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The laryngeal class in RcvP and voice phenomena in Dutch

Harry van der Hulst

This article proposes a system for representing phonation distinctions in consonants within Radical CV Phonology (RCVP), a dependency-based model that uses unary "features" (called elements). The RCVP model is briefly outlined. The proposal for phonation distinctions is compared to traditional binary systems and other unary proposals in the context of Government Phonology. The model is applied to phonation distinctions in Dutch, English and French which have traditionally been claimed to have different analyses. RCVP proposes a more unified analysis that uses the notion of enhancement. This article pays specific attention to voicing phenomena in Dutch (final devoicing, progressive and regressive voice assimilation) to illustrate and motivate certain aspects of the proposed system.

1. Introduction

In this article I propose a system of elements ("unary features") for phonation distinctions among consonants. This system is part of a general theory of phonological elements called *Radical CV Phonology* (RcvP) which I have developed in a number of previous articles (most recently in van der Hulst, 2005). While not all aspects of my proposal can be empirically underpinned in this article, I will discuss voicing phenomena in Dutch (final devoicing, progressive and regressive voice assimilation) to illustrate and motivate certain aspects of the theory. In this connection I will include a discussion of recent proposals in Cyran (2014) who offers a detailed study of voicing phenomena in Polish and several other languages, including Dutch. I refer to van der Hulst (in prep.) for a full discussion of RcvP.

2. Radical CV Phonology

In van der Hulst (2005), following Clements (1985), I adopt the view that each segment has a tripartite structure consisting of three *classes*: the Laryngeal, Manner and Place class, the latter two being subclasses of the superclass Supralaryngeal. In this article, I elaborate this tripartite structure as in Figure 1. Within each class, we find two subclasses called *components* and each component contains two elements which, referring to their articulatory correlates, I will also call *gestures*):[1]

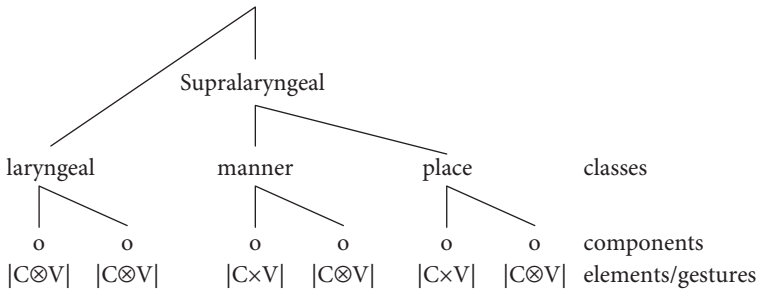


Figure 1. The "geometry" of phonemes in Radical cv Phonology.

("|C×V|" means "can combine", "|C⊗V|" means "cannot combine"; cf. below.) The various labels for the classes are for convenience only, having no formal status in RcvP. Each unit in the structure can be defined in purely formal terms. The elements |C| and |V| are also strictly formal units. I assume that the limitation of the set of elements to two units per component can be seen as resulting from a basic principle of categorization. In van der Hulst (to appear) I dub this principle the *Opponent Principle*.[2] Assuming that each component in Figure 1 correlates with a "phonetic space or dimension", |C| and |V| correlate with maximally opposed phonetic categories within such a space. This, however, does not entail that phonemic contrast must be expressed in terms of |C| versus |V|.[3] A strictly minimal way of representing contrast will make

1. In this article I will not focus on the acoustic correlates of phonological elements nor on the relation between articulatory and acoustic correlates.

2. Avery & Idsardi (2001) propose a theory of features which also introduces the notion of antagonistic pairs, referring to Sherrington (1947) who claimed that muscles are organized in antagonistic pairs. In their theory, members of a pair cannot both be active in a single segment. Nor can both be distinctive in a single language. For a comparison of this theory, called Dimension Theory, to RcvP, I refer to van der Hulst (in prep.).

3. Since I use the term 'phonological' as comprising both the study of contrastive or distinctive units at the cognitive level and of phonetic categories (as well as the relation between them), I will refer to the level of cognitive ('symbolic' or 'formal') representations as 'phonemic'.

use of the zero option. Thus, contrast for a given dimension can be expressed in terms of |C| versus zero or |V| versus zero and one would expect that this choice comes with empirical consequences. While the elements are strictly substance-free, elements do correlate with phonetic events (phonetic categories). The relation between formal units such as elements and phonetic events is referred to by terms like "phonetic interpretation" or "phonetic implementation". Naturally, since the elements |C| and |V| occur in all components, these elements correlate with a variety of phonetic interpretations. In (1), I indicate some of these interpretations for the four head components, mostly in very rough articulatory terms:

(1)

|V|-elements	|C|-elements
|Place: V| = labiality	|Place: C| = palatality
|Manner: V| = continuant, lateral	|Manner: C| = non-continuant, nasal
|Folds: V| = voicing, L tone	|Folds: C| = fortis, H tone
|Glottis: V| = spread, low register	|Glottis: C| = glottal, high register

The exact phonetic interpretation of the elements is dependent not only (a) on which class or component they occur in, but also (b) on whether they occur in a syllabic C-position ("onset") or a syllabic V-position ("rhyme"), and (c) on their status as head or dependent within the component (see below).

In each gesture, then, the two elements form an *antagonistic pair*. As mentioned, the members of such a pair correlate with opposite extremes within a certain "phonetic dimension", but this does not mean that they are like the plus and minus value of a binary feature. The two members in each opposition must have *independent status* because, unlike the values of binary features, they can sometimes be combined (and, then, enter in head-dependency relations). For ease of use, I will adopt in many cases the element *names* drawn from other feature theories which are more mnemonic. For example, I will use element names that have been in use in Dependency and Government phonology, such as |A, U, L, ∀, I, H| or, sometimes, element names that I have added for convenience, such as |f, v|. I do this to avoid cumbersome (although more accurate) expressions such as "|Place: V|" (= "|U|") (where the term "place" is a shorthand for a structural position in the segmental structure):

(2)

|V|-elements	|C|-elements
|Place: V| = |U|	|Place: C| = |I|
|Manner: V| = |A|	|Place: C| = |∀|
|Folds: V| = |L|	|Folds: C| = |H|
|Glottis: V| = |v|	|Glottis: C| = |f|

In comparing RcvP to other feature theories, I will also sometimes use labels such as [voiced], [spread] etc. Where it is relevant to remind the reader of the C- or V-nature of an element, I will write "V/U" or "V/[voiced]".

As mentioned, in some components elements can enter into combinations, each combination being maximally binary. This is indicated in Figure 1 by "|C×V|". Specifically, this is needed in the head components of Manner and Place. This level of complexity is not required in the Laryngeal head component, however. In addition, none of the dependent components require combinations of |C| and |V|. Where combining |C| and |V| within a component is blocked, this is indicated by "|C⊗V|". The fact that combinations are allowed in head components but not in dependent components is a clear instance of a head-dependent asymmetry; heads allowing greater complexity than dependents (Dresher & van der Hulst, 1998). Thus, the Manner and Place class allow the following 12 structures:

(3)

C	C + C	C + V
CV	CV + C	CV + V
VC	VC + C	VC + V
V	V + C	V + V

The option of having structures that lack a head component element, which would create two additional possibilities (∅ + C, ∅ + V), is simply not available as part of the RcvP syntax. RcvP also rules out (∅ + ∅) as a contrastive option. In general, elements in dependent nodes can only be activated when elements in corresponding head nodes have been activated.[4] The four-way distinction in the first column in (3) regards the combinations of elements within the head component. The second and third columns represent a combination of each of these four options and one element in the dependent component. As mentioned, this full array of structural possibilities is only exploited in the manner class and in the place class (in the latter, only for consonants since for vowels we do not need the dependent place component). In this article, I cannot justify the required set of structures for manner and place and I must refer for this to van der Hulst (in prep.). Here I will focus on the laryngeal class, for which we only need a subset of options:

(4)

C	C + C	C + V
~~CV~~	~~CV + CV~~	~~CV + V~~
~~VC~~	~~VC + C~~	~~VC + V~~
V	V + C	V + V

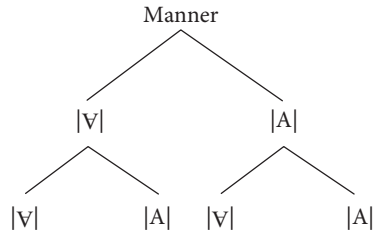
4. The idea that *within a class*, the head component elements must be activated before we get to the dependent elements correlates with the fact that in vowel systems, the manner class (more specifically its head component which accounts for aperture) must be activated before we get to the place component elements. It has been shown in typological studies of vowel systems that a minimal system would use only manner (i.e. aperture), leading to a so-called *vertical vowel system*, found in some Northwest Caucasian languages (Kabardian, Adyghe); see Lass (1984). There are no vowel systems that only use place distinctions. This further motivates the head-status of the manner class (which expresses aperture for vowels and stricture for consonants).

The relevant constraint is simply that the laryngeal class bars CV-combinations within both the head and the dependent component, as shown in Figure 1. Again, we see an instantiation of the head-dependent asymmetry in that the laryngeal class, being the dependent class, shows a smaller array of complexity (in its head component).[5]

I will specifically discuss the laryngeal class as needed for phonation types, which means that I will not discuss tonal distinctions. For vowels, laryngeal distinctions cover tone proper and register distinctions (see Yip, 1980).[6] In the ideal case, phonation interpretations would arise when laryngeal elements are expressed in a consonantal segment, while tonal interpretations would arise when such elements are part of a vowel structure. For the moment, I will maintain this idealization, leaving the occurrence of phonation distinctions (such as breathy and creaky voice) for vowels unaccounted for.[7]

The possibility of combining elements within a head component can be seen as one way of capturing the fact that some phonetic spaces can give rise to more than two phonetic categories, perhaps forming a scale of some sort. The combination of elements can be seen as an instance of *recursion*, in that an element can be said to contain an instance of itself (or of the antagonistic element):[8]

(5) a.



b. V̲ V̲ A A̲ V A̲

ci.	high	high-mid	low-mid	low	(for vowels)
cii.	stop	affricate	fricative (mellow)	fricative (strident)	(for obstruents)

5. Both laryngeal and place are dependent classes, but the place class is included in the super class supralaryngeal. Thus, the fact that the place class allows more structures than the laryngeal class is, once more, an example of an expected head-dependent asymmetry.

6. See Bao (1991) and Duanmu (1990) for similar proposals.

7. I assume that, if needed, phonation distinctions for vowels (see Gordon, 1998), where they co-occur with tonal properties, require a further level of complexity, which is most likely also needed for secondary and multiple place distinctions for consonants; see van der Hulst (in prep.).

8. Salting (2005) proposes a model, 'the nested subregister model', which also represents phonological categories in terms of a double split. He applies this to vowel height and place categories and discusses the parallels of his model to RcvP.

This being so, I will follow the practice in Dependency and Government phonology in which the left- and right-hand options in structure (5a) are simply written as |V| and |A|, rather than as |V,V| and | A,A|; see van der Hulst (in prep.) for further discussion of this point. The combination of elements within a component captures the scale-like character of phonetic categories within a phonetic dimension, while at the same time putting a discrete limit on the number of categories (up to four). In (5c) I indicate, in rough terms, the interpretation of the four manner categories for vowels and obstruents respectively. For sonorant consonants and many other details I must refer to van der Hulst (in prep.). One might ask why this recursive split of phonemic categories halts after one loop. I surmise that this is due to the fact that a further corresponding subdivision of phonetic spaces would create problems for the auditory detection of the distinctions between the resulting categories.

3. Phonation types

For consonants the most common phonation distinction is that between *voiced* and *voiceless*. However, *aspiration* is also a phonation type. In this case the opening between the vocal cords is "extra wide" which causes a delay in the onset of voicing in the next phoneme, the aspiration effect.[9] When the vocal folds are tight together this results in *glottalization* as a phonation type. In addition there are two further phonation types, called *creaky voice* and *breathy voice*. It has been claimed that these 6 types are sufficient as a basis for all possible phonemic contrasts that are attested in the world's languages.

Features for phonation

There is a considerable amount of literature about laryngeal features that I cannot do justice to here. Important work on potentially contrastive distinctions can be found in Ladefoged (1973), Halle & Stevens (1971), Keating (1984) and Gordon & Ladefoged (2001). In Halle & Stevens (1971) phonation (and tone) distinctions are captured with the features [±constricted glottis]/[±spread glottis] and [±stiff vocal folds]/[±slack vocal folds], each creating a three-way distinction. In later works, when referring to phonation, [±stiff vocal folds]/[±slack vocal folds] were replaced by the "older feature" [±voice] (see Kenstowicz, 1994):

9. Aspiration is often expressed in terms of Voice Onset Time (VOT); Lisker & Abrahamson (1964). When a voiceless stop is followed by a vowel, the voicing of the vowel will 'ideally' start right after the release of the stop. But if a stop is aspirated the onset of voicing is delayed and the vowel will start voiceless. Reluctant to build the notion 'time' into phonemic representations, I adopt the view that the onset delay of voicing could be seen as an effect of the wider glottal opening which takes more time to close and this 'spills' over in the vowel.

(6) *Voicing* *Glottal width/constriction*
[±voice] [±constricted glottis], [±spread glottis]

These features produce the following array of possible combinations and interpretations:

(7)

	[−voice] stiff vocal folds	[+voice] slack vocal folds
[+constricted] [−spread]	pˀ / p’ glottalized (ejective)	bˀ = IPA b̰ creaky (laryngealized)
[+constricted] [+spread]	???	???
[−constricted] [−spread]	p voiceless	b voiced (modal)
[−constricted] [+spread]	p^h aspirated	b^h = IPA b̤ breathy

The two glottal width features allow three, not four options because the combination [+constricted, +spread] is considered impossible.

A further development was the proposal that phonation features are unary (Lombardi, 1991, 1995a, 1995b; Iverson & Salmons, 1995; Avery, 1996; Avery & Idsardi, 2001; Kehrein & Golston, 2004),[10] which limits the set of possible phonation types to 6 (3 for sonorant consonants which are inherently voiced) as follows

(8)

	Voiceless –	aspirated spread	breathy spread voiced	modal – voiced	creaky constricted voiced	glottal constricted
Obs	+	+	+	+	+	+
Son	*	*	+[11]	+	+	*

Avery & Idsardi (2001) return to the Halle & Stevens features in a unary form; they use the unary feature pair [stiff]/[slack] and [constricted]/[spread]. They also introduce a unary pair [raised]/[lowered] to account for glottal height in ejectives and implosives. I take larynx raising to be a side effect of glottal stricture. To equate ejectives with voiceless glottalized consonants is common in the phonation literature (see Kenstowicz, 1994). It is tempting to say that implosives are phonetic variants for "creaky/laryngealized phonation", so that we do not have to adopt an extra feature pair, thus creating overgeneration (Ahn & Iverson, 2004).

10. This system is prefigured in Anderson & Ewen (1987) who also use three unary features: |V| for voice, |O| for [spread] and |G| for glottalic.

11. This option represents what is often called a "voiceless sonorant".

It is an understatement to say that glottal distinctions are very complex, as are the interactions between glottal states and other aspects of sound structure (see Miller, 2012). Here I will adopt the view that minimally three different articulatory dimensions are necessary to acknowledge the phonation distinctions that can be linguistically relevant (i.e. potentially distinctive). The feature [±voice] regulates the stretching (elongating) of the vocal folds. [-voice] means that the folds are stretched. [+voice] means that the folds are less stretched (and therefore more likely to vibrate). (Elongation causes "stiffness" and lack of elongation "slackness".) Instead of using a binary feature, this contrast can also be expressed in terms of [voice] versus zero or, as in Avery & Idsardi (2001), by two unary features [stiff] and [slack]. The opening of the glottis is controlled by the *arytenoid cartilages* (AC) which are attached to one side of the vowel folds. Their movement can change glottal width by outward and inward movement (ad/abduction) and they can "rotate inward" at their top bringing the vocal folds together "in the middle":

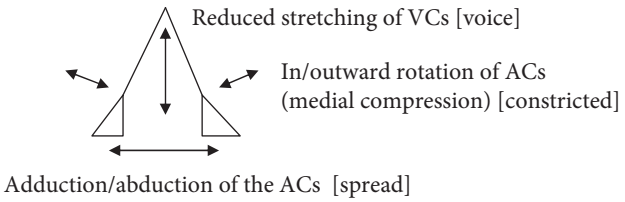


Figure 2. Phonation mechanisms.

As shown, while (presence or absence of) [voice] captures the stretching of the VCs (with [stiff] and [slack] as an alternative), the two glottal width features can be taken to refer to the two different activities of the ACs.

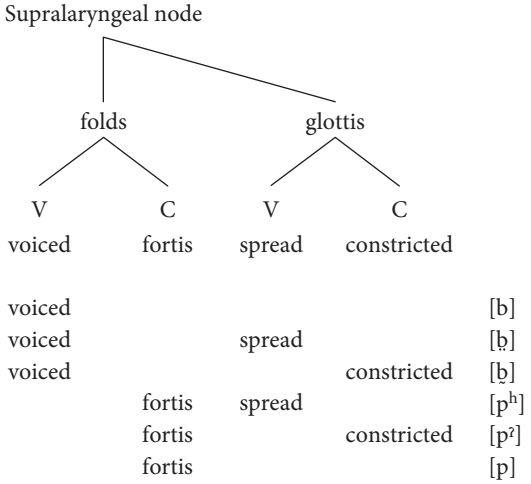
A RcvP proposal for phonation

How can we capture the array of 6 phonation types using RcvP "logic"?[12] Let us assume that the laryngeal component has two subcomponents, here called folds and glottis, each specifying two gestures:[13]

12. Unary proposals for phonation can be found in both Dependency Phonology and Government Phonology. Space limitations prevent me from discussing these proposals, but I must emphasize that my RcvP system is based on important work within these models, especially Anderson and Ewen (1987), Harris (1994, 2009), Brockhaus (1991, 1995), Backley (2011) and Cyran (2014).

13. Unlike Avery and Idsardi's Dimension Theory, RcvP does not, in general, disallow combinations of elements (gestures) that belong to one subcomponent (or 'dimension') since this possibility is crucial in the place and manner gesture and possibly in the tonal instantiation of the laryngeal elements (see van der Hulst, 2005, in prep.).

(9)



The RcvP logic suggests that we supply [voice] with an opponent counterpart, here labeled [fortis].[14] To reduce the number of available options to the 6 that we need, we have to assume that the syntax of the laryngeal gesture does not allow combinations *within* both subcomponents. (The full array of 12 phonemic categories is formally available, but if we assume that simpler categories get priority in being linked to the available phonetic categories, 6 categories remain "unemployed".) This, then, permits the 6 structures in (10) (which were already given in (4)):

(10)

C	C+C	C+V	V+C	V+V	V
voiceless	glottal	aspirated	creaky	breathy	voiced

Recall that having structures that lack a head component are not available as part of the RcvP syntax. As a result, if there is a phonation contrast, V/[voice] or C/[fortis] must be active in the system; this is one justification for regarding the fold-class as the head of the laryngeal class.[15] This being said, if a system such as French or English opposes [voiced] to voiceless (i.e. [fortis]) obstruents, one specification can be taken to be the unspecified (i.e. literally *unmarked*). As I will discuss in more detail below, it has been argued that the choice for English and French should be different because both languages realize the contrast between "p" and "b" very differently. In French, there really seems to be a voicing contrast, but in English the burden of differentiating "b" and "p"

14. Here I could also have adopted [slack] and [stiff]. I choose the label [fortis] with the intention to express that the phonetic correlate of this C-element is 'resistance to voicing', a property that is characteristic of strong consonants such as obstruents.

15. Unlike Avery and Idsardi's theory, in which contrast can only be made at the level of dimensions (my components), RcvP does not exclude contrast being made in terms of the elements themselves.

(at least in the onset of a stressed syllable) seems to be on "p" being aspirated (while "b" is hardly voiced). In the model that I propose here we could capture this fact by specifying these languages as in (11), where in French the specified element is [voice], whereas in English the specified element is [fortis]. (Below, I will modify this and suggest that we could assume that both systems specify their phonation contrast in term of C/[fortis] versus "zero".) An implication of this is that the [spread] specification for non-voiced consonants in English (which appears in the onset of stressed syllables) must be analyzed as a redundant, i.e. an *enhancing* addition which occurs when fortis stops occur in syllable initial position of stressed syllables. This squares with the most common analysis of aspiration, namely as a positional allophonic effect:

(11) Binary phonation contrast in French and English

		"b"	"p"	
a.	French	[voice]	–	
b.	English	–	[fortis]	(→[spread] / onset[16])

However, in the domain of phonation it has been argued in various publications that the distinction between French and English should be expressed as in (12):

(12) Binary phonation contrasts

		"b"	"p"
a.	French	[voice]	–
b.	English	–	[spread]

This view point has been widely accepted in the phonation literature (see Iverson & Salmons, 1995, 2003; Avery & Idsardi, 2001; Honeybone, 2002; Cyran (2014) for discussion and further references), where the general claim is that Germanic languages (except in some cases, such as Dutch) are "[spread] languages", whereas the Romance languages are "[voiced] languages".[17]

If this approach, which Honeybone (2002) refers to as *laryngeal realism*, is correct, it seems to follow that English has a phonation system that does not activate the vocal fold element class at all, as in (12b). However, this analysis of English (and other alleged [spread] languages) violates the above-mentioned restriction in RcvP that a phonation contrast must involve activation of the head component in the laryngeal class. That being said, it would seem that the analysis in (11) is also "realistic" in that it also captures the difference between English and French in terms of different phonemic specifications.

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16. The context for aspiration is here indicated in a simplified manner. I also ignore that no aspiration is assigned when the obstruent is preceded by /s/.

17. The 'switch' that Dutch has made from the presumed original [spread] contrast to a [voiced] contrast is said to have occurred due to Romance influences which specifically affected the stops. The specific reference to stops opens the door to a treatment of Dutch obstruents which differentiates between stops and fricatives; cf. below.

As mentioned, the literature cited above, classifies Dutch as a [voice] system because it lacks the typical aspiration that other Germanic languages have, implying that Dutch has the analysis in (11a/12a) that also applies to French. However, given the analysis in (11b) for English, which sees aspiration as a redundant property, it would be possible to maintain that Dutch did not drift away from the Germanic group in phonemic terms, but merely in phonetic terms, namely by not having redundant aspiration:

(13) Binary phonation contrast in Dutch

		"b"	"p"	
a.	Dutch	–	[fortis]	(*→[spread] / onset)
b.	English	–	[fortis]	(→[spread] / onset)
c.	French	[voice]	–	

In this analysis, the "voiced" character of obstruents transcribed with the IPA symbol "b" would not be due to a phonemic element [voiced], neither in English, nor in Dutch. Rather voicing in these languages would be contextual, i.e. a result of what is sometimes called *passive voicing*. It would then have to be assumed that passive voicing is more "aggressive" in Dutch[18] than in English (due perhaps to the influence of the phonemically voiced "b" of French).

A third option for Dutch is considered in Iverson & Salmons (2003), who analyze Dutch as a "split system" with presence versus absence of voicing being contrastive for stops, while the contrast in fricatives is specified equipollently in terms of [voiced] versus [spread]. In other words, fricatives display the "legacy" of Germanic aspiration. In this connection these authors refer to a generalization concerning fricatives, proposed in Vaux (1998), according to which non-voiced fricatives in a [voice] system display redundant [aspiration]. The Dutch non-voiced fricatives, according to Iverson and Salmons, display this redundant aspiration feature phonemically, as a legacy specification; this property has remained phonemic, even after the obstruent system had switched over to using contrastive [voice]. Iverson and Salmons thus claim that the Romance influence has changed the phonemic specification of Dutch obstruents.

In the RcvP system, a split analysis would come out as follows:

(14) Mixed analysis (moderate)

	"b"	"p"
Dutch	[voice]	–
	"v"	"f"
Dutch	[voice]	[fortis] (→[spread])

18. Although more so for stops than for fricatives; cf. below.

We can also consider a more "extreme" version of the mixed analysis, namely one in which the entire contrastive load for fricatives is placed on the [fortis] specification, the claim being that the Romance influence did not affect fricatives at all. This would entail that the voicing properties of fricatives are purely contextual/passive:

(15) Mixed analysis (extreme)

	"b"	"p"
Dutch	[voiced]	–
	"v"	"f"
Dutch	–	[fortis] (→[spread])

A minor issue is that I see no reason to assume that fricatives are redundantly specified as [spread], at least not for Dutch (despite Vaux' Law).

We now have a variety of possible analyses for Dutch obstruents, of which only (13) and (15) are consistent with RcvP. My next goal is to consider yet another analysis, consistent with RcvP, in which all obstruents are specified as [fortis] which would entail that the phonation contrasts in French, English and Dutch do not differ at the phonemic level at all. Rather, we could say that all these languages make a phonemic contrast between fortis and non-fortis phonation, and that the differences between them are a result of redundant properties:

(16)

Dutch	"b"	"p"
	– (→[voiced] / onset)	[fortis]
	"v"	"f"
	–	[fortis]
French	"b/v"	"p/f"
	– (→[voiced])	[fortis]
English	"b/v"	"p/f"
	–	[fortis] (→[spread] / onset)

In this analysis, I distinguish between enhancement (adding a redundant element such as [voiced]) and contextual passive voicing, which would account for the "voicing" of stops in non-onset positions and for that of fricatives in all positions. Enhancement (as suggested in Stevens, Keyser, & Kawasaki, 1986, and Stevens & Keyser, 1989) explains the addition of redundant elements. To justify enhancement, we could say that if the acoustic phonetic correlates of [fortis] are "weak" in that [fortis] essentially encodes the absence of voicing, it would make sense to reinforce contrast by adding enhancement properties to one of the two contrasting categories. In English type languages, the fortis category is enhancement with aspiration (i.e. the element [spread]), whereas in French type languages the enhancement targets the unmarked category (by adding the element [voiced]). Conceivably, a language might then also choose to apply both types of enhancements, and Swedish (as analyzed in Helgason & Ringen, 2008)

is a candidate for this "overdifferentiation" of the two contrasting obstruent groups. Contextual/passive voicing on the other hand accounts for the voice properties of obstruents that remain unmarked after enhancement. In English it attributes minimal voicing to initial obstruents, but more voicing to intervocalic obstruents (in *pepper* versus *rubber*) and final "b" (in *cap* versus *cab*) obstruents. This perspective, as we will see below, accords well with accounts of final devoicing that seek to avoid phonemic identity between phonemically voiceless (i.e. fortis) obstruents and "devoiced" (unmarked) obstruents. In languages with final "devoicing", final obstruents receive no or hardly any voicing. With reference to Dutch it might be said that the fact that 'voiced' fricatives are much less voiced than "voiced" stops is accounted for in (16) by attributing voicing for fricatives to contextual/passive voicing in all environments, including onsets. (However, below we will encounter a reason for reconsidering this aspect of the proposal in (16)).

The analysis in (16) not only follows from the logic of RcvP, it also squares with proposals made in Cyran (2014) whose theoretical model is that of Government Phonology.

4. Government Phonology

The set of elements that is "generated" by the RcvP model matches the Government Phonology (GP) views of Harris (1994, 2009) and Cyran (2014) to a certain degree. Both authors employ two laryngeal elements to make a four-way distinction:

(17)	H	–	H, L	L
	aspirated	modal	breathy	voiced

However, this array only covers a subset of phonation types needed. Harris (1994), whose focus is on English, does not refer to creaky and glottalized phonation. I assume here that the "stop" element ʔ would be invoked (see Backley, 2011). The six-way set of phonation contrasts that must be recognized can then be represented in GP as in (18). For comparison I added the RcvP specifications:

(18)	voiced				L	[b]
	voiced		spread		LH	[b̤]
	voiced			constricted	Lʔ	[b̰]
		fortis	spread		H	[p^h]
		fortis		constricted	ʔ	[$p^ʔ$]
		fortis			–	[p]

We must also note that Harris' unmarked phonation corresponds to my "pure" fortis type. Harris agrees with prior phonation scholars in claiming that English is an H (i.e. aspiration/spread) language. In agreement with the cited literature on voicing in

Germanic and Romance languages, Harris classifies French (and also Dutch) as a L (or voice) language. Cyran (2014) investigates voicing phenomena within the context of Government Phonology. His focus is on Polish, which previous researchers have analyzed as a L (or voice) system. Cyran's main goal is to show that at least some major dialects of Polish (specifically Cracow-Poznan Polish) may, in fact, be H (or aspiration/spread) systems. He then includes a brief excursus to Dutch and suggests that this language too could be analyzed as an H-system, contrary to popular belief. A consequence of this view is that the allophonic aspiration that we find in English for voiceless stops is not a necessary consequence of bearing the H element (as Harris, 1994 suggests), since Dutch does not display this allophonic effect. This consequence, as we have seen, falls out from the RcvP system proposed in the preceding section. (19) summarizes Cyran's proposal for languages such as Dutch, French and English:

(19)			
	Dutch	"b/v"	"p/f"
		/voicing/	H
	French	"b/v"	"p/f"
		L	–
	English	"b/v"	"p/f"
		–	H /aspiration/

The voicing of Dutch and French obstruents is the result of what Cyran calls *systemic interpretation*. It affects unmarked obstruents in an H-system, but not in an L-system, i.e. this kind of voicing is dependent on the system (hence *systemic*). In (19) I indicated systematic voicing as "/voicing/", i.e. where it seems to correspond with what I call enhancement, but for Cyran systemic voicing *includes* contextual/passive voicing of obstruents in all positions, whereas I single out the onset position for formal enhancement, referring to other positions as being subject to passive voicing. Aspiration of stops in English is, then, presumably, also systemic in Cyran's model. The following are differences between Cyran's account in (19) and my proposal in (16). Firstly, Cyran still recognizes the distinction between voice systems (his L-system, e.g., French and some dialects of Polish, such as Warsaw Polish) and H-systems (albeit that these no longer must have aspiration). Secondly, Cyran treats stops and fricatives in Dutch in the same way, whereas I formally distinguish between enhancement and passive voicing, assuming that stops have enhancement, while fricatives do not. Thirdly, and relatedly, whereas I say that English has enhancement ([spread]) *and* passive voicing, Cyran covers both under his heading of "systemic". An important point of agreement between both analyses is that, in both, Dutch did not leave the Germanic group by changing its phonemic representations.

In the next section I will develop my own proposal with reference to the facts of Dutch voicing phenomena and contrast it with the (laryngeally realistic) proposals discussed in Section 3 and, once more, with Cyran's proposal.

5. Final Obstruent Devoicing (FOD)

Consider the following "data" from Dutch:

(20)	<want> [wɑnt]	'mitten'	<want-en> [wɑntən]	'mitten-PLUR'
	<wand> [wɑnt]	'wall'	<wand-en> [wɑndən]	'wall-PLUR'

The classical textbook analysis runs as follows:

(21) /wɑnt/ 'mitten'
/wɑnd/ 'wall'

(22) [–son] → [–voice] / – #

Most textbook treatments of Final Obstruent Devoicing (FOD) continue to ignore a growing literature in which it is claimed that devoicing is not complete, which means that it is not a neutralizing process in any sense of that term (Port et al., 1981; O'Dell & Port, 1983; Dinnsen & Charles-Luce, 1984; Fourakis & Iverson, 1984; Charles-Luce, 1985; Dinnsen, 1985; Port & O'Dell, 1985; Port & Crawford, 1989; Ernestus, 2000). In production experiments "devoiced" obstruents prove not to be the same as underlyingly voiceless obstruents. In perception experiments subjects identify "voiceless" obstruents that are underlyingly voiced correctly above chance; see Brockhaus (1991, 1995) for extensive discussion. It must be mentioned that these claims have not remained uncontested. Jassem & Richter (1989) reject the result of studies on Polish final devoicing not being neutralizing (Slowiaczek & Dinnsen, 1985); see Cyran (2014) and also Kohler (undated).

One response to the potential incompleteness of FOD is to refer FOD to the phonetic implementation (as proposed in Port & O'Dell, 1985). In this case the implementation of voicing on obstruents is sensitive to context, in itself a property that phonetic implementation rules must presumably have anyway. The other response is to account for the phonetic difference between final underlying /t/ and final underlying "devoiced" /d/ *in the phonology,* which means that these two entities (/t/ and devoiced /d/) must not be phonologically identical. Within Government Phonology, Brockhaus (1995) proposes such a phonological analysis in which devoiced obstruents indeed differ from lexically voiceless obstruent. The voicing contrast is specified equipollently as H versus L, but the L-specification is not licensed in syllable final position (here indicated by placing it between parentheses). This creates the following three-way distinction:[19]

19. Brockhaus (1991, 1995) offers an excellent overview of FOD accounts. Both Brockhaus and Cyran, as is standard in GP, assume that FOD occurs when a voiced obstruent occurs before an empty nucleus. Here, without rejecting that view, I will simply assume that FOD occurs syllable-finally.

(23) Brockhaus (1995)

/t/	final /d/	/d/ elsewhere
H	(L)	L

Taking this analysis as a point of departure, van der Hulst (2008) adopts a more minimal, privative specification of the system, using only the element L:

(24) Van der Hulst (2008)

/t/	final /d/	/d/ elsewhere
–	(L)	L

It is then suggested that we could account for the partiality of FOD by assuming that while the element L is not licensed in final position, one might argue that an unlicensed element can have an effect on phonetic implementation. Indeed, if we assume, as is done in Government Phonology, that no element (or structure) ever gets deleted, an unlicensed L would remain a part of the representation. The question is whether there is any evidence for maintaining the L element in the representation. In van der Hulst & Ritter (2000) a case is made for keeping unlicensed elements in the representation so that they can play a role in accounting for certain types of opacity.[20] However, it is one thing to say that unlicensed elements can have a bleeding or feeding effect with respect to phonological processes, it is quite another to say that these elements, while unlicensed, can be phonetically interpreted "in a partial" manner. The idea that phonetic interpretation can see unlicensed elements and therefore does not have to totally ignore them, potentially giving them a "bit of interpretation", adds a significant degree of power to the phonetic interpretation module, and thus to phonology as a whole. I therefore conclude that a privative L-analysis of the Dutch obstruent system does not provide a straightforward account for the partial devoicing of syllable-final obstruents. (Note here that this negative result carries over to those Romance languages that are said to be L-languages and have non-neutralizing FOD, such as Catalan (Charles-Luce & Dinnsen, 1987). Below I will argue that this indicates that the distinction between L (voice) and H (aspiration) languages should not be made at the phonemic level.) Let us now turn to Cyran's account, where it is postulated that Dutch is an H-language:

(25) Cyran (2014)

/t/	final /d/	/d/ elsewhere
H	–	–

The central idea, as we have seen in the preceding section, is that voiced obstruents are unmarked. Their voicing properties are a result of what is called systemic voicing, which refers to the voicing of unmarked obstruents in an H system, when H-marked

20. This result is also achieved within Optimality Theory by using 'turbidity' (cf. Goldrick, 2000; van Oostendorp, 2008) which essentially also makes the claim that allegedly deleted material actually remains in the representation.

obstruents are not aspirated. Systemic voicing attributes voicing to obstruents in onset position only. In this account FOD is purely the result of the absence of systemic voicing. Crucially, this account delivers a representational difference between lexically voiceless (H-marked) "t" and "devoiced" (i.e. lexically unmarked) "d", thus providing a basis for the non-completeness of FOD. (However, as we will see below, Cyran (2014) assumes that syllable-final H is removed (delaryngealization) to arrive at a consistent account of regressive voicing assimilation in Dutch and this move, then, eliminates the advantage of his H-analysis with respect to FOD.)

Summarizing, we have compared three Government-style analyses:

(26)	/t/	final /d/	/d/ elsewhere	
a.	H	(L)	L	(Brockhaus, 1995)
b.	–	(L)	L	(van der Hulst, 2008)
c.	H	–	–	(Cyran, 2014)

Having rejected (26b) for its questionable reference (by phonetic interpretation) to unlicensed elements, we noted that (26c), i.e. analyzing Dutch as an H-language, provides a basis for the alleged non-neutralizing character of FOD. However, as already mentioned, we must also note that a similar explanation for the alleged non-neutralizing character of FOD in an L-language (such as Calatan) is not available.

Brockhaus (1995) does not explicitly address this issue, but we can construct the difference between H- and L-languages along the following lines:

(27)	/t/	final /d/	/d/ elsewhere	
a.	H	–	–	(H-language)
b.	H	(L)	L	(L-language)

That is, we can adopt Cyran's analysis for H-languages (including Dutch), while L-languages would have *equipollent* H/L-systems. This, at least, provides a basis for the incompleteness of FOD in L-languages. Translated into the RcvP system, this is tantamount to saying that *all* laryngeal obstruent systems specify the non-voiced series as C/[fortis], while voice languages also specify the voiced series with V/[voice]. However, returning to the proposal in (16), repeated for convenience as (28), we can now take this one step further. We do, in fact, not have to assume that the V/[voiced] specification is phonemically specified at all, ever, which indeed brings us to the proposal in (16/28):

(28)			
	Dutch	"b" – (→[voiced] / onset)	"p" [fortis]
		"v" –	"f" [fortis]
	French	"b/v" – (→[voiced])	"p/f" [fortis]
	English	"b/v" –	"p/f" [fortis] (→[spread] / onset)

In this account, so-called H- and L-languages do not differ at the level of contrastive specification. They differ in using different redundant features for enhancement.

In both types of languages, there is now a uniform account for FOD: final unmarked (non-fortis) obstruents differ from lexically [fortis] ("voiceless") obstruents. The former are unmarked, whereas the latter are always specified as [fortis]. Note, however, that there is one consequence to treating stops and fricatives differently in (16/28) (i.e. as enhancement for stops and contextual/passive voicing for fricatives). With this difference, final devoicing in fricatives is a direct result of suppressing passive voicing, while for stops we need to suppress enhancement in final position and then also passive voicing. To avoid this "duplication problem" I suggest that we treat stops and fricatives in Dutch the same way. I suggest that all obstruents that are not marked [fortis] are enhanced with [voiced] in onset position. Note, however, that this will be amended as being more restricted for fricatives in the next section:

(29)			
	Dutch	"b/v" – (→[voiced] / onset)	"p/f" [fortis]
	French	"b/v" – (→[voiced])	"p/f" [fortis]
	English	"b/v" –	"p/f" [fortis] (→[spread] / onset)

In this analysis, the FOD-effect is treated in the same way as initial aspiration in English and German, namely in terms of enhancement being context-sensitive. Unmarked obstruents in Dutch are enhanced with [voiced] in onset position. In English, obstruents marked with [fortis] are enhanced with [spread] in initial position. Context-sensitive enhancement rules create allophonic variation. It lies in between the phonemic and the phonetic representation. This, I add, is the essential insight of Cyran (2014). The difference between his and my model is that my notion of enhancement is a special (i.e. more aggressive) case of passive voicing. The potential empirical consequences of distinguishing enhancement *as a formal operation* need to be further explored.

I note that the approach suggested here, while not, in my view, "laryngeally unrealistic", embodies a return to what Honeybone (2002) calls the "traditional approach" (which he contrasts with the new approach labeled "laryngeal realism") that treats "voicing" contrasts in obstruents the same way in all languages (see, for example, Lisker & Abrahamson, 1964; Keating, 1984). However, it differs from this traditional approach in putting, somewhat unexpectedly perhaps, the burden of contrast on C/[fortis] (versus ∅) rather than on V/[voice] (versus ∅). To put the burden on C/[fortis] makes sense within RcvP because obstruents are C-type phonemes from a syllabic point of view because the onset is a C-type syllabic constituents and opposed to the V-type rhyme (see van der Hulst, in prep.).[21]

21. Since in French the unmarked category is enhanced with [voiced] in all positions, the skeptical reader might object that we then might just as well say that the burden of phonemic

6. Voicing assimilation

We also need to take into account the effect of regressive and progressive voicing assimilation in Dutch.[22] The following table schematically specifies the voicing properties of all the possible combinations that can occur across compound boundaries:

(30)

C1 – C2	stop – stop	fricative – fric	stop – fricative	fricative – stop
vcl – vcl	t – p [tp]	f – s [fs]	t – f [tf]	f – t [ft]
voi – voi	d – b [db]	v – z [fs]	b – z [ps]	z – b [vb]
voi – vcl	d – p [tp]	v – s [fs]	t – f [tf]	v – p [fp]
vcl – voi	t – b [db]	z – v [sf]	p – v [pf]	f – b [vb]

There is an enormous amount of work on voicing assimilation in Dutch which suggests or explicitly claims that voicing assimilation is gradient and therefore should be handled "in the phonetics" (cf. Slis, 1986; Ernestus, 2000; Janssen, 2004, 2007). Unlike what is claimed in many standard descriptions or analyses, voicing assimilation in Dutch is demonstrably non-neutralizing, at least in many cases. The degree of voicing is dependent on a number of factors (involving speech style, tempo, gender etc.) which give regressive voicing all the necessary qualifications for being a variable, gradient, non-neutralizing process.

An additional notable feature of the voicing facts is the special behavior of fricatives. Voiced fricatives in C2 position do not trigger regressive voicing, but on the contrary "lose" their voicing.

In Cyran's model, regressive assimilation is indeed seen as a matter of *phonetic co-articulation*. Phonetic co-articulation is different from his systemic interpretation that lies behind the voicing of obstruents in H-languages. Regressive voicing results from the fact that in Dutch unmarked obstruents are systemically voiced and this voicing then spills over in the preceding obstruents as a matter of co-articulation. Cyran assumes that systemic voicing (including FOD) applies cyclically. This means

specification lies with [voiced] rather than [fortis]. This analysis perhaps better predicts robust voicing in all positions, including the absence of FOD. My reason for stubbornly pursuing the extreme position that it is always [fortis] that carries this burden of contrast for obstruents is that we can then make a sharp distinction between obstruents and sonorants if we say that sonorants, being syllabic V-positions, *must* select the element specification [voiced], while the laryngeal C-element [fortis] is obligatory for obstruents. The caveat of this idea is that while sonorants do not allow the unmarked ∅-option (which would allow a 'voicing' contrast for sonorants), obstruents do.

22. See Zonneveld (2007) for a comprehensive overview of data and approaches. Generative analyses of voicing assimilation in Dutch are Mey (1968), Hubers & Kooij (1973), Tops (1974), Brink (1978), Trommelen & Zonneveld (1979) and van der Hulst (1980).

that the non-voicing of final obstruents is "fixed" as a matter of systemic voicing such that they cannot be revoiced later on (after the compound has been formed). Therefore regressive voicing, for him, must be a phonetic process. However, since phonetic co-articulation is assumed to be incapable of overriding the lexical voicelessness of obstruents, which are specified with H, Cyran proposes that final H is delinked (delaryngealization), which makes the regressive effect identical to what we get when the first obstruent is lexically non-voiced. This assumption turns out to be crucial for his account of the past tense suffix, but, as noted above, it undermines the idea that the non-completeness of FOD can be explained in terms of the distinction between H and ∅. Cyran explains why clusters in which the second obstruent is a fricative are fully non-voiced by assuming that the systemic passive voicing of fricatives after a non-voiced obstruent is simply nil.

In phonological rule based accounts, progressive devoicing requires a separate rule which is either an assimilation rule that targets fricatives, given that FOD applies first, guaranteeing that a preceding obstruent is voiceless, or a rule about the distribution of fricatives stating that following an obstruent, fricatives lose their voice property, as proposed in Zonneveld (2007) and Iverson & Salmons (2003).[23] This distributional account makes sense if we assume that the voicelessness of fricatives is the result of the fact that in this position, fricatives were never voiced when a sound change in Old Dutch turned initial fricatives into voiced fricatives. In van der Hulst (1979) I have suggested that this sound change was blocked precisely in those cases in which fricatives were preceded by an obstruent that was either lexically voiceless or voiceless due to FOD.[24]

Adopting the RcvP approach that was sketched in the preceding section, voicing assimilation in Dutch can also be regarded as phonetic co-articulation due to the enhancement element [voiced] that is assigned to non-fortis obstruents.[25] So how can

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23. See also the rule of Progressive Delinking in Rubach (1996) for an identical phenomenon in Polish which is discussed in Cyran (2014).

24. In Cyran's analysis (which embodies the distributional view on the voicelessness of fricatives in C2 position in terms of his passive voicing account) there is no ordering statement concerning Regressive voicing assimilation and FOD, while in traditional rule based approaches it has to be assured that a syllable final obstruent that has become voiced due to REVO does not lose its voice as a result of FOD. This requires an extrinsic ordering statement and an appeal to something like Proper Inclusion Precedence if REVO can be seen as more specific than FOD (cf. van der Hulst, 1980), unlike the [voice] specification on non-tense stops which is the basis for the phonetic implementation version of regressive voicing assimilation.

25. The effect of voicing on preceding 'devoiced' obstruents (which are unmarked) and preceding voiceless obstruents (which are marked [fortis]) is, presumably, the same. If so, rather than deleting [fortis] in final position (paralleling Cyran's rule of H-deletion), which undermines the basis for an account of incomplete FOD, I will assume that phonetic processes have no access to element specifications as such.

we account for the special behavior of fricatives? Given the analysis in (29), the most direct way is to assume that no enhancement of non-fortis fricatives occurs when a fricative is preceded by another obstruent. (This is better than saying that fricatives do not get enhanced at all because this triggers the duplication problem with respect to final devoicing that was noted earlier.) Given that fricatives lack the enhancement property V/[voiced] in C2 position, they cannot cause the phonetic regressive voicing process. Note that this account agrees with Zonneveld's distributional explanation, except that it accounts for the distribution of voiced and voiceless fricatives with a limited insertion of [voiced] rather than with a limited deletion of [voiced].

It is now interesting to ask whether voicing assimilation processes are systematically different in aspiration and voice languages. This question cannot be answered without differentiating between obstruent clusters in terms of the kind of "boundary" that occurs between the obstruents. If we take the simple case of two obstruents, there are several possible relations between them:

(31) a. both belong to a syllable onset (*sp*ot)
b. both belong to a syllable coda (a*sk*)
c. both obstruents form onset – coda sequence
i. within a monomorphemic unit (pa*st*a)
ii. within a derived word (a*bd*uction)
iii. within a compound (foo*tb*all)
iv. within a phrase (ea*t b*read)

Cross-linguistically, there is a strong tendency for obstruent clusters that are not separated by a strong grammatical boundary (such as a compound or phrasal boundary) to be "harmonic" in terms of phonation in both aspiration and voicing languages (see Cho, 1990; Wetzels & Mascaró, 2001). It would seem that regressive voicing assimilation across a strong grammatical boundary is perhaps more pervasive in "voice enhancement" languages such as Dutch and French. In aspiration enhancement languages such as Norwegian and English, regressive voicing across compound boundaries does not occur as much, or perhaps not at all. If this is true, it would support the claim that regressive voicing is fed by voicing enhancement in non-fortis obstruents. It is perhaps also to be expected that aspiration languages will have progressive "devoicing" (such as in English plural and past tense allomorphy: cat-z > [ts], walk-d > [kt]) caused by the spread of the enhancement property of fortis obstruents and the unmarkedness of non-fortis obstruents.[26]

26. Even though non-onset fortis obstruents are not phonetically aspirated, it is reasonable to assume that fortis obstruents resist passive voicing in all contexts, thus suppressing passive voicing in non-fortis obstruents with which they form a cluster.

Finally, let us consider voicing assimilation in suffixed words in Dutch, another crucial piece of the voicing assimilation facts. Focusing on three suffixes that all share the phonological form of starting with a coronal stop followed by a schwa:[27]

(32)

Past tense suffix	*sta[f-t]e, e[b-d]e*
Noun forming suffix	*ruim[t]e, leeg[t]e*, etc.
Numeral suffix	*der[d]e, zeven[d]e*, etc.

The past suffix alternates and this alternation follows from a progressive assimilation. It is as if the coronal obstruents of the past suffix behave like a fricative (see Trommelen & Zonneveld, 1979; Zonneveld, 2007). Van der Hulst & Kooij (1981) write a separate progressive assimilation rule that makes specific reference to the past suffix.

Cyran's analysis of the past-tense suffix is different. He proposes that this suffix has a non-voiced obstruent and then following a stem with a voiceless obstruent, passive voicing is blocked because of the preceding H-marked obstruent. Here we see that it is crucial to assume that stem-final H is not delinked. Cyran says that the verb stem is not a cyclic "spell out domain". This strikes me as an ad hoc solution. Instead I propose that the dental suffix has a *disjunctive representation*, whereas the other two suffixes in (32) have a fixed lexical representation:

(33)

Past tense suffix	{C/[fortis]~∅}, C/[fortis] after C/[fortis], ∅ elsewhere (*staf-te, eb-de*)
Noun forming suffix	{C/[fortis]} (*ruimte, leegte*, etc.)
Numeral suffix	{∅} (*derde, zevende*, etc.)

The "correct" form of the dental suffix is chosen based on the lexical voice property of the stem final consonant. This way we do not need to make a special stipulation about FOD not applying. When the stem ends in a voiceless obstruent, the form /te/ is chosen; elsewhere /de/ appears. This creates the correct conditions for the alleged progressive voicing assimilation in a form like /eb-de/.

7. Conclusions

In my RcvP model there "has to be" a counterpart to [voice] (which is a V-element). I proposed that this is C/[fortis]. I then proposed in both "H (or aspiration/spread) and L (or voice) languages" the phonological contrast is: C/[fortis] versus ∅. Assuming that [fortis] is mostly a "negative property" (meant to prevent voicing) it does not provide

27. For a complete account of voicing assimilation in affixed words, see Zonneveld (2007).

much of an acoustic cue to make a perceptually salient difference between the two types of obstruents. This is where enhancement comes in. In so-called H-languages, the [fortis] obstruents are enhanced with [spread], while in so-called L-languages the zero or unmarked obstruents are enhanced with [voiced]. In a language like Swedish, both enhancements are in play. In (34) I omit the specific contexts for enhancement:

(34)	Basic opposition		[fortis]	zero (i.e. unmarked)
	Enhancement	English	[aspirated]	–
		French/Dutch	–	[voice]
		Swedish	[aspirated]	[voice]

This approach is "traditional" in that all languages with a binary phonation contrast have the same phonological specification ([fortis] vs. ∅), but it is "realistic" in that the enhancement properties account for the fact that this basic contrast is realized phonetically in both types of languages in different ways, as well as allowing for the Swedish case. Following Cyran's (2014) idea that Dutch is an "H-language", we can say that what changed from the old Germanic system (also assumed to be an "H-system" that has been preserved in most other Germanic languages) to Dutch is the enhancement system. Dutch remained an "H-system", but it changed phonetically toward a voicing language. But I take Cyran's proposal one step further[28] by saying that all languages with a minimal phonation contrast are phonemically the same (i.e. C/[fortis] versus ∅ languages).[29] In my analysis, FOD in both voicing and aspiration languages creates obstruents that are distinct from fortis obstruents. This accounts for the fact, or at least allows for the possibility, that such "devoiced obstruents" differ from obstruents that are lexically "voiceless" obstruents (i.e. [fortis]). Finally, I suggested that being an aspiration or voicing language might have systematic consequences for the type and direction of "voicing assimilation" processes, but this is a domain for further research. Compared to the model advanced in Cyran (2014) I have suggested splitting his systemic module into a formal step of enhancement (addition of elements) and passive voicing. As mentioned, the potential empirical consequences of distinguishing enhancement *as a formal operation* need to be further explored.

Final devoicing and voicing assimilation have long been presented as prominent rules in the "phonology" of Dutch. Several publications referred to in this article have cast doubt on the "phonological" nature of these processes, usually by denying them the status of neutralizing rules. Although not all phonological rules need to be

28. Cyran (p.c.), in fact, also contemplates this further step.

29. If a language has no 'voicing contrast', but distinguishes plain versus glottalized and/or aspirated obstruents (as in the Mayan language K'ekchi; see Ahn & Iverson, 2004) or in several Northern Californian languages (Haynie, 2012), the contrast is between [fortis] obstruents without and with a dependent C/[constricted] and/or V[spread]/ element.

necessarily neutralizing (at least in most phonological theories), it has often been concluded that final devoicing and voicing assimilation processes belong to the realm of phonetics. But this strict division is ill conceived, as Cyran (2014) convincingly argues. I have shown in this article that these "phonetic" processes interact with well-defined phonemic representations in which licensing and enhancement play a crucial role in setting up the conditions for phonetic implementation. In this sense, FOD and voicing assimilation are not just "phonetic" (although the latter is more so than the former).

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