From Positions to Transitions: A Contour-Based Account of Lenition

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Abstract

On the basis of the problems posed by phonologization of contextual allophones, this chapter makes two claims on phonological representations: (i) like length, the laryngeal properties associated with 'voice onset time' (VOT) – [±voice], [±spread gl.], etc. – are not segmental features; (ii) the syllabic components 'onset' (O) and 'nucleus' (N) are autosegmental melodies, VOT and length contrasts following from similar and symmetric ON- and NO-*contours* respectively.

A model based on such contours is shown to capture a number of typologically grounded generalizations involving VOT and syllable markedness, while accounting for a large array of processual facts, from final devoicing and voice(lessness) assimilation to closed syllable shortening, and, in particular, consonant lenition. In this respect, not only does the contour theory succeed in computing 'positional strength', but it also provides a unitary account of several otherwise heterogeneous changes covered by the label 'lenition', such as degemination and voicing. By unifying positional and melody-driven phenomena, the contour theory explains why such and such a context is likely to trigger such and such a process; it can thus be understood as a formal way of eliminating one of the main sources of arbitrariness within phonological rules and representations.

1. Introduction

This chapter aims to present a novel thesis about the nature of phonological primes.[1] It will be argued that glottal states are *not* encoded by symbolic features, unlike, e.g., coronality or roundness, but that, like length, they follow from plurilinear configurations. More specifically, it will be shown why and how the laryngeal properties usually encoded by the features 'aspirated' ([spread gl.]) and 'voiced' can and must be represented in terms of discrete *contours* characterising the transitions between syllabic positions, in such a way that these laryngeal qualities appear as the mirror-image of consonantal and vocalic length respectively.

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[1] A first draft of these views was presented at the Colloque Inaugural du GDR 1954 Phonologie on Lenition and fortition, Nice, 24-25 June 1999, and published in Carvalho (2002b). A detailed overview is given in Carvalho (2002a).

As will be seen, besides markedness considerations, one of the main empirical arguments for a contour-based reanalysis of laryngeal states is brought by lenition processes: not only does it provide a unitary account of apparently heterogeneous changes, but it also answers such questions as why lenition processes typically occur between vowels, why geminates do not undergo voicing, why degemination does not trigger compensatory lengthening, etc. Though this contribution is couched within Strict CV phonology, its basic ideas do not rely on any particular model, and should be of interest for phonologists working outside this framework.

The chapter is organized as follows. In section 2.1, temporal contours, as opposed to simple segmental features, are shown to be necessary objects in phonological theory in that they provide the sole convincing explanation of why and how contextual allophones are sometimes phonologized, sometimes not. In section 2.2, it will be seen why this explanation of diachronic morphogenesis should entail a drastic reduction of the number of features allowed by phonological theory, while increasing the importance of the role allotted to autosegmental configurations. In section 3, an overall picture of a contour-based model of laryngeal features and length contrasts is provided, on the basis of markedness considerations about the distribution of laryngeal qualities and length both in the world's languages and within the word. In section 4, it is shown how the present views are independently supported by processual evidence, and in particular by lenition.

2. From features to contours

2.1. A diachronic paradox

Does phonology presume that lexical inputs resemble pearl necklaces, sequences of sets of features called 'segments'? The past fifteen years have seen a focus on constraint-based theories like Optimality theory (OT), and, until very recently, issues concerning representations were largely outside the mainstream of research interests in these frameworks; as a result, for an increasing number of phonologists, the image of the lexical input has remained the same as within the previous rule-based theories. Nevertheless, given the advances allowed by autosegmental phonology from Goldsmith (1976) till the mid nineties, the letter-like tokens that appear in the first cell of OT'ist tableaux should be viewed, at the best, as mere notational shorthands for much more complex structures. As will be seen, far from being a surface characteristic (a property of candidates in OT terms), the plurilinearity of phonological representations must be assumed at the lexical level. This follows from sound change, and addresses the question of why and how certain allophones could become phonologized.

Let us examine a typical case of what is commonly called 'transphonologization', 'feature transfer' (Martinet 1970: § 6.19) or 'secondary split' (Hoenigswald 1960: 93-94): the one that is caused by contextual change. Old Russian had a short /i/-like vowel (henceforth *i*) – the 'front *jer*' ь – which palatalized the preceding consonant (exemplified by *t*). Consequently, in classical terms, Old Russian showed the allophonic rules in (1).

(1) a. /t/ → [t^j] / __ i

b. /t/ → [t] elsewhere

At this stage, we are told that there was only one /t/-phoneme: the phonetic difference between the allophones [t] and [t^j] was not perceived as such by the speaker; it was assigned to the presence of /i/ in the second case and to its absence in the first case. Later on, /i/ was deleted; its palatalizing effect remained nevertheless; hence, since /i/-deletion implies the loss of the conditioning context, a /t^j/ : /t/ contrast emerged from the split of the previously unique */t/.

However, the second stage of this change is absurd. If the context of an allophone happens to change, then the allophone must also change. Let us imagine a word-game in Spanish consisting in syllable permutation. Given a word like /ˈlago/ 'lake', pronounced as [ˈlaɰo], [unˈlaɰo] 'a lake' will give [uŋˈgola] and not *[uŋˈɰola], /g/ being realized as [ɰ] in intervocalic position but as [g] elsewhere. Accordingly, if the palatality of Old Russian [t^j] is assigned by the speaker to the /i/-phoneme, the loss of the latter should logically lead to *t*-depalatalization; the preservation of the palatalizing effect is, thus, incomprehensible.

Yet, facts crucially contradict the predictions resulting from structural phonology, and seem to support the unsustainable claim of the 'secondary split'! It is well-known, indeed, that */ti/ gave Modern Russian /t^j/, or, at the least, that [i] > Ø *did not imply the deletion of t-palatality*. Why is structural phonology unable to explain a change like [t^ji] > [t^j]? There are three possible answers; one only is satisfactory.

First, according to structuralist principles, and to most scholars who discussed the problem (see references in Carvalho 2005), if this was possible, it ought to be because [t^j] was *already* a phoneme before [i]-deletion. Now, once again, such a claim would be absurd for both theoretical and empirical reasons.

On the one hand, we should have had, given the rules in (1), two (phonetically similar) phonemes (/t/ and /t^j/) in complementary distribution, which is a contradiction in terms. As pointed out by Janda (2003: 409), analyses assuming such 'marginal', 'quasi-' or 'secondary' phonemes, as they were called, 'provide neither any motivation for *why* nor any mechanism for *how* certain [...] allophones which are in complementary distribution could become phonologized'. On the other hand, if we consider certain varieties of Brazilian Portuguese which undergo coronal palatalization by /i/ and loss of the latter in final unstressed syllables, the resulting [t^j]-like consonants are still perceived as /ti/; interestingly, speakers are unable to pronounce onsets containing *ch*-like affricates in loanwords, and use vowel epenthesis therein (pers. obs.). Thus, the mysterious 'transmutation' of the palatal feature from the vowel to the consonant, which underlies the concept of transphonologization, lacks empirical basis.

A second solution, much in line with current empiricist claims, is brought by Booij (2002) and Janda (2003), where it is argued that allophonic properties must be lexically stored in order to survive after loss of the conditioning context. A rather costly solution, indeed: this amounts to rejecting the concept phoneme in its core sense, that is not only linearity but also invariance, since the underlying representations should contain both allophonic and distinctive features; nevertheless, nothing tells us why the former may also disappear, as in the Spanish example above.

Interestingly (and ironically, given the assumptions of the aforementioned empiricist trends), *t*-palatality would be viewed in this latter thesis as an allophonic property of /t/, much in the same way as in the classical linear phoneme theory, where /t/ is said to be realized as [ç] *before* the phoneme /i/, as in (1a). Now, there is a third solution which accounts for the change [t^ji] > [t^j] as well. This could be glossed as follows: /i/ was first realized as [^{j}i] (where [^{j}] stands for the palatal feature of the preceding consonant) whenever it was, say, *combined* with /t/; later on, it was simply realized as [^{j}]; thus, [t^j] preserved its palatal feature after the loss of the vowel because /i/ *remained despite* [i]-*deletion*. This view, which dates back to Baudouin de Courtenay ([1881] 1963: 121 ff.; cf. Cao 1985: 165, n. 26), is the one that autosegmental phonology expresses by distinguishing between segmental melodies (*ti* below) and skeletal positions (*CV*).

(2) a. [t^ji] b. [t^j]

t i > t i

C V C V

The solution in (2a,b) avoids the difficulties met by the other theses. There are no /t/ and /t^j/ phonemes in complementary distribution since /i/ is still there in (2b). The fact that [t^j] is perceived as /ti/ naturally follows from (2a,b): *i*-delinking does not imply deletion of the second slot, which remains available for contextual *i*-association (e.g., in glide formation before vowel).[2] Finally, [t^j] survived in Russian because the *i*-melody involved a *contour* (= 2a), and the change affected the contour, not the melody itself, whence (2b). On the contrary, in the Spanish example above, the process consists of *melody* permutation, whence [ɰ] changes into [g].

2.2. Does allophony exist?

The above explanation for the shift of allophones into phonemes has an interesting consequence for current debates between 'abstractionist' and 'exemplarist' models of phonological knowledge. The supporters of the latter type of theory often focus on the fact that speakers perceive, and should therefore stock, 'language-specific phonetic patterns down to extremely fine levels of detail, most naturally described using continuous mathematics rather than an inventory of phonetic categories such as the IPA' (Pierrehumbert 1999). Now, this notion of 'fine phonetic detail' is somewhat misleading, precisely because phonology is no longer based on IPA-like objects. Let us return to the example of /ti/. Following exemplarist theses, *t*-palatality should be seen as 'phonetic detail'. As was seen in § 2.1, however, if this phonetic characteristic was perceived by the speakers, and hence survived in Russian, the reason is precisely that it was *not* a 'detail', but the distinctive feature of /i/! Following on from, e.g., Steriade (1987), let us assume that 'assimilatory' phenomena involve propagation of *distinctive* features. The question, then, is: if the advocates of the 'phonetic detail' are right in claiming that, according to psycholinguistic evidence, speakers are sensitive to *all* possible allophonic alternations,

2 As a result, transphonologization is not an all-or-nothing process: it is only when *t* and *i* are linked to the same C-position, and only to this position, since the V-slot has been lost, that a new '/t^j/-phoneme' can be said to emerge.

(3) does *any* allophonic alternation[3] result from some sort of 'assimilation', i.e. from a contour, involving propagation of distinctive objects?

This is the kind of challenge phonology should be faced with, and it is by no means a trivial one. Indeed, a positive answer to (3) should lead us to revisit the content of phonological primitives on the basis of their temporal behaviour. The example of Old Russian /ti/ may seem trivial, and actually it is, since [–back] (or the element 'I', according to Kaye *et al*.'s (1985) unarist theory) is a well-known feature of the vowel system. But let us consider the case of a language like Korean where *lenis* obstruents are voiced between vowels but voiceless elsewhere, or that of a number of languages like German, Russian, Turkish, etc. where voiced obstruents are devoiced word-finally, that is when there is no vowel following the consonant. If the answer to (3) is 'yes', and since voice as such cannot be a distinctive feature of vowels in most languages, these allophonic alternations suggest that voice and, say, voweliness or syllabicity are two 'states' of the same distinctive object, according to the configuration involved. Let X be such an object; 'voweliness' is nothing but a cover-term for the association of X to a V-position, and 'voice' equals association of X to the preceding C-position; in languages having final devoicing, X/C_i-association implies X/V_{i+1}-association. Interestingly, this amounts to constraining the number of phonological primes, since two distinct primitives (voice and voweliness) become one: X. The question, then, becomes: what is X?

3. Generalizing contours

3.1. The VOT/length symmetry

By following the above line of thought, I am actually proposing to generalise a remarkable result of autosegmental phonology, an example of which is the treatment of length. As is well-known, the distinction between long and short vowels or consonants, which relied on a [±long] feature in most works in structural phonemics and, later on, in *SPE*, is now seen as resulting from a contour-based opposition such as the one in (4), where X = S = any segment (i.e. set of features), and • = skeletal slot:

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[3] I am speaking here of *contextual* alternations only. The sole true 'allophonic' alternations may be those people are aware of, i.e. those that are perceived *as such*, and these are precisely *not* context-dependent. The so-called 'free' variants are, thus, usually assigned to socio-stylistic parameters by the speakers.

(4) a. /Sː/ b. /S/

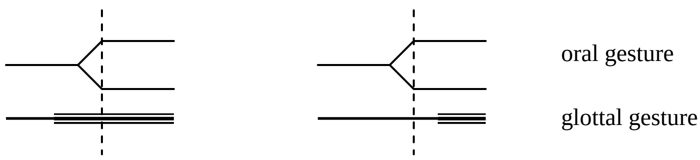
Hence, one element was eliminated from the inventory of symbolic primes assumed by phonological theory, while the role of configurations became more important. Shortening does not consist in changing the value of a [+long] feature: just as the 'fall' of [i] in (2a,b), it requires contour loss.

Now, it is worth noting that the parallel drawn between length and voice is empirically supported by their sharing the characteristics in (5).

(5) a. Phonetic temporal basis.
  b. Symmetric distribution.

If speaking about the temporal dimension of phonological length is a truism, it should be recalled that phoneticians have long defined the notion of 'voice onset *time*' (VOT), according to which consonantal voice results from *anticipation* of glottal vibrations from the syllable peak to the moment preceding the oral closure release, as in (6a) (where *d* = any voiced onset, *a* = any vowel); conversely, 'aspiration' (or [+spread glottis]) follows from the *delayed* onset of glottal vibrations, which occurs after the oral release, as in (6b) (t^h = any aspirated onset).

(6) a. /da/ b. /tʰa/



Accordingly, both aspirated and voiced consonants happen to be marked in word-final position, as if they implied a *following nucleus*. Now, so are geminates in word-initial position, as if consonantal length presupposed a *preceding* nucleus, and, though less frequently noticed, so are long vowels in word-final position (cf. Myers & Hansen 2007: 157-158), as if they implied a following *onset*.[4] There seems to be, indeed, a symmetric relationship between VOT and length. Hence, aspiration and voice, as distinctive features, appear as optimally associated with consonants rather than with vowels because they are emerging properties of the 'onset' defined as the *onset-nucleus transition*; likewise, gemination and, more generally, length are properties of the 'rhyme', viz of the *nucleus-onset transition*. In short, occurring in mirror contexts within the syllable, VOT and length are in complementary distribution. Could it, then, be the case that they result from propagation of the same objects? If so, what are those spreading objects?

3.2. ON and NO contours

As is shown by typology, the triplet /t^h/ ~ /t/ ~ /d/ functions as a strength scale: /t^h/ is *fortis* with respect to /t/, while /d/ is *lenis vis-à-vis* /t/. What is interesting about this scale is that it involves two opposite values, 'tension' (the *fortis* term /t^h/) and 'sonority' (the *lenis* term /d/), which are the very same concepts as those that have long been discussed, since Jespersen (1904), regarding the nature of the syllable. In the line of views dating back to van Ginneken (1907), the syllable is something like a vector spreading from a peak of tension and a trough of sonority to a peak of sonority and a trough of tension (for a detailed discussion, cf. Klein 1993).

Let us take seriously the idea that the 'tension' and 'sonority' poles of segmental strength scales are the same articulatory and perceptual objects as those involved by syllable structure. The peak of tension, represented by the onset (O), can thus be defined, in articulatory terms, as an open (and tense) state of the glottis; sonority, represented by the nucleus (N), is a closed (and lax) state of the glottis. It follows that, given an ON sequence, VOT-values are properties that emerge either from the spreading of the onset to the following N-position (aspiration), or from the spreading of the nucleus to the preceding O-position (voice). The resulting ambiassociation of one slot naturally accounts for the mechanism of voice onset time: O-propagation to N in (7a) formalises voice delayed release in (6b); inversely, N-propagation to O in (7b) stands for voice anticipation in (6a).

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4 That is: if a language has word-initial long consonants or word-final long vowels, it also has long consonants or vowels elsewhere, but the converse is false.

(7) ON contours (provisional account):

a. /t^ha/ O N
• •

b. /da/ O N
• •

Furthermore, assuming the complementarity between VOT and length, (7a,b) imply the NO contours in (8), in which, contrary to all current representations of long vowels and geminates, no additional slot is required.

(8) NO contours (provisional account):

a. /att/ N O
• •

b. /aat/ N O
• •

Hence the table in (9), where the syllabic elements O and N appear as the spreading objects concerned in both VOT and length, which, in turn, emerge from the transition involved.[5]

(9)

	ON-transition (VOT)	NO-transition (length)
O-spreading ('tension')	Laryngeal aperture (aspiration)	Supralaryngeal closure (C-gemination)
N-spreading ('sonority')	Laryngeal closure (voicing)	Supralaryngeal aperture (V-lengthening)

The properties assigned in (9) to O- and N-spreading refer to 'ideal' or, say, unmarked syllable types, where onsets are assumed to be tension peaks with minimal sonority, and nuclei are seen as sonority peaks with minimal tension. Languages may have, of course, sonorants and even glides as onsets, and there may be syllabic consonants. Also, despite the complementary distribution assumed between VOT and length, there are final aspirated and voiced conso-

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5 It might be objected that VOT and length cannot be assigned to propagation of the same objects because some languages (e.g., Semitic) exhibit (i) consonantal roots, which may contain voiced consonants, and (ii) morphologically distinct syllabic templates, where length plays a crucial role, but which are supposed to provide the voicing nuclei according to our theory. This objection lies on the hypothesis that the morphemes of a word are stocked separately, and hence should not overlap at the lexical level. However, morpheme overlapping may bring crucial evidence for claiming that lexical units are phonological *words* viewed as 'morphemic clusters'. Semitic facts simply show that O/N-*elements* can belong to both roots and templates, while some ON- and NO-*contours* can be specific to templates (e.g., length), and others to roots (e.g., voice).

nants (which may thus occur within the rhyme), as well as initial geminates (which are thus possible onsets). Similarly, the 'supralaryngeal closure' in the NO-transition does not rule out, e.g., geminate fricatives. What is meant here is that all such cases are marked in some way and require either additional specifications (e.g., for frication) or some marked characteristic in their representation.

3.3. Tension and sonority as autosegments

3.3.1 Let us assume, as we did in (7), that /t^ha/ ~ /da/ contrasts are based on O- *vs* N-spreading to the following or the preceding slot respectively. If O and N belong to the same tier, then the No Crossing Principle (NCP) disallows simultaneous propagation of O and N; in other words, there cannot be aspirated voiced consonants. Now, this is empirically false: some languages (in particular, many Indian languages) do have such a combination, which is often referred to as 'breathy voice' (cf. Ladefoged 1993: 139-147). That this is not a phonologically distinct state of the glottis, but the 'sum' of aspiration and voice, is shown by the fact that all languages having /$\text{d̤}^{\text{ɦ}}$/ also have *both* /t^h/ (i.e. aspiration) and /d/ (i.e. voice), though the converse is false (e.g., Thai), whence the implicational scale of laryngeal values in (10) where breathy voice is the most marked degree.

(10) Markedness: 0 1 2

0	1	2
	/t^h/	
/t/		/$\text{d̤}^{\text{ɦ}}$/
	/d/	

How, then, can breathy voice be accounted for in terms of O/N-spreading?

Assuming that aspiration and voice are due to O/N-propagation, it is clear that the possibility of both O- and N-spreading in /$\text{d̤}^{\text{ɦ}}$a/ implies that onsets and nuclei belong to different tiers. Accordingly, syllable components will be assigned, as is shown in (11), to two distinct planes, which will be provisionally labeled the 'O-tier' and the 'N-tier', in such a way that aspiration and voice may combine without violation of NCP.[6]

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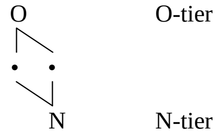
[6] Needless to say, O/N segregation is assumed to be universal and not limited to breathy voice languages, which would be a circular thesis. Note that the necessity of this segregation can be independently demonstrated (cf. Carvalho 2005).

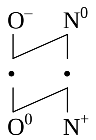
(11) /d̤ʱa/:



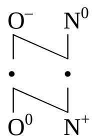
However, if O and N are segregated and spread to the same slots, then any form of linearity within the syllable is ruled out. Indeed, (11) cannot be viewed as an 'ON-sequence': neither O 'precedes' N, nor does N 'follow' O. Given the two-tiered representation of syllable structure adopted here, the only way of preserving a linear relationship between the onset and the nucleus is to assume that there is, as it were, a nucleus in the O-tier, just as there is an onset in the N-tier. O/N-segregation should thus consist of two ON-tiers. In each tier, as is shown in (12), O and N have, say, different and specific values or, as I shall put it, different *markedness states*: in the O-tier, O has a marked minus-value while N has an unmarked zero-value; conversely, in the N-tier, N has a marked plus-value while O is unmarked.

(12) ON contours:

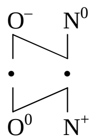
a. /ta/ (voiceless)



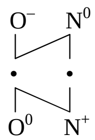
b. /d̤ʱa/ (breathy)



c. /tʰa/ (aspirated)



d. /da/(voiced)



3.3.2 These markedness states need further discussion that space does not permit here. Suffice it to say that they should be viewed as *potential energies* assigned to syllabic positions within a model of phonological representations where such metaphorical notions as 'autosegmental association' or Kaye *et al.*'s (1985, 1990) concept 'charm' are mathematically grounded (cf. Carvalho 2007). For the present purposes, only two points matter. Firstly, having a null potential energy of their own, the O^0 and N^0-elements are given a non-null potential when they associate with O^-- and N^+-linked slots respectively, and they associate with skeletal slots whenever this is not disallowed by the spreading of adjacent N^+ and O^--elements, whence (13a,b). In other words, only marked elements actually obey NCP.

(13) a. Unmarked elements can be delinked by propagation of marked ones;

b. Marked elements cannot be delinked by propagation of unmarked ones.

Secondly, the opposite non-null markedness values of O and N encode the phonological notions of 'tension' and 'sonority' defined in (9). More accurately, in an ON-transition, O^- and N^+ are aspiration and voice potentials, which emerge as actual properties of the syllable onset whenever O^- or N^+ spread to two skeletal slots. Hence, as will be seen, the contours in (12) provide a built-in representation of the markedness scale in (10).

Since long segments are marked *vis-à-vis* short segments because they involve two slots *vs* one, as is shown in (4), markedness will be expressed in terms of *elementary weight* (W_X), viz the number of slots an X-element is associated with. It will be assumed that (X/Y = O/N, α = +/–):

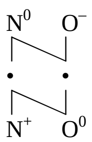
(14) In a given ON-tier, an ON contour is marked if and only if $W_X\alpha \geq W_Y0$.

It follows from (14) that (12a) is an *unmarked symmetry*, since both unmarked elements (N^0, O^0) spread to more slots than their marked counterparts (O^-, N^+). The stronger the violation of this symmetry is, the more marked the resulting configurations are: thus, the symmetric structure in (12b) is the most marked one, since all marked elements and only marked elements spread to two slots therein, while (12c,d) are intermediate types. Indeed, as is shown in (10), (12b) implies both (12a) and (12c,d) in a given language, whereas either (12c) or (12d) presuppose (12a) only.

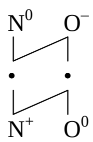
The symmetry postulated in § 3.1 between VOT and length entails the NO-counterparts to (12a-d) shown in (15a-d).

(15) NO contours:

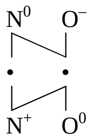
a. /at/



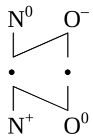
b. /aatt/



c. /aat/



d. /att/



The same markedness considerations as those formulated for (12a-d) hold for (15a-d): (15a) is an unmarked symmetry since all unmarked elements and only unmarked elements spread to two slots; the structure in (15b) is the most marked type of rhyme since all marked elements and only marked elements spread to two slots; (15c,d) are intermediate types of rhyme as to their markedness degree. Indeed, any language having (15b) also has both (15a) and (15c,d), whereas either (15c) or (15d) imply (15a) only.

3.3.3 It is worth stressing two points. Firstly, the fact that O^- and N^+ operate in different tiers means that: (a) tension and sonority are parallel and autonomous aspects of phonological representations; (b) the interface of both aspects is *time*. Time and length are, or should refer to, different things in phonology. Here, time comprises both length, as a property of the so-called 'long' segments, and the way laryngeal and supralaryngeal gestures interact, as in the VOT distinctions in (6). Phonological time emerges as length in the NO-transition, where the tension peak represented by O^--spreading is a long period of supralaryngeal closure, and the sonority peak represented by N^+-spreading is a significant duration of supralaryngeal aperture. Time emerges under a different form in the ON- transition, where the tension peak involved by O^--spreading may be defined, in articulatory terms, as the assignment of some duration to laryngeal aperture and tension, hence noise from an acoustic point of view; the sonority peak associated to N^+-spreading is a significant duration of laryngeal closure and laxness, whereby a large part of the CV-sequence is voiced. Thus, it does not follow from the present theory that a sequence of aspirated stop + short vowel is expected to have the same phonetic duration as a short vowel + geminate consonant, nor that an aspirated stop is as long as a long vowel or a geminate, although all these segments involve the same number of skeletal slots. What is expected is that the assumed relationship between both manifestations of tension and sonority is phonetically grounded, and this is, indeed, the case. In particular, decades of research demonstrate the affinity between voice and vowel length (and low tone).

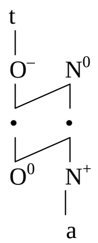
Another point that is worth mentioning is that, although only aspiration and (breathy) voice are discussed in this chapter, all other laryngeal specifications should be accounted for in terms of contours. As a preliminary hypothesis on the way this could be done, Carvalho (2007) argues that, O and N being potential energies (cf. § 3.3.2), the so-called 'association lines' represent variable *flows*, from which the different glottal states emerge.

3.4. Further markedness considerations

3.4.1 O/N segregation has two important issues. Firstly, the C/V segregation found in non-concatenative morphologies should actually be seen as a universal effect of O/N segregation. There are two reasons for this. Formal simplicity, on the one hand: why should *both* ON and segmental (CV) components be independently segregated? Theoretical naturalness, on the other hand: why should a major *phonological* characteristic like C/V segregation be due to purely morphological factors? This is, indeed, the case in McCarthy's (1979, 1981) theory, where morphemes, not phonemes *per se*, are in fact segregated in Semitic languages. Rather, non-concatenative morphologies simply exploit a universal phonological characteristic.[7]

Secondly, if C/V segregation is an effect of O/N segregation such as shown in (12, 15), then segments (C and V) do not have direct access to the skeleton. O^{-} and N^{+} will be seen as the *roots* (cf. Clements 1985) of C and V respectively, that is the elements to which consonantal and vocalic features are linked, as is shown in (16) (where *t* = [coronal], *a* = [low]).

(16) /ta/



[7] A similar claim is also made by some speech production theories, which argue that consonants and vowels belong to separate channels in the speech 'plan', but must interact through implementation in the same vocal tract (Fujimura 1992).

Accordingly, *empty* segments, which lack segmental material, can be defined as having empty roots, as is shown in (17).[8]

(17) a. Empty onset: /ʔa/ [9] b. Empty nucleus: /tə/

Empty segments are to be distinguished from *null* segments, which lack skeletal position (cf. Encrevé 1988), as in (18), and, hence, have no phonetic realization; the reason why there are no O^-/N^+-elements will be made clear in § 4.1. Null segments are marked according to the condition on contour markedness given in (14), since N^+ and O^- spread to as many slots as O^0 and N^0 in (18a) and (18b) respectively. As a result, a number of languages lack either onsetless syllables or closed syllables.[10]

(18) a. Null onset: /a/ b. Null nucleus: /t/

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8 Whether features may also associate with O^0- and N^0-elements will not be discussed here. In Carvalho (2007), it is argued that certain segmental types, like sonorants, glides and syllabic consonants, involve such a configuration.

9 I follow here Kaye *et al.* (1990) and Harris & Lindsey (1995) in characterising [ʔ] as the product of the loss of everything but 'manner' (at least insofar as the glottal stop is not correlated with a series of ejectives: cf. note 11). If plosiveness is the unmarked term of a privative opposition (the marked term being frication), then [ʔ] is a 'pure consonant', whence (17a) which parallels the 'pure vowel' (*schwa*) in (17b).

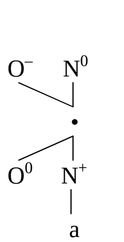
10 If the 'coda' is seen as an onset preceding a null nucleus. In this respect, I follow the Strict CV approach (Lowenstamm 1996), except in the case of geminates, which, as is shown in (15d), do not involve any additional slot; indeed, languages may have geminates without having codas (Japanese), and conversely.

3.4.2 One question arises from such apparently different facts as the initial glottal fricative and final voiced consonants. Why is it that /h/ is so often prone to fall (Latin, modern Greek, middle French, some English, etc.)? Why do final voiced consonants so often undergo devoicing (most Germanic and Slavic languages, Turkish, etc.)? Many languages have only voiceless obstruents word-finally; others have both voiced and voiceless final obstruents; no language shows only voiced obstruents in word final position, Somali being the sole exception I know of.

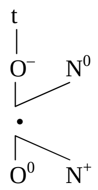
As regards the glottal fricative, a further question is why /h/ is so often restricted to word-initial position (most Germanic languages, classical Greek)? Though languages may have /h/ in all positions available to consonants, two points must be emphasized: (a) even in these cases, /h/ is more frequently found in initial position (cf., e.g., classical Latin, English); (b) I do not know of languages having /h/ everywhere but word-initially.[11]

Within the contour-based theory, both problems are given a simple and straightforward solution by assuming that both initial /h/ and final voiced consonants imply null segments, as is shown in (19):

(19) a. /ha/



b. /d/



[11] I shall leave aside the case of languages where a change has occurred of the form /s/ > [h] in coda position, and which lack /h/ elsewhere (e.g., *rioplatense* Spanish). Though this point would need further discussion that is not possible in this chapter, I shall assume that there is no necessary one-to-one correspondence between surface segments and their phonological representations (cf. note 9). Thus, it is not the case that all *h*-sounds have to be assigned the same phonological structure: Sp. [h] is not an empty segment; it is an empty fricative, simply lacking place feature. I follow, thus, the school of thought that sees /s/ → [h] as the loss of everything but frication (e.g., Kaye *et al*. 1990, Harris & Lindsey 1995), not the one that sees this process as the loss of everything but the laryngeal feature (e.g., Lass 1976, McCarthy 1988, Keyser & Stevens 1994), while retaining the latter definition of /h/ wherever the glottal fricative is correlated with a series of aspirated consonants, as is precisely the case in most Germanic languages and classical Greek.

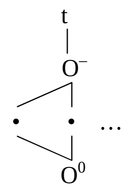
Note that both (18) and (19) are marked: null segments *necessarily* obey the condition on syllable markedness in (14), since $W_X0 = W_Y\alpha$. However, (19a,b), where $W_X0 = W_Y\alpha$ in *both* ON-tiers, are even more marked than (18a,b), which show only one marked ON contour; hence, such changes as *h*-loss and final devoicing are likely to occur.

Furthermore, the reason why /h/ is favoured word-initially also follows from the markedness definition given in (14). While $W_X0 = W_Y\alpha$ in a single ON-sequence in (19a), word-internal /h/'s imply the same marked contours in *both* ON- and NO-sequences, that is, on both sides of the null segment. Likewise, many languages have /#V-/-words, with initial null onsets, but avoid hiatuses (*via* gliding or glottal epenthesis, for example), which would involve intervocalic null onsets. Restricting null segments to word edges is, thus, a natural way of restricting syllable markedness violation.

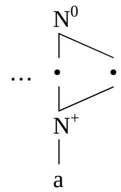
3.4.3 Let us examine a last typological point: why are word-initial geminates less often attested than their intervocalic counterparts, and why are long vowels less commonly found word-finally than in internal open syllables? Indeed, if a language has either /#tt-/ or /-aa#/, it also has /-at.ta-/ or /-aa.ta-/ respectively, while the converse is false.

Compare the representations in (20a,b) with those in (21a,b).

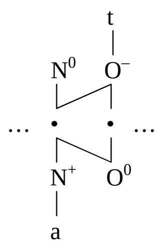
(20) a. /#tt-/



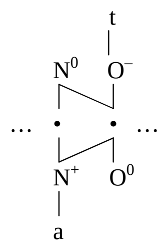
b. /-aa#/



(21) a. /-att-/



b. /-aat-/



The $O^{-}N^{0}$-tier in (20a) shows $W_{O}- = 2$ and $W_{N}0 = 0$ *vs* $W_{O}- = 2$ and $W_{N}0 = 1$ for the $O^{-}N^{0}$-tier in (21a). Both configurations are marked, since $W_{X}0 < W_{Y}\alpha$; the second, however, is so at a lesser degree, since, the difference between $W_{X}0$ and $W_{Y}\alpha$ being smaller, it is closer to the unmarkedness formula ($W_{X}0 > W_{Y}\alpha$). Likewise, the $O^{0}N^{+}$-tier in (20b) shows $W_{N}+ = 2$ and $W_{O}0 = 0$ *vs* $W_{N}+ = 2$ and $W_{O}0 = 1$ for the $O^{0}N^{+}$-tier in (21b), whence (21b) is less marked than (20b).

It follows from what was seen in (18-20) that contours are necessarily marked if there are *more* ON-elements than timing positions, as in (18, 19), and if there are *less* ON-elements than timing slots, as in (20). Unmarked contours, thus, involve one-to-one correspondence between the elements of each ON-tier and those of the temporal skeleton.

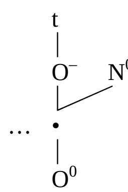
4. Empirical evidence

I will now present some pieces of processual evidence for the contour theory exposed so far.

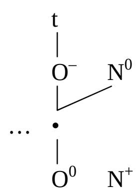
4.1. Voicing alternations

Consider the last segment of the German stems *Rat* 'council', genitive *Rates*, and *Rad* 'wheel', gen. *Rades*. Both involve final null nuclei, such as those in (18b, 19b); however, while there is no N^{+}-element in *Rat*, as is shown in (22a), a *floating* N^{+} will be assumed in *Rad*, as in (22b), in the same way as certain tonal processes are said to involve floating tones, or *liaison*-type facts, as those of French, imply final floating consonants.

(22) a. *Rat*

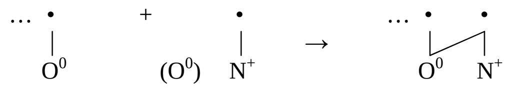


b. *Rad*

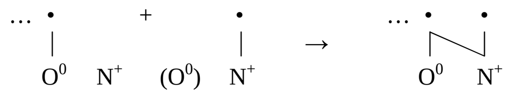


Vowel-initial suffix implying N^{+}-addition to (22a,b), there will be one final N^{+} in *Rates*, but *two* N^{+}'s in *Rades*; hence, as is shown in (23b), one N^{+} associated with *two* slots, voicing alternations being, thus, a particular case of the Obligatory Contour Principle.

(23) a. *Ra*[tə]*s*



b. *Ra*[də]

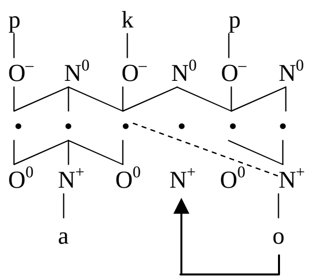


In sum, morphophonological alternations based on final devoicing are accounted for in such a way that nuclei clearly behave as the melodies they are supposed to be according to the contour theory.

4.2. Directionality: voice(lessness) assimilations

Most voice(lessness) assimilations in the world's languages have two characteristics: (a) they are allowed by consonant contiguity; (b) they involve leftward spreading within heterosyllabic clusters. Now, both facts are naturally captured by the contour-based theory, as is shown in (24).

(24) French [pak̬bo] *paquebot* 'packet-boat'

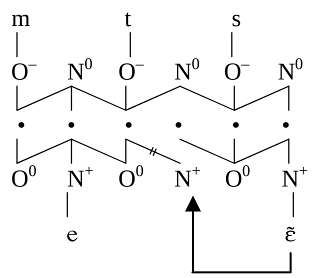


Being properly governed by N^+_3, N^+_2 floats and is therefore, like O^0_3 under (13a), unable to block spreading of the lexically left-oriented N^+_3.[12]

[12] As is seen in (24), voice assimilation implies spreading of only one N^+-element to two O^--associated slots. This is why, despite the voice/length symmetry assumed here, length does *not* spread: there cannot be such processes as /aptːa/ → *[apːtːa], which would involve arbitrary propagation of *two* O^--elements.

If N^+_3 were not lexically associated with the preceding onset, this would result in voicelessness default assimilation, that is in simply delinking the properly governed N^+_2, as is shown in (25).

(25) French [med̥sɛ̃] *médecin* 'doctor'



I shall leave aside here the case of complex onsets like *pr*, *tr*, *pl*, etc., which provide the sole systematic examples of rightward voice spreading. Nor shall I discuss the claim (Greenberg 1978) that there is no tautosyllabic laryngeal disagreement, whence no monosyllabic words like *[pda], *[gso], etc.. Suffice it to say that both facts automatically follow from contour-based representations, if tautosyllabic [CCV]-sequences are seen as implying *two* O^-N^0-transition (hence the existence of a cluster)[13] for *two* skeletal slots associated with *one* O^0N^+-transition only (hence the tautosyllabicity of the sequence).[14] Thus, the whole [CC]-cluster is voiced or voiceless according to whether N^+ spreads to the first slot or not.

4.3. Preliminaries to lenition: positional strength

As is well-known, especially from historical evolution, consonants behave differently according to their place in the syllable structure of the word, and typically show the 'strength scale' in (26).[15]

13 The sonorant occurring in typical complex onsets is, then, associated with N^0_1 (cf. note 8), while the second obstruent of such clusters as classical Greek *pt-*, *kt-* is associated with O^-_2.

14 Let us recall that, according to what was seen about null elements (cf. 18a,b), the O^-N^0- and the O^0N^+-tiers do not necessarily have the same length, though this involves marked representations (cf. § 3.4.3).

15 Unlike Scheer & Ségéral (2001), I do not think that the word-initial position is inherently strong. My reasons are given in Carvalho (this volume a: § 3.3).

(26) Strength:

	2	1	0
	C__V	V__V	V__

The strongest degree characterises the post-coda context, where consonants massively tend to escape any lenition-type process, and even to undergo fortition; strength decreases between vowels, where voicing lenition typically takes place; the syllable coda is the weakest syllabic context, often showing specific lenition processes (and never voicing word-finally: cf. § 4.1). We shall now see that the ON- and NO-contours given in (12, 15) are likely to capture the strength hierarchy in (26).

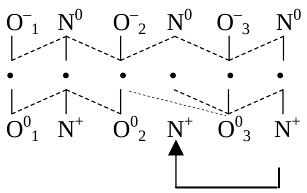
Assuming the three notions in (27), let us consider the contours in (28):

(27) a. *Elementary weight* of O^0 (W_O0):
number of skeletal *positions* associated with an O^0-*element* (cf. § 3.3.2).

b. *Positional weight* of N^0 in O (W_N0/O):
number of N^0-*elements* associated with an O-linked skeletal *position*.

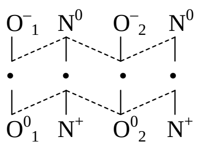
c. *Positional strength* of O (S_O): $W_O0–W_N0/O$.

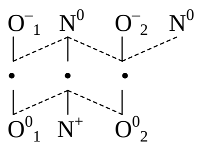
(28) a. [takta]



2	2	4	= W_O0
1	2	2	= W_N0/O
1	**0**	**2**	= S_O

b. [tata] c. [tad̥]





2	3	2	2	= W_O0
1	2	1	2	= W_N0/O
1	**1**	1	**0**	= S_O

The relative strength provided by the representations above is 'positional' since (28a-c) involve the same contours (voiceless consonants and short open rhymes): /takda/, for example, would have given $W_O0 = 3$, and therefore $S_{O3} = 1$, like the intervocalic consonant in (28b).[16] [17] Hence, *the strength of a voiced consonant in post-coda position can be shown to be equivalent to that of a voiceless consonant in intervocalic position*.

4.4. Lenition: the polarisation principle

4.4.1 An interesting issue of converting the laryngeal features into configurational properties is that the latter provide a unitary, and therefore non-arbitrary, account of consonant *lenition* between vowels. This frequent type of sound change is illustrated by Romance data in (29) (WR = Proto-Western Romance, NWR = Proto-Northwestern Romance):

(29)	a.	/atta/ > /ata/	Lat. *gatta*	> WR **gata*	> Pt. *gata* 'cat (*f.*)'
	b.	/ata/ > /ada/	Lat. *nata*	> WR **nada*	> Pt. *nada* 'nothing'
	c.	/ada/ > /aða/	Lat. *vada*	> WR **vaða*	> Pt. *vá* 'go (*subj.*)'
	d.	/alla/ > /ala/	Lat. *balla*	> NWR **bala*	> Fr. *balle* 'ball'
	e.	/ala/ > /aala/	Lat. *ala*	> NWR **aala*	> Fr. *aile* 'wing'

As was seen in Carvalho (this volume a, § 3.2), a number of questions arise from (29a-e). Why does a quantitative change like the one in (29a) play the same role as putatively qualitative changes like those in (29b,c)? Why does the change in VOT in (29b) parallel the change in manner features in (29c)? Why does degemination in (29a,d) involve either voicing like in (29b), or vowel lengthening like in (29e), both processes playing once again the same role despite their apparent diversity?

4.4.2 We have seen in § 4.1 why devoicing typically occurs word-finally. Let us now consider its apparent counterpart: intervocalic voicing. Why is voicing

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16 X^0's seek any X^α-counterpart available (cf. § 3.3.2). However, O^0_2-spreading to the slot of O^-_3 in (28a) would have implied a tautosyllabic cluster ([ta-kta]).

17 $S_{O2} = 2$ in (28a) if, and only if, there is an *empty* nucleus at the left, while $S_{O2} = 0$ in (28c) if, and only if, there is a final *null* nucleus in /tat/. This needs further discussion that space does not permit here. Note, however, that French, for example, provides independent evidence for the idea that internal and final codas differ in that the former but not the latter imply a following skeletal slot.

a commonly attested process between vowels?[18] There is a problem here for the contour theory, which can be summarized as follows.

If voicing resulted from simple N^+-spreading to the preceding onset, as was assumed above, and as is supported by final devoicing, i.e. when there is no vowel at the right, then voicing would be expected to occur after coda as well. Yet, this context typically precludes voicing: cf. Lat. *capu(t), rota* > Sp. *cabo, rueda vs campu* > *campo* (Carvalho, this volume a).

If voicing (rather than length) resulted from simple N^+-spreading to the *following* onset, contrary to our hypothesis, but as is suggested by the absence of voicing after coda, i.e. wherever there is no vowel at the left, then voicing would be expected to occur in coda position as well, which is contradicted at least by final devoicing.

The problem, thus, lies on the formalisation of the well-known triggering context of voicing: the assumed definition of voice, based on leftward N^+-spreading, cannot account for voicing as a process, which implies voiced segments in either sides of the consonant; it seems that voicing processes suppose a double contour: both in NO- and ON-intervals.

It follows from what was seen in § 3.3 that segments are generally characterised by a X^0/X^α *polarisation* (where α = + or –). As is shown in (30), a non-null onset results from the association of an O^--element with an O^0-element *via* the skeleton; a non-null nucleus results from the association of a N^+-element with a N^0-element. Thereby (cf. § 3.3.2), X^0-elements acquire a non-null potential, as opposed to the case of null segments (cf. § 3.4.1), which have X^0-elements without X^α-counterparts, as in (18).

(30) /t+a+t+a/

$$\begin{array}{cccc} O^- & N^0 & O^- & N^0 \\ | & | & | & | \\ \bullet & \bullet & \bullet & \bullet \\ | & | & | & | \\ O^0 & N^+ & O^0 & N^+ \end{array}$$

On the other hand, we saw that all X^0-elements and only such elements spread to more than one skeletal position in unmarked contours, as shown in (31).

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18 More accurately, voicing typically requires a preceding vowel and a following [+son., –cont.] segment, since it also occurs within complex onsets (cf. Lat. *capra* > Sp. *cabra*) which are generally obstruent+liquid clusters. This presents no difficulty for the contour-based theory: cf. note 13 and Carvalho (2002a: § III.3.3) on the representation of complex onsets within this framework.

(31) /tata/

O^{-} N^{0} O^{-} N^{0} Tension curve

• • • •

O^{0} N^{+} O^{0} N^{+} Sonority curve

Assuming that voice is leftward spreading of N^{+}, intervocalic voicing shows that N^{+}-propagation to the slot on the left depends on the rightward association of the preceding N^{0} with this slot, whence the principle in (32) ruling N-sensitive processes.

(32) Polarisation principle:

If X^{α}_{i} spreads to a given slot, then $X^{0}_{i\pm1}$ is also associated with this slot.

As will be made clear below, voicing is not the only phenomenon that is accounted for by (32).

4.4.3 We can now provide a unitary account of three changes involved in Romance lenition. As is represented in (33, 34), /tt/ ~ /t/ > [t] ~ [d] consists in the replacement of contrasts based on O^{-}/O^{0} (or O-)polarisation with contrasts based on N^{0}/N^{+} (or N-)polarisation.

Voicing is N-polarisation of O_2, intervocalic voiced onsets undergoing both O- and N-polarisations, as is shown in (34b). Thereby, intervocalic /t/-onsets acquire allophones that are identical to their /d/-counterparts after codas, which have the same strength as /VtV/ (cf. § 4.3). Lenition is thus an *adjustment of allophonic realization to positional strength*.

(33) a. /tatta/ > b. [tata] loss of O^{0}/O^{-} polarisation

a.				>	b.				
O^{-}	N^{0}	$\mathbf{O^{-}}$	N^{0}		O^{-}	N^{0}	O^{-}	N^{0}	
•	•	•	•	>	•	•	•	•	
$\mathbf{O^{0}}$	N^{+}	O^{0}	N^{+}		O^{0}	N^{+}	O^{0}	N^{+}	
2		3			2		3		$= W_O0$
1		**1**			1		**2**		$= W_N0/O$
1		**2**			1		**1**		**=** S_O

(34) a. /tata/ > b. [tada] N^0/N^+ polarisation [19]

O^- N^0 O^- N^0 O^- $\mathbf{N^0}$ O^- N^0

• • • • > • • • •

O^0 N^+ O^0 N^+ O^0 N^+ O^0 $\mathbf{N^+}$

2	**3**	2	**2**	= W_O0
1	2	1	2	= W_N0/O
1	**1**	1	**0**	**=** S_O

It follows from (32) that voicing is impossible wherever N^0 cannot spread to the right, either because there is no N^0, as may be the case word-initially (at least when there is no word-final vowel at the right: cf. Carvalho, this volume a: § 3.3), or because N^0-propagation is disallowed by NCP, since O^- spreads to the left, as in (33a). Hence, /tata/ > [tada] is not expected to be accompanied by a change like /tatta/ > [tadda].[20]

Furthermore, assuming that S_O decreases from only one degree at a time, a change like /tatta/ > [tada], /tata/ remaining unchanged, is not expected to occur either.

Another natural issue of (32) is that voicing is only one possible lenitive evolution. As was shown in (29d,e), sonorants undergo both changes in (33) and in (35) in Northern Romance.

(35) a. /tata/ > b. [taːta] N^0/N^+ polarisation

O^- N^0 O^- N^0 O^- N^0 O^- $\mathbf{N^0}$

• • • • > • • • •

O^0 N^+ O^0 N^+ O^0 $\mathbf{N^+}$ O^0 N^+

2	**3**	2	**2**	= W_O0
1	2	1	2	= W_N0/O
1	**1**	1	**0**	**=** S_O

19 Accordingly, Lat. /tada/ > Proto-Western Romance *[taða] (cf. (29c)) involves further decrease of W_O0 (through loss of O^0/O^--polarisation), hence $S_O = -1$. Thus, not only laryngeal qualities (cf. § 3.3.3), but also manner 'features' should be viewed as resulting from contours (cf. Tifrit 2005, Carvalho 2007).

20 Though voiced obstruent geminates may exist (and are, of course, allowed by the contour model), this ban on geminate voicing may explain the relative rarity of voiced (obstruent) geminates.

As can be seen, (34b) and (35b) differ solely in terms of 'axis' of N-polarisation. Hence, voicing and lengthening appear as formally equivalent lenition strategies.

Furthermore, just as /tt/ > [d] is impossible, so is compensatory lengthening of the form /atta/ > [aːta] disallowed. Only the contour-based theory is able to capture this equivalence and this impossibility.[21]

In sum, it is no longer surprising that quantitative changes such as degemination and vowel lengthening in (33, 35), and 'qualitative' changes such as voicing may pattern and function together: they are all quantitative as far as they emerge from similar contours.

4.5. Constraining polarisation: no lenition and closed syllable shortening

As was assumed in § 4.4.3, voicing is impossible whenever polarisation cannot take place, that is, if N^0 cannot spread to the right; hence, geminates do not undergo voicing. I will leave aside the question of whether the frequent absence of lenition word-initially is due to phonological or to analogical reasons (cf. Carvalho, this volume a: § 3.3), and focus on the less dubious case of heterosyllabic clusters such as Lat. *nocte*, *testa*, *campu*, *porta*, *saltu* > Western Romance *nɔχte, *tɛsta, *campu, *pɔrta, *saltu. Why is the second element of these clusters (generally) preserved, even when it is preceded by a sonorant?

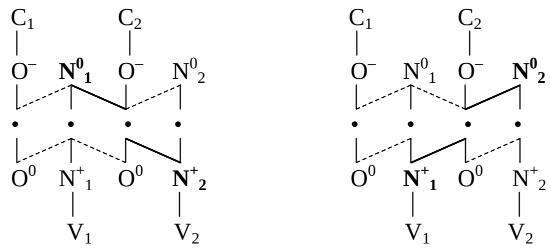
The simplest answer to this question could be that such clusters behave like geminates, and that association of their first element blocks N^0-spreading and therefore N-polarisation. However, this amounts to saying that the internal consonants of *nocte*, *testa*, etc. are phonologically adjacent. Now, I will assume that all clusters involve a null nucleic position (cf. Lowenstamm 1996). I shall not discuss here why the contour-based theory follows the 'strict CV' claim in this respect. One basic reason (cf. Carvalho 2002a: § II.1) lies in its generalizing power: if both V- and CVC-syllables are assumed to contain empty segments, the ONSET and NOCODA constraints can be unified into a single one: 'avoid empty categories'; and, indeed, empty categories appear as marked objects within the contour theory (cf. § 3.4.1). As will now be seen, assuming null positions within a contour-based framework crucially allows for a unitary account of two major, and apparently independent, phonological

[21] Indeed, the impossibility of /atta/ > [aːta] is hardly comprehensible if geminates and long vowels involve an additional specific slot, as is the case in standard autosegmental accounts, including Government phonology.

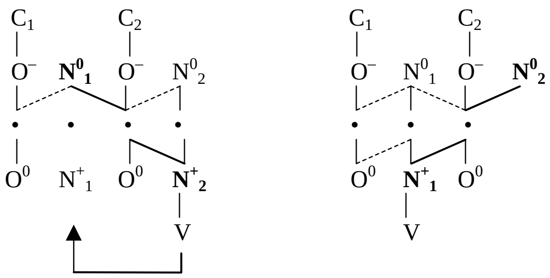
facts: that both post-coda lenition and vowel lengthening in closed syllables are marked processes.

Let us assume that X^0-elements acquire a non-null energy by their association with X^α-counterparts (cf. § 3.3.2), viz through X^0/X^α polarisation (cf. § 4.4.2). If so, it follows that the $N^0{}_1/N^+{}_2$ and $N^+{}_1/N^0{}_2$ polarisations in (36a,b) involve two *independently non-null* N^0's, via their association with $N^+{}_1$ and $N^+{}_2$ respectively. However, in (37a,b), *only* the $N^0{}_1/N^+{}_2$ and $N^+{}_1/N^0{}_2$ polarisations are likely to assign a non-null energy to $N^0{}_1$ and $N^0{}_2$ respectively, since no other N^+-element is associated with them.

(36) a. C_2-voicing: b. V_1-lengthening:



(37) a. Post-coda voicing: b. V_1-lengthening in CVC:



Polarisations involving non-null potentials by definition, $N_i/N_{i\pm1}$ polarisations are naturally favoured if their poles are *already* 'activated', i.e. non-null, as is the case in (36a,b) but crucially not in (37a,b), whence the marked nature of the latter configurations. Indeed, languages may show vowel lengthening in closed syllables, as well as voicing after codas (like in Aragonese, where *mp*, *nt*, *nk*, *lt*, *rt* > *mb*, *nd*, *ng*, *ld*, *rd*, and *mb*, *nd* > *mm*, *nn*). However, if a language has lengthening and/or lenition in such contexts, then it also has lengthening and/or lenition in the unmarked environments in (36), while the converse is false.[22]

5. Conclusion

The contour theory exposed in this chapter is based on the claim that *there is no contextual allophony*, as is shown by diachronic morphogenesis (cf. § 2.1). The so-called allophonic phenomena are all due to a linear view of what is in fact temporal overlapping of diverse phonological properties; in other words, they all involve what is usually called *assimilation*. If these properties are perceived by speakers, this is because they are all *distinctive* on their own autosegmental tier, not because speakers are sensitive to some hypothetical 'fine phonetic detail' (cf. § 2.2).

To quote Lass's (1984: 33) comment on the structuralist axiom of 'separation of levels', 'what counts is not how 'right' a theoretical claim is, but how testable it is, and what we can learn from trying to push it as hard as possible. Strong claims, even if untenable, can be heuristics: methodological guidelines or strategies for analysis'. Why is it a strong (if not untenable) claim to suppose that *any* contextual allophony involves spreading of distinctive objects? And why can it be heuristic? As regards the first question, a problem arises from the fact that contextual allophonies may be either 'combinatory' (e.g., palatalization) or 'positional' (e.g., lenition), only the former type being usually viewed as involving propagation of (possibly distinctive) melodies. Now, if both allophonies are to be treated alike, then it turns out that *positions are melodies*. This is exactly the assumption I made in generalizing contour-based representations to the laryngeal effects of positional allophonies like aspiration and voice, in such a way that there are no [±voice] or [±spread gl.] features: just like length, these laryngeal properties emerge from what are *prima facie* purely positional objects such as onsets and nuclei.

A unitary account of lenition is a direct result of unifying positions and melodies, and this is where the present approach is heuristic. Not only does it allow a similar formalisation of functionally related processes like degemination, voicing and vowel lengthening, but it also provides another type of unifi-

22 Though this will not be discussed here, let us add that contour-based representations also account for voice/length interactions such as /ăg-tu/ > Lat. *āc-tu* vs /făk-tu/ > Lat. *făc-tu* (Lachmann's law), and explain a crucial asymmetry: if voice can change into length, length cannot be replaced with voice, that is there is no change of the form /āk-tu/ > **ăg-tu*.

cation. Two sorts of phenomenologies are commonly assumed to exist : positional and melodic. This is particularly explicit in CV phonology (cf., e.g., Scheer 2004: § I.8), and Government theory has particularly focused on the former, the concept lenition providing one of the clearest examples thereof. However, even standard GP accounts of lenition and other phenomena must have recourse to both positions and melodies: if the conditions under which processes take place appear as basically positional, and can therefore be described in terms of government/licensing stipulations, the phonetic manifestations of the processes themselves necessarily involve segmental primes, and some of these processes are, indeed, generally viewed as assimilation, i.e. as melody propagation. Now, this raises the eternal problem of the arbitrariness of phonological rules and representations (Chomsky & Halle 1968: § 9): why should such and such a feature be 'strong' or 'weak', and, therefore, more or less likely to be activated by position-driven commands? This is where the contour-based model of phonological representations brings an interesting contribution by attempting to fill the gap, and to unify both aspects of the facts. Thereby, the contexts required, and the material involved by lenition no longer belong to different worlds.

Acknowledgements

I would like to thank two reviewers for their comments on a first draft of this chapter. Naturally, I owe all responsibility for any errors.

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