view in which the laryngeal elements must have direct association with exactly defined phonetic qualities *and* are bound to exhibit specific phonological behaviors is not tenable.

If we accept that |L| represents active voicing, and |H| marks fortisness, we will also need to assume, for example, that |L| is present in the lenis obstruents of Swedish and Southern American English, which are strongly voiced (cf. Beckman & Ringen 2004 and Hunnicutt & Morris 2016); but then it follows that the behavior of the laryngeal elements will be unpredictable (e.g., |L| spreads from right to left in languages like Hungarian but does not cause any kind of assimilation in Swedish and Southern American English; |H| is phonologically not active in standard dialects of English but spreads in both directions in Swedish). Furthermore, however faithfully a representation is intended to reflect phonetic reality, it is actually inevitable to

---

[57] It might seem at first glance that just like in traditional analyses assuming SPE-type rules, the present account also resorts to rule ordering (delaryngealization followed by a voicing rule or a rule triggering paradigm uniformity effects). This, however, is not the case. There is one phonological process taking place, delaryngealization. It results in a phonological object, which is realized with a phonetic form. This assigned quality can appear to be phonetically natural, influenced by some effects like paradigm uniformity or can be unnatural, whatever the speaker has learned from their exposure to the ambient language, which results in arbitrariness. I believe that this analysis does not rely on rule ordering any more than one that assumes delaryngealization first, after which the segment can receive a phonetic form, however automatic the phonetic process may be regarded.

allow space for a certain degree of arbitrariness in the phonology–phonetics relationship (e.g., a plosive specified for |H| is realized before an unstressed vowel as an aspirated segment in Icelandic but as a plain voiceless sound in English; the extent to which obstruents can undergo passive voicing in H-languages, and the environment that can function as a voicing context may show considerable variation, e.g., in Icelandic vs. English, again). If we acknowledge the phonetic differences across identically treated laryngeal systems, we are already headed toward Laryngeal Relativism, which can therefore be supported not only on a theory-specific ground but should be to a certain extent necessarily assumed independently of the framework one works in.

Instead of using the laryngeal elements only to strictly encode the phonetic characteristics of obstruents (their behavior should then be regarded as unpredictable), we can decide to associate certain fixed phonological behaviors with them based on the observed cross-linguistic tendencies. Then, all the languages that do not display a particular pattern will need to be excluded from the given language type even though the phonetic characteristics of their obstruents might suggest otherwise. This means that the phonetic implementation of the laryngeal specifications will be necessarily arbitrary—and we are not far from the Laryngeal Relativism view. Furthermore, it is unavoidable to assume arbitrariness in relation to the laryngeal elements and their behaviors too. Taking standard English, Yorkshire English and Swedish as examples, we have no reason to consider either of them as an L(-only)-system. This leaves us with the option of analyzing all three as having |H|, which does not spread in standard varieties of English, but in the Yorkshire dialect, as fortisness (and only fortisness) triggers regressive assimilation, it appears to spread leftward, while in Swedish, it exhibits spreading in both directions. This can prove that the way a laryngeal element behaves in a system is not an inherent characteristic of the element but has to be stipulated.[58]

All in all, if we take the phonetic variations across laryngeal systems into consideration and do not sweep the phonological patterns that do not conform to the general tendencies under the rug, any analysis applying both |L| and |H| to encode two-way oppositions needs to involve arbitrariness and stipulation. Therefore, it seems that we do not gain much if binary laryngeal oppositions are represented by two elements. On the contrary, I argue that it is even more advantageous to use only one element, |H|, for this purpose.

---

[58] In the analyses of Balogné Bérces (2017) and Huszthy (2019), the difference between languages like standard English or Italian (lacking laryngeal activity) and languages like Yorkshire English (displaying laryngeal assimilation) is already encoded in the phonological representation. The authors apply the obstruency-marking nonlaryngeal element |h|, considered to be incapable of spreading, to represent the opposition between the obstruent series in English or Italian and use the mobile |H| in the case of Yorkshire English. Adopting this idea to the present analysis and thus re-increasing the number of melodic elements recognized in standard versions of ET (see Backley 2012: 66–67) would be a disadvantageous step from the point of view of economy. In fact, even if we do not consider this principle to be of the highest priority and choose to sacrifice it, introducing |h| would not solve the problem of unpredictability regarding the behavior of |H|: even though the issue of nonspreading vs. spreading would be accounted for, the direction of spreading would still remain a language-specific property of |H| that needs to be stipulated anyway if we accept the arguments in section 4.2.2. and assume phonological assimilation, for instance, in Swedish.

Now, let us continue with why an H-only analysis can fare better than a two-element approach. As we are going to see in detail in the next subsection, both voicing and fortisness appear to display virtually any phonological behavior: we can find instances of both properties being licensed in any position as well as of their licensing being limited to presonorant position; moreover, their spreading can be blocked or required, and in the latter case, the direction of assimilation is also language-specific. Thus, the application of one element will not involve more stipulation than has been necessary all along anyway. Plus in a comprehensive analysis, assuming a certain degree of arbitrariness in the relationship between phonological representation and phonetic realization is already supposed to be unavoidable. That is to say, the simplification resulting from the reduction in the number of laryngeal elements will not need to be compensated for in other areas of the analysis, so its overall complexity will also decrease. This is a desirable step from the viewpoint of the principle of economy and is intended to contribute to the enterprise of reducing redundancy in the phonological representation in Element Theory (for details about the changes in the element inventory of ET as well as in the role of elements in the system, see, e.g., Backley 2012).

In sum, as the laryngeal analysis proposed here treats the obstruent series falling closer to the “aspiration” end of the VOT scale uniformly in both Hungarian- and English-type languages, taking them to contain |H|, the phonological representation of laryngeal contrasts is generalized cross-linguistically.[59] As for the phonetic realization of the opposition, “defined relatively, as more or less voicing” (Keating 1984: 286), it is to be ignored as a factor interfering with phonological processes.

4.3.3.2 A [spread glottis]-only analysis in OT

In this subsection, a short excursus will be taken, showing that it is not necessary in Optimality Theory (OT)[60] either to automatically assume a laryngeal feature in a system based on the observation of phonetic qualities. As an illustration, two languages will be examined in which we can find traces of both aspiration and voicing: Alabama and Mississippi English (henceforward Southern American English) and Swedish.

The tables in (54) and (55) show VOT values of word-initial plosives in the two languages. In both cases, fortis plosives are strongly aspirated at the beginning of a word. Lenis obstruents in Swedish are always significantly prevoiced, and the same tendency can be observed in the English dialect in question: about 78% of its lenis obstruents have a negative VOT word-initially. It is precisely the unmarked (i.e., voiceless unaspirated) obstruent series that is missing from these languages, which is unusual.

---

[59] As a result, rule equivalence across languages (and language types) may be explained just like in the analysis of Keating (1984), who mentions three cases (292–294), two of which are relevant and I summarize using the obstruent categories of the present analysis: (i) vowel duration tends to be shorter before an obstruent containing |H| than before an unmarked one, and (ii) the fundamental frequency of vowels following an obstruent specified for |H| is normally higher than after an |H|-less segments.

[60] For details on OT, see, e.g., McCarthy (2002).

(54) VOT values of word-initial plosives in Southern American English (in ms) (Hunnicutt & Morris 2016)

		bilabial	alveolar	velar
Lenis	negative VOT (77.8%)	−92.6	−96.9	−85.7
	short lag VOT (22.2%)	11.7	15.7	22.6
Fortis	(positive VOT)	69.2	81.4	77.3

(55) VOT values of word-initial plosives in Swedish (in ms) (Helgason & Ringen 2008)

		bilabial	alveolar	velar
Lenis	(negative VOT)	−96	−90	−61
Fortis	(positive VOT)	49	65	78

The data in (56) show the laryngeal characteristics of plosives and plosive clusters in Swedish.

(56)	a.	kö[ʰp]a~kö[p]a			‘to buy’
		kö[ʰpt]e~kö[pt]e	←	kö/p#d/e	‘buy-PAST’
		kö[ʰpt]~kö[pt]	←	kö/p#t/	‘buy-SUP’
	b.	vä[g]a			‘to weigh’
		vä[gd]e	←	vä/g#d/e	‘weigh-PAST’
		vä[ʰkt]~vä[kt]	←	vä/g#t/	‘weigh-SUP’

According to Beckman & Ringen (2004), Ringen & Helgason (2004) and Hunnicutt & Morris (2016), whose analyses are done within the framework of OT, both of the distinctive features [spread glottis] and [voice] should be made use of in order to represent the two-way laryngeal contrast in these languages. The tableaux in (57), (58) and (59) illustrate how the analysis of Beckman & Ringen (2004) works.[61] They say that the reason for the necessity of both features in the phonology of these languages is that “if we take seriously the OT tenets of Richness of the Base and Lexicon Optimization, we will be forced to assume both [voice] and [spread] in input representations” (2004: 113). Richness of the Base states that there are no language-specific restrictions on the input, i.e., “[a]ny input that meets universal well-formedness criteria … is a possible input to the grammar of the language; it is the task of the language’s grammar, by means of constraint ranking, to map any input onto a well-formed output.” As for Lexicon Optimization, it insures that out of the several possible input forms that could be mapped to the desired output form, the one whose mapping to the output is the most harmonic (i.e., which is closest to the output form) should be assumed in the underlying representation (Beckman & Ringen 2004: 104–105).

---

[61] The constraints used in Ringen & Helgason (2004) for this analysis: SPECIFY$_{\text{[Lar]}}$: stops must be specified for a laryngeal feature; *VOI/SG: segments specified as both [voice] and [spread] are prohibited; *VOI: segments specified as [voice] are prohibited; *SG: segments specified as [spread] are prohibited; FAITH$_{\text{[voi]}}$: an input [voice] segment must be [voice] in the output; FAITH$_{\text{[spread]}}$: an input [spread] segment must be [spread] in the output; AGREE: obstruents in clusters must agree in laryngeal specifications.

Thus, as a result of accepting the above principles, the underlying representation of [kʰ]*ub* and [g]*ap* should be /kʰ/*ub* and /g/*ap*, respectively. This is also supported by the facts that word-initial plosives are phonetically either significantly prevoiced or strongly aspirated and that the amounts of voicing and aspiration are in inverse proportion to speaking rate, which might be an indicator of their also being phonological in nature (see Beckman, Helgason, McMurray & Ringen 2011 and Lehnert-LeHouillier 2009 and section 3.3 for a discussion on speaking rate effects and their relevance to phonology).

(57) Swedish [kʰ]*ub* 'cube'

/k^{sg}/ub	Specify	*voi/sg	Faith$_{[spread]}$	Faith$_{[voi]}$	*sg	*voi
[k]ub	*!		*			
[g]ub			*!	*		*
☞ [k^{sg}]ub					*	
[g^{sg}]ub		*!		*	*	*
/g^{sg}/ub	Specify	*voi/sg	Faith$_{[spread]}$	Faith$_{[voi]}$	*sg	*voi
[k]ub	*!		*	*		
[g]ub			*!			*
☞ [k^{sg}]ub				*	*	
[g^{sg}]ub		*!			*	*

(58) Swedish [g]*ap* 'mouth'

/k/ap	Specify	*voi/sg	Faith$_{[spread]}$	Faith$_{[voi]}$	*sg	*voi
[k]ap	*!					
☞ [g]ap				*		*
[k^{sg}]ap			*!		*	
[g^{sg}]ap		*!	*	*	*	*
/g/ap	Specify	*voi/sg	Faith$_{[spread]}$	Faith$_{[voi]}$	*sg	*voi
[k]ap	*!			*		
☞ [g]ap						*
[k^{sg}]ap			*!	*	*	
[g^{sg}]ap		*!	*		*	*

(59) Swedish *kö*[$^{(h)}$p]*a* + [d]*e* → *kö*[$^{(h)}$pt]*e* 'buy-PAST'
vä[g]*a* + [t] → *vä*[$^{(h)}$kt] 'weigh-SUP'

kö/p^{sg}+d/e	Agree	Specify	*voi/sg	Faith$_{[spread]}$	Faith$_{[voi]}$	*sg	*voi
kö[pt]e		*!*		*	*		
kö[p^{sg}d]e	*!*					*	*
kö[bd]e				*!	*		**
☞ kö[p^{sg}t^{sg}]e					*	**	
vä/g+t^{sg}/	Agree	Specify	*voi/sg	Faith$_{[spread]}$	Faith$_{[voi]}$	*sg	*voi
vä[k^{sg}t]	*!	*		*	*	*	
vä[gt^{sg}]	*!*					*	*
vä[gd]				*!			**
☞ vä[k^{sg}t^{sg}]					*	**	

Nevertheless, it can also be argued that there is no need for both laryngeal features in the phonology of Southern American English and Swedish, even in OT with its theory-specific principles, and we can assume that it is only [spread glottis] that insures the two-way laryngeal contrasts.[62] In this analysis, the marked stops are pronounced voiceless aspirated, and the unmarked ones as voiced. As to the fact that a laryngeally unspecified obstruent is phonetically realized as a voiced segment, it should be accounted for in the phonetics of the given language.

Actually, Lexicon Optimization seems not to provide a strong basis for the necessity of two laryngeal features in the underlying representation either. According to McCarthy (2002: 78),

> [a]s a learning strategy rather than as a principle of grammar, it is decisive only in situations where the learner has no evidence in the primary data about which potential underlying form is the 'actual' one. In fact, when there is real evidence for the underlying form—such as alternations within a paradigm—learners must attend to that evidence and ignore lexicon optimization. …
>
> Because lexicon optimization is only a learning strategy to be invoked when the evidence fails, it is illegitimate to use it to draw inferences and construct arguments about the synchronic grammars of adults.

Based on the above description, we can see that Lexicon Optimization is not a criterion that has to be met at all costs, which is why it might not be too advantageous to use it as an argument for the assumption of a laryngeal

---

[62] There *are* tendencies cross-linguistically for minimality requirements, e.g., regarding the minimum size of content words or the obligatory specification of consonants for place of articulation, probably for perceptual reasons (Péter Rebrus and Katalin Mády, personal communication). However, demanding that obstruents be specified for a laryngeal feature or element and redundantly representing contrasts in the phonology at the cost of sacrificing the principle of economy (see Beckman, Helgason, McMurray & Ringen 2011: 17–18) are a different issue, especially when no proper phonological process evidences the need for a prime in a system.

system, which would be extremely rare and would also violate the principle of economy.

Furthermore, negative support for the absence of voicing in the phonological representations in these languages can be that this feature does not play a phonologically active role in either language. Whereas laryngeal assimilation is not characteristic of Southern American English, the examples in (56) show that in Swedish, this process is restricted to the spreading of voicelessness/aspiration: in both *kö*/pd/*e* and *vä*/gt/ it is the “voiced” obstruent that undergoes assimilation regardless of its position relative to the other obstruent: their realizations will be *kö*[ʰpt]*e*~*kö*[pt]*e* and *vä*[ʰkt]~*vä*[kt], displaying both regressive and progressive assimilation.

Also, the data in (56) can be handled in OT as well without assuming [voice]. The tableaux in (60), (61) and (62) show an alternative analysis: SPECIFY$_{[Lar]}$ no longer needs to be ranked high (if it is necessary at all to assume this constraint to be universally present in languages), and *VOI is ranked higher in order for voiced obstruents not to be required outputs in the language. Finally, the winning candidates that are unspecified for a laryngeal feature (i.e., the outputs of the tableaux in (61)) will be subject to phonetic voicing.

(60) Swedish [kʰ]*ub* ‘cube’

/k^{sg}/ub	*VOI/SG	*VOI	FAITH$_{[spread]}$	*SG
[k]ub			*!	
[g]ub		*!	*	
☞ [k^{sg}]ub				*
[g^{sg}]ub	*!	*		*
/g^{sg}/ub	*VOI/SG	*VOI	FAITH$_{[spread]}$	*SG
[k]ub			*!	
[g]ub		*!	*	
☞ [k^{sg}]ub				*
[g^{sg}]ub	*!	*		*

(61) Swedish [g]*ap* ‘mouth’

/k/ap	*VOI/SG	*VOI	FAITH$_{[spread]}$	*SG
☞ [k]ap				
[g]ap		*!		
[k^{sg}]ap			*!	*
[g^{sg}]ap	*!	*	*	*
/g/ap	*VOI/SG	*VOI	FAITH$_{[spread]}$	*SG
☞ [k]ap				
[g]ap		*!		
[k^{sg}]ap			*!	*
[g^{sg}]ap	*!	*	*	*

↳ voicing of the unmarked plosive in the phonetics

(62) Swedish *kö*[$^{(h)}$p]*a* + [d]*e* → *kö*[$^{(h)}$pt]*e* ‘buy-PAST’
vä[g]*a* + [t] → *vä*[$^{(h)}$kt] ‘weigh-SUP’

kö/p^{sg}+d/e	Agree	*voi/sg	*voi	Faith$_{[spread]}$	*sg
kö[pt]e				*!	
kö[p^{sg}d]e	*!*		*		*
kö[bd]e			*!*	*	
☞ kö[$p^{sg}t^{sg}$]e					**

vä/g+t^{sg}/	Agree	*voi/sg	*voi	Faith$_{[spread]}$	*sg
vä[k^{sg}t]	*!			*	*
vä[gt^{sg}]	*!*		*		*
vä[gd]			*!*	*	
☞ vä[$k^{sg}t^{sg}$]					**

All in all, I hope to have shown in this subsection that even in OT, which has principles that appear to dictate the assumption of overspecification, we have no serious reason really to force two laryngeal features into the phonology of languages like Southern American English and Swedish. Although their plosives are indeed phonetically strongly aspirated or significantly voiced, the feature [spread glottis] or the element |H| will suffice to represent this contrast and to account for the potential laryngeal assimilations—for ET-based analyses in Laryngeal Relativism applying one melodic element to distinguish the two obstruent series in Swedish, see Cyran (2017), Balogné Bérces & Huszthy (2018) and Huszthy (2020).

Having aimed to show that applying both |L| and |H| as laryngeal elements in binary systems is unnecessary, and that it can be even more beneficial to assume only |H| in any of these languages,[63] in the following subsection, I will discuss the details of this analysis.

---

[63] In three- and four-way-contrast systems such as Thai and Hindi, respectively, we might, of course, need both |L| and |H| to represent laryngeal oppositions (Thai has voiceless aspirated plosives (marked with |H|) and voiced unaspirated plosives (containing |L|) besides the unmarked category (|Ø|), in addition to which Hindi has a voiced aspirated series too (presumably specified for both |H| and |L|)). In light of this, an analysis in which only |H| is available for two-way systems suggests that |L| as a laryngeal element in a language implies the presence of |H| in the system. This idea is actually justified by language acquisition data, namely that in both Thai and Hindi, voiced plosives are learned later than voiceless aspirates (Vaux & Samuels 2005: 409; cf. Huber & Balogné Bérces’s (2010) representation of the two properties as |L| and |h|, which is also in line with these facts). So, observing the obstruent types within such systems, we find that |L|-containing obstruents are articulatorily more marked than those specified for |H|. As Péter Szigetvári has pointed out (personal communication), |L| is more natural in nonprototypical consonants, representing nasality in sonorants, whereas voicelessness/aspiration and frication, features generally associated with |H|, are more characteristic of obstruents (see, e.g., Backley 2011: 161).

This may imply that laryngeal systems applying only |L| are more marked, and therefore unexpected. Hawaiian, a language with only one obstruent series, shows characteristics of an aspirating system, further supporting the claim that this is the “default” language type: although in a precontrast system, we would expect voiceless unaspirated plosives, these segments may indeed be pronounced aspirated (see Jones 2018), and passive voicing in intervocalic position is not unprecedented either (see Schütz 1994: 80–81).

For a possible representation of the above-mentioned functional loads and their relation, see sections 7.2 and 7.3.

4.3.4 The alternative laryngeal typology

In this part, I provide an example of all possible types of laryngeal systems, which will be analyzed in the H-only approach and categorized based on the phonological processes that can target the element |H|, and the consequent laryngeal typology will also be introduced.

As has been mentioned in connection with current analyses applying two laryngeal elements in the Laryngeal Realism view, the behavior of both |L| and |H| must be considered language-specific even in these approaches. Practically, any combination of the application and nonapplication of the relevant phonological processes, delaryngealization and spreading (rightward and leftward), can be attested. The categories that can be established accordingly are summarized and exemplified in (63).

(63) A typology of languages with two obstruent series which can be established in current analyses using two laryngeal elements (or features)

Licensing of the laryngeal element	Spreading of the laryngeal element	Example of an H-language	Example of an L-language
independent of position	none	English	Italian
	unidirectional (regressive)	Meccan Arabic	Ukrainian
	bidirectional	Swedish	?
before sonorants	none	German	(Hungarian)
	unidirectional (regressive)	(German)	Hungarian
	bidirectional	not possible	not possible

The table shows that the major division is between languages whose laryngeal elements are licensed in any environment (i.e., there is no delaryngealization) and those in which licensing is possible only in presonorant position. The words in (64b) containing fortis+lenis and lenis+fortis consonant clusters (based on the examples in Szigetvári 2020a: 47) show that in standard dialects of English like Standard Southern British English, licensing is not context-dependent, plus the laryngeal element does not spread since no assimilation can be observed (i.e., there is no laryngeal neutralization in the language). The same applies to Italian; see (65b), from Huszthy (2019: 44, 48). The difference between the two languages is that in English, the opposition in word-initial position is between aspirated and unaspirated voiceless plosives, whereas Italian contrasts plain voiceless obstruents with voiced ones (see Balogné Bérces 2017: 151); compare the words in (64a) and (65a). The general principle of Laryngeal Realism dictates that English should therefore be regarded as an H-language and Italian as an L-language.[64]

(64) a. Paul [pʰoːl] – ball [poːl~b̥oːl]
b. foo/tb/all
vo/dk/a

(65) a. Paolo [paolo] – ballo [ballo]
b. foo/tb/all
vo/dk/a

There are also languages in which licensing is independent of the context, just like in English and Italian, but the laryngeal element appears to spread leftward. Examples of such linguistic systems include Meccan Arabic (de Lacy 2002: 337–338) and Yorkshire English (Wetzels & Mascaró 2001: 227), in which |H| can be considered the phonologically active laryngeal element, as well as Ukrainian (de Lacy 2002: 307–308) and Durham English (Cyran 2014: 201–202), where it is |L| that seems to cause assimilation. The absence of delaryngealization before obstruents combined with the spreading of |H| and |L| in the analysis results in what we can perceive as asymmetrical assimilation, i.e., the spreading of either voice or voicelessness/fortisness. Some examples of regressive laryngeal assimilation in Meccan Arabic and Ukrainian are given in (66) and (67),[65] respectively.

(66)	/ʔakbar/	>	[ʔakbar]	'older'
	/matʤar/	>	[matʤar]	'shop'
	/ʔagsam/	>	[ʔaksam]	'he made an oath'
	/ʔabtahal/	>	[ʔaptahal]	'he supplicated'

(67)	o/sʲ-d/e	>	o[zʲd]e	'here/there'
	vo/k-z/al	>	vo[gz]al	'station'
	vi/d-p/ovidaty	>	vi[dp]ovidaty	'answer-INF'
			ri[dk]o	'rarely'

Among the languages with context-independent licensing, we find a few in which the laryngeal element can spread both left- and rightward. The words in (68) show that fortis obstruents trigger bidirectional assimilation in Swedish (Ringen & Helgason 2004: 60 and Lombardi 1999: 285). Other languages exemplifying the bidirectional spreading of |H| include Afrikaans (Wissing 2020) and Frisian (Visser 2020a, 2020b).

---

[64] English is often mentioned as a language in which progressive laryngeal assimilation occurs: its past tense/past participle morpheme /d/ and its plural/possessive/3rd person singular present tense morpheme /z/ turn into their fortis counterparts if they follow a fortis consonant, e.g., in *stopped* /stɒp-t/ and *stops* /stɒp-s/. However, I ignore these allomorphic alternations here. In fact, it is not even necessary to assume any kind of assimilation in these cases, following Szigetvári's (2020a) analysis—see the discussion on the difference between laryngeal phenomena in English and in Swedish in section 4.2.2.

[65] The symbol ">" means 'phonetically realized as'; and "→" represents phonological changes.

(68)	a. vä/g-d/e	>	vä[gd]e	‘weigh-PAST’
	vä/g-t/	>	vä[kt]~vä[ʰkt]	‘weigh-SUP’
	kö/p-d/e	>	kö[pt]e~kö[ʰpt]e	‘buy-PAST’
	kö/p-t/	>	kö[pt]~kö[ʰpt]	‘buy-SUP’
	b. hö/g-t/id	>	hö[⁽ʰ⁾kt]id	‘festival’
	ti/s-d/ag	>	ti[st]ag	‘Tuesday’

Whether languages displaying bidirectional |L|-spreading as a clear phonological process exist remains a question, although there may be no phonological reason why such a laryngeal system should be impossible. Oromo is the only language that I am aware of in which voice seems to cause regressive as well as progressive assimilation (Geshe & Devardhi 2013: 335–336, 341); see (69). It should be noted (besides the fact that it is not a two-way-contrast system) that regressive assimilation might be limited to /k/ as the target of the process and might not always take place (see (69a)), while in its progressive version, it might be only /t/ that undergoes voicing due to a preceding /b, d, g/, and the process can also be simply analyzed as a case of morphophonological alternation (see (69b)). Moreover, the words in (69c) exemplify the leftward spreading of voicelessness, instead of the rightward spreading of voicing, in case /g/ or /b/ is followed by /s/ in the next morpheme. The rarity of L-languages with bidirectional assimilation compared to their H-system counterparts, to the extent that they might even be practically nonexistent, might have psychological and phonetic reasons (see footnote 39).

(69)	a. /waak’gaarii/	>	[waaggaarii]	‘(name)’
	/waak’gaʃʃaa/	>	[waaggaʃʃaa]	‘(name)’
	/waak’ʤiraa/	>	[waakʤiraa]	‘(name)’
	b. /ʧab-t-e/	>	[ʧabde]	‘break-3SG.F/2SG-PRF’
	/fid-t-an/	>	[fiddan]	‘bring-2PL-PRF’
	/fiig-t-e/	>	[fiigde]	‘run-3SG.F/2SG-PRF’
	c. /ʤig-s-e/	>	[ʤikse]	‘fall-CAUS-1SG/3SG.M-PRF’
	/ʧob-s-e/	>	[ʧopse]	‘pour-CAUS-1SG/3SG.M-PRF’

In accordance with Hansson’s statement about the strong bias toward leftward directionality in the case of consonant harmonies (see footnote 39), it seems that progressive laryngeal assimilation in a given language implies its regressive counterpart. This means the absence of laryngeal systems with the spreading of the laryngeal element as an exclusively progressive phonological process.[66]

The second major category of laryngeal systems contains languages in which licensing is limited to presonorant position, i.e., those with the Laryngeal Constraint in (42) or (44). German appears to belong to the

---

[66] Norwegian may seem to contradict this generalization; however, progressive voicing without its regressive variant in the language is the artifact of the allomorphic alternation of the past tense and the preterit suffix (see the examples in section 4.2.2). For discussions on positing [voice] (or |L|) in the system to account for laryngeal patterns, see Kristoffersen (2000: 72ff) and Brown (2006).

subcategory in which the laryngeal element is |H| and does not spread; see (70) (based on Wetzels & Mascaró 2001: 208 as well as Jessen 1998: 67–68).

(70) a. [pʰ]aul 'Paul' – [p]all 'ball'
ba[k]en~ba[k] 'bake-INF~bake-2SG-IMP'
sa[g]en~sa[k] 'say-INF~say-2SG-IMP'

b. ba/k^0-b^0/ar > ba[kp]ar 'bakeable'
ba/k^0-t^H/e > ba[ktʰ]e 'bake-1SG-PAST'
sa/g^0-b^0/ar > sa[kp]ar 'sayable'
sa/g^0-t^H/e > sa[ktʰ]e 'say-1SG-PAST'

As a matter of fact, German could also be analyzed as an aspirating language with context-dependent licensing and H-spreading (listed in the appropriate cell of the table in parentheses). The only way of phonetically implementing the fortisness of a German plosive is via the aspiration of the segment—unlike in languages like Swedish and English, which use preaspiration and prefortis clipping, respectively, as phonetic cues. This means that there might be no way of showing whether *ba*[ktʰ]*e* and *sa*[ktʰ]*e* are the physical realizations of *ba*/k^0-t^H/*e* and *sa*/g^0-t^H/*e* (without |H|-spreading) or of *ba*/k^H-t^H/*e* and *sa*/g^H-t^H/*e* (after the spreading of |H|) since in this position, both an unmarked and a marked plosive is expected to be pronounced voiceless and unaspirated.

The words in (71) suggest that Hungarian is a typical example of laryngeal systems with presonorant licensing and L-spreading (see Siptár & Törkenczy 2000: 199–200). The Laryngeal Constraint active in the language along with the spreading of the laryngeal element insures that both voice and voicelessness spread symmetrically in the system.

Similarly to the German-type languages, L-systems like Hungarian could also be categorized differently: as a language with context-dependent licensing but not displaying |L|-spreading (see it in the table in parentheses). This reanalysis would mean that the unmarked coda obstruents in *fo*/k^0-b^L/*ól* and *fo*/g^0-b^L/*ól* undergo voicing as a result of coarticulatory (i.e., phonetic) assimilation (see Cyran 2017: 493–494).[67]

---

[67] The cross-linguistic analysis of laryngeal assimilation as a coarticulatory phenomenon would require an idiosyncratic choice in the phonetics as to whether or not the process should apply: actually, this would be the difference between the realization of *foo*/t^{0}b^L/*all* in Hungarian ([db]) vs. Italian ([tb]). The absence of coarticulation in Italian, can also fall out of an analysis assuming |h| (see Huber & Balogné Bérces 2010 and Huszthy 2020).

Coarticulatory assimilation instead of element spreading could be assumed in other types of laryngeal system too, in which case we would need to stipulate where it occurs, and where it does not. For example, in both English and Meccan Arabic, |H| could be regarded as licensed in any position without exhibiting spreading, and, additionally, the latter but not the former should be considered to display this phonetic assimilation.

As to what exactly the difference between coarticulatory and phonological assimilation lies in in Cyran's (2017: 493–494) analysis, it has to do with the trigger of the process: if it is caused by element spreading, it is phonological, if not (i.e., its source is, for example, enhanced passive voicing, without a phonological category behind it), it is considered coarticulatory (phonetic), without any implication regarding the phonetic details like the degree of voicing.

(71) a. [p]ál ‘Paul’ – [b]ál ‘ball’
a[p]a ‘father’ – A[b]a ‘Aba (proper noun)’
jó[t] ‘good-ACC’ – jó[d] ‘iodine’

b. fo/k^0-b^L/ól > fo[gb]ól ‘degree-ELA’
fo/g^0-b^L/ól > fo[gb]ól ‘tooth-ELA’
fo/k^0-t^0/ól > fo[kt]ól ‘degree-ABL’
fo/g^0-t^0/ól > fo[kt]ól ‘tooth-ABL’

Finally, the combination of the Laryngeal Constraint and the bidirectional spreading of |H| or |L| is logically impossible: if the laryngeal element of the first member of an obstruent cluster is delinked due to the lack of a following sonorant, it cannot spread rightward.[68]

Now, having surveyed the typological categories that can be distinguished in current two-element frameworks, let us examine the alternative typology in the H-only analysis, discussing the phonological and phonetic properties of the revised categories. So, if we take any binary system contrasting obstruents along the VOT continuum to be an H-language, we can establish the categories summarized in (72). Actually, this is the result of merging the two columns of the table in (63) listing the L- and H-language types separately.

(72) An alternative typology of languages with two obstruent series

Licensing of |H|	Spreading of |H|	Example
independent of position	none	English Italian
	unidirectional (regressive)	Meccan Arabic
	bidirectional	Swedish
before sonorants	none	German Ukrainian
	unidirectional (regressive)	Hungarian
	bidirectional	not possible

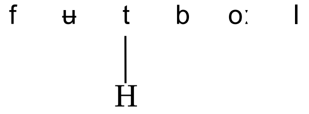
---

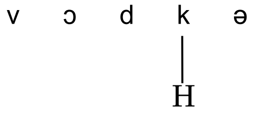
[68] In many laryngeal analyses (e.g., in Lombardi 1999: 268–269, Lombardi 1995: 67, Wetzels & Mascaró 2001: 208, 225 and de Lacy 2002: 364), word/utterance-final neutralization vs. the application of Final Exceptionality (discussed in footnote 43) is a dimension along which languages can be further divided. This is what, say, Russian and Hungarian differ in: the former exhibits the final neutralization, while the latter has Final Exceptionality, i.e., does not display delaryngealization at the end of an utterance. This difference, which is relevant in the case of languages where the licensing of the laryngeal element is restricted to presonorant position, I consider to be of relatively minor importance and thus ignore here.

Again, the difference between the languages of the two major categories is whether their laryngeal element is licensed in any position or only before sonorants. Furthermore, we can create subcategories in both groups based on the characteristics of the spreading of |H|.

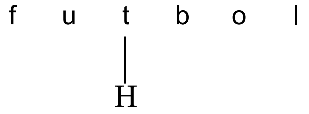
To begin with, according to this new table, English and Italian represent the same language type from a phonological point of view. |H| is always licensed in their obstruents, regardless of their position, and it does not spread; compare (73) and (74). The difference between the two systems is purely phonetic: the marked plosives are aspirated in English, and the unmarked ones are plain voiceless, whereas in Italian, this laryngeal contrast is shifted toward the "voiced" end of the VOT scale as the marked plosives are realized as plain voiceless segments, and the unmarked ones are fully voiced.

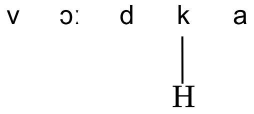
(73) a. English *foo*/tb/*all* b. English *vo*/dk/*a*





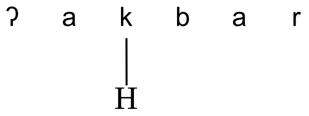
(74) a. Italian *foo*/tb/*all* b. Italian *vo*/dk/*a*



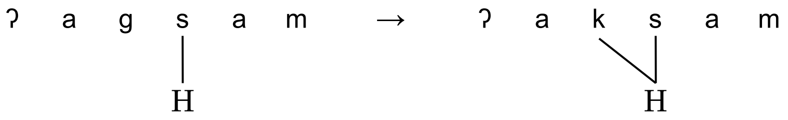


In the next language type, including Meccan Arabic and Yorkshire English, fortisness is a stronger property in the sense that besides its being licensed in any context, it exhibits (leftward) spreading as well. Practically speaking, fortis obstruents cause but do not undergo assimilation, which is therefore an asymmetrical process.

(75) a. Meccan Arabic /ʔakbar/ > [ʔakbar] 'older'

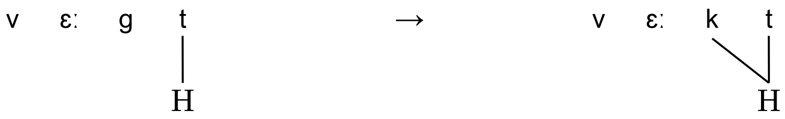


b. Meccan Arabic /ʔagsam/ > [ʔaksam] 'he made an oath'

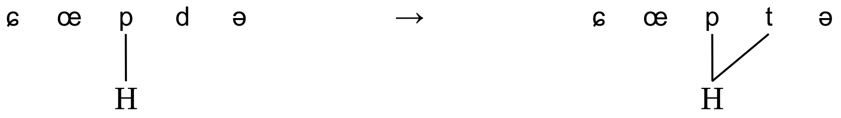


Fortisness has the most dominant role in the third subcategory of languages with context-independent licensing such as Swedish, Afrikaans and Frisian as it can trigger the assimilation of another obstruent regardless of its position relative to it:

(76) a. Swedish *vä*/g-t/ > *vä*[$^{(h)}$kt] 'weigh-SUP'

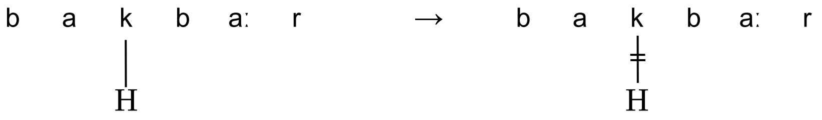


b. Swedish *kö*/p-d/*e* > *kö*[$^{(h)}$pt]*e* 'buy-PAST'

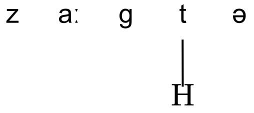


A most typical representative of the first subcategory of laryngeal systems in which the licensing of |H| is tied to presonorant position while the element does not spread is German. As far as the precise phonetic realization is concerned, the examples in (77) show that both members of the obstruent cluster in words like *ba*/k^{0}b^0/*ar* are pronounced voiceless because none of them occurs in intervocalic position. This is also true of the first member of the cluster in words such as *sa*/g^{0}t^H/*e*, whose second member tends to be aspirated.

(77) a. German *ba*/k-b/*ar* > *ba*[kp]*ar* 'bakeable'

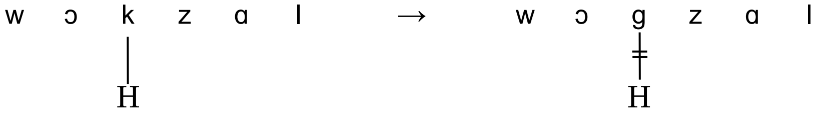


b. German *sa*/g-t/*e* > *sa*[kt^h]*e* 'say-1SG-PAST'

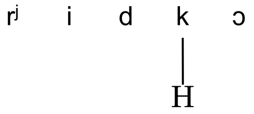


If we compare the representations in (77) with the ones in (78), it becomes clear that phonologically speaking, Ukrainian belongs to exactly the same category as German.[69] The reason why one might have the impression that the two languages are typologically different is because of the surface dissimilarity: in Ukrainian, an unmarked obstruent is fully voiced in any position, and the implementation of fortisness does not involve aspiration.

(78) a. Ukrainian *vo*/k-z/*al* > *vo*[gz]*al* 'station'



b. Ukrainian *ri*[dk]*o* 'rarely'



Examples of laryngeal systems whose obstruents undergo neutralization in non-presonorant position, and in which the |H| spreads leftward include Hungarian and Russian.[70] In these languages, just like in Ukrainian, unmarked obstruents are realized as fully voiced segments independently of

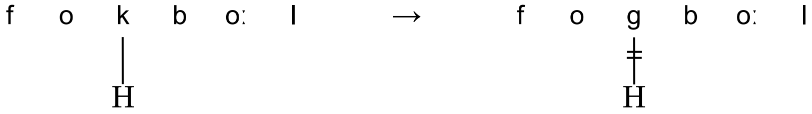
---

[69] The only difference is that Final Exceptionality is active in Ukrainian but not in German.

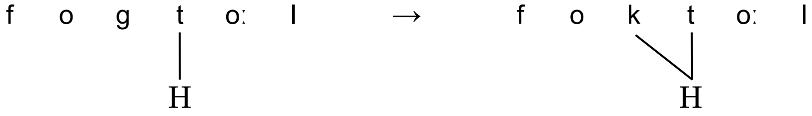
[70] For the difference between the two languages, see footnote 43.

their position, while the laryngeally specified ones are pronounced as plain voiceless consonants. Laryngeal phenomena in such systems are illustrated in (79).

(79) a. Hungarian *fo*/k-b/*ól* > *fo*[gb]*ól* 'degree-ELA'



b. Hungarian *fo*/g-t/*ól* > *fo*[kt]*ól* 'tooth-ABL'



Finally, as has been mentioned before, languages in which the Laryngeal Constraint is active may not exhibit bidirectional spreading since obstruents in such systems undergo delaryngealization if followed by another obstruent, that is, they are unable to keep their |H| and spread it rightward.

In sum, I have attempted to show that both voicing and aspirating languages can be analyzed as H-systems, and how these two-way-contrast systems can be grouped into typological categories.[71] In this laryngeal typology, languages are actually distinguished based on how strong phonologically voicelessness/consonantalness is in the systems (one extremity can be exemplified by Swedish, in which |H| is never delinked and can spread in both directions; at the other end of the scale, we can find languages like Ukrainian, where licensing is context-dependent, and the laryngeal element does not spread). For this analysis to be possible, no more stipulation and arbitrariness are needed than have been necessary anyway (concerning whether the laryngeal element triggers assimilation, and if so, what the directionality of the process is, as well as how the different obstruent categories are physically realized). As a desirable result, the number of laryngeal elements in VOT-based binary-contrast systems has been reduced to one, leading to a more uniform laryngeal analysis of such languages.

4.3.5 Placing the present approach

Now that the analysis of the present study has been discussed in detail, let us see in what ways it resembles and differs from other approaches in the phonological literature.

First of all, the analysis is carried out in Element Theory, which implies that it is a privative model, i.e., one in which a contrast in represented as the presence vs. absence of an element and not as the positive vs. negative specification of a two-valued feature. Furthermore, it differs from Laryngeal Realism and Laryngeal Relativism in that it makes use of only one laryngeal element (|H|) instead of two (|L| and |H|). In this respect, it is rather similar

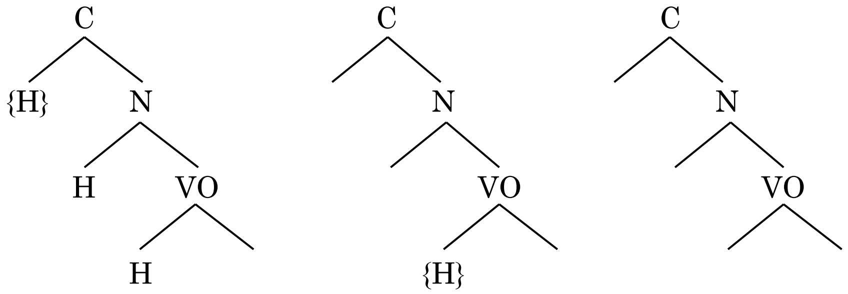
---

[71] For different laryngeal typologies assuming one distinctive feature, namely [(±)voice], see, e.g., the references in footnote 68.

to traditional approaches referred to as the "broad interpretation of the feature [voice]" and advocated by authors like Keating (1984); however, in the present analysis, it is the voiceless/fortis obstruents that constitute the marked category. As for the cross-linguistic variance in the physical properties of the obstruent series, it is taken to fall outside the domain of the phonological component and should be accounted for in the phonetics. This is possible if the relationship between phonological representation and phonetic realization is considered largely arbitrary, a view which the present approach shares with Laryngeal Relativism.

There are two laryngeal analyses that are worth mentioning here as both of them treat the relatively more voiceless obstruent series as the marked category. However, unlike the present approach, they encode the voicing–aspirating language division in the phonology (Eugeniusz Cyran, personal communication). One of the advantages of these models is that they seem to be able to effectively account for optional/incomplete word-final neutralization and presonorant sandhi voicing. One of them can be found in Schwartz (2016), where sound segments are represented as "hierarchical structures of phonetic events" (116). The trees in (80) show the differences between the three plosive categories assumed in aspirating and voicing languages; "C" is shorthand for Closure, "N" for Noise (= release burst) and "VO" for Vocalic Onset, all of which are relevant phases for this segment type, and "{H}" indicates where the laryngeal element enters the tree and trickles down from. Aspirating languages like English contrast the plosives in (80a) with those in (80c), whereas voicing languages like Hungarian have the series represented in (80b) and (80c). In the case of an aspirated plosive in (80a), |H| is assigned to the Closure level and therefore occupies the Noise node, meaning that the segment is aspirated, as well as the Vocalic Onset node. The presence of |H| at the Vocalic Onset node and the underspecification of the Closure and the Noise node in (80b) is how unaspirated voicelessness is represented. The trees of voiced/lenis plosives in (80c), which can be found in both voicing and aspirating languages, lack |H| completely. That is, in Schwartz's (2016) model, phonetic differences between voiced and aspirating languages are encoded in the phonological representation as well.

(80) a. [pʰ, tʰ, kʰ] b. [p, t, k] c. /b, d, g/



The other analysis in which the voiceless/fortis obstruents are considered to form the laryngeally marked set in aspirating as well as voicing languages is that of van der Hulst (2015). As can be seen in (81), the two obstruent categories in, say, Hungarian and English are identical at the phonemic level. What the two systems actually differ in is what redundancy rules they apply to enhance the contrast between the two series: in Hungarian, the unmarked obstruents are enhanced with [voice], whereas in English, the fortis series is supplemented with [spread] in the onset of a stressed syllable, processes which take place in the phonological component (Cyran 2017: 504–505). So, the separation of voicing and aspirating languages is encoded phonologically in this model too, and as laryngeal assimilation is triggered by the redundant properties assigned to [Ø] and [fortis], it is connected to the phonological specification of the segments (see van der Hulst 2015 and Cyran 2019: 148–152).

(81)

	/b/	/p/
Hungarian	[Ø] (→ [voice])	[fortis]
English	[Ø]	[fortis] (→ [spread] / onset)

As has been shown in the previous subsection, in the analysis proposed here, languages are not distinguished by different laryngeal specifications in the phonology but according to the different processes operating on the laryngeal element (and based on the phonetic implementation of the element, with which the element has an arbitrary relationship). Furthermore, as far as these processes are concerned, we have seen that almost all possible versions of their application are observable across languages, regardless of whether one or two laryngeal elements are used in an analysis: the nonspreading of the element as well as its spreading, in which case its direction can be right-to-left or left-to-right. As a consequence, accounting for laryngeal phenomena in the present approach—and, I suppose, in most comprehensive analyses in general—appears to support the necessity for the freedom assumed in a substance-free view—see section 3.2.[72] This unrestrictive phonological theory seems to be exploited by the cross-linguistically observable behaviors of |H| (or |H| and |L|). As to which patterns are the most frequent (e.g., the rightward spreading of voicing), which are marginal (e.g., the bidirectional spreading of voicelessness), and which are unattested (phonologically conditioned progressive laryngeal assimilation without its regressive counterpart), these tendencies can be normally explained with reference to extragrammatical factors and should be considered irrelevant to phonological analysis. According to Reiss, a phonological theory "should not account for generalizations about statistics of attested or attestable patterns of phonetic substance, even those that are presumed to be absolute, such as the (assumed here) impossibility of final voicing" (2018: 425).

As was mentioned in section 3.3, Cyran (2014: 198–201, 2016) examines the possibility of analyzing the two Polish dialects in a substance-free approach as well. He suggests using the same feature/element in both dialects to mark one of the obstruent series; however, in contrast to the present analysis, he continues to specify the voiced category in WP and the voiceless one in CP (explaining the difference in the implementation of the feature/element in the

---

[72] The assumption made in Keating's analysis (discussed in more detail in section 2.2.1) is also in harmony with this view: as phonological rules apply to the values of phonological features prior to the assignment of phonetic categories to them, "the occurrence of a phonological rule in a language should not depend on, or be correlated with, the phonetic details of the language" (1984: 292).

two laryngeal systems with the principle of Laryngeal Relativism stating that the relationship between the feature/element and its phonetic realization is arbitrary).

4.4 Conclusion

In this chapter, I have presented an alternative approach to laryngeal analysis, the Same-Element-Different-Processes model, with the aim of showing that it might fare better than many current analyses.

One of the main assumptions in this study is that it is unnecessary to reserve both |L| and |H| for encoding laryngeal oppositions in VOT-based binary-contrast systems (i.e., voicing and aspirating languages). Instead, I propose applying only |H| to mark the obstruent series that falls closer to the "aspiration" end of the VOT scale in both language types. Positing |H| instead of |L| seems to be fair better cross-linguistically.

In the present analysis, two-way laryngeal systems are considered to differ only in the processes operating on |H|: it can be licensed in any context or only in presonorant position, it can spread or not, and in case it exhibits spreading, its direction can be regressive or progressive. The fact that the combinatorial possibilities of these parameter settings have been exploited cross-linguistically seems to support the need for a set of functions unconstrained by extralinguistic factors, which can be provided by a substance-free model. As for cross-linguistic variations in the physical realization of the marked and unmarked obstruent series, these differences can be explained if we adopt the principle of the Laryngeal Relativism view according to which the relationship between the phonological makeup of a segment and its phonetic qualities should be considered arbitrary.

As an advantage of this approach, abandoning |L| as a laryngeal element results in a simpler and more uniform representation. In addition, this reduction in the number of elements does not increase complexity in other areas: The present analysis only makes use of phonological processes which have been supposed to be present all along even in two-element approaches—provided that they do not ignore lower frequency laryngeal patterns. Also, assuming arbitrariness regarding the relation between phonetic qualities and phonological specifications seems to be inevitable in general.

In the next chapter (chapter 5), I will argue that laryngeal dissimilation cross-linguistically supports the proposed model. Then, in chapter 6, I will attempt to show that not even languages displaying interactions between voicing and nasality, the two manifestations of |L|, necessitate the assumption that |L| should be present in the system as a laryngeal element.

Chapter 5

Laryngeal dissimilation

This section provides an overview of laryngeal dissimilation, and it will be shown how this phenomenon supports cross-linguistically the claim that in two-way laryngeal systems, fortis obstruents constitute the marked category.

5.1 Background to dissimilation

Dissimilation can be defined as "a situation in which a segment becomes less similar to a nearby segment with respect to a given feature" (Bye 2011: 1408). Bye captures the most important characteristics of dissimilation, some of which are going to be summarized below (the authors mentioned in this part are cited in Bye (2011)), and he points out the significance of the proper investigation of the process as it might contribute to understanding, for instance, "the nature of rules and representations, and the relation between the two" (2011: 1409). This is what the present chapter aims at.

An oft-cited example of the phenomenon is the case of the Latin adjectival suffix -*ālis*, the liquid of which dissimilates to /r/ when it is preceded by /l/ in the stem:

(82) a. *nāvālis* 'naval' b. *lūnāris* 'lunar'
vītālis 'vital' *rēgulāris* 'regular'

Besides laterality, features that can be involved in dissimilatory patterns include place of articulation (labiality and coronality), manner of articulation (continuancy, nasality and rhoticity), vowel height, suprasegmental properties like length and tone as well as laryngeal state (voicing, spread glottis and constricted glottis), of which it is the latter, of course, that will concern us. As a regular synchronic phonological process, dissimilation is far less frequent than assimilation. Furthermore, examining 45 cases, Bye finds a more or less even distribution as to the directionality of the process (24 regressive and 21 progressive cases)—one way in which it differs from assimilation, which is characterized by a strong bias toward right-to-left directionality (Hansson, as cited in Finley 2017: 4). As far as locality conditions are concerned, dissimilation can take place between segments of a root and an affix, requiring that the two constituents be adjacent, it can happen between adjacent syllables, or its application can be unbounded and span a longer distance.

Regarding the possible motivations for this relatively rare phenomenon and its conditions, several theories have been proposed. One possible explanation for the phenomenon is the attempt to avoid ambiguity (the Coarticulation-Hypercorrection Theory of Ohala): If two instances of the same feature occur in the same domain, it might be difficult for the listener to identify whether it is the first or the second segment or both that bears the phonetic property cued by the given feature. This situation has led to the reversal of the effect of what was judged by the listener as coarticulatory assimilation, resulting in the dissimilation of the segments. This theory entails that the possibility of dissimilation is tied to features with phonetic cues extending beyond the duration of a segment since it is only in these cases that overlapping articulation is to be expected. It predicts dissimilation of aspiration but not of voicing as vocal fold vibration is localized on the segment itself. This assumption does not appear to hold water though as dissimilation involving voicing/voicelessness *is* an attested phonological process.[73]

Another theory is proposed by Berkley, who considers the general tendency of languages to avoid similarity in neighboring consonants in roots (reflected, for example, in the dispreference of homorganic consonants in monomorphemic English words of the form CVC), and she takes it to be the driving force of dissimilation too. The idea, explained in terms of neurological processes, is that if one is exposed to two stimuli of the same type within a short interval, it is possible that they might attribute the heard phonetic cue to the first occurrence of the given feature, believing that the perception of its second instance is due to the fact that it takes some time for the neural excitation of the first stimulus to be inhibited, and they might reverse this presumed effect. This reanalysis results in a dissimilatory pattern. As the temporal extension of the acoustic signal is not considered to play a role here, voice dissimilation can be as easily handled in this theory as the dissimilation of aspiration. It follows from this explanation that the process should be more frequently progressive than regressive. This is, however, not supported by the distribution of the cases in Bye's list mentioned above. Furthermore, it might be worth noting that it has also been argued that, contrary to the prediction of this theory, consonantal dissimilation is prototypically regressive because it is not conditioned by automatic physical and physiological factors. It happens because the speaker can think ahead and change the quality of a segment, considering the quality of another segment to be uttered after it, so it rather has a psychological basis (Kent 1936). Kent claims that when the direction of dissimilation (and assimilation) is left-to-right, it normally has a semantic reason.

According to a third theory, a motivation for dissimilation may be the aim of the speaker to increase cue robustness, which would be harder to perceive in the original form of the sound sequence.

---

[73] It might be the case that the existence of voice dissimilation does not necessarily go against the implication of this theory. /l~r/ alternations exemplified in (82) can be accounted for with reference to the raising and lowering effect of /l/ and /r/, respectively, on the F2 and F3 values of neighboring high vowels, which, in fact, is observable even several syllables away from the liquid (Bye 2011: 1421). By the same token, the impact of voiced vs. voiceless obstruents on the fundamental frequency of adjacent vowels shows that voicing/voicelessness is not restricted to the duration of the obstruent. Whether the perceptual salience of this phonetic cue of the feature and the degree to which it can be extended beyond the segment are enough for the dissimilation to be expected should be investigated in greater depth.

5.2 Phonological analysis of laryngeal dissimilation

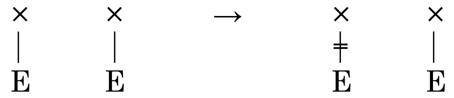
Now, let us continue with the phonological treatment of dissimilation. Although the phonetic, biological and psychological factors discussed in the previous section are worth considering if we want to get a complex picture of the characteristics of the phenomenon in particular languages and cross-linguistically. However, according to the substance-free view on phonology, the computational system itself should be regarded as free to manipulate phonological primitives independently of the mentioned extralinguistic factors.

To begin with, the process can be described with the following feature-changing rule, where “F” stands for feature (Bye 2011: 1414):

(83) $X \rightarrow [-F] \,/\, \_\_\ [+F]$

That is, if a segment bearing the marked value of a given feature is followed by another one with the same specification for the feature, the first segment must be specified for its unmarked value. In privative terms, this means that the first segment loses its distinctive feature or melodic element (E):

(84)



Examples of this process where aspirated obstruents are involved in dissimilation can be found in languages like Ancient Greek and Meithei. Ancient Greek has a laryngeal constraint which prohibits two aspirated segments in adjacent onsets; see (85), from Szigetvári (1996: 106–107). In (85a, c, d), the first of the two obstruents undergoes deaspiration to repair an illicit form (note how aspirated plosives and /h/ pattern together); in (85b, e), the nominative and the future suffix suppress the aspiration of the second obstruent, protecting the first one from dissimilation. This process is referred to as Grassmann’s Law. The examples in (86), from Chelliah (1997: 54–55), illustrate the phenomenon in Meithei, a Tibeto-Burman language spoken in India. The difference is that here, it is the second aspirated obstruent that dissimilates. (Note, based on (86c–d), how fricatives, including /h/, pattern with aspirated plosives.)

(85) Deaspiration in Ancient Greek

a.	/pʰe-pʰeuga/	→	/pe-pʰeuga/	‘flee-PERF-1SG’
b.	/tʰrikʰ-s/	→	/tʰrik-s/	‘hair-NOM’
c.	/tʰrikʰ-a/	→	/trikʰ-a/	‘hair-ACC’
d.	/hekʰ-ē/	→	/ekʰ-ē/	‘has’
e.	/hekʰ-s-ē/	→	/hek-s-ē/	‘have-FUT-3SG’

(86) Deaspiration in Meithei

a. *thin* ‘pierce’ + *khət* ‘upward’ → *thingət* ‘pierce upward’
b. *khik* ‘sprinkle’ + *khət* ‘upward’ → *khikʔət* ‘sprinkle upward’
c. *hi* ‘trim’ + *thok* ‘outward’ → *hidok* ‘trim outward’
d. *sét* ‘tear’ + *khay* ‘totally affect’ → *ségay* ‘tear up’

Dissimilation of aspiration is, in fact, robustly attested. Further languages in which it is present as an active phonological process can be found all over the world: e.g., Ekoti (also known as Makhuwa/Makua, a Bantu language spoken in Mozambique), Ofo (a Siouan language spoken by the Ofo tribe in Arkansas and Mississippi), Cuzco Quechua (a Southern Quechuan dialect spoken in Peru), Sanskrit and possibly Adiyaman Kurmanji (a Kurdish Indo-Iranian language spoken in Eastern Turkey) (see Bennett 2013: 591 and references therein). The dissimilation of laryngeally unmarked segments to their aspirated counterparts is unattested (Bennett 2013: 593).

The same is true of the dissimilation of constricted glottis. Cuzco Quechua Salis languages (spoken in the Pacific Northwest of North America) including Columbian, Okanagan Shuswap and Tillamook provide examples of this pattern; whereas the dissimilation of unmarked segments to segments specified for constricted glottis is unattested (see Bennett 2013: 593–594 and references therein).

5.3 Laryngeal dissimilation supporting the markedness of fortes

5.3.1 Voicing languages with phonologically active voicelessness

The table in (87) provides a general summary of all the possible versions of laryngeal dissimilation patterns along with their attestation. The difference between the features [voice], on the one hand, and [spread glottis] and [constricted glottis], on the other, can be clearly seen: it appears that in voicing languages with laryngeal dissimilation, it is regularly the marked obstruent type that an unmarked obstruent changes to when it undergoes the process, while its reverse is atypical.

(87) Attested and unattested types of long-distance laryngeal dissimilation (Bennett 2013: 501)

Laryngeal feature	Feature value undergoing dissimilation	Attested?
[voice]	+	moderately
	–	robustly
[spread glottis]	+	robustly
	–	unattested
[constricted glottis]	+	robustly
	–	unattested

An apparent advantage of feature changing rules is that they can arbitrarily require either value of a distinctive feature to turn into its opposite; however, in privative models, the representation of the pattern in question is quite problematic as the source of the feature [voice] or the element |L| is unclear; see (88) vs. (89).

(88) X → [+voice] / __ [−voice]

(89) $$\times \qquad \times \qquad \rightarrow \qquad {}^{?}\underset{\substack{| \\ \mathrm{L}}}{\times} \qquad \times$$

If we consider other features, too, summarized in the table in (90), it becomes even more striking how the behavior of the feature [voice] stands out.

(90) Types of dissimilation, by robustness of attestation (Bennett 2013: 502)

Robustness of attestation	Feature (specification) undergoing dissimilation
Robustly attested	[Labial] nasal+C clusters/prenazalization [+spread glottis] [+constricted glottis] [−voice] [+rhotic]/[−lateral], in liquids
Moderately attested	[Coronal] [+voice] [+lateral]/[−rhotic], in liquids
Weakly attested	[Dorsal] [Radical] [+liquid] [±anterior] (in liquids)
Questionably attested	[+continuant] [−continuant] [+nasal]

It is almost always the marked value of a feature that participates in dissimilation. Of course, it might vary to some extent what this table looks like depending on exactly what features or elements are assumed in a given theory, but it seems that the tendency remains the same even if one works within a framework using a more or less modified set of the one applied here: dissimilatory processes that must be analyzed as the addition of an element to the representation of a segment with no explicable source might be limited to the case of voice dissimilation. As for the dissimilation of labiality, coronality, dorsality or anteriority involving the place elements |A|, |I| and |U| (instead of the place features [Labial], [Coronal], [Dorsal] and [±anterior]), it might be possible to account for these processes in the given language by reconsidering the makeup of segments with different places of articulation, which is what their behavior can be taken to reveal (this might include deciding whether a velar consonant is a headless phonological expression lacking a place element, as proposed by Kaye (2000: 4), or velarity is represented by a non-headed |U|, as argued for in Backley (2011: 96–98), etc.). When dissimilation is related to the manner of articulation of a segment (i.e., the feature [±continuant] or [±rhotic]/[±lateral]), which is weakly or questionably attested, the possible “appearance” of the occlusion element |ʔ| might be derivable from relations between skeletal positions (see, e.g., Szigetvári 2004).

The most puzzling case remains that of the dissimilation involving voicing, where it is [−voice] segments that most frequently participate in the process rather than their marked counterparts. The dissimilation of [−voice] occurs, for instance, in a number of Eastern Bantu languages including Kikuria, Ekegusii, Embu, Meru, Kikuyu, Kinyarwanda and Kirundi, in which the process is referred to as Dahl’s Law, but also in Moro (a Niger–Congo language spoken in Sudan) and in Minor Mlabri (an Austroasiatic language spoken in the border area between Thailand and Laos). The examples in (91), from Bennett & Rose (2017: 474), illustrate laryngeal dissimilation in Moro, which is a productive process in the language.

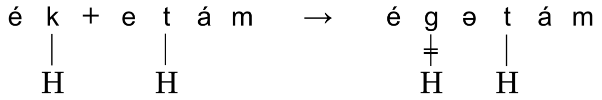
(91) Dissimilation of voicelessness in Moro

a.	/ék-/	+	/ómóná/	→	/ék-ómón/	‘LOC-tiger’
b.	/ék-/	+	/etám/	→	/ég-ətám/	‘LOC-neck’
c.	/lalogó/	+	/-at̪/	→	/lalog-at̪-ó/	‘they said (at)’
d.	/lapó/	+	/-at̪/	→	/lab-at̪-ó/	‘they carry into/at’

Bennett & Rose (2017) point out that in Moro, fortisness is the phonologically active feature participating in dissimilatory processes; however, they use this to support the claim that [voice] is a binary feature, which makes [−voice] available for the phonological analysis. Also, they exclude the possibility of categorizing Moro as an aspirating language with [spread glottis] based on the phonetic characteristics of its plosives: its fortes are simply voiceless without aspiration, whereas the production of its lenes involves active voicing.

Moro as well as all the other languages displaying laryngeal dissimilation where fortis obstruents turn into lenes makes it clear that in a privative model like Element Theory, one is sometimes unambiguously forced to decide whether they take the phonetic properties of obstruents or their phonological behavior to base the phonological makeup of segments on because both criteria cannot be met. Bennett’s (2013) summary of dissimilatory patterns shows that not only do languages exist which are voicing in a phonetic sense with the voiceless series being phonologically active, but also that this is, in fact, the trend. I argue that dissimilation unanimously provided evidence that in phonological analysis, laryngeal systems displaying this phenomenon which are traditionally regarded as L-languages should be categorized as H-languages. This is illustrated in (92). For a similar and detailed analysis of Dahl’s Law (treating it as the licensing or delinking of H-heads), see Ploch (1999: 204–218).

(92)



5.3.2 Two peculiar cases

We have seen that of the languages featuring laryngeal dissimilation, even voicing languages provide clear evidence for the phonological activeness of voicelessness. Therefore, it is not only possible but also necessary to take them as H-systems. In this subsection we are going to examine two cases the analyses of which might be more puzzling, but it still seems more advantageous to categorize them as H-languages: Bakairi and Azerbaijani.

5.3.2.1 Bakairi

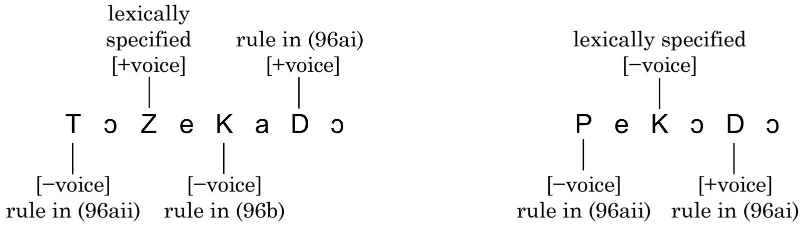
In Bakairi, a Caribian language spoken in Brazil, which is reported to contrast voiced obstruents with a voiceless series, laryngeal dissimilation is a phonologically active process. Based on the descriptions of Wetzels (1997), the following regularities can be summarized: The language has (C)V syllables, so consonant clusters do not form. As for the laryngeal pattern, sequences of voiceless and voiced or voiced and voiceless obstruents can be found alternating within polysyllabic roots (see (93a–e)); morphemes in which voiced obstruents follow each other, like in (93f), are rare. Furthermore, no more than one voiceless obstruent can occur in any root, disregarding the initial one, if any, which is always voiceless. The allomorphs of the same roots in (94) show that once the morpheme-initial voiceless obstruent gets into intervocalic position, it will be voiced.

(93)				Pattern
	a.	/tɔzekadɔ/	‘bench’	(−) + − +
	b.	/pekɔdɔ/	‘woman’	(−) − +
	c.	/paʒika/	‘ant eater’	(−) + −
	d.	/itubi/	‘skin’	− +
	e.	/ɔdɔpigɔ/	‘heat’	+ − +
	f.	/azage/	‘two’	+ +

(94) a. /təkə/ ‘bow’ ~ /tə-dəka-ge/ ‘have a bow’
b. /pepi/ ‘canoe’ ~ /i-βepi-re/ ‘his canoe’

In order to account for the data, Wetzels (1997) proposes an analysis in which obstruents are laryngeally underspecified in the underlying representation. Laryngeal features are, in fact, present in the lexical entry as floating features. For example, /tɔzekadɔ/ ‘bench’ and /pekɔdɔ/ ‘woman,’ shown in (95), are stored in the lexicon with the feature [+voice] and [−voice], respectively, which will be associated with the first intervocalic obstruent, i.e., the /Z/ and /K/ (capitals represent laryngeally underspecified obstruents in the underlying representation). The initial /T/ and /P/ will be voiceless in this position as a result of the universal markedness constraints in (96a). The /K/ in /tɔzekadɔ/ will be voiceless due to the Voice Dissimilation rule in (96b). Finally, according to the rules in (96a), the /D/’s in both words will be voiced. In exceptional cases, the lexical entry of the word, like the one in (93f), does not carry any laryngeal feature to be associated with an obstruent. Therefore, the rule in (96ai) will make all intervocalic obstruents voiced, which explains why dissimilation fails to take place. The reason why the rule in (96b) does not apply to the /G/ of /azage/ to make it voiceless is that the rule needs a lexical [+voice] in the preceding obstruent to be triggered, and the /z/ of /azage/ is not lexically specified for it.

(95) a. b.



(96) a. i. Ø laryngeal → [+voice] / V__V
ii. Ø laryngeal → [−voice] / elsewhere

b. Voice Dissimilation
Insert [−voice] / [+voice]__

Wetzels's (1997) aim was to provide evidence for the phonological relevance of the negative value of the feature [voice] in Bakairi. In accordance with his proposal but going one step further, I argue that it is precisely voicelessness that is necessary to account for the data presented above, which is, in fact, possible without taking voicing to be phonologically active in the system. This assumption will not involve more stipulations than have been introduced.

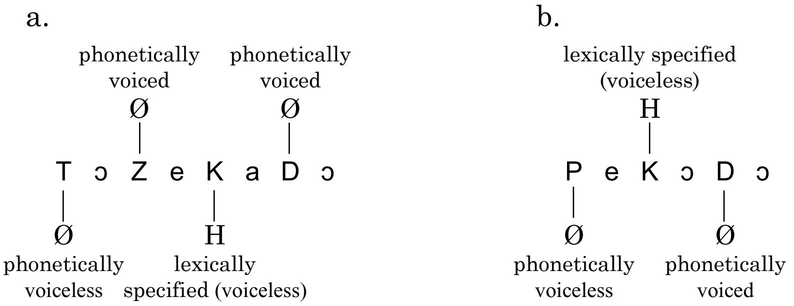
Let us take, again, /tɔzekadɔ/ and /pekɔdɔ/ in (95) as examples. My suggestion is that instead of a floating [±voice] in the lexicon, which will be associated with the first intervocalic obstruent, we should assume only |H| (or an active [−voice]), of which only one is possible per root. As to which of the first two intervocalic obstruents will be specified for this element, it is a lexical property of the word, i.e., the association does not happen mechanically.[74] This means that on the one hand, the number of elements decreases, so information about which element a root contains does not have to be stored; on the other hand, it has to be specified for each lexical entry which is the laryngeally marked obstruent in it: e.g., in /tɔzekadɔ/, it is the second intervocalic obstruent from the beginning (/k/), and in /pekɔdɔ/, the first one (also /k/). The constraint concerning the nonspecification of morpheme-initial obstruents remains the same. Whether these segments are pronounced voiced or voiceless is not a phonological issue. They will be realized as voiced sounds only if they occur in intervocalic position, that is, as the result of passive voicing, a process phonetic in nature; see the alternations in (94). Finally, the unmarked /d/'s in both /tɔzekadɔ/ and /pekɔdɔ/ are voiced based on their being in intervocalic position, and so is the voicing of the /z/ in /tɔzekadɔ/ explained. An advantage of this approach is that the voicing or voicelessness of an obstruent by virtue of the environment in which it occurs is characteristic of the unmarked obstruents in

---

[74] The language seems to have a constraint requiring that the laryngeal element be associated with one of the first two intervocalic obstruents—similarly to the Early Stress Requirement of English, which prohibits words from beginning with two unstressed vowels (see Nádasdy 2006: 191–192). (Just like laryngeal specification, stress can also be considered a segmental property, unlike accent, whose placement is a prosodic phenomenon—see Szigetvári (2020b).)

H-systems. If Bakairi is analyzed as an H-language this process can be delegated to the phonetic component and does not need to be stipulated in the phonology with the markedness rules in (96a). In (97a–b), the alternative representations of the words in (95a–b) can be seen.

(97)



Wetzels (1997) goes on to treat derived words as well like the ones in (98). In (98a–b), the same pattern can be seen as in monomorphemic words (see the representations in (95a–b)). Wetzels argues for the necessity of the positive value of [voice] with reference to words like the ones in (98a) and (98c), where the difference is that in the former case, the root contains a lexical [+voice], causing the Voice Dissimilation rule in (96b) to specify the next obstruent in the suffix as [−voice], while in the latter, with the absence of [+voice] in the lexicon, only (96ai) can apply, requiring every intervocalic obstruent to be voiced. He cites (98d–e) as evidence for floating features, which cannot dock on a consonant in the root not containing any obstruents. Therefore, the floating [−voice] and [+voice] of /ema/ 'win' and /ema/ 'steal,' respectively, will be associated with the initial obstruent of the following suffix, and the voicing of the rest of the obstruents will be determined by the rules in (96), as expected. The cases, Wetzels claims, also show that the suffix /Ke/ cannot be assumed to contain an underlyingly voiceless obstruent.

(98)	a.	/n-ige-aki/	'3-die-PAST' ('died')
	b.	/n-ike-agi/	'3-sleep-PAST' ('slept')
	c.	/ezedi-ge/	'with the name'
	d.	/n-ema-ke-agi/	'3.ABSOL-hand-VBZR-PAST' ('won')
	e.	/n-ema-ge-aki/	'3.ABSOL-hand-VBZR-PAST' ('stole')

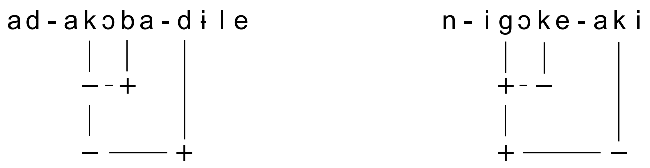
Actually, the derived words in (98) can be used to argue for the existence of floating elements or features but do not necessarily require the presence of |L| (or [+voice]) in the system. This is how Wetzels's analysis could be transformed into a privative model: As has been mentioned, the decrease in the number of laryngeal elements, or feature (specification)s, involves that it is a lexical property of a root which obstruent is the laryngeally specified one, if any, i.e., it is not automatically the first intervocalic obstruent. Therefore, the difference between /n-ige-aki/ 'died' in (98a) and /ezedi-ge/ 'with the name' in (98c) is not that the obstruent of /ige/ is laryngeally marked while those of /ezedi/ are underspecified but that the root /ige/ bears a floating |H|, which, as lexically specified, does not dock on the first intervocalic obstruent of the word but on the one following it. The result is the same as in the case of /n-ema-ke-agi/ 'won' in (98d); the voicelessness of the obstruent of the suffix following it is caused by the floating laryngeal element of the root it receives.[75]

Furthermore, Wetzels's analysis, which mostly accounts for laryngeal dissimilation in roots and words containing a single suffix, which seem to behave like monomorphemic words, might need to be revised if cases such as the ones in (99) are also taken into account; (99a–c) from Souza (1991) and (99d–f) from Souza (2014).

(99)	a.	/ad-akɔba-dɨle/	'INTRANS-hunt-ASP' ('to hunt')
	b.	/n-ekɔbɨze-agi/	'3-sweat-PAST' ('sweated')
	c.	/n-igɔke-aki/	'3-wash-PAST' ('washed')
	d.	/n-eki-ge-aki/	'3.ABSOL-grain-VBZR-PAST' ('threshed')
	e.	/n-emaɣaze-dai/	'3.ABSOL-steal-PAST' ('stole')
	f.	/inh-emaɣaze-tɨbe/	'3.ERG.3.ABSOL-steal-PAST' ('stole')

Although the forms in (99a–b) are predicted by Wetzels's approach, the one in (99c) is not what we expect (it should be */n-igɔke-agi/ as the result of the universal markedness rules in (96a)), and the voicelessness in /aki/ in (99d) is also unmotivated in the current state of his analysis. Souza (1991) claims that dissimilation in Bakairi does not apply strictly sequentially; it is triggered by the leftmost obstruent of the root, and it restarts every time a syntactic boundary is reached, as in (99a) and (99c), represented in (100a) and (100b) (the +/− signs indicate the [voice]-specification of the obstruents). Also, fricatives can interrupt the process, as can be seen in (99b).[76]

(100) a. b.



---

[75] One could argue against treating the voicelessness of the obstruent of the suffix /Ke/ in /n-ige-aki/ in (98a) and in /n-ema-ke-agi/ in (98d) as the same phenomenon in the reanalysis proposed. If /ema/ bears a floating |H|, then it follows without any further stipulation that the element will dock on the obstruent of the suffix as the only possibility with the root having only sonorants. As for roots like /ige/, on the other hand, it must be further assumed that an obstruent-containing root can bear an |H| which is not associated with the obstruent. This is nevertheless the case in, for example, /u-di-aki/ '1-go-PAST' ('went'): the obstruent of /di/ 'go' cannot be laryngeally specified root-initially in Wetzels's analysis either (the only reason why it is voiced can be that it occurs in intervocalic position; elsewhere it must surface as /ti/, I suppose), so the word must come with a floating |H|, which docks on an obstruent other than that of the root. This transfer is motivated by the constraint that root-initial obstruents must be nonspecified in the language. In a privative analysis in which it is the lexical property of a word which obstruent it marks laryngeally and in which floating elements must be assumed, taking roots like /ige/ to contain a floating |H| does not require any additional stipulation.

[76] Of course, further details would be necessary for gaining a more comprehensive insight into Souza's (1991) analysis (e.g., her argument that dissimilation is "a multidimensional phenomenon, which takes place in stages and at various levels" (320)). However, the claims cited above are sufficient for an illustration of how problems arising when further data are considered can be possibly handled.

With the words in (99d–f), the situation becomes even more complex. The form in (99d) is in contrast with what Wetzels (1997) and Souza (1991) might both predict—on different bases though—i.e., */n-eki-ge-agi/. In Souza (2014), we can find numerous instances of the occurrence of the verbalizer suffix /-ke/~/-ge/ followed by the past tense suffix of inaccusative verbs /-aki/~/-agi/ (277), some of which have already been cited:

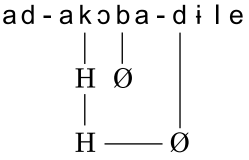
(101)	a.	/n-epɨ-ge-agi/	‘3.ABSOL-?-VBZR-PAST’ (‘pulled’)
	b.	/n-eki-ge-aki/	‘3.ABSOL-grain-VBZR-PAST’ (‘threshed’)
	c.	/n-urrudu-ge-agi/	‘3.ABSOL-feather-VBZR-PAST’ (‘plucked a feather’)
	d.	/n-au-ge-aki/	‘3.ABSOL-?-VBZR-PAST’ (‘tore’)
	e.	/n-ema-ke-agi/	‘3.ABSOL-hand-VBZR-PAST’ (‘won’)
	f.	/n-ema-ge-aki/	‘3.ABSOL-hand-VBZR-PAST’ (‘stole’)

Besides all the possible phonological processes shaping the Bakairi dissimilation pattern already complex enough, Souza mentions that the variant /-ge/ of the verbalizer attributes a kind of “negative” sense to the derived verbs in (101a–c, e–f), while the word in (101e) with /-ke/ is associated with a less “negative” sense (cf. (101f), derived from the same root), an influencing factor falling outside the scope of phonology. So, the coexistence of forms like /n-ema-ke-agi/ ‘won’ in (101e) and /n-ema-ge-aki/ ‘stole’ in (101f) can be thought of as the result of what Souza calls the “harmony game” responsible for the dissimilatory pattern coupled with the “reverse game of the distribution of voiceless and voiced segments, forming words within the same semantic field,” an old and quite productive process in the language (2014: 277–278).

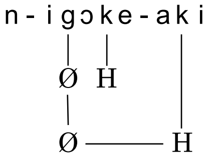
Finally, although it has been suggested that since the alternation of /-ke/ and /-ge/ is conditioned by the dissimilation process, we cannot posit an underlying form for the morpheme (Wetzels 1997: 31), the words in (99e–f) seem suspicious: the suffixes /-dai/ and /-tɨbe/, the former beginning with a voiced plosive, the latter a voiceless one, both follow exactly the same root, /emaɣaze/ ‘steal,’ and behave differently. It might mean that at least some suffixes can be assumed to have an underlying laryngeal specification, but to draw a safe conclusion, a more thorough investigation of the phenomena would be needed.

Based on the above examples, it can be concluded that laryngeal dissimilation in derived and inflected words generally conforms to the processes represented in (100a–b), whose alternative versions expressed in privative terms are given in (102a–b).

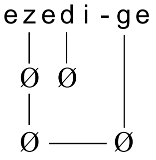
(102) a.



b.



c.



In fact, these cases can be regarded as instances of allomorphic alternations, where the first obstruent of a suffix is required to be laryngeally unmarked if the first intervocalic obstruent of the root is marked, and vice versa. That is, they are not examples of dissimilation as phonological processes. As for words containing only voiced obstruents and failing to participate in dissimilation (see (98c)), they are rare and, in the present analysis, should be considered exceptions; see the representation in (102c)—cf. (102b).

For the proper development of an alternative analysis of laryngeal dissimilation in Bakairi, more data would be necessary. For example, it would be important to learn whether there are further cases in which semantic considerations influence the distribution of voiced and voiceless obstruents, and if so, which suffixes are involved. Another question that would need to be answered is whether we have reason to posit underlying forms for some (or all) of the suffixes of the language. Also, Souza (1991) does not treat roots containing only sonorants, and it is not clear to me from Souza (2014) either whether we can only account for dissimilation involving such roots with reference to floating elements, as suggested by Wetzels (1997), or the cases that seem to force us to assume such unassociated elements are generally affected by semantic factors.

Nevertheless, the point here is that for the laryngeal analysis of Bakairi, we do not need two laryngeal elements (or distinctive features or both values of a binary feature). What can be thought of as laryngeal dissimilation within roots is actually the artifact of the constraints insuring that one root morpheme contains no more than one |H| and that this |H| marks either of the first two intervocalic obstruents. If we extend the scope of our study to derived and inflected words, we find allomorphic alternations motivated by a constraint requiring that one and only one out of the first intervocalic obstruent of the root and the first obstruents of the following suffixes must be marked for |H|, resulting in the opposite laryngeal specification. There are subregularities and exceptions, which could be treated in more depth, but they do not seem to undermine the claim that the patterns in both mono- and polymorphemic words can be generally accounted for using the element |H| only.

5.3.2.2 Azerbaijani

Laryngeal phenomena in Azerbaijani, a survey of which focusing on the Tabriz dialect spoken in the south of Azerbaijan is provided in Salimi (1976), seem to be a minefield for phonological theories; but, at the same time, they tend to support the markedness of the fortis obstruent series. This is the only language I have come across which seems to display laryngeal dissimilation in adjacent segments (i.e., with no intervening vowel).

First of all, as Payam Ghaffarvand Mokari (personal communication) also confirms, phonetically speaking, Azerbaijani contrasts unaspirated voiceless plosives with a voiced series; see, e.g., the minimal pair [tuman] ‘pants’ vs. [duman] ‘fog.’ Furthermore, as can be seen from the phonetic realizations of the underlying forms in (103), from Salimi (1976: 38, 82–83, 126), the language displays word-final devoicing, which is a somewhat more complex process than, for example, in Polish: The labial and the dental voiced stop become voiceless at the end of polysyllabic words, otherwise they remain voiced (see (103a)). The voiced velar plosive regularly does not occur at the end of words; it undergoes spirantization accompanied by the devoicing of the fricative regardless of the number of syllables the word consists of—devoicing is only inhibited by a preceding underlyingly long vowel. In literary pronunciation, it is possible to hear [k]'s at the end of polysyllabic words, unspirantized but still voiceless (see (103b)). Word-final voiced plosives become voiceless independently of the syllable number if they are preceded by a sonorant consonant (see (103c)).[77]

(103)	a.	/gɑb/	>	[gɑb]	'dish'
		/boʃgɑb/	>	[boʃgɑp]	'plate'
		/ɑd/	>	[ɑd]	'name'
		/murɑd/	>	[murɑt]	'man's name'
	b.	/jɑg/	>	[jɑx]	'spread, burn'
		/jɑːg/	>	[jɑɣ]	'oil'
		/budɑg/	>	[budɑx](~[budɑk])	'branch of tree'
	c.	/gænd/	>	[gæt]	'pipe'
		/kænd/	>	[ʧæt]	'village'

Moreover, the alternation in (104) exemplifies the word-final devoicing of a spirantized /g/ along with its voicing once it occurs in intersonorant position (Salimi 1976: 79, 83).

(104) [yʃɑx] 'child' ~ [yʃɑɣ olmɑ] 'Don't be a child.'

Based on the behavior of plosives and affricates in word-final position, the lenis series can be considered laryngeally unmarked, and what is conceived of as word-final devoicing can be analyzed not as a phonological process, i.e., delaryngealization, but simply as the absence of passive voicing of the segment. In one case, we can observe passive voicing in intersonorant position, like in Cracow Polish, which is a feature of H-languages.[78]

Another support for the phonetic nature of word-final devoicing might come from its being likely to be noncategorical. This is at least what may be concluded based on the way the words in (103) were pronounced by Orxan Nazirov, a native speaker of Azerbaijani in his 20s, coming from Baku, the capital city situated in the east of the country. He was asked to pronounce each word four times. I disregard the fact that he speaks a dialect different from the Tabriz variety because word-final devoicing is characteristic of Azerbaijani in general (Salimi 1976: 124); the only relevant difference is that the velar plosive is normally realized voiced word-finally as well in the eastern dialect (79–80), which is why I only focused on the bilabial and the dental plosives. In my

---

[77] There exist a couple of words such as [ot] 'fire' and [syt] 'milk' in which the voicelessness of the final plosives is regarded by Salimi as unpredictable (1976: 127–128).

[78] As it is only the spirantized segment that is subject to intersonorant voicing, it could be argued, as has been suggested by one of the reviewers, that fricatives in Azerbaijani might belong to a different laryngeal subsystem than plosives, i.e., the former can be specified for |H| while the latter for |L|—similarly to the analysis proposed by Iverson & Salmons (2008: 261) for Dutch.

judgement,[79] he pronounced both plosive types in the words in (103a) voiced regardless of the number of syllables; nevertheless, the words in (103c) were both articulated with a voiceless [t]. Although, of course, no conclusion can be drawn on the basis of such a small sample collected without any serious planning, but it might suffice to cast doubt on the categorical nature of the application of devoicing depending on syllable number. In case the pattern we can observe in (103a) is, in fact, a tendency only, the phenomenon could be explained in terms of aerodynamic (and psychological), i.e., extralinguistic, factors: the longer the word, the more extensive lenition it can be subject to (see, e.g., Kirchner 1998: 202–203), which is manifested as a greater chance of the absence of vocal fold vibration at the end of disyllabic words.

As for fricatives in word-final position, they are pronounced voiced in the Tabriz dialect; see (105a), from Salimi (1976: 125). As illustrated in (105b), from Salimi (1976: 59–60 n. 19), words that originally had a voiceless word-final /s/ now also end in a voiced /z/.[80] In this respect, the Tabriz variety differs from other Azerbaijani dialects, which tend to maintain a voiceless /s/ in these words.

(105)	a.	/næmaːz/	>	[namaz]	‘worship’
		/garaʒ/	>	[garaʒ]	‘garage’
	b.	Arabic *aṭlas*	>	[ætlæz]	‘silk satin’
		Persian *xurus*	>	[xoruz]	‘rooster’

In order to account for the voicedness of word-final fricatives, I argue that instead of stipulating a constraint requiring that any fricative in this position be marked for |L|, they should be taken to be laryngeally unmarked in an H-system (perhaps as a result of lenition), and their voicing is to be regarded as a phonetic property. Although Ohala (1983: 202) notes that, for example, “in American English the ‘voiced’ fricatives /v, z/ are more likely to be devoiced in word-final position than are the stops /b, d, g/” and presents statistical data to show that cross-linguistically too, passive voicing in the Catalan dialect continuum still appears earlier in fricatives than in plosives (see, e.g., Jiménez & Lloret 2008). A possible explanation for this can be found in Recasens (2002: 333–334): due to the lesser degree of constriction during the articulation of a fricative, the buildup of supraglottal air pressure, which eventually quenches vocal fold vibration, happens more slowly, possibly making it easier to maintain voicing in a fricative than in a plosive.[81] It has also been pointed out that due to the fact that certain cues to voicing are present in plosives but absent from fricatives, it might be easier to reach a voicing percept in the latter obstruent type (see Strycharczuk 2012: 65–69)—this may result in diachronic changes like in the case of the Catalan dialects. Therefore, although the voicing of laryngeally unmarked fricatives in word-final position before a pause is not

---

[79] Simply measuring the duration of glottal pulsing during the closure of word-final plosives may not necessarily be too revealing as whether these obstruents are perceived as voiced or voiceless may depend on other phonetic cues as well.

[80] There exist a few sporadic exceptions though such as [ælmɑs] ‘diamond’ (from Arabic *almās*) in which the final [s] remains voiceless.

[81] For objections against this account, see Ohala (1983: 201–202); also see the summary of passive voicing in fricatives in section 2.1.

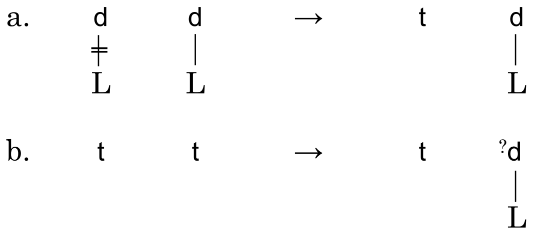
a common phenomenon cross-linguistically, it might not be too surprising either why they are the obstruent type in this language failing to show up voiceless, rather than the plosives.[82]

Now, moving on to the voice dissimilation of obstruents, which can be described as "contiguous medial obstruents differ[ing] in voice, the first being voiceless, the second voiced," let us consider the examples in (106) (Salimi 1976: 136–137).[83]

(106)	/ættɑr/	>	[ætdɑr]	'druggist'
	/dæftær/	>	[dæfdær]	'notebook'
	/ɑxtɑr/	>	[ɑxdɑr]	'search'
	/sækkiz/	>	[sæʧʤiz]	'eight'
	/dogguz/	>	[dokguz]	'nine'

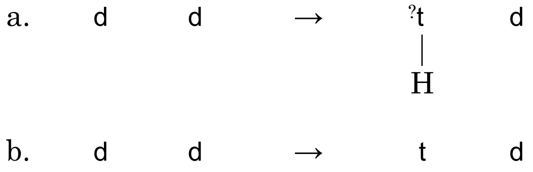
Based on the above examples, it can be seen that, for instance, a surface [td] sequence may be the realization of both /dd/ and /tt/. Accounting for this phenomenon seems to be problematic whether Azerbaijani is regarded as an L-language or an H-language; however, the latter option still appears to fare better. If the language is considered to be an L-system, the process /dd/ > [td] can be thought of as the delaryngealization of the coda obstruent, which is thus pronounced voiceless. In the case of /tt/ > [td] though, we need to assume that the second obstruent of the cluster has acquired an |L|, from an unknown source:

(107)



If, on the other hand, Azerbaijani is an H-system, /dd/ → [td] is not a phonological process, as illustrated in (108a), but the phonetic realization of the unmarked obstruent cluster, the details of which are discussed presently; see (108b).

(108)



As for /tt/ > [td], first of all, we have to assume the delaryngealization of the second obstruent. Let us consider the possibility of the process being lenition triggered by the position of the obstruent: In CV Phonological terms, a consonant in this case is licensed by the following full vowel, whose governing

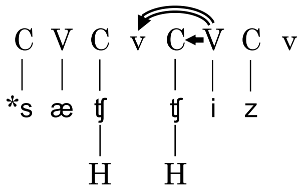
---

[82] For further exceptions to final devoicing, see van Oostendorp (2003).

[83] One of the reviewers points out that this seems to be a templatic pattern, where it does not matter whether the template makes reference to |H| or |L|.

force is absorbed by the preceding empty v, as shown in the representation of *[sæʧʧiz] in (109).

(109)



Peculiar as the lenition of the onset /ʧ/, suggested by the form [sæʧʤiz], might be, it is not an unattested phenomenon at all. The issue is discussed and exemplified in Ségéral & Scheer (2008: 140–143),[84] and we find further examples of its occurrence in Azerbaijani itself as well—see (110), from Salimi (1976: 133), where the possible assimilation of the /t/ to /s/ in the environment s__$V_{[+high]}$# involves the spirantization of a dental stop in onset position.[85] Even stranger is the process of glottal weakening targeting /ʔ/ and /h/ illustrated by the Arabic loanwords in (111), from Salimi (1976: 141). The glottal obstruents undergo weakening to the extent that they are deleted in intersonorant and word-final, i.e., weak, position (in (111a–c)). However, in (111e–f), we can see that /ʔ/ undergoes a greater degree of lenition when it is the second member of a consonant cluster (in onset position) than when it is followed by a consonant (occurring in coda position), which contradicts the generalization that "for a given input in a given language and regarding a given phenomenon, strong positions … will produce outputs that are at least as strong as those that appear in weak positions" (Ségéral & Scheer 2008: 140).

(110)	a.	/isti/	>	[isdi]~[issi]	'warm'
		/jɑsti/	>	[jɑsdi]~[jɑssi]	'flat'
	b.	/jɑstɯg/	>	[jɑsdɯx]	'pillow'
		/istæk/	>	[isdæç]	'love'

(111)	a.	/sæhær/	>	[sæær]
	b.	/sɑːʔæt/	>	[sɑɑt]
	c.	/ʃæmʔ/	>	[ʃæm]
	d.	/mæshæd/	>	[mæʃæt]
	e.	/tælʔæt/	>	[tælæt]
	f.	/fæʔlæ/	>	[fæhlæ]

With this in mind, we can draw the conclusion that the second obstruent of the cluster in (109) can be subject to lenition, in which case we must assume that it is neither licensed nor governed by the full vowel following it; see the revised representation in (112a). As for the first obstruent of the cluster, it either keeps its laryngeal element (112b) or gets deprived of it (112c). As it occurs in a position weaker than that of the following obstruent, the latter scenario seems

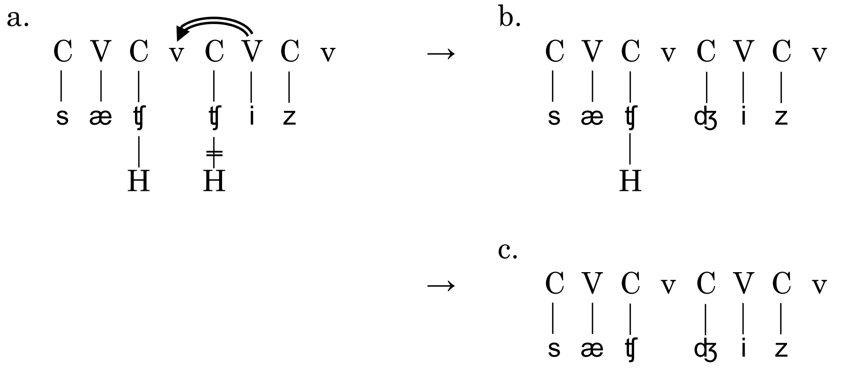
---

[84] It should be noted that lenition in strong position involving laryngeal properties are not mentioned as a possible case in this work.

[85] The assimilation of a coda /t, d, z, l/ to a following onset /s/ is also observable in the language: e.g., /it + sa/ > [issæ] 'if lost' and /dɑd + siz/ > [dɑssɯz] 'tasteless' (Salimi 1976: 135).

more probable, which produces the same cluster type as the one in (108b), namely one that consists of two unmarked obstruents.

(112)



So, what phonologically underlies laryngeal dissimilation in Azerbaijani is actually the language-specific constraint requiring that both members of a word-internal obstruent cluster be laryngeally unmarked—either lexically (see (108b)) or as a result of delaryngealization (see (112a, c)). Then, the specification of the two obstruents regarding their physical voicing properties takes place in the phonetic component of the language: the production of the second member of the cluster occurring in onset position involves phonetic voicing, which does not spread to the first obstruent in coda position.

In this proposal, the phonetic component is held responsible for providing two adjacent obstruents with different articulatory properties which are otherwise contrastive in the language, and it seems to happen in a quasi-arbitrary way. Nevertheless, it should be noted that it is a laryngeally neutralized object that the two segments constitute, and phonetic characteristics are mapped to all instances of this type of object consistently, so the process may not bring about any minimal pairs. It follows then that it would be possible to find another variety of the language which assigns different phonetic qualities to the same neutralized cluster.[86]

All in all, even though Azerbaijani contrasts phonetically voiced and voiceless obstruents, when we examine the behavior of these segments in this system, it turns out that the word-final voicelessness of plosives and voicedness of fricatives along with the lenition of obstruents in word-internal clusters can be accounted for more easily if the language is categorized as an H-system, and these phenomena are explained in terms of the phonetic realization of the segments in question, which are laryngeally unmarked. In other words, what is conceived of as laryngeal dissimilation is a phonetic pattern.

---

[86] This language-specific assignment of phonetic characteristics, peculiar as it may be in the present case, is similar to how phonetic qualities are mapped to neutralized obstruents in final position differently in the Catalan dialects (for details, see section 4.3.2).

5.3.3 Two imperfect exceptions

There appear to exist only two "well-behaved" voicing languages in which voiced obstruents become voiceless as a result of laryngeal dissimilation: Japanese and Western Bade (see Bennett 2013: 587–591 and Bye 2011: 1410, and references therein). Nevertheless, if we take a closer look at laryngeal phenomena in these languages, we find that analyzing them as L-systems also leads to problems.

5.3.3.1 Japanese

In Japanese, there is a voicing rule, referred to as Rendaku, which requires that the initial obstruent of the second element of a compound be voiced; see (113a). This process is blocked though when this element already contains a voiced obstruent; this is referred to as Lyman's Law and exemplified in (113b) (Itô & Mester 1986: 52, 55). As can be seen in (114), the constraint that a morpheme can contain no more than one voiced obstruent also holds in the Yamato word forms constituting the native stratum of the Japanese vocabulary (Itô & Mester 1995: 817–819).

(113) Dissimilation of voice in Japanese

a. Rendaku voicing in compounds

iro 'color' + *kami* 'paper' → *irogami* 'colored paper'
yu 'hot water' + *toofu* 'tofu' → *yudoofu* 'boiled tofu'
yo 'night' + *sakura* 'cherry' → *yozakura* 'blossoms at night'

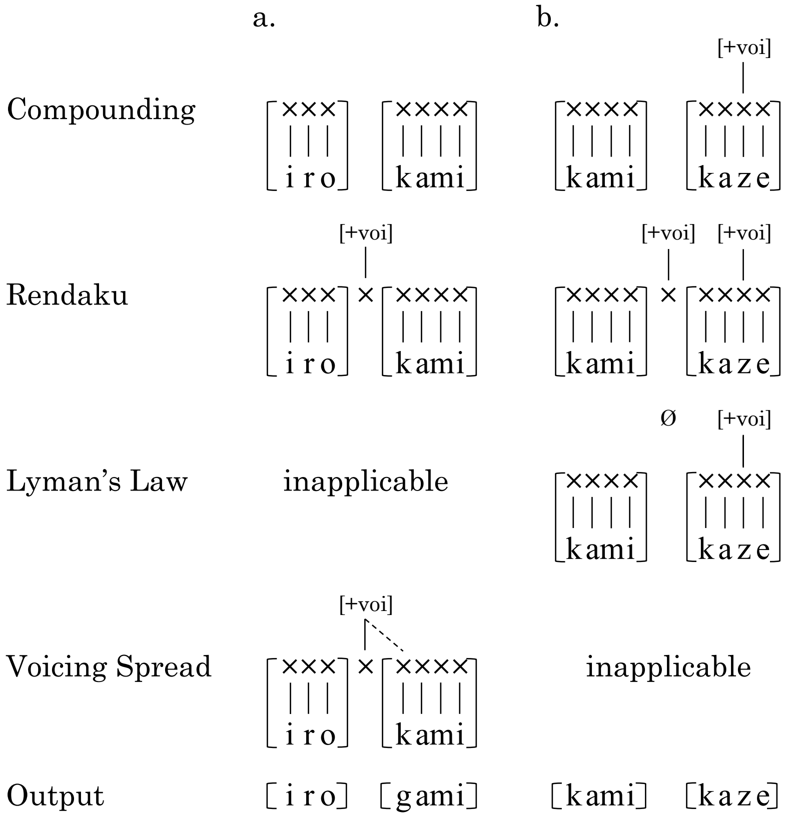
b. Rendaku voicing blocked

kami 'divine' + *kaze* 'wind' → *kamikaze* 'divine wind'
siro 'white' + *tabi* 'tabi' → *sirotabi* 'white tabi'

(114) a. *futa* 'lid' c. *buta* 'pig'
b. *fuda* 'sign' d. **buda*

In Itô & Mester's analysis within the framework of autosegmental phonology, Rendaku is "a morphological process [requiring] an insertion of a [+voi] autosegment bound to its skeletal anchor at the compound juncture," which is afterward attached to the initial obstruent of the second element of the compound as a result of the Voicing Spread rule (1986: 57–61). The application of these rules is shown in (115a) through the example of [*iro*][*kami*] → [*iro*][*gami*] 'colored paper.' In the case of [*kami*][*kaze*] in (115b), on the other hand, Lyman's Law insures the deletion of the feature [+voice] introduced by the Rendaku rule due to the fact that it is followed by another instance of the feature on the voicing tier, which is why it will not be able to spread onto the initial obstruent of the second element of the compound.

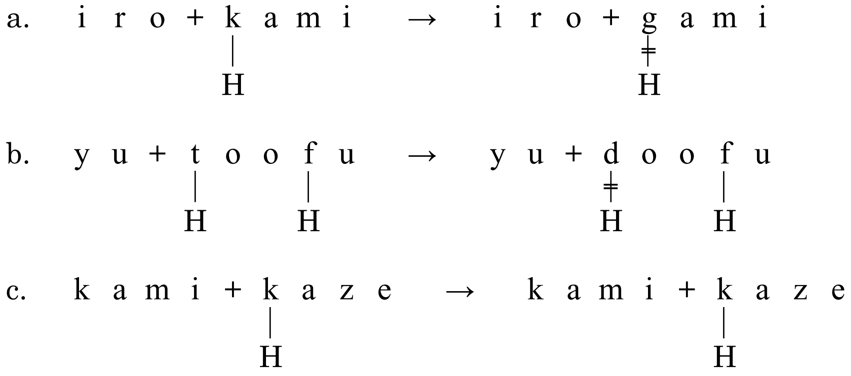
(115)



Although the analysis of Lyman's Law as the deletion of the laryngeal feature already present in the representation is in accordance with the idea that dissimilation involves delinking, the introduction of the feature [voice] *ex nihilo* as an account of Rendaku seems rather problematic in a model not based on arbitrary rules. Or, alternatively, it could be assumed that this process does not take place in the phonology but is phonetic in nature, i.e., is an example of the passive voicing, a property of H-systems.

If we take fortis obstruents in Japanese as the laryngeally marked segments, the application of Rendaku (in, e.g., [*iro*][*kami*] → [*iro*][*gami*] and [*yu*][*toofu*] → [*yu*][*doofu*]) and the blockage thereof (in, e.g., [*kami*][*kaze*]) can be represented in the following way:

(116)



In (116a) and (116b), a marked obstruent undergoes delaryngealization when it gets into intervocalic position across a morpheme boundary,[87] and the lenited consonants are now pronounced voiced. This process fails to take place in (116c), which can be the result of a well-formedness constraint active in the language, which can be formalized as follows:

(117) Laryngeal Minimality Constraint in Japanese

A morpheme cannot contain more than two laryngeally unmarked obstruents.

The effect of this minimality constraint is reflected either in the nonexistence of morphemes with two voiced obstruents in the native vocabulary of Japanese or in the blockage of the delaryngealization of the obstruent occurring after a morpheme boundary within a compound.[88]

All in all, my goal was to show that even though Japanese could be categorized as an L-language based on the phonetic realization of its two series of plosives and on the fact that it is the voiced series that takes part in dissimilation, accounting under this assumption for a wider range of laryngeal phenomena in the language is indeed problematic. Taking Rendaku into consideration, we might have reason to treat Japanese as an H-system. Further details of this proposal remain to be worked out, but, hopefully, I have managed to show that this *is* a possible analysis of the language and that it may explain Rendaku more successfully than traditional approaches, while in order to account for other laryngeal processes, we do not need more stipulations than in earlier analyses.

---

[87] This is an instance of cross-boundary lenition which does not happen in the same phonological environment morpheme-internally. A similar case is that of flapping in General American English: generally speaking, for an intervocalic alveolar plosive to turn into [ɾ], the vowel following it must be unstressed, a condition which does not have to be met if there is an intervening word boundary between the plosive and the next vowel (e.g., *á*[ɾ]*om*, **a*[ɾ]*ómic* vs. *a*[ɾ]#*Ómsk*).

[88] Minimality conditions are most commonly imposed on word size (see, e.g., Elordieta 2014: 17–18), but it may regulate other properties too. For instance, in Swedish, which contrasts voiced plosives with aspirated plosives (i.e., lacks the plain voiceless series), there is a requirement that an obstruent be laryngeally marked phonetically. In Beckman & Ringen's (2004) analysis within the framework of Optimality Theory, the phonetic minimality condition on the complexity of obstruents is also reflected in the phonology through the high-ranked constraint SPECIFY, which rules out laryngeally unmarked obstruents having subminimal laryngeal specification. A perhaps more similar constraint to the one in (117) is related to stress assignment in English: if the last vowel of a disyllabic word is stressed, the vowel preceding it may or may not bear a main stress; however, in the case of trisyllabic words with ultimate stress, both of the first two vowels may not be unstressed (this constraint is referred to as the Early Stress Requirement; see Nádasdy 2006: 191–192 and Szigetvári 2020b). So, in both Japanese and English, it seems that with an increase in the number of a certain type of segments, there is a limit on how many of their subprominent/subcomplex instances can occur in a given domain.

5.3.3.2 Western Bade

Western Bade, an Afroasiatic language spoken in the northwest of Nigeria, exhibits voice assimilation and is the other language besides Japanese that displays a dissimilatory pattern which seems to support the markedness of the voiced obstruent series. Schuh illustrates voice dissimilation with the examples in (118) (2002: 7).

(118) Dissimilation of voice in Western Bade

a. The prefix /gə-/ ‘2.M.PFV.SBJ’

/gə́-lágú/	‘you stopped’
/gə̀-kə́rū/	‘you stole’
/kə́-də̀kʷú/	‘you heard’

b. The prefix /da(a)-/ ‘3.SJV’

/dáː-làgə́ʧî/	‘that he stop’
/dà-kə́rə́ʧî/	‘that he steal’
/táː-də̀kʷə́ʧî/	‘that he hear’

c. The prefix /də-/ ‘STAT’

/də́-làgí/	‘standing’
/də́-kʷtà/	‘stolen’
/tə́-bàkà/	‘burned’

Even if laryngeal dissimilation in the above cases might be most easily analyzed as the dissimilation of obstruents marked with |L|, we find certain patterns in Western Bade which are rather atypical of a voicing language. First of all, when the first CV of a word is reduplicated to mean ‘do something repeatedly,’ the obstruent of the reduplicated syllable must be voiceless if the following obstruent that it has been derived from is voiced; see (119a). If, however, the reduplicated obstruent occurs word-internally, as in (119b), it is not subject to dissimilation. Choosing to attribute this voicing to the intersonorant position in order to explain a synchronic phenomenon would be more grounded if Western Bade were taken as an H-language.[89]

(119) CV reduplication (‘do something repeatedly’) in Western Bade

a.	/ə̀bdú/	→	/pábdú/	‘ask repeatedly’
b.	/ə̀rgʷə̀ɗú/	→	/ə̀rgʷàgʷɗú/	‘cook many portions’

In sum, even the only example of languages with laryngeal dissimilation that might be used to support the markedness of the lenis series that I have come across seems to feature a trait which is more typically associated with H-

---

[89] Furthermore, interestingly, the prefix /gə-/ ‘2.M.PFV.SBJ’ has evolved from the historical form */kV/ (unlike the prefix /da(a)-/ ‘3.SJV,’ whose initial obstruent has always been voiced). As affixes are more likely to contain unmarked structures than roots (see, e.g., Iscrulescu 2006: 68), a laryngeally unmarked morpheme-initial obstruent would be unexpected to undergo laryngeal fortition (through the addition of |L| in this case). However, if this voicing was a passive phonetic process due to the effects of the environment, which might be a more probable scenario, it would reflect a trait more characteristic of H-languages.

systems. A further indicator of how atypical this system is may be the fact that in most varieties of Western Bade, voice dissimilation is not an active phonological rule (i.e., voiced and voiceless obstruents in prefixes do not alternate, but voicing is retained in them); in these dialects, dissimilatory patterns can be considered a static restriction on the co-occurrence of voiced obstruents within morphemes.

5.4 Conclusion

I have aimed to show in this chapter that laryngeal dissimilatory patterns as processes involving delinking support the markedness of the fortis obstruent series cross-linguistically. In languages analyzable as H-systems on a phonetic basis as well, such as Ancient Greek and Meithei, it is always the fortis obstruents that can dissimilate, losing their laryngeal element and turning into their lenis congeners. In languages which contrast voiced obstruents with plain voiceless ones and are traditionally categorized as L-systems, we would expect the members of the voiced series to become voiceless in the process as the result of delaryngealization. However, this is not what regularly happens in phonetically voicing languages; to the contrary, we can observe dissimilation to voicing in the majority of these systems too. (Although the greatest part of the discussion in this chapter was devoted to more complex or problematic cases, it must be emphasized that it is languages like Moro mentioned in section 5.3.1 that can be taken to represent laryngeal dissimilatory phenomena in voicing languages.) If the lenes and not the fortes are considered the marked category in these systems, dissimilation as a phonologically active process is hard to account for.

Four phonetically voicing languages which may count as more problematic cases have been treated in detail. Two of them, Bakairi and Azerbaijani, appear to display a more complex pattern, which may obscure which obstruent series should be taken as the marked category; however, analyses in which they are considered to be H-languages seem to fair better. Dissimilation in Bakairi can be accounted for using constraints on where |H| can occur in a root, and how many of them are possible per root. Furthermore, the allophonic alternations observable in suffixed words can also be explained if we assume |H| only—instead of both values of a binary feature as suggested in the literature. Also, the behavior of word-final obstruents as well as the dissimilatory pattern in Azerbaijani seem to support the analysis of the language as an H-system, in which case we can assume a lenition process in obstruent clusters, and the dissimilation of their members can be treated as a phonetic phenomenon. Finally, even the two languages which feature laryngeal dissimilation and are the strongest candidates to be regarded as L-systems, Japanese and Western Bade, cannot be analyzed as such without any problems. At the same time, the recategorization of Japanese does not pose a greater difficulty. As for Wester Bade, it also displays a phenomenon atypical in L-systems.

All in all, observing the dissimilation of other phonological features, we can find that segments regularly dissimilate to the unmarked category, which can be translated into privative models as the delinking of an element. The fact that in the case of laryngeal dissimilation, phonetically aspirating and voicing languages typically behave uniformly, the latter turning their voiceless obstruents into their voiced counterparts, and that there are only few (peculiar) exceptions supports the analysis of fortes as the marked obstruent type. Although it does not follow that all binary-contrast systems must be analyzed as H-languages, it has been shown how natural languages may carry out the “(re)analysis” of their obstruent systems which is proposed here, evidenced in the present case by laryngeal dissimilatory patterns. Accounting for the treatment of voiced obstruents in these languages as the unmarked series may require a substance-free analysis.

Chapter 6

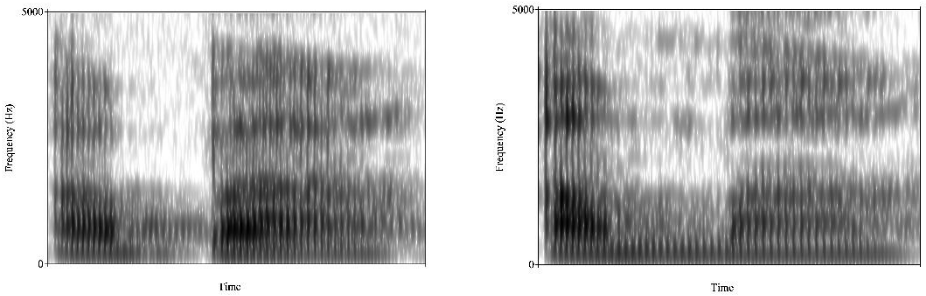
Voicing and nasality

As has been mentioned earlier, voicing and nasality can be regarded as related qualities. Several arguments can be brought up to support this claim on both phonetic and phonological bases. This has led to the unification of the two properties in one prime, usually denoted by “L,” in standard versions of Element Theory. Then, whether the element in question represents voicing or nasality in a given segment can be expressed in terms of headedness, more on which in chapter 7. It will be argued in this chapter that even in languages where voicing seems to be related to nasality, one should not necessarily assume the laryngeal element |L| in the system in order to account for the connection between the two properties. Instead, it will be shown that the nasality–voicing interaction can be expressed in terms of the relationship between |L| and |H|.

6.1 A unified representation for voicing and nasality

Firstly, the relationship between voicing and nasality is reflected in their physical manifestations. In acoustic terms, voicing is characterized by f_0 perturbations, the lowering of F_1 and an increase in the intensity of low frequency energy in the speech signal while nasality involves the introduction and prominence of low frequency energy, often referred to as nasal murmur, as well as the dampening of higher frequency amplitude peaks (Breit 2013: 203–204 and Breit 2017: 17); see in (120) the spectrograms of recordings in which I pronounce [aba] and [ama]. In a non–substance-free approach, this might provide reason to assume that these two properties should also be formally related.

(120) Spectrograms of [aba] and [ama]



a. [aba]

b. [ama]

However, such a phonetic relation may not be sufficient for the unification of two primes even in ET. In this framework, melodic elements are not phonetic entities but abstract cognitive objects, the identification of which should happen on the basis of their phonological behavior (see, e.g., Backley 2011: 15). This criterion is indeed met if one wants to establish a unified prime for voicing and nasality. The relevant phenomena supporting this decision include nasal harmony, prenasalization and postnasal voicing (see, e.g., Ploch 1999). In feature theories, applying [+voice] and [+nasal], and in conservative versions of ET, which use the elements |L| and |N| for voicing and nasality, respectively, it is impossible to formally link the two properties. Therefore, it has been proposed in standard ET that they should be represented by the same melodic element, namely |L| (see, e.g., Ploch 1999, Botma 2004 and Nasukawa 2005).[90] In the following section, I will give a brief overview of each of the phonological phenomena mentioned above and aim to show that they can be generally accounted for even if the role of |L| is only to represent nasality, and the system lacks it as a laryngeal element. In fact, the relation between voicing and nasality can be formally expressed in these alternative accounts too, just like in analyses assuming a unified prime for the two properties.

6.2 Phonological relations between voicing and nasality

As Backley (2011: 194–204) points out, certain combinations of elements in ET are more marked than others. |A| and |ʔ| represent opposite values of resonance and therefore can be regarded as an antagonistic pair of elements: |A| is typically a vowel property, associated with nuclear positions, the most resonant part of a syllable, while |ʔ| signifies a sudden drop in acoustic energy and belongs to onset positions occupied by consonants. Similarly, |I| and |U| also form an antagonistic pair, giving different “colors” to speech sounds: |I| characterizes front vowels as well as coronal and palatal consonants, whereas |U| can be found in round vowels as well as labial and (depending on the analysis) velar consonants. Finally, |H| and |L| also mark conflicting properties with regard to the way in which acoustic energy is distributed across the spectrum: |H| represents high-frequency energy, and |L| is associated with the concentration of acoustic energy in the low-frequency range. Consequently, we expect that their combination, resulting in, e.g., voiced aspirated plosives such as [bʱ], will be generally restricted across languages.

Nevertheless, the incompatibility of |H| and |L| may also apply across sounds, determining the makeup of adjacent segments. The depressor-induced |H| displacement of Zulu exemplifies this intersegmental incompatibility (see Ploch 1999: 200–201). As can be seen in (121a), the 3rd person singular subject marker /ú/ contains a high tone (denoted by the acute accent). In (121b), on the other hand, the high tone lexically present in the vowel of the 3rd person plural subject marker /zí/ is shifted to the next nucleus (to the /a/ of /ya/) while the |L| encoding the voicing of the onset of /zí/ spreads to the following nucleus, resulting in a vowel with low tone (denoted by a grave accent).

---

[90] In Nasukawa (2005), “N” is used instead of “L” to represent nasality and voicing, which is simply a denotational difference in comparison with other analyses.

(121) Depressor-induced |H| displacement

a. ú - ya - letʰ - él - a → úyaletʰéla
3SG.SUBJ-PRES-bring-BENEF-ASP
'(s)he is bringing for'

b. zí - ya - letʰ - él - a → zìyáletʰéla
3PL.SUBJ-PRES-bring-BENEF-ASP
'they are bringing for'

In this section, I will argue that the aim to account for interactions between voicing and nasality does not always necessitate the assumption that |L| must represent both of these properties. Instead, we can resort to the incompatibility of |H| and |L| to motivate nasal harmony and postnasal voicing, which are often cited in support of the unification of voicing and nasality into the element |L|. This relation between these two particular elements has to be stipulated in a substance-free approach, since for the phonological computation, any two elements could be incompatible and trigger a phonological process. As to tendencies regarding why precisely these two behave as antagonistic elements, it can be explained in the phonetics (see the description above). The point is that it does not follow from the phonological faculty. (The fact that there exist languages with postnasal devoicing (see, e.g., Prickett 2018) might support the idea that the phonology should have the freedom to manipulate primitives in an arbitrary way.)

Furthermore, prenasalization, the other meeting point of voicing and nasality, is explicable as variations in the phonetic realizations of stops.

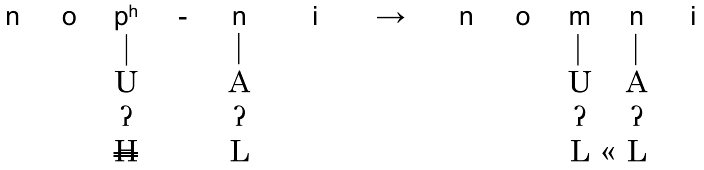
6.2.1 Nasal harmony

Nasal harmony is the transmission of nasality. Korean, among many other languages, provides an example of the process (see, e.g., Botma 2004: 75–76). The language has three series of plosives: plain voiceless, tense and aspirated. These categories can be considered to be encoded as being laryngeally unmarked and containing (headed) |ʔ| and |H|, respectively. As the words in (122) illustrate, if a word-final plosive, regardless of its laryngeal specification, is followed by a nasal stop, the plosive will turn into a nasal stop. The natural class involved in this process can be defined as the consonants containing the element |ʔ|, i.e., (nasal and oral) stops. The representation in (123) shows that the delaryngealization of a final plosive, which happens independently of the following nasal in the present case, is accompanied by the spreading of the nasality-marking |L| onto it. As a result, the plosive turns into a nasal segment but preserves its place of articulation—the role of headedness is neglected here; it will be discussed in chapter 7.

(122) Nasal harmony in Korean

/mək-ni/	>	[məŋni]	'eat-inter'
/k'ək'-ni/	>	[k'əŋni]	'greetings'
/nopʰ-ni/	>	[nomni]	'to tie'

(123) A representation of nasal harmony in Korean

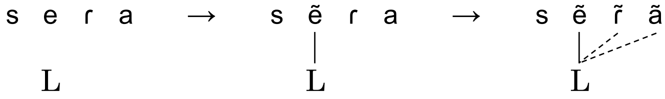


Nasal harmony can also operate between vowels as well as between consonants. Nasal vowel–consonant harmony can be observed in Tucano, a language with two series of obstruents (Maddieson 1984) spoken in Brazil and Colombia (see Walker 2011: 1848–1849). In this language, there are nasal and oral morphemes, as illustrated in (124a–b) and (124c), respectively. It can be assumed in the former case that the nasal element is lexically stored with the morpheme as a feature of the whole constituent. It is thus a floating, i.e., unassociated, element, which is automatically linked to the first segment, from where it is shared with the other sounds of the morpheme (Noske as cited in Walker 2011: 1849). The process is represented in (125).

(124) Nasal vowel–consonant harmony with transparent segments in Tucano

a.	/w̃ẽõ/	‘panpipe flutes’
	/w̃ĩʔ̃mã/	‘child’
	/ɨ̃mɨ̃/	‘man’
b.	/sẽɾ̃ã/	‘pineapple’
	/j̃õh̃kã/	‘<a drink made from bitter manioc>’
	/mãsã/	‘people’
c.	/jai/	‘jaguar’
	/kahpea/	‘eye’
	/ᵐbeʔro/	‘later’

(125) A representation of nasal harmony in Tucano



It should be noted that there are segments in Tucano that do not undergo nasal assimilation, nor do they impede the process: they are the fortis obstruents; see (124b). We can capture the interaction between voicing and nasality, reflected in the fact that voiced (or prenasalized) plosives and nasal stops are in complementary distribution, as the alternation of the headedness of |L| in a segment. That is, the spreading of nasality to a voiced (or prenasalized) plosive can be analyzed as the promotion of an operator |L| to headhood—or the other way around, depending on the analysis (for a possible account, see, e.g., Ploch 1999: 200); the role of headedness will be discussed in chapter 7. So, besides head alignment for |L| (cf. Backley 2012: 80) in voiced obstruents, |L|-spreading needs to be assumed in the case of spontaneously voiced sounds (oral sonorant consonants and vowels) lacking |L|, a process which must exclude the laryngeally unmarked voiceless obstruents as its targets. An alternative analysis, which seems to fair better, is one that postulates fortis obstruents specified for |H| and laryngeally unmarked lenes, which are similar to oral sonorants in this respect. In this way, we can state that any segment lacking |H| will be the target of nasal spreading, in accordance with the idea of |H|–|L| incompatibility.

Epera, a language spoken in Ecuador, also displays nasal vowel–consonant harmony (see Walker 2011: 1843–1844). However, it is a typologically different system because, as opposed to Tucano, the segments that do not undergo assimilation here, namely the fortis plosives, also block the spreading of nasality, which is why they are referred to as opaque segments. See the examples in (126).

(126) Nasal vowel–consonant harmony with opaque segments in Epera

/bẽa/	>	[mẽã]	‘bush’
/hĩ-/	>	[h̃ĩ-]	‘to tie’
/bẽɾa/	>	[mẽɾ̃ã]	‘greetings’
/põsa/	>	[põⁿsa]	‘termite’
/sãki/	>	[sãᵑki]	‘which’
/ĩbaba/	>	[ĩmãmã]	‘tiger’

Nasal harmony can also operate solely on consonants. A major way in which this type differs from nasal vowel–consonant harmonies is that it typically targets nonadjacent consonants, i.e., it tends to be a long-distance process. Another disparity is the tendency of phonologically similar segments to participate in the harmony. For instance, in Kikongo, a Bantu language spoken mainly in Congo, lenis stops and /l/ become nasal if they are preceded by a prevocalic nasal stop at any distance in the stem; see the examples in (127). The targets of the process are thus the segments containing |ʔ| and lacking |H|. Accounting for long-distance harmony operating on similar segments can be done in a correspondence-driven approach illustrated in (128): A formal correspondence relation can be established between consonants due to their phonological similarity, which is indicated by the co-indexation of the segments in question. Then, a constraint requiring that corresponding segments be specified identically for a certain element, |L| in the present case, can induce the nasal harmony (see Walker 2011: 1857–1858).

(127) Nasal consonant harmony in Kikongo

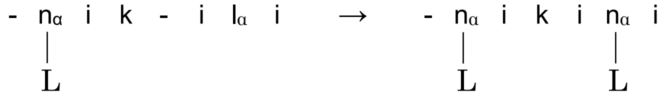
Perfective active forms

a.	-suk-idi	‘wash’	b.	-nik-ini	‘grind’
	-bud-idi	‘hit’		-sim-ini	‘prohibit’
	-sos-ele	‘search for’		-leːm-ene	‘shine’

Applicative forms

a.	-toːt-il-a	‘harvest for’	b.	-nat-in-a	‘carry for’

(128) A representation of nasal consonant harmony in Kikongo



Now, a final note on the directionality of nasal harmony is due (see, e.g., Walker 2011: 1858–1861). Unlike laryngeal assimilation in languages traditionally categorized as voicing systems, which show a strong bias toward right-to-left directionality, nasal harmony can be bidirectional, progressive or regressive. For instance, in Ganda, a Bantu language spoken in the African Great Lakes region, bidirectional nasal harmony takes place between nasal and voiced oral stops within a root if they share place of articulation. As far as voiceless oral stops are concerned, they assimilate to a nasal stop having the same place of articulation if it occurs after the nasal, meaning that nasal harmony applies to them only progressively, a restriction reflecting to some extent the incompatibility of |H| and |L|. See the examples in (129).

(129) Bidirectional nasal harmony in Ganda

-mémèká	‘accuse, denounce’
-nónà	‘fetch, go for’
-bábùlá	‘smoke over fire to make supple’
-bónèká	‘become visible’
-táná	‘grow septic, fester’

The Johore dialect of Malay, an Austronesian language of Malaysia, exemplifies progressive nasal harmony, in which vowels, glides and the laryngeals /h/ and /ʔ/ undergo assimilation while liquids and obstruents block the process; see (130). Capanahua, a Panoan language spoken by about 400 people in Peru, on the other hand, has regressive nasal harmony targeting vocoids and laryngeals, which is blocked by other segment types, as illustrated in (131). In still other cases, nasal harmony may also appear to operate in a certain direction; however, this directionality is the epiphenomenon of the process being root- or stem-controlled—this applies in Kikongo (discussed above).

(130) Progressive nasal harmony in Johore Malay

pənə̃ŋãɦ̃ãn	‘central focus’
pəŋãw̃ãsan	‘supervision’
pəmãndaŋãn	‘scenery’
mə̃rattapi	‘to cause to cry’

(131) Regressive nasal harmony in Capanahua

ɦ̃ãmawi	‘step on it’
ɦ̃ãmãʔ̃õna	‘coming stepping’
warã(n)	‘squash’
põj̃ã(n)	‘arm’

In this section, we have seen that even though there are cross-linguistic variations in the characteristics of nasal harmony (with regard to, e.g., the types of segments it operates on, the presence or absence of transparent and opaque segments in the system, the direction of the process), voiced obstruents, more specifically, plosives, show a tendency to undergo nasalization. This apparent relation can be thought of as resulting from the fact that |L| cannot spread to the voiceless counterparts of the voiced plosives because they contain |H|.

6.2.2 Postnasal voicing

Postnasal voicing is the phenomenon that turns voiceless obstruents into voiced ones following nasal stops; see, e.g., Nasukawa (2005: 2–4) and Ploch (1999: 194–199). This can be observed, among others, in Yamato Japanese and in Zoque, a language spoken in Mexico; see the words in (132) and (133), from Nasukawa (2005: 3–4) and Itô, Mester & Padgett (2001: 57). The voicing of the onset fortis plosives can be attributed to their receiving the element |L| from the preceding nasal stop, which makes the phenomenon a phonological process (for a possible analysis of the Zoque data, see, e.g., Ploch 1999: 272–280). Besides, the nasals also assimilate to the following plosives with regard to their place of articulation in both systems.

(132) Postnasal voicing in Yamato Japanese

a.	[ʃombori]	*[ʃompori]	‘discouraged’
	[ʃindoi]	*[ʃintoi]	‘tired’
	[kaŋgae]	*[kaŋkae]	‘thought’

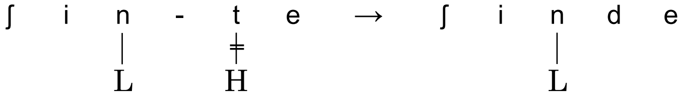
b.	i.	/ʃin/	+	/te/	>	[ʃinde]	‘die-GER’
		/ʃin/	+	/ta/	>	[ʃinda]	‘die-PAST.IND’
		/kam/	+	/ta/	>	[kanda]	‘chew-PAST.IND’
		/kam/	+	/tara/	>	[kandara]	‘chew-SUBJ’
	ii.	/mi/	+	/te/	>	[mite]	‘see-GER’
		/haʃir/	+	/ta/	>	[haʃitta]	‘run-PAST.IND’

(133) Postnasal voicing in Zoque

/min/	+	/pa/	>	[mimba]	‘come-3SG.M’
/min/	+	/tam/	>	[mindamʌ]	‘come-IMP.2PL’
/pʌn/	+	/ksi/	>	[pʌŋgʌsi]	‘on a man’

Alternatively, if we take fortis obstruents to be specified for |H| and lenis obstruents to be laryngeally unmarked in these languages—both of which are VOT-based binary systems (Maddieson 1984)—we can consider the |H|–|L| incompatibility to motivate the delaryngealization of the postnasal fortes. The fortis plosive is in onset position, which is prosodically a strong context; in Strict CV theoretical terms, the segment is supposed to be licensed and not governed by the following vowel (the governing capacity of the vowel being spent on the silenced vocalic position preceding the plosive). As was mentioned in section 5.3.2.2, lenition of this kind in onset position *is* an attested phenomenon though. Examples include cases in Azerbaijani like /isti/ > [isdi]~[issi] ‘warm,’ where an onset /t/ undergoes spirantization in order to assimilate to the preceding coda fricative, as well as the realization of Arabic loanwords like /tælʔæt/ > [tælæt] and /fæʔlæ/ > [fæhlæ], where /ʔ/ is subject to a greater degree of lenition in onset position than in coda position (for further examples, see, e.g., Ségéral & Scheer 2008: 140–143). In the present case, the incompatibility of |H| and |L| seems to be a sufficiently strong constraint to cause the postnasal onset fortis plosive to delaryngealize. The resulting laryngeally unmarked plosive will be realized as a phonetically voiced segment,[91] i.e., we do not need an additional stipulation requiring that the |L| responsible for nasality spread to the plosive, where it will occupy a different position with regard to headhood in order to encode voicing this time. The process is illustrated in (134).

(134) An alternative representation of postnasal voicing in Yamato Japanese



We can draw parallels between the phenomenon of postnasal voicing represented in (134) (the delaryngealization of the plosive as a phonological process and the voicing of the resulting segment as a matter of phonetic implementation) and the changes that took place in the history of Jicaque, a language spoken in Honduras; see (135), from Botma (2004: 174): In Proto-Jicaque, we could find plain voiceless and aspirated plosives in non–word-initial position, which is still preserved in Tol, a sister language of Jicaque. In contemporary Jicaque, however, these plosives underwent voicing word-internally in postnasal, postliquid and intervocalic position; see (135a), (135b) and (135c), respectively. In the case of the first two examples in (135a), the targets of voicing were laryngeally unmarked plosives while in the third word, voicing needed to be preceded by the delaryngealization of the fortis segment. The question is whether the voicing process involved |L|-spreading or could be regarded as passive voicing, i.e., whether it was phonological or phonetic in nature. In principle, either analysis could work, but if we want to provide a uniform account of the entire voicing phenomenon, considering the cases in (135b–c) as well, where |L| was not available, we must conclude that postnasal voicing was also an instance of passive voicing. (For a different account, involving |L|-spreading, see Botma (2004: 174–175).)

(135) The diachronic voicing of plosives in Jicaque

	Proto-Jicaque	Tol	Jicaque	
a.	/kampa/	/kampa/	/kamba/	‘far, long’
	/mantɨ/	/mantɨ/	/mandɨ/	‘vulture’
	/m-pʰats’/	/m-pʰats’/	/m-bat/	‘my ear’
b.	/alpa-/	/alpa-/	/arba-/	‘above’
c.	/pɨka/	/pɨʔa/	/pɨga/	‘jaguar’
	/tepé/	/tepé/	/tebé/	‘he died’
	/(j)ulupʰana/	/(j)ulupʰana/	/ulubana/	‘four’

---

[91] For phonetic details about why the postnasal context is especially favorable for voice induction in obstruents, see Hayes & Stivers (2000). It is also worth noting the implicational relationship between voicing environments: the presence of postvocalic and postliquid voicing in a language implies their postnasal equivalent, but not the other way around (Botma 2004: 175).

The difference between the delaryngealization process assumed in Zoque or Yamato Japanese and the one in Jicaque is that whereas in the synchronic examples, the delinking of |H| is driven by the incompatibility of |L| and |H| in a nasal+obstruent sequence, the lenition in Jicaque was motivated by the position of the plosives (and applied in a wider range of environments). The voicing of obstruents though can be analyzed in both cases as the phonetic implementation of laryngeally unmarked obstruents as voiced sounds. The main points is that in the proposed analysis, accounting for this interaction between voicing and nasality does not require |L| as a laryngeal element in the system.

6.2.3 Nasalization and prenasalization

Before discussing the issue of the nasalization and prenasalization of voiced plosives, let me mention the fairly peculiar case of Jula, a language spoken in West Africa, as an example of a mismatch between phonetic and phonological nasality (see Ploch 1999: 180–183). Jula contrasts oral and nasal vowels; it has two series of seven vowels: /i, u, a, e, o, ɛ, ɔ/ and /ĩ, ũ, ã, ẽ, õ, ɛ̃, ɔ̃/. The examples in (136) illustrate their occurrence in word-final position. Any oral vowel can be found in this context (some examples are provided in (136a)), and they never trigger nasal harmony. Four of the seven phonologically nasal vowels, /ĩ, ũ, ẽ, õ/, surface as oral sounds ([i, u, e, o]) domain-finally, but they nasalize the word-initial onset of the following morpheme; see (136b) and (136ci). As for the remaining three underlyingly nasal vowels, /ɛ̃, ɔ̃, ã/, they are pronounced with nasal airflow ([ɛ̃, ɔ̃, ã]) in final position as well but do not cause nasal harmony, as exemplified in (136b) and (136cii).

(136) Oral and nasal vowels in Jula

a. Oral vowels

/bí/	[bí]	‘to scoop’
/kúlu/	[kúlú]	‘yesterday’
/sé/	[sé]	‘to be able to’
/sò/	[sò]	‘horse’
/sɔ́/	[sɔ́]	‘village’
/sà/	[sà]	‘to die’

b. Nasal vowels

/bĩ́/	[bí]	‘herb’
/kúlũ/	[kúlu]	‘dug-out’
/sẽ́/	[sé]	‘bridge’
/sõ̀/	[sò]	‘thief’
/sɔ̃́/	[sɔ̃́]	‘antelope’
/sã̀/	[sã̀]	‘to buy’

c. The behavior of nasal vowels

i. Nasality movement

/fĩ́-ja/	>	[fíɲá]	‘blackness’
/sùlũ-ja/	>	[sùrùɲà]	‘smallness’

ii. No nasality movement

/fyɛ̃́-ja/	>	[fyɛ̃́já]	‘easiness’
/kùnã-ja/	>	[kùnã̀jà]	‘(the state of) being bitter’

Regardless of how nasality-related phenomena are analyzed in Jula (e.g., by means of a floating nasal element, denasalization, etc.), there is a clear mismatch between the phonological behavior and the phonetic quality of its vowels with regard to their nasal specification. Consequently, similarly to the laryngeal specification of obstruents and its arbitrary relation to the physical implementation of the segments in the Laryngeal Relativism view, discussed in chapter 4, in the case of nasality too, we might not necessarily be able to predict the phonological specification of a segment by reading it off the way it is phonetically realized. As Ploch puts it, the possibility of phonologically nasal vowels being phonetically oral "should make it abundantly clear to anyone that the phonological side of 'nasality' is not motivated by or grounded in phonetics" (1999: 190). This seems to support the substance-free approach to phonological analysis.

With this in mind, we might not be surprised to find that a voiced plosive pronounced with some nasal quality might be nothing else but a realization of oral phonemes like /b, d, g/. Let us take as a point of departure Rotokas, a Papuan language of New Guinea (see Botma 2004: 62). In one dialect of the language, there is only one series of oral stops, which are plain voiceless plosives, and there is a set of nasal stops of the same places of articulation. That is, the system displays an oral–nasal opposition. In the other dialect, this contrast is between plain voiceless stops and a series of more sonorous segments showing a great deal of variation in their continuancy as well as nasality; see (137) and (138), the latter from Breit (2017: 6).

(137) The stop inventories of the two dialects of Rotokas

Rotokas A			Rotokas B		
p	t	k	p	t	k
m	n	ŋ	b~β~m	d~r~l~n	g~ɣ~ŋ

(138) Nasalization in Rotokas B

/βaβae/	>	[βaβa^{e}~baba^{e}~mama^{e}]	'five, hand'
/ɾagai/	>	[ɾaga^{i}~daga^{i}~naga^{i}]	'I, me'
/βegei/	>	[βeɣe^{i}~βege^{i}~βeŋe^{i}]	'we two'

In Rotokas B, there is free variation between the alternants of the voiced phonemes, the nasal variants though are "rarely heard except when a native speaker is trying to imitate a foreigner's attempt to speak Rotokas" (Firchow & Firchow as cited in Botma 2004: 62). This may suggest, as Botma points out, that nasality is not present in the system as an underlying property of the voiced counterparts of the voiceless plosives, so their "variable realization … is a matter of phonetic implementation." Examples of other languages in which optional nasalization can be observed includes Pirahã, spoken in Brazil (Breit 2017: 6).

Moving on to prenasalization, let us consider some examples from Southern Barasano, a language spoken in Colombia; see (139), from Nasukawa (2005: 16–17). In this system, nasal and oral words can be distinguished. In nasal words, nasal harmony targets all segments and nasalize them, except for fortis obstruents. Again, it might be more reasonable to take their reluctance to participate in the process as the result of their being specified for |H|, making them incompatible with |L|. Otherwise we would need to assume two processes driving the harmony: the spreading of |L| to the vowels and a headed–nonheaded shift in the case of the |L| already present in voiced obstruents in order to encode voicing. What might be more interesting here is the occurrence of prenasalized voiced plosives in the oral words in (139b). The complementary distribution of nasal and prenasalized voiced stops in nasal and oral words, respectively, seems to support the claim that prenasalization is unrelated to phonological nasality in Southern Barasano. As such, the nasalization of the onset of a voiced plosive can be thought of as an instance of "hypervoicing," "a means of further reinforcing the characteristics of voicedness in an already voiced stop" (Breit 2013: 204–205). As for the alternation of prenasalized and plain voiced plosives in the prosodically weaker intervocalic context, it can be compared to the variation in the degree of aspiration in different phonological environments in languages like English. I argue that fine phonetic details like whether a fortis plosive in English is aspirated or not (or aspirated to some extent), or whether a voiced plosive in Southern Barasano is prenasalized or not, as a means of enhancing fortisness and lenisness, respectively, should not necessarily be reflected in the phonological representation of the segment (see, however, Backley 2011: 141).

(139) Nasalization and prenasalization in Southern Barasano

a. Nasal words		b. Oral words	
/mãnõ/	'none'	/ⁿdiro/	'fly'
/mĩnĩ/	'bird'	/waᵐba~waba/	'come!'
/ẽõnõ/	'mirror'	/ᵐbaᵑgo~ ᵐbago/	'eater'
/mãsã/	'people'	/wesika/	'above'
/kãmõkã/	'a rattle'	/hikoro/	'tail'

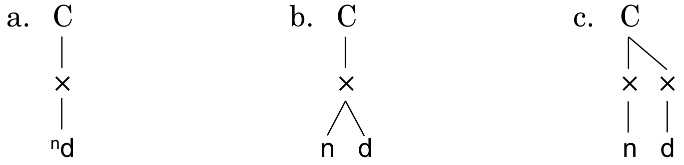
Telena, a language spoken in Brazil, also exhibits nasal harmony and prenasalized realizations (see Nasukawa 2005: 135ff). As the sample words in (140) show, 1st person forms appear nasalized while 3rd person forms do not. In the former case, nasality spreads rightward from the left edge of the morpheme and is blocked by any obstruent, which, in turn, will be realized as a prenasalized segment. Now, one option is to stipulate that, unlike transparent or opaque segments in harmony processes, these obstruents do receive the |L| but do not pass it on. If, however, we take the voiceless obstruents to be marked with |H|, what happens is that when the |L| spreading through the morpheme reaches the segment, it causes it to undergo delaryngealization but does not spread to it—just like in the case of postnasal voicing. Then, the unmarked obstruent will be realized as a voiced sound, its voicing being enhanced by means of prenasalization. It also follows that nasal harmony is blocked at this point since the |L|-less obstruent will not be able to spread it further.

(140) Nasal spreading and prenasalization in Terena

a. 1st person forms		b. 3rd person forms	
ãỹõ	'my brother'	*ayo*	'his brother'
õw̃õᵑgu	'my house'	*owoku*	'his house'
ᵐbiho	'I went'	*piho*	'he went'
ãⁿžjaʔašo	'I desire'	*ahjaʔašo*	'he desires'
õⁿdopiko	'I chopped'	*otopiko*	'he chopped'

In other cases, we might have reason to believe that prenasalized sounds should in fact be analyzed either as contour segments or as nasal stop+oral obstruent sequences; see the representations in (141b) and (141c), respectively, from Breit (2017: 11).

(141) The possible representations of prenasalized segments



For example, in Tonga-Inhambane and Ndali, Bantu languages spoken in Mozambique and Tanzania, prenasalization is the product of morphological concatenation, involving prefixes consisting of or containing nasality; see (142) and (143), from Nasukawa (2005: 31). These instances of prenasalization can be regarded as a sequence of two segments and represented with the structure in (141c). In this analysis, prenasalization is actually equivalent to the formation of nasal+voiced oral stop clusters, involving postnasal voicing too in (143).[92]

(142) Prenasalization in Tonga-Inhambane

N + banyis + i	–	^{m}*banyisi*	'savior'
N + loy + i	–	^{n}*doyi*	'witch'
N + ɣuyu	–	^{ŋ}*guyu*	'fig tree'

(143) Prenasalization in Ndali

iN + puno	–	*i*^{m}*buno*	'nose'
iN + tunye	–	*i*^{n}*dunye*	'banana'
iN + ku^{n}*da*	–	*i*^{ŋ}*gu*^{n}*da*	'dove'

My main goal in this subsection was to argue that whether a prenasalized voiced obstruent is analyzed as one segment or two, it is not necessary to assume that nasalization is the result of the presence of |L| in the obstruent.

6.3 Conclusion

I hope to have been able to show that although voicing and nasality are phonologically related properties, this connection can be accounted for even if |L| only encodes nasality and is not present as a laryngeal element in a given system. I have proposed that the interactions of voiced and nasal segments can be explained with reference to the incompatibility of |L| (marking nasality) and |H| (responsible for voicelessness/aspiration in fortis obstruents). In this way, the combination of the two antagonistic elements in nasal harmony

---

[92] This morphological operation in Tonga-Inhambane is also accompanied by the strengthening of the initial onset of the stem: in the case of ^{ŋ}*guyu*, the *ɣ* seems to have received the element |ʔ| from the preceding nasal stop, and it is this occlusion element that must be involved in the strengthening of the *l* to *d* in ^{n}*doyi* too.

should be avoided, the epiphenomenon of which is that lenis, i.e., phonetically voiced, and nasal segments interact. Furthermore, the postnasal voicing of a fortis obstruent can be analyzed simply as the delaryngealization of the segment, a process driven by the presence of |L| in the preceding nasal stop, which does not have to be assumed to spread to the obstruent. As for prenasalized voiced plosives, nasalization is only a phonetic characteristic of these segments and does not need to be reflected in their phonological makeup; in other cases, such sounds can be regarded as nasal stop+oral voiced obstruent sequences. In conclusion, a language that displays interactions between voicing and nasality does not necessarily have to be categorized as an L-system if we want to capture the relation between the two properties; the phenomena in question can also be generally accounted for if such languages are considered to be H-systems.

Chapter 7

Headedness and nonheadedness

7.1 Subsegmental relations

As was mentioned in chapter 1, in most current models of subsegmental representation, it is assumed that the elements a phonological expression is made up of contract an asymmetrical relationship: an element can function as a head or as a dependent, often referred to as an operator. For an overview of headhood, see, e.g., Breit (2013).

When the bases of Element Theory were laid down, headedness had a somewhat different sense than in current versions of the theory (see Kaye, Lowenstamm & Vergnaud 1985). In the first place, the idea of the nature of elements was also different as they were defined as matrices of features with defined values. That is, elements were considered then to be more directly related to the phonetics than nowadays. When two elements were compounded (fused), the feature matrix of one of them served as the basis of the phonological expression to be formed while the other element only contributed the specification of its main defining feature to the expression. The former was called the head, and the latter the operator or dependent.

In current versions of ET (standard ET), the definition of headedness is a bit vaguer. According to Backley, "headedness relates to strength in the sense that a head element displays a stronger and more prominent acoustic pattern than a dependent element" (2011: 43). Also, phonological behavior should be considered when it comes to deciding which of two relatable acoustic cues the headed and nonheaded version of an element should be picked to represent. For example, Backley takes the element |U| to signify labiality as well as velarity in consonants. Which one is acoustically more prominent, I believe, might not be self-evident; however, headed |U| is generally taken to encode labiality, and nonheaded |U| velarity based on cross-linguistic phonological patterns: velars are more typical targets of assimilation processes, and they occur in weak positions more often than labials, which is why velarity can be regarded as a weaker instantiation of |U| than labiality.

Let us consider the table in (144), which exemplifies how different varieties of standard ET might posit different representations for a given phoneme, containing the version proposed in the present dissertation too. On the one hand, the number and identity of the elements a segment is thought to contain may vary across theories. For instance, a velar plosive contains the occlusion element |ʔ| representing stopness in both Backley (2011) and Kaye (2000). In the analysis proposed by the former author, velarity is the manifestation of a nonheaded |U| while the latter author denotes velarity as the empty headedness of the phonological expression. On the other hand, for instance, Eng. /d/ or Hun. /t/ consists of the same elements in the two theories; the only difference lies in the status of |A|: it is nonheaded in Backley's (2011) analysis and headed in Kaye's (2000) version.

(144) The composition of phonological segments in different versions of ET

	Backley (2011)	Kaye (2000)	An alternative proposal	
Eng. /p/	[p^h]: |$\underline{H}$.ʔ.$\underline{U}$| [p]: |H.ʔ.$\underline{U}$|	|H.ʔ.$\underline{A}$|	Eng. /p/: Hun. /p/:	|U.ʔ.$\underline{H}$|
Eng. /b/ Hun. /p/	|ʔ.$\underline{U}$|	|ʔ.$\underline{U}$|	—	
Hun. /b/	|$\underline{L}$.ʔ.$\underline{U}$|	|L.ʔ.$\underline{U}$|	Eng. /b/: Hun. /b/:	|ʔ.$\underline{U}$|
Eng. /t/	[t^h]: |$\underline{H}$.ʔ.A| [t]: |H.ʔ.A|	|H.ʔ.$\underline{A}$|	Eng. /t/: Hun. /t/:	|A.ʔ.$\underline{H}$|
Eng. /d/ Hun. /t/	|ʔ.A|	|ʔ.$\underline{A}$|	—	
Hun. /d/	|$\underline{L}$.ʔ.A|	|L.ʔ.$\underline{A}$|	Eng. /d/: Hun. /d/:	|ʔ.$\underline{A}$|
Eng. /k/	[k^h]: |$\underline{H}$.ʔ.U| [k]: |H.ʔ.U|	|H.ʔ.$\underline{\quad}$|	Eng. /k/: Hun. /k/:	|ʔ.$\underline{H}$|
Eng. /g/ Hun. /k/	|ʔ.U|	|ʔ.$\underline{\quad}$|	—	
Hun. /g/	|$\underline{L}$.ʔ.U|	|L.ʔ.$\underline{\quad}$|	Eng. /g/: Hun. /g/:	|ʔ.$\underline{\quad}$|
Eng. /f/	|$\underline{H}$.A.$\underline{U}$|	|H.$\underline{U}$|	Eng. /f/: Hun. /f/:	|U.$\underline{H}$|
Eng. /v/ Hun. /f/	|H.A.$\underline{U}$|	|$\underline{U}$|	—	
Hun. /v/	|$\underline{L}$.H.A.$\underline{U}$|	|L.$\underline{U}$|	Eng. /v/: Hun. /v/:	|$\underline{U}$|
Eng. /s/	|$\underline{H}$.A|	|H.$\underline{A}$|	Eng. /s/: Hun. /s/:	|A.$\underline{H}$|
Eng. /z/ Hun. /s/	|H.A|	|$\underline{A}$|	—	
Hun. /z/	|$\underline{L}$.H.A|	|L.$\underline{A}$|	Eng. /z/: Hun. /z/:	|$\underline{A}$|
Eng. /ʃ/	|$\underline{H}$.$\underline{I}$|	|H.I.$\underline{A}$|	Eng. /ʃ/: Hun. /ʃ/:	|I.A.$\underline{H}$|
Eng. /ʒ/ Hun. /ʃ/	|H.$\underline{I}$|	|I.$\underline{A}$|	—	
Hun. /ʒ/	|$\underline{L}$.H.$\underline{I}$|	|L.I.$\underline{A}$|	Eng. /ʒ/: Hun. /ʒ/:	|I.$\underline{A}$|
/h/	|H| or |$\underline{H}$|	|H.$\underline{\quad}$|	|$\underline{H}$|	

	Backley (2011)	Kaye (2000)	An alternative proposal
/m/	|L.(ʔ).$\underline{\text{U}}$|	|L.(ʔ).$\underline{\text{U}}$|	|U.(ʔ).$\underline{\text{L}}$|
/n/	|L.(ʔ).A|	|L.(ʔ).$\underline{\text{A}}$|	|A.(ʔ).$\underline{\text{L}}$|
/ŋ/	|L.(ʔ).U|	|L.(ʔ)._|	|(ʔ).$\underline{\text{L}}$|
/l/	|ʔ.A|	|A.$\underline{\text{ʔ}}$|	|A.ʔ._|
/r/	|A|	|A._|	|A._|
/w/	|$\underline{\text{U}}$|	|U._|	|U._|
/j/	|$\underline{\text{I}}$|	|I._|	|I._|

Furthermore, we can observe several theory-specific characteristics of headhood in the different varieties of standard ET. Backley (2011) allows more than one head per phonological expression, and segments are also allowed not to contain any headed element. The reason behind this is the following: In order to be able to cover all, or at least the majority, of the cross-linguistically attested contrastive sound segments, it seems necessary to fully exploit the small number of available elements, |A, I, U, ʔ, H, L|, including their headed and nonheaded versions. That is, it is not the characteristic of a phonological expression that, for example, it should have one head, but the characteristic of elements whether a given phonological property is expressed by the headed or nonheaded version of a prime. For instance, as has been mentioned, headed |U| represents labiality, and nonheaded |U| velarity, regardless of whether it results in a multiheaded or headless expression. In the analysis proposed by Kaye (2000), a phonological expression may have maximally one head, and their head position may also be empty, which is taken to represent velarity.[93] When proposing subsegmental representations in this chapter, I will use this variety of standard ET as a point of departure.

---

[93] Although this version of ET may generally succeed in providing representations for the inventories of particular languages, it can appear to be its drawback that it may run out of means to represent the relatively great number of cross-linguistically observable phonological contrasts. As to what this limited capacity means from the viewpoint of a substance-free approach, it depends on the particular model that one assumes—for a brief overview of the differences relevant to the issue at hand, see section 3.3. In SFP, representing Reiss and his collaborator's view, even different forms of the same phonetic quality (i.e., cross-linguistic variation) can be traced back to different phonological primes. For them, even Backley's (2011) version would be problematic. For Radical Substance Free Phonology, on the other hand, the reduction in the contrastive capacity of elements in Kaye's (2000) version would not count as an undesirable step. Elements, which are assumed to be emergent, are posited in the phonological faculty of the speaker evidenced by the observed contrasts and the phonological processes during acquisition. Therefore, according to this model, there is no need to account for all the possible cross-linguistic contrasts.

7.2 Headedness vs. nonheadedness of |H|: fortisness and laryngeal neutralization

7.2.1 Incomplete laryngeal neutralization

The delaryngealization of obstruents in domain-final position was discussed in chapter 4 in connection with the Polish data. It is, however, not a unique feature of Polish but a common phenomenon across languages. Further laryngeal systems displaying the process include German, Dutch, Catalan, Russian and Sanskrit (see, e.g., Lombardi 1999). Whether laryngeal neutralization is complete in these languages or not has recently been subject to more serious investigation. Different experimental studies might get different results and draw different conclusions based on the methods they apply (for details, see, e.g., Jassem & Richter 1989). Also, it must be decided what exactly qualifies as incomplete neutralization: whether a systematic difference in the acoustic signal is sufficient for neutralization to be regarded as incomplete, or it should be categorized as such only if the partially preserved difference is also perceptible to some extent, which is evidenced by better-than-chance identifications of the underlying laryngeal specifications (see, e.g., Bárkányi & G. Kiss 2019). Dinnsen & Charles-Luce (1984), Port & O'Dell (1985) and Slowiaczek & Dinnsen (1985), for example, find incomplete neutralization in Catalan, German and Polish, respectively, while Jassem & Richter (1989) reports complete neutralization for Polish. The results of Strycharczuk's (2012) acoustic experiment, also for Polish, show a third scenario: word-final laryngeal neutralization is not incomplete but categorical and optional.

In the phonological representation, languages which do not exhibit final neutralization or in which the process is optional can be analyzed as laryngeal systems in which the delinking of |H| in final position fails to take place or takes place optionally. If, however, neutralization is actually incomplete, the way it should be represented phonologically is not so straightforward. For some solutions to this issue, see, e.g., Brockhaus (1995), van Oostendorp (2008) and van der Hulst (2015). Brockhaus (1995) applies two laryngeal elements, |H| and |L|, to encode two-way laryngeal contrasts, so the delinking of |H| from an obstruent does not result in neutralization in the phonological representation. Van Oostendorp assumes the possibility of a double relation between features and skeletal positions: projection and pronunciation. In the case of final obstruents, of the two relations that may form between [voice] and the skeletal slot, only the projection relation is realized. This keeps it distinct from a laryngeally specified obstruent contacting both relations with [voice] as well as from an unspecified obstruent. Van der Hulst (2015) argues that underlyingly, fortis obstruents are marked with [fortis] and lenis obstruents are laryngeally unspecified in aspirating and voicing languages alike; the difference between the two language types lies in what features a system employs to enhance the opposition, e.g., English might add [aspiration] to [fortis] segments while Hungarian provides laryngeally unmarked obstruent with [voice] (see section 4.3.5). In this model, the lack of enhancement can be understood as incomplete neutralization as the underlying opposition is still maintained.

Another possible phonological representation of incomplete laryngeal neutralization will be proposed in the following subsection after further details of laryngeal representations are discussed.

7.2.2 Representations

We can find a great deal of variation across different versions of ET in the application of “aitches” to mark obstruent-related qualities. The noise element |h| was initially used to signify obstruency, i.e., aperiodic energy given to the speech signal, which can be achieved by the narrowing of the vocal tract to the extent that turbulent airflow is created. These phonetic qualities characterize fricatives and affricates as well as released plosives. For analyses employing |h|, see, e.g., Harris (1994), Huber & Balogné Bérces (2010) and Balogné Bérces & Huszthy (2018). For further distinction, Harris (1994: 123–126) suggests that headed |h| mark greater stridency or noisiness, meaning that, for example, the strident /s/ should contain headed |h|, while the head of the phonological expression representing the nonstrident /θ/ should be the place element. In Huber & Balogné Bérces (2010), headed |h| encodes aspiration in languages like English and nonheaded |h| is associated with oral release.

Nevertheless, in standard ET, |h| has been merged with “old” |H| responsible for aspiration. As can be seen in the table in (144), Backely (2011) advocates the following representations: In plosives, headed |H| should encode aspiration, nonheaded |H| should be present in simple released voiceless segments, and the absence of |H| should mean in an aspirating language that the plosive is unreleased or laryngeally neutral—plosives in voicing languages do not contain |H| at all. In fricatives, the presence of nonheaded |H| represent frication in both aspirating and voicing languages; in the former language type, headed |H| (without the presence of |ʔ|) means that the fricative is fortis.

Kaye (2000) provides a somewhat different set of representations: in his account, no headed–nonheaded bifurcation is needed. This is because frication is not expressed by means of the element |H|. Fricatives differ from plosives in that they lack the element |ʔ|, and the difference between a fricative and an approximant of the same place of articulation is that the place element is the head of the expression in a fricative while it has an operator status in an approximant. This indicates well that actually, approximants are weaker versions of fricatives. So, in this model, all that |H| should represent is fortisness in aspirating languages (whether the production of a plosive involves aspiration or not, or whether it is a properly released segment or not), and as place elements take the head position in obstruents, |H| will be an operator in phonological expressions.

In the segmental representations I propose, the laryngeal element |H|, which is to represent fortisness alone like in Kaye’s (2000) analysis, should function as the head of an expression. Following Kaye’s proposal, I will assume one head per segment. If an obstruent is not marked with |H|, the head position is taken by the place element, so the representation of a fortis–lenis pair like /p/–/b/ and /s/–/z/ will be |U.ʔ.H̲|–|ʔ.U̲| and |A.H̲|–|A̲|, respectively. Expressions lacking |H| and possessing a nonheaded place element are representations of approximants, e.g., |A| encodes /r/. The idea that the place element is phonologically weaker in a fortis obstruent is corroborated by the fact that these segments undergo debuccalization much more frequently than lenes (see, e.g., O'Brien 2012). Again, the only available laryngeal element in a binary system is |H|, so there is no difference in the laryngeal specification of, say, an English /p/ and a Hungarian /p/.

In this new representation, incomplete final neutralization can be analyzed as the headed |H| being demounted to operator status. The next step, complete neutralization, would be the delinking of the element. (145a) illustrates the difference in the laryngeal specifications of plosive and fricative pairs when they occur in licensed position and when they undergo incomplete neutralization. In a sense, the representation of an incompletely neutralized contrast falls between how Backley (2011) and Kaye (2000) apply |H|: Backley uses the headed–nonheaded |H| distinction to differentiate between the two allophones of fortis plosives in aspirating languages: e.g., Eng. [pʰ] and [p], a phonetic detail which is noncontrastive in the language. He argues that "elements are units of linguistic information, not units of contrast. Of course, linguistic information usually *is* contrastive, but it need not be. Sometimes elements carry information which is important for perception, for example, which is the case here" (2011: 126, emphasis in original). As for Kaye (2000), he uses |H| strictly to encode underlying contrast. In my proposal, the nonheaded status of the element is the representation of weakening in the expression of laryngeal opposition.

(145) Laryngeal oppositions

a. in obstruents

i. in licensed position

/p/ |U.ʔ.$\underline{\text{H}}$|
/b/ |ʔ.$\underline{\text{U}}$|

/s/ |A.$\underline{\text{H}}$|
/z/ |$\underline{\text{A}}$|

ii. after incomplete neutralization

/p/ |H.ʔ.$\underline{\text{U}}$|
/b/ |ʔ.$\underline{\text{U}}$|

/s/ |H.$\underline{\text{A}}$|
/z/ |$\underline{\text{A}}$|

b. in sonorants

/r/ |A.$\underline{\quad}$|
/r̥/ |H.A.$\underline{\quad}$|

/m/ |U.(ʔ).$\underline{\text{L}}$|
/m̥/ |H.U.(ʔ).$\underline{\text{L}}$|

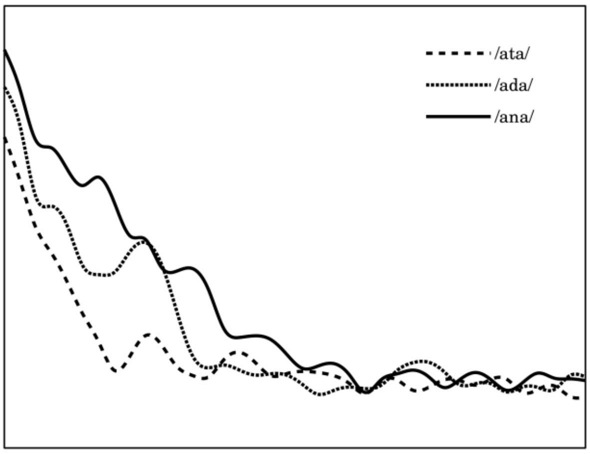
In (145b), aspirated sonorants are represented along with their unmarked equivalents. The idea that fortisness should be encoded by a nonheaded |H| in sonorants can be supported by the fact that it tends to be phonologically weaker when it is in sonorants than when it occurs in obstruents: although |H| in sonorants may interact with tone and be dislodged from the sonorant (e.g., in Lakkia and Havasupai, languages spoken in Arizona and southern China, respectively), it seems not to be able to spread to an obstruent, turning it into a fortis, while fortis obstruents can bring about aspirated sonorants (e.g., in Welsh)—see, e.g., Botma (2004: 211ff). The representation of an aspirated nasal as containing a headed |L| to mark nasality and a nonheaded |H| to mark fortisness is in line with the impressionistic view that such segments are characterized by nasality as their main property, and fortisness only introduces further contrast into the system of nasals. The issue of headedness in the case of |L| will be discussed presently in the next subsection.

7.3 Headedness vs. nonheadedness of |L|: the relation between nasality and voicing

As has been discussed earlier, the element |L| is used in standard ET to represent both voicing and nasality. Which phonological property should be represented by headed |L| and which one by nonheaded |L| has been up to debate. Conventionally, in consonants, headed |L| has been chosen to encode voicing and nonheaded |L| nasality, a view which is roughly identical to the proposals of authors like Ploch (1999), Nasukawa (2005) and Backley (2011)—for a summary, see, e.g., Breit (2017).

In contrast, Breit (2013, 2017) advocates taking headed |L| to represent nasality and nonheaded |L| to mark voicing. A phonetic argument for this decision is that nasality has greater acoustic prominence than voicing, which is indicated by the larger amount of energy in the low frequency range in the case of nasals, shown in (146), from Breit (2013: 204). In Backley's (2011) view, the headed version of an element is associated with more acoustic strength and prominence, which supports the idea that nasality should be expressed by headed |L|.

(146) Spectral pattern for the hold phase of intervocalic voiceless, voiced and nasal alveolar stops for a speaker of German



In a substance-free approach, the phonetic criterion suggested by Backley and thus the physical qualities reported by Breit would be irrelevant. However, there is a phonological argument for representing nasality with headed |L|: its tendency to be a relatively stronger phonological property than voicing. The examples in (147) from three languages, from Breit (2017: 20), illustrate how nasal stops do not undergo lenition in contexts where their oral counterparts do. For further arguments for the claim that nasality is phonologically stronger than voicing and for the refutation of counterarguments, see Breit (2017). Based on this, I also choose headed |L| to represent nasality.

(147) The phonological strength of nasality compared to voicing

a. Spanish

/la bota/	[la β̞ota]	‘the boot’
/la nota/	[la nota]	‘the note’

b. Estuary English

/bɪt/	[bɪʔ]
/bɪn/	[bɪn]

c. Liverpool English

/bak/	[bax]
/ban/	[ban]

7.4 Conclusion

In sum, besides headed |L| representing nasality, nonheaded |L| will encode voicing in languages which have more than two series of obstruents and need to resort to the nasal element as an extra means to create further laryngeal contrasts. In this way, in the case of both |H| and |L|, it is the headed version that can be considered the default case, which language apply most frequently (laryngeal contrast and nasal sounds are regularly present in human languages). The nonheaded versions can be thought of as “supplementary” devices.

It might be characteristic of a substance-free model that it cannot take cross-linguistic tendencies to justify the generalization of the headed/nonheaded status of a prime across languages. If a phonological strength relation between nasality and voicing is detectable through a phonological phenomenon in a given linguistic system, it can be used as an argument for positing the head–nonhead relation in that language. Therefore, in systems where such a hierarchy is not evidenced (i.e., there is no incomplete laryngeal neutralization or nasality–voicing interaction), the question of headedness with regard to these elements is irrelevant.

Conclusions

In the present dissertation, I have proposed a model of phonological analysis in which only one melodic element, namely |H|, is available to encode laryngeal contrast in both aspirating and voicing languages. It has been suggested that laryngeal systems be distinguished according to the phonological processes targeting |H| in them; in addition, they can differ on the surface, i.e., in the way their obstruent series are phonetically realized. Analyses throughout the dissertation are made within the framework of Strict CV Phonology, using the unary primes of Element Theory.

First of all, it has been illustrated that languages within the said categories are far from being uniform either from a phonetic or from a phonological point of view. Besides the fact that, for instance, the degree of aspiration may show cross-linguistic variation, not yet an unexpected phenomenon, we find aspirating languages like Swedish in which lenis obstruents are also pronounced fully voiced, which has been shown to result from active articulatory gestures. This property, however, is phonologically inactive. Considering such languages, I argue that the Laryngeal Realism view, which establishes phonological markedness relations based on the phonetic correlates of laryngeal contrasts is not tenable. For this, as a point of departure, I used Cyran's Laryngeal Relativism, whose main principle is that phonological representations of laryngeal contrasts are phonetically interpreted in a largely arbitrary way as long as a sufficient phonetic distance is kept between the two categories.

The reverse also seems to hold true: whether one or two melodic elements are assumed cross-linguistically to encode laryngeal contrasts, their behavior will not follow from their phonetic content. Phonetically active voicing can be phonologically active or inactive; in some languages, it is inhibited before a voiceless obstruent, while in others, it is not; and similar variance can be observed in aspirating languages too. Therefore, I argue that replacing |L| with |H| and reversing the markedness relations in languages traditionally considered voicing systems will not result in more stipulation with regard to what phonological processes we have to assume: the licensing of a laryngeal element can be context-dependent (it applies in presonorant position), or independent of the position; the element can either spread or not; if it does, it can spread leftward or exhibit bidirectional spreading. That is, although phonological processes can be analyzed in a nonarbitrary way in the sense that, for instance, we should not have to stipulate the insertion of a sourceless element, the way the computational system treats an element is to a great extent arbitrary.

The fact that a laryngeal element can be subject to virtually any combination of the processes defined in Strict CV Phonology, namely delinking and linking, may lend support to substance-free approaches to phonology, whose central tenet is that phonetic substance does not influence the way the phonological computation as a cognitive system operates on phonological primitives. It has been argued that phonology as a discipline studying the language faculty does not have to account for observed tendencies. Without running into a duplication problem of investigating the same aspect of a phenomenon at two levels of analysis, we may explain its occurrence and frequency with reference to phonetic or physical considerations, but a phonetic form can also be unnatural having come about diachronically, which is equally learnable by the speaker.

Dissimilation was also used to support an |H|-only analysis. This phonological process involves delinking in Strict CV terms. In the case of laryngeal dissimilation, on the other hand, we see that voicing languages regularly dissimilate to the voiced category. With respect to this long-distance phenomenon, voicing languages (with a few peculiar exceptions) behave as H-systems. Then, it was also shown that although we can find languages displaying a phonological relation between voicing and nasality, assumed in ET to be represented by the same prime, we do not have to posit L as a laryngeal element even in these systems to account for the phenomena. Nasal assimilation and postnasal voicing can result from the interactions of |H| as a laryngeal element and |L| as the nasal element while (pre)nasalization can be thought of as a phonetic phenomenon.

There have been attempts in Element Theory to decrease the number of its primes since its foundation. Although from a substance-free point of view, positing only one laryngeal element to mark the fortis series in general in order to treat two-way contrast systems uniformly is not a goal, it can be an advantageous step in ET to reduce the number or functional load of primes, considering what generalizations we may lose by taking the principle of economy to be of high priority. Furthermore, the compatibility of the substance-free view and ET as well as Strict CV Phonology could be a subject for further research.

Summary

The present dissertation proposes a phonological model in which only one subsegmental element, the fortis-marking |H|, is available to encode laryngeal contrast in both aspirating and voicing languages.

Analyses are made within the framework of Strict CV Phonology, using the unary primes of Element Theory. Chapter 1 provides an overview of the said theories and points out aspects that play an important role from the point of view of the proposed model, e.g., arbitrariness in phonological processes, the nature of melodic elements and the relation between phonological representation and its phonetic implementation.

Chapter 2 gives a phonetic background to the laryngeal properties of speech sounds as well as to phenomena related to them and summarizes the main phonological approaches in which they have been accounted for in the literature. In "traditional" analyses, only the distinctive feature [(±)voice] is used to represent laryngeal contrast in voicing and aspirating languages alike while proponents of the "nontraditional view" apply two features, [(±)voice] and [(±)spread glottis], or their equivalents in Element Theory, the melodic elements |L| and |H|, distinguishing between the two language types right at the phonological level.

Chapter 3 briefly discusses the question regarding the role of phonetic considerations in phonology and the views differing in this respect. On one end of the scale, we find functionalist phonologists who claim that phonetics and phonology cannot be considered autonomous; by integrating the two disciplines, we can explain sound patterns in languages more effectively. The opposite view can be referred to as substance-free phonology, whose main assumption is that the phonetic properties of a phonological element are irrelevant from the point of view of how the computational system of the phonological module will manipulate the element. The cases analyzed in the present study seem to support this latter view.

In chapter 4, I collect examples of languages which can be assumed to belong to the same typological category in the nontraditional view but vary significantly with respect to the phonetic realization of their obstruent series. Furthermore, it can be seen that phonological behaviors associated with the two laryngeal elements are tendencies only, and if we consider less regular cases, we find that these elements may display virtually any pattern. Therefore, I argue that abandoning |L| and replacing it with |H| in voicing languages results in a simpler and more uniform analysis of binary-contrast laryngeal systems. This requires no more stipulation than has already been necessary for phonological processes and the relationship between phonological representation and phonetic realization. In the present model, laryngeal systems can be distinguished according to the phonological processes operating on |H| and may show phonetic variation in the implementation of the obstruent categories.

In chapter 5, laryngeal dissimilation is examined, and it is shown that in general, it is the voiceless obstruents of voicing languages that behave as the laryngeally marked category, just like the fortes in aspirating languages:

laryngeal dissimilation as a delinking process targets voiceless obstruents and turns them into voiced ones.

Chapter 6 discusses languages in which voicing and nasality interact, which can be basically encoded by representing both properties with the element |L|. The phenomena in question are nasal harmony, postnasal voicing and (pre)nasalization. I claim that it is not necessary to assume |L| as a laryngeal element even in these languages in order to account for the relation between the two properties: the voiceless series can be taken as the laryngeally marked category containing |H|, in which case nasal harmony and postnasal voicing can be analyzed as processes motivated by the incompatibility of |H| and |L|, and (pre)nasalization as a phonetic implementation issue.

Finally, the role of headedness is the topic of chapter 7, where headed |H| is taken to encode fortisness, leaving nonheaded |H| available for the representation of incomplete laryngeal neutralization; while headed |L| represents nasality, and nonheaded |L| voicing (in languages where this element needs to be exploited for the establishment of more than two sets of obstruents).

Összefoglaló

A jelen disszertáció egy olyan fonológiai modellt javasol, amelyben egyetlen szegmentumalkotó elem, a fortis sort jelölő |H| áll rendelkezésre a laringális szembenállás kódolására mind az aspiráló, mind a zönge alapú nyelvekben.

Az elemzéseket a szigorú CV fonológia keretében, az elemelmélet egyértékű melodikus elemeinek használatával végeztem. Az 1. fejezet áttekintést nyújt az említett elméletekről, illetve kiemeli azokat a szempontokat, amelyek fontos szerepet játszanak a javasolt modell szempontjából – ilyenek például az önkényesség a fonológiai folyamatokban, a melodikus elemek természete, valamint a fonológiai ábrázolás és a fonetikai megvalósulás közötti kapcsolat.

A 2. fejezet a beszédhangok laringális tulajdonságai és az ehhez kapcsolódó jelenségek fonetikai hátterét ismerteti, és összefoglalja az ezeket magyarázó főbb fonológiai megközelítéseket, melyekkel a szakirodalomban találkozhatunk. A „hagyományos" elemzésekben csak a [(±)zönge] megkülönböztető jegyet használják a laringális szembenállás ábrázolására a zönge- és az aspiráló nyelvekben egyaránt, míg a „nem hagyományos" nézetet képviselők a [(±)zönge] és a [(±)tág hangrés] jegyeket vagy az elemelméletben használatos, ezeknek megfelelő |L| és a |H| melodikus elemeket alkalmazzák, megkülönböztetve ezzel a két nyelvtípust már fonológiai szinten.

A 3. fejezet röviden tárgyalja a fonetikai tényezők fonológiában játszott szerepének kérdését, illetve az e tekintetben eltérő nézeteket. A skála egyik végén találjuk azokat a funkcionalista fonológusokat, akik szerint a fonetika és a fonológia nem tekinthető autonómnak; a két tudományág integrálásával hatékonyabban magyarázhatók a nyelvekben megfigyelhető mintázatok. Ennek a nézetnek az ellentettje anyagmentes fonológia ('substance-free phonology') néven ismert, melynek alapfeltevése, hogy egy fonológiai elem fonetikai tulajdonsága irreleváns abból a szempontból, hogy a fonológiai modul számítási rendszere hogyan manipulálja az elemet. A jelen tanulmányban elemzett esetek ez utóbbi álláspontot látszanak alátámasztani.

A 4. fejezetben olyan nyelvekre találunk példát, amelyeknél feltételezhető a nem hagyományos elemzésekben, hogy tipológiailag ugyanabba a kategóriába tartoznak, viszont jelentős mértékű eltérést mutatnak a zörejhangsoraik fizikai megvalósulását illetően. Továbbá láthatjuk, hogy a két laringális elemhez köthető fonológiai viselkedések tendenciák csupán, és ha kevésbé gyakori eseteket is figyelembe veszünk, jóformán bármilyen mintázat megfigyelhető. Ezért amellett érvelek, hogy a zöngenyelvekben az |L| elhagyása és |H|-val történő helyettesítése a kettős szembenállást mutató laringális rendszerek egyszerűbb és egységesebb elemzését eredményezi. Ez nem követel több kikötést, mint amennyit már eddig is szükséges volt feltételezni a fonológiai folyamatokkal, valamint a fonológiai ábrázolások és a fonetikai megvalósulásuk viszonyával kapcsolatban. A jelen modellben a laringális rendszerek a |H|-ra irányuló fonológiai folyamatok szerint különböztethetők meg, és eltérést mutathatnak a zörejhangkategóriáik fonetikai megvalósulásában.

Az 5. fejezetben a laringális elhasonulás vizsgálatából kiderül, hogy a zöngenyelvekben általában a zöngétlen zörejhangok viselkednek laringálisan jelöltként, csakúgy, mint a fortisok az aspiráló nyelvekben: a laringális disszimiláció mint elemvesztéssel járó folyamat a zöngétlen zörejhangokat célozza, és zöngéssé teszi azokat.

A 6. fejezet olyan nyelveket tárgyal, amelyekben a zöngésség és a nazalitás kölcsönhatásban áll egymással, amit alapvetően úgy lehet kódolni, hogy az |L| elemmel jelöljük mindkét tulajdonságot. Az ide tartozó jelenségek a nazális harmónia, a nazális utáni zöngésedés és a (pre)nazalizáció. Amellett érvelek, hogy még ezekben a nyelvekben sem szükséges az |L| mint laringális elem feltételezése ahhoz, hogy számot tudjunk adni a két tulajdonság közötti kapcsolatról: a zöngétlen sor tekinthető a laringálisan jelölt, azaz |H|-t tartalmazó kategóriának, amely esetben a nazális harmónia és a nazális utáni zöngésedés elemezhető a |H| és az |L| összeférhetetlensége által kiváltott folyamatokként, a (pre)nazalizáció pedig fonetikai megvalósulást érintő esetként.

Végül a 7. fejezet témája a szerkezetifej-státusz, ahol a |H| fejként a zörejhangok fortisságát kódolja, alárendelt pozícióban pedig a részleges laringális semlegesedés ábrázolására alkalmas. Az |L| fejként a nazalitást jelöli, ellenkező esetben a zöngésséget (olyan nyelvekben, ahol szükség van rá a kettőnél több zörejhang-kategória ábrázolásához).

References

Abercrombie, David. 1967. Elements of general phonetics. Edinburgh: Edinburgh University Press.

Anderson, John M. and Colin J. Ewen. 1987. Principles of dependency phonology (Cambridge Studies in Linguistics 47). Cambridge/New York, NY: Cambridge University Press. https://doi.org/10.1017/cbo9780511753442

Anderson, Stephen R. 1981. Why phonology isn't "natural." Linguistic Inquiry 12(4): 493–539.

Archangeli, Diana. 1988. Aspects of underspecification theory. Phonology 5(2): 183–207. https://doi.org/10.1017/s0952675700002268

Archangeli, Diana and Douglas Pulleyblank. 1994. Grounded phonology (Current Studies in Linguistics 25). Cambridge, MA/London: MIT Press.

Árnason, Kristján. 1980. Quantity in historical phonology: Icelandic and related cases (Cambridge Studies in Linguistics 30). Cambridge/New York, NY: Cambridge University Press.

Bach, Emmon and Robert T. Harms. 1972. How do languages get crazy rules? In: Robert P. Stockwell and Ronald K.S. Macaulay (eds.). Linguistic change and generative theory: Essays from the UCLA Conference on Historical Linguistics in the Perspective of Transformational Theory, February 1969. Bloomington, IL/London: Indiana University Press. 1–21.

Backley, Phillip. 2011. An introduction to Element Theory. Edinburgh: Edinburgh University Press. https://doi.org/10.1515/9780748637447

Backley, Phillip. 2012. Variation in Element Theory. Linguistic Variation 12(1): 57–102. https://doi.org/10.1075/lv.12.1.03bac

Balogné Bérces, Katalin. 2017. *A News Feedem a Facebookon*: fonológiaalapú laringális nyelvtipológia [*My News Feed on Facebook*: phonologically based laryngeal typology]. Nyelvtudományi Közlemények 113: 147–166. https://doi.org/10.15776/NyK.2017.113.5

Balogné Bérces, Katalin and Bálint Huszthy. 2018. Laryngeal Relativism predicts Italian. Yearbook of the Poznań Linguistic Meeting 4: 153–177. https://doi.org/10.2478/yplm-2018-0007

Bárkányi, Zsuzsanna and Štefan Beňuš. 2015. Prosodic conditioning of pre-sonorant voicing. In: The Scottish Consortium for ICPhS 2015 (ed.). Proceedings of the 18th International Congress of Phonetic Sciences [ICPhS 2015]. Glasgow: University of Glasgow.

Bárkányi, Zsuzsanna and Zoltán G. Kiss. 2019. A fonetikai korrelátumok szerepe a zöngekontraszt fenntartásában: Beszédprodukciós és észleléses eredmények [The role of phonetic correlates in the maintenance of voicing contrast: Results from speech production and perception]. Általános Nyelvészeti Tanulmányok XXXI: 57–102.

Bárkányi, Zsuzsanna and Zoltán Kiss. 2012. A phonetic approach to the phonology of *v*: A case study from Hungarian and Slovak. In: Susanne Fuchs, Martine Toda and Marzena Żygis (eds.). Turbulent sounds: An interdisciplinary guide (Interface Explorations [IE] 21). Berlin/New York, NY: De Gruyter Mouton. 103–142.

Beckman, Jill, Pétur Helgason, Bob McMurray and Catherine Ringen. 2011. Rate effects on Swedish VOT: Evidence for phonological overspecification. Journal of Phonetics 39(1): 39–49. https://doi.org/10.1016/j.wocn.2010.11.001

Beckman, Jill, Michael Jessen and Catherine Ringen. 2009. German fricatives: coda devoicing or positional faithfulness? Phonology 26(2): 131–168. https://doi.org/10.1017/S0952675709990121

Beckman, Jill, Michael Jessen and Catherine Ringen. 2013. Empirical evidence for laryngeal features: Aspirating vs. true voicing languages. Journal of Linguistics 49(2): 259–284. https://doi.org/10.1017/S0022226712000424

Beckman, Jill and Catherine Ringen. 2004. Contrast and redundancy in OT. In: Vineeta Chand, Ann Kelleher, Angelo J. Rodríguez and Benjamin Schmeiser (eds.). WCCFL 23: Proceedings of the 23rd West Coast Conference on Formal Linguistics. Somerville, MA: Cascadilla Press. 101–114.

Bennett, William G. 2013. Dissimilation, consonant harmony, and surface correspondence. PhD dissertation. Rutgers University, New Brunswick, NJ.

Bennett, William G. and Sharon Rose. 2017. Moro voicelessness dissimilation and binary [voice]. Phonology 34(3): 473–505. http://doi.org/10.1017/S0952675717000252

Blaho, Sylvia. 2008. The syntax of phonology: A radically substance-free approach. PhD dissertation. University of Tromsø, Tromsø.

Blevins, Juliette. 2006. A theoretical synopsis of Evolutionary Phonology. Theoretical Linguistics 32(2): 117–165. https://doi.org/10.1515/tl.2006.009

Botma, Bert. 2004. Phonological aspects of nasality: An element-based dependency approach. Utrecht: Netherlands Graduate School of Linguistics [LOT].

Breit, Florian. 2013. Voice–nasality interaction and headedness in voiceless nasals. UCL Working Papers in Linguistics [UCLWPL] 25: 201–221.

Breit, Florian. 2017. Melodic heads, saliency, and strength in voicing and nasality. Glossa: a journal of general linguistics 2(1): 85. 1–35. https://doi.org/10.5334/gjgl.462

Brockhaus, Wiebke. 1995. Final devoicing in the phonology of German (Linguistische Arbeiten [Linguistic Works] 336). Tübingen: Max Niemeyer Verlag. https://doi.org/10.1515/9783110966060

Broe, Michael and Janet B. Pierrehumbert (eds.). 2000. Papers in laboratory phonology V: Acquisition and the lexicon. Cambridge/New York, NY/Melbourne/Madrid: Cambridge University Press.

Brown, Jason. 2006. Laryngeal assimilation, markedness and typology. Phonology 33(3): 393–423. https://doi.org/10.1017/S0952675716000191

Browman, Catherine P. and Louis M. Goldtstein. 1986. Towards an articulatory phonology. Phonology Yearbook 3: 219–252. https://doi.org/10.1017/s0952675700000658

Browman, Catherine P. and Louis M. Goldstein. 1995. Dynamics and articulatory phonology. In: Robert F. Port and Timothy van Gelder (eds.). Mind as motion: Explorations in the dynamics of cognition. Cambridge, MA/London: MIT Press. 175–194.

Bye, Patrik. 2011. Dissimilation. In: Marc van Oostendorp, Colin J. Ewen, Elizabeth V. Hume and Keren Rice (eds.). The Blackwell companion to phonology, Volume III: Phonological processes. Malden, MA/Oxford: Wiley-Blackwell. 1408–1433. https://doi.org/10.1002/9781444335262.wbctp0060

Charette, Monik. 1990. Licence to govern. Phonology 7(1): 233–253. https://doi.org/10.1017/s0952675700001196

Chelliah, Shobhana L. 1997. A grammar of Meithei (Mouton Grammar Library [MGL] 17). Berlin/New York, NY: Mouton de Gruyter. https://doi.org/10.1515/9783110801118

Chomsky, Noam and Morris Halle. 1968. The sound pattern of English. New York, NY/Evanston, IL/London: Harper & Row.

Clements, George N. 1985. The geometry of phonological features. Phonology Yearbook 2: 225–252. https://doi.org/10.1017/s0952675700000440

Cohn, Abigail C. 1998. The phonetics-phonology interface revisited: Where's phonetics? In: Amanda R. Doran, Tivoli Majors, Claude A. Mauk and Nisha Merchant Goss (eds.). Exploring the boundaries between phonetics and phonology: Proceedings of the 1998 Texas Linguistics Society Conference (Texas Linguistic Forum 41). Austin, TX: Department of Linguistics, University of Texas at Austin. 25–40.

Cyran, Eugeniusz. 1997. Resonance elements in phonology: A study in Munster Irish. Lublin: Folium.

Cyran, Eugeniusz. 2011. Laryngeal realism and laryngeal relativism: Two voicing systems in Polish? Studies in Polish Linguistics 6: 45–80.

Cyran, Eugeniusz. 2014. Between phonology and phonetics: Polish voicing (Studies in Generative Grammar [SGG] 118). Boston, MA/Berlin: De Gruyter Mouton. https://doi.org/10.1515/9781614515135

Cyran, Eugeniusz. 2016. Laryngeal Relativism. Why? And what now? Paper presented at the Thirteenth Old World Conference in Phonology [OCP13], Budapest, January 13–16, 2016.

Cyran, Eugeniusz. 2017. 'Voice' languages with no [voice]? Some consequences of Laryngeal Relativism. Acta Linguistica Academica 64(4): 477–511. https://doi.org/10.1556/2062.2017.64.4.1

Cyran, Eugeniusz. 2019. New Laryngeal Realism meets Polish voicing. In: Anna Bondaruk & Krzysztof Jaskuła (eds.). All around the world: Papers in honour of Bogdan Szymanek on his 65th birthday. Lublin: Wydawnictwo KUL. 129–158.

de Lacy, Paul. 2002. The formal expression of markedness. PhD dissertation. University of Massachusetts Amherst, Amherst, MA.

Dienes, Péter and Péter Szigetvári. 1999. Repartitioning the skeleton: VC Phonology. Manuscript. Eötvös Loránd University, Budapest.

Dinnsen, Daniel A. and Jan Charles-Luce. 1984. Phonological neutralization, phonetic implementation and individual differences. Journal of Phonetics 12(1): 49–60. https://doi.org/10.1016/S0095-4470(19)30850-2

Elordieta, Gorka. 2014. The word in phonology. In: Iraide Ibarretxe-Antuñano and José-Luis Mendívil-Giró (eds.). To be or not to be a word: New reflections on the definition of word. Newcastle: Cambridge Scholars Publishing. 6–68.

Fagyal, Zsuzsanna, Frederic Jenkins and Douglas Kibbee. 2006. French: A linguistic introduction. Cambridge/New York, NY: Cambridge University Press. https://doi.org/10.1017/CBO9780511791185

Finley, Sara. 2017. Locality and harmony: Perspectives from artificial grammar learning. Language and Linguistics Compass 11(1). https://doi.org/10.1111/lnc3.12233

G. Kiss, Zoltán. 2017. Aspiration of stops after fricatives in English: Results from a pilot experiment. In: Péter Szigetvári (ed.). 70 snippets to mark Ádám Nádasdy's 70th birthday. Budapest: Department of English Linguistics, Eötvös Loránd University. Retrieved August 31, 2022, from http://seas3.elte.hu/nadasdy70/gkiss.html

Geshe, Dejene and Julia Devardhi. 2013. Assimilation in Oromo phonology. Language in India 13(10): 331–358.

Goldsmith, John A. 1976. Autosegmental phonology. PhD dissertation. Massachusetts Institute of Technology, Cambridge, MA.

Gósy, Mária. 2000. The VOT of the Hungarian voiceless plosives in careful and spontaneous speech. Govor 17(1): 15–28.

Gussmann, Edmund and Jonathan Kaye. 1993. Polish notes from a Dubrovnik café: I. The yers. In: Margaret Cobb and Yan Jiang (eds.). SOAS Working Papers in Linguistics and Phonetics 3. London: Department of Linguistics, School of Oriental and African Studies, University of London. 427–462.

Hale, Mark and Charles Reiss. 2000. "Substance abuse" and "dysfunctionalism": Current trends in phonology. Linguistic Inquiry 31(1): 157–169. https://doi.org/10.1162/002438900554334

Hall, T. Alan. 2001. Introduction: Phonological representation and phonetic implementation of distinctive features. In: T. Alan Hall (ed.). Distinctive feature theory (Phonology and Phonetics [PP] 2). Berlin/New York, NY: Mouton de Gruyter. 1–40. https://doi.org/10.1515/9783110886672.1

Hall, T. Alan. 2005. Paradigm uniformity effects in German phonology. Journal of German Linguistics 17(4): 225–264. https://doi.org/10.1017/s1470542705000097

Halle, Morris and Kenneth N. Stevens. 1971. A note on laryngeal features. MIT Research Laboratory of Electronics Quarterly Progress Report 101: 198–213.

Harris, John. 1990. Segmental complexity and phonological government. Phonology 7(1): 255–300. https://doi.org/10.1017/s0952675700001202

Harris, John. 1994. English sound structure. Oxford/Cambridge, MA: Blackwell Publishers.

Harris, John. 2009. Why final obstruent devoicing is weakening. In: Kuniya Nasukawa and Phillip Backley (eds.). Strength relations in phonology (Studies in Generative Grammar [SGG] 103). Berlin/New York, NY: Mouton de Gruyter. 9–46. https://doi.org/10.1515/9783110218596.1.9

Harris, John and Geoff Lindsey. 1995. The elements of phonological representation. In: Jacques Durand and Francis Katamba (eds.). Frontiers of phonology: Atoms, structures, derivations. Harlow, Essex: Longman. 34–79. https://doi.org/10.4324/9781315845098-12

Haspelmath, Martin. 2006. Against markedness (and what to replace it with). Journal of Linguistics 42(1): 25–70. https://doi.org/10.1017/S0022226705003683

Hayes, Bruce. 1999. Phonetically-driven phonology: The role of Optimality Theory and inductive grounding. In: Michael Daswell, Edith Moravcsik, Michael Noonan, Frederick Newmeyer and Kathleen Wheatley (eds.). Functionalism and formalism in linguistics, Volume I: General papers (Studies in Language Companion Series 41). Amsterdam/Philadelphia, PA: John Benjamins Publishing Company. 243–285. https://doi.org/10.1075/slcs.41.13hay

Hayes, Bruce, Robert Kirchner and Donca Steriade (eds.). 2004. Phonetically based phonology. Cambridge/New York, NY: Cambridge University Press. https://doi.org/10.1017/cbo9780511486401

Hayes, Bruce and Tanya Stivers. 2000. Postnasal voicing. Manuscript. University of California, Los Angeles, CA.

Helgason, Pétur and Catherine Ringen. 2008. Voicing and aspiration in Swedish stops. Journal of Phonetics 36(4): 607–628. https://doi.org/10.1016/j.wocn.2008.02.003

Honeybone, Patrick. 2005. Diachronic evidence in segmental phonology: the case of obstruent laryngeal specifications. In: Marc van Oostendorp and Jeroen van de Weijer (eds.). The internal organization of phonological segments (Studies in Generative Grammar [SGG] 77). Berlin/New York, NY: Mouton de Gruyter. 319–354. https://doi.org/10.1515/9783110890402.317

Hualde, José Ignacio and Marianna Nadeu. 2011. Lenition and phonemic overlap in Rome Italian. Phonetica 68(4): 215–242. https://doi.org/10.1159/000334303

Huber, Dániel and Katalin Balogné Bérces. 2010. [voice] and/versus [spread glottis] in the modified Leiden model. Acta Linguistica Hungarica 57(4): 444–457. https://doi.org/10.1556/ALing.57.2010.4.6

Hughes, Arthur, Peter Trudgill and Dominic Watt. 2012. English accents & dialects: An introduction to social and regional varieties of English in the British Isles, 5th edition. Abingdon, Oxon/New York, NY: Routledge. https://doi.org/10.4324/9780203784440

van der Hulst, Harry. 1994a. An introduction to Radical CV Phonology. SKY 1994: Yearbook of the Linguistic Association of Finland. 23–56.

van der Hulst, Harry. 1994b. Radical CV Phonology: the locational gesture. UCL Working Papers in Linguistics [UCLWPL] 6. 439–477.

van der Hulst, Harry. 1995. Radical CV Phonology: the categorial gesture. In: Jacques Durand and Francis Katamba (eds.). Frontiers of phonology: Atoms, structures, derivations. Harlow, Essex: Longman. 80–116. https://doi.org/10.4324/9781315845098-13

van der Hulst, Harry. 2015. The laryngeal class in RcvP and voice phenomena in Dutch. In: Johanneke Caspers, Yiya Chen, Willemijn Heeren, Jos Pacilly, Niels O. Schiller and Ellen van Zanten (eds.). Above and beyond the segments: Experimental linguistics and phonetics. Amsterdam/ Philadelphia, PA: John Benjamins Publishing Company. 323–349. https://doi.org/10.1075/z.189.26hul

Hunnicutt, Leigh and Paul A. Morris. 2016. Prevoicing and aspiration in Southern American English. University of Pennsylvania Working Papers in Linguistics [PWPL] 22(1): 214–224.

Huszthy, Bálint. 2019. How can Italian phonology lack voice assimilation? PhD dissertation. Pázmány Péter Catholic University, Budapest.

Huszthy, Bálint. 2020. Is Italian Swedish? An uncommon look at Italian laryngeal phonology. In: Sho Akamine (ed.). Proceedings of the Thirty-first Western Conference on Linguistics [WECOL 2019], Volume 25. Fresno, CA: Department of Linguistics, California State University. 42–50.

Iscrulescu, Cristian. 2006. The phonological dimension of grammatical markedness. PhD dissertation. University of Southern California, Los Angeles, CA.

Itô, Junko and Armin Mester. 1986. The phonology of voicing in Japanese: Theoretical consequences for morphological accessibility. Linguistic Inquiry 17(1): 49–73.

Itô, Junko and Armin Mester. 1995. Japanese phonology: Constraint domains and structure preservation. In: John A. Goldsmith (ed.). The handbook of phonological theory (Blackwell Handbooks in Linguistics Series). Cambridge, MA/Oxford: Blackwell Publishers. 817–838.

Itô, Junko, Armin Mester and Jaye Padgett. 2001. Alternations and distributional patterns in Japanese phonology. Journal of the Phonetic Society of Japan 5(2): 54–60.

Iverson, Gregory K. and Joseph C. Salmons. 1995. Aspiration and laryngeal representation in Germanic. Phonology 12(3): 369–396. https://doi.org/10.1017/S0952675700002566

Iverson, Gregory K. and Joseph C. Salmons. 2003. Laryngeal enhancement in early Germanic. Phonology 20(1): 43–74. https://doi.org/10.1017/s0952675703004469

Iverson, Gregory K. and Joseph C. Salmons. 2007. Domains and directionality in the evolution of German final fortition. Phonology 24(1): 121–145. https://doi.org/10.1017/s0952675707001133

Iverson, Gregory K. and Joseph C. Salmons. 2008. Germanic aspiration: Phonetic enhancement and language contact. Sprachwissenschaft 33: 257–278.

Jakobson, Roman, C. Gunnar M. Fant and Morris Halle. 1952. Preliminaries to speech analysis: The distinctive features and their correlates. Cambridge, MA: MIT Press.

Jansen, Wouter. 2004. Laryngeal contrast and phonetic voicing: A laboratory phonology approach to English, Hungarian, and Dutch. PhD dissertation. University of Groningen, Groningen.

Jassem, Wiktor and Lutosława Richter. 1989. Neutralization of voicing in Polish obstruents. Journal of Phonetics 17(4): 317–325. https://doi.org/10.1016/s0095-4470(19)30447-4

Jessen, Michael. 1998. Phonetics and phonology of tense and lax obstruents in German (Studies in Functional and Structural Linguistics 44). Amsterdam/Philadelphia, PA: John Benjamins Publishing Company. https://doi.org/10.1075/sfsl.44

Jessen, Michael and Catherine Ringen. 2002. Laryngeal features in German. Phonology 19(2): 189–218. https://doi.org/10.1017/S0952675702004311

Jiménez, Jesús and Maria-Rosa Lloret. 2008. Asimetrías perceptivas y similitud articulatoria en la asimilación de sonoridad del catalán [Perceptual asymmetries and articulatory similarity in the voice assimilation of Catalan]. Cuadernos de Lingüística del I.U.I. Ortega y Gasset 15: 71–90.

Johnson, Keith. 2003. Acoustic and articulatory phonetics, 2nd edition. Malden, MA/Oxford: Blackwell Publishing.

Jones, Daniel. 1922. An outline of English phonetics. New York, NY: G. E. Stechert & Co.

Jones, ʻŌiwi Parker. 2018. Hawaiian. Journal of the International Phonetic Association 48(1): Prosody and pragmatic functions: 103–115. https://doi.org/10.1017/S0025100316000438

Kaye, Jonathan. 1990. ʻCodaʼ licensing. Phonology 7(1): 301–330. https://doi.org/10.1017/s0952675700001214

Kaye, Jonathan. 1992a. Do you believe in magic? The story of $s+C$ sequences. In: Asli Göksel and Elizabeth Parker (eds.). SOAS Working Papers in Linguistics and Phonetics 2. London: Department of Phonetics and Linguistics, School of Oriental and African Studies, University of London. 293–313.

Kaye, Jonathan. 1992b. On the interaction of theories of Lexical Phonology and theories of phonological phenomena. In: Wolfgang U. Dressler, Hans C. Luschützky, Oskar E. Pfeiffer and John R. Rennison (eds.). Phonologica 1988: Proceedings of the 6th International Phonology Meeting. Cambridge: Cambridge University Press. 141–155.

Kaye, Jonathan. 2000. A users' guide to Government Phonology (GP). Manuscript. University of Ulster, Coleraine.

Kaye, Jonathan. 2005. "GP, I'll have to put your flat feet on the ground." In: Hans Broekhuis, Norbert Corver, Riny Huybregts, Ursula Kleinhenz and Jan Koster (eds.). Organizing grammar: Linguistic studies in honor of Henk van Riemsdijk (Studies in Generative Grammar [SGG] 86). Berlin/New York, NY: Mouton de Gruyter. 283–288. https://doi.org/10.1515/9783110892994.283

Kaye, Jonathan. 2014. The ins and outs of phonology. In: Sabrina Benjaballah, Noam Faust, Mohamed Lahrouchi and Nicola Lampitelli (eds.). The form of structure, the structure of form: Essays in honor of Jean Lowenstamm. Amsterdam/Philadelphia, PA: John Benjamins Publishing Company. 255–270. https://doi.org/10.1075/lfab.12.20kay

Kaye, Jonathan, Jean Lowenstamm and Jean-Roger Vergnaud. 1985. The internal structure of phonological elements: a theory of charm and government. Phonology Yearbook 2(1): 305–328. https://doi.org/10.1017/s0952675700000476

Kaye, Jonathan, Jean Lowenstamm and Jean-Roger Vergnaud. 1990. Constituent structure and government in phonology. Phonology 7(1): 193–231. https://doi.org/10.1017/S0952675700001184

Keating, Patricia A. 1984. Phonetic and phonological representation of stop consonant voicing. Language 60(2): 286–319. https://doi.org/10.2307/413642

Keating, Patricia A. 1988. Underspecification in phonetics. Phonology 5: 275–292. https://doi.org/10.1017/s095267570000230x

Kenstowicz, Michael. 1994. Phonology in generative grammar (Backwell Textbooks in Linguistics 7). Cambridge, MA/Oxford: Blackwell Publishers.

Kent, Roland G. 1936. Assimilation and dissimilation. Language 12(4): 245–258. https://doi.org/10.2307/409151

Kingston, John. 2007. The phonetics–phonology interface. In: Paul de Lacy (ed.). The Cambridge handbook of phonology. Cambridge/New York, NY: Cambridge University Press. 401–434. https://doi.org/10.1017/cbo9780511486371.018

Kirchner, Robert M. 1998. An effort-based approach to consonant lenition. PhD dissertation. University of California, Los Angeles, CA.

Kiss, Zoltán. 2007. The phonetics–phonology interface: Allophony, assimilation and phonotactics. PhD dissertation. Eötvös Loránd University, Budapest.

Kristoffersen, Gjert. 2000. The phonology of Norwegian (The Phonology of the World's Languages). Oxford/New York, NY: Oxford University Press.

Kumashiro, Fumiko. 2000. Loan word phonology: A case for a non-reductionist approach to grammar. Proceedings of the 25th Annual Meeting of the Berkeley Linguistics Society. 359–370. https://doi.org/10.3765/bls.v25i1.1191

Ladefoged, Peter and Sandra F. Disner. 2012. Vowels and consonants, 3rd edition. Malden, MA/Oxford: Wiley-Blackwell.

Lass, Roger. 1984. Phonology: An introduction to basic concepts (Cambridge Textbooks in Linguistics). Cambridge/New York, NY/Melbourne: Cambridge University Press.

Lehnert-LeHouillier, Heike. 2009. Phonetic and phonological aspects of liquid devoicing in Thai, Hungarian, and American English stop-liquid sequences. In: Heike Lehnert-LeHouillier and Alex B. Fine (eds.). University of Rochester Working Papers in the Language Sciences [URWPLS] 5(1). Rochester, NY: Center for Language Sciences, University of Rochester. 49–68.

Lieberman, Philip. 1970. Towards a unified phonetic theory. Linguistic Inquiry 1(3): 307–322.

Lindsey, Geoff and Péter Szigetvári. 2013–. CUBE: Current British English searchable transcriptions. http://cube.elte.hu/

Lisker, Leigh and Arthur S. Abramson. 1964. A cross-language study of voicing in initial stops: Acoustical measurements. Word 20(3): 384–422. https://doi.org/10.1080/00437956.1964.11659830

Lombardi, Linda. 1995. Laryngeal neutralization and syllable wellformedness. Natural Language and Linguistic Theory 13(1): 39–74. https://doi.org/10.1007/BF00992778

Lombardi, Linda. 1999. Positional faithfulness and voicing assimilation in Optimality Theory. Natural Language and Linguistic Theory 17(2): 267–302. https://doi.org/10.1023/A:1006182130229

Lowenstamm, Jean. 1996. CV as the only syllable type. In: Jacques Durand and Bernard Laks (eds.). Current trends in phonology: Models and methods, Volume 1. Salford, Manchester: European Studies Research Institute, University of Salford. 419–441.

Maddieson, Ian. 1984. Patterns of sounds (Cambridge Studies in Speech Science and Communication). Cambridge/New York, NY: Cambridge University Press. https://doi.org/10.1017/CBO9780511753459

Martin, Andrew and Sharon Peperkamp. 2011. Speech perception and phonology. In: Marc van Oostendorp, Colin J. Ewen, Elizabeth V. Hume and Keren Rice (eds.). The Blackwell companion to phonology, Volume IV: Phonological interfaces. Malden, MA/Oxford: Wiley-Blackwell. 2334–2356. https://doi.org/10.1002/9781444335262.wbctp0098

McCarthy, John J. 1986. OCP effects: Gemination and antigemination. Linguistic Inquiry 17(2). 207–263.

McCarthy, John J. 2002. A thematic guide to Optimality Theory (Research Surveys in Linguistics). Cambridge/New York, NY: Cambridge University Press. https://doi.org/10.1017/CBO9780511613333

Mielke, Jeff. 2004. The emergence of distinctive features. PhD dissertation. The Ohio State University, Columbus, OH.

Mielke, Jeff. 2011. Distinctive features. In: Marc van Oostendorp, Colin J. Ewen, Elizabeth V. Hume and Keren Rice (eds.). The Blackwell companion to phonology, Volume I: General issues and segmental phonology. Malden, MA/Oxford: Wiley-Blackwell. 391–415. https://doi.org/10.1002/9781444335262.wbctp0017

Nádasdy, Ádám. 2006. Background to English pronunciation (phonetics, phonology, spelling). Budapest: Nemzeti Tankönyvkiadó.

Nasukawa, Kuniya. 2005. A unified approach to nasality and voicing (Studies in Generative Grammar [SGG] 65). Berlin/New York, NY: Mouton de Gruyter. https://doi.org/10.1515/9783110910490

O'Brien, Jeremy. 2012. An experimental approach to debuccalization and supplementary gestures. PhD dissertation. University of California, Santa Cruz, CA.

Ohala, John J. 1983. The origin of sound patterns in vocal tract constraints. In: Peter F. MacNeilage (ed.). The production of speech. New York, NY/Heidelberg/Berlin: Springer-Verlag. 189–216. https://doi.org/10.1007/978-1-4613-8202-7_9

Ohala, John. J. 1990. There is no interface between phonology and phonetics: a personal view. Journal of Phonetics 18(2): 153–171. https://doi.org/10.1016/s0095-4470(19)30399-7

van Oostendorp, Marc. 2003. An exception to final devoicing. Manuscript. Royal Netherlands Academy of Arts and Sciences, Amsterdam.

van Oostendorp, Marc. 2008. Incomplete devoicing in formal phonology. Lingua 118(9): 1362–1374. https://doi.org/10.1016/j.lingua.2007.09.009

Őri, Péter. 2020a. An alternative laryngeal analysis of languages with two obstruent series. The Even Yearbook 14: 91–133.

Őri, Péter. 2020b. Same element, different processes. Argumentum 16: 187–208. https://doi.org/10.34103/ARGUMENTUM/2020/12

Ploch, Stefan. 1999. Nasal on my mind: The phonetic and the cognitive approach to the phonology of nasality. PhD dissertation. University of London, London.

Port, Robert F. and Michael L. O'Dell. 1985. Neutralization of syllable-final voicing in German. Journal of Phonetics 13(4): 455–471. https://doi.org/10.1016/s0095-4470(19)30797-1

Pöchtrager, Markus A. 2006. The structure of length. PhD dissertation. University of Vienna, Vienna.

Prickett, Brandon. 2018. Post-nasal devoicing as opacity: A problem for natural constraints. In: Wm. G. Bennett, Lindsay Hracs and Dennis Ryan Storoshenko (eds.). WCCFL 35: Proceedings of the 35th West Coast Conference on Formal Linguistics. Somerville, MA: Cascallida Press. 331–340.

Raphael, Lawrence J., Gloria J. Borden and Katherine S. Harris. 2011. Speech science primer: Physiology, acoustics, and perception of speech, 6th edition. Baltimore, MD/Philadelphia, PA: Lippincott Williams & Wilkins.

Recasens, Daniel. 2002. Weakening and strengthening in Romance revisited. Rivista di Linguistica 14(2): 327–373.

Reiss, Charles. 2018. Substance Free Phonology. In: S.J. Hannahs and Anna R.K. Bosch (eds.). The Routledge handbook of phonological theory (Routledge Handbooks in Linguistics). Abingdon, Oxon/New York, NY: Routledge. 425–452. https://doi.org/10.4324/9781315675428-15

Riad, Tomas. 2014. The phonology of Swedish (The Phonology of the World's Languages). Oxford: Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199543571.001.0001

Rice, Keren D. 1992. On deriving sonority: a structural account of sonority relationships. Phonology 9(1): 61–99. https://doi.org/10.1017/s0952675700001500

Ringen, Catherine and Pétur Helgason. 2004. Distinctive [voice] does not imply regressive assimilation: Evidence from Swedish. International Journal of English Studies 4(2): 53–71.

van Rooy, Bertus and Daan Wissing. 2001. Distinctive [voice] implies regressive voicing assimilation. In: T. Alan Hall (ed.). Distinctive feature theory (Phonology and Phonetics [PP] 2). Berlin/New York, NY: Mouton de Gruyter. 295–334. https://doi.org/10.1515/9783110886672.295

Sagey, Elizabeth C. 1986. The representation of features and relations in non-linear phonology. PhD dissertation. Massachusetts Institute of Technology, Cambridge, MA.

Salimi, Hosseingholi. 1976. A generative phonology of Azerbaijani. PhD dissertation. University of Florida, Gainesville, FL.

Schane, Sanford A. 1984. The fundamentals of particle phonology. Phonology Yearbook 1: 129–155. https://doi.org/10.1017/s0952675700000324

Scheer, Tobias. 2004. A lateral theory of phonology, Volume 1: What is CVCV, and why should it be? (Studies in Generative Grammar [SGG] 68.1). Berlin/New York, NY: Mouton de Gruyter. https://doi.org/10.1515/9783110908336

Schuh, Russell G. 2002. Voicing dissimilation in Western Bade. Manuscript. University of California, Los Angeles, CA.

Schütz, Albert J. 1994. The voices of Eden: A history of Hawaiian language studies. Honolulu: University of Hawai‘i Press. https://doi.org/10.1515/9780824847234

Schwartz, Geoffrey. 2016. Representing non-neutralization in Polish *sandhi*-voicing. In: Jolanta Szpyra-Kozłowska and Eugeniusz Cyran (eds.). Phonology, its faces and interfaces (Sounds – Meaning – Communication 2). Frankfurt am Main: Peter Lang. 103–121.

Ségéral, Philippe and Tobias Scheer. 1999. The Coda Mirror. Manuscript. Université Paris 7, Paris/Université de Nice, Nice.

Ségéral, Philippe and Tobias Scheer. 2008. Positional factors in lenition and fortition. In: Joaquim Brandão de Carvalho, Tobias Scheer and Philippe Ségéral (eds.). Lenition and fortition (Studies in Generative Grammar [SGG] 99). Berlin/New York, NY: Mouton de Gruyter. 131–172. https://doi.org/10.1515/9783110211443.1.131

Siptár, Péter. 2006. A fonéma tündöklése és… [The rise of the phoneme and its…]. Magyar Nyelv 102(4): 407–419.

Siptár, Péter and Miklós Törkenczy. 2000. The phonology of Hungarian (The Phonology of the World's Languages). Oxford/New York, NY: Oxford University Press.

Slowiaczek, Louisa M. and Daniel A. Dinnsen. 1985. On the neutralizing status of Polish word-final devoicing. Journal of Phonology 13(3): 325–341. https://doi.org/10.1016/s0095-4470(19)30763-6

Souza, Tania Conceição C. de. 1991. The case of consonantal harmony in Bakairi language (Carib). Documentação de Estudos em Lingüística Teórica e Aplicada 7(1): 295–332.

Souza, Tania Conceição C. de. 2014. Ergatividade e funcionamento dos verbos em Bakairi (Karib) [Ergativity and the function of verbs in Bakairi (Carib)]. Revista FSA 11(2): 263–287. https://doi.org/10.12819/2014.11.2.14

Steriade, Donca. 1997. Phonetics in phonology: The case of laryngeal neutralization. Manuscript. University of California, Los Angeles, CA.

Steriade, Donca. 2000. Paradigm Uniformity and the phonetics-phonology boundary. In: Michael B. Broe and Janet B. Pierrehumbert (eds.). Papers in laboratory phonology V: Acquisition and the lexicon. Cambridge/New York, NY/Melbourne/Madrid: Cambridge University Press. 313–334.

Strycharczuk, Patrycja. 2012. Phonetics-phonology interactions in pre-sonorant voicing. PhD dissertation. University of Manchester, Manchester.

Szigetvári, Péter. 1996. Laryngeal contrasts and problematic representations. The Even Yearbook 2: 97–110.

Szigetvári, Péter. 1999. VC Phonology: a theory of consonant lenition and phonotactics. PhD dissertation. Eötvös Loránd University, Budapest.

Szigetvári, Péter. 2004. Manner as a skeletal relation. To appear in: Friedrich Neubarth, Markus Pöchtrager and John Rennison (eds.). Phonologica 2002: Structure and melody, Proceedings of the 9th International Phonology Meeting. Berlin: De Gruyter.

Szigetvári, Péter. 2020a. Emancipating lenes: A reanalysis of English obstruent clusters. Acta Linguistica Academica 67(1): 39–52. https://doi.org/10.1556/2062.2020.00004

Szigetvári, Péter. 2020b. Posttonic stress in English. In: Krzysztof Jaskuła (ed.). Phonological and phonetic explorations. Lublin: Wydawnictwo KUL. 163–189.

Szigetvári, Péter, Péter Rebrus and Zoltán Kiss. 2008. Jó fonológiák: Válasz Szépe Györgynek, Szende Tamásnak és Szépe Juditnak [Good phonologies: Response to György Szépe, Tamás Szende and Judit Szende]. Magyar Nyelv 104(1): 25–38.

Thráinsson, Höskuldur. 1994. Icelandic. In: Ekkehard König and Johan van der Auwera (eds.). The Germanic languages. London/New York, NY: Routledge. 142–189.

Trubetzkoy, Nikolai S. 1939. Grundzüge der Phonologie [Principles of phonology] (Travaux du Cercle Linguistique de Prague [Works of the Linguistic Circle of Prague] 7). Prague: Cercle Linguistique de Copenhague.

Vaux, Bert and Bridget Samuels. 2005. Laryngeal markedness and aspiration. Phonology 22(3): 395–436. https://doi.org/10.1017/S0952675705000667

Visser, Willem. 2020a. Progressive Voice Assimilation: function words beginning with /d-/. Taalportaal. Retrieved August 31, 2022, from https://www.taalportaal.org/taalportaal/topic/pid/topic-14020545865859386

Visser, Willem. 2020b. Progressive Voice Assimilation: the past tense of the weak verbs of the first conjugation class. Taalportaal. Retrieved August 31, 2022, from https://www.taalportaal.org/taalportaal/topic/pid/topic-14020545865642245

Volenec, Veno and Charles Reiss. 2020. Formal Generative Phonology. Radical: A Journal of Phonology 2: 1–148.

Wagner, Michael. 2002. The role of prosody in laryngeal neutralization. MIT Working Papers in Linguistics 42: 373–392.

Walker, Rachel. 2011. Nasal harmony. In: Marc van Oostendorp, Colin J. Ewen, Elizabeth V. Hume and Keren Rice (eds.). The Blackwell companion to phonology, Volume III: Phonological processes. Malden, MA/Oxford: Wiley-Blackwell. 1838–1865. https://doi.org/10.1002/9781444335262.wbctp0078

Wells, John C. 1982. Accents of English 2: The British Isles. Cambridge/New York, NY/Oakleigh: Cambridge University Press. https://doi.org/10.1017/CBO9780511611759

Wetzels, W. Leo. 1997. Bakairi and the feature 'voice.' Boletim da Associação Brasileira de Linguística 20: 21–34.

Wetzels, W. Leo and Joan Mascaró. 2001. The typology of voicing and devoicing. Language 77(2): 207–244. https://doi.org/10.1353/lan.2001.0123

Whisker-Taylor, Kate and Lynn Clark. 2019. Yorkshire Assimilation: Exploring the production and perception of a geographically restricted variable. Journal of English Linguistics 47(3): 221–248. https://doi.org/10.1177/0075424219849093

Wissing, Daan. 2020. Progressive voice assimilation. Taalportaal. Retrieved August 31, 2022, from http://www.taalportaal.org/taalportaal/topic/pid/topic-20170703154025461