Radical CV Phonology: the locational gesture[*]

HARRY VAN DER HULST

1 Goals

'Radical CV Phonology' is a variant of Dependency Phonology (Anderson and Jones 1974, Anderson & Ewen 1980, Ewen 1980, Lass 1984, Anderson and Ewen 1987, van der Hulst 1988a,b, 1989). In this article, the symbols C and V do **not** refer to skeletal units in the sense of Clements and Keyser (1983), but to two phonological elements, that play a pivotal role in theory that this article contributes to. Radical CV phonology shares with Dependency Phonology most of its 'leading ideas' and tries to further develop the execution of these in specific domains. In this article the domain I focus on is **segmental structure** and, specifically, place or locational properties. In van der Hulst (ms., in prep.) I deal with non-locational properties and syllable structure respectively.

To set the stage for my proposal I will first, in section 2, offer a short introduction to Dependency Phonology (DP) as presented in Anderson and Ewen (1987), henceforth AE, limiting myself to the segmental domain.[1] In section 3 I mention the main differences between DP and Radical CV Phonology (RCVP). In section 4 I present the Radical CV theory of locational properties. In section 5 I compare the model to a number of other current proposals for place primes. Section

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[*]I wish to thank John Harris for giving me helpful comments on this article and its predecessors and for inviting me to discuss this work at the London Phonology Seminar at UCL in May 1992. It was at this meeting that David Leslie suggested the name **Radical CV** Phonology.

This paper is extracted from a longer manuscript *Principles of Radical CV Phonology* that contains work in progress (van der Hulst, ms, b). In a paper which complements this one, I discuss the representation of categorial properties (van der Hulst, forthc.). Earlier versions of van der Hulst (ms) have circulated under the title *Book of segments*. During the period 1990-1993, I have presented a number of talks based on this material, using subtitles such as *The molecular structure of phonological segments* and *On the nature of phonological primes and the structure of segments*. I have received useful comments on these oral presentations from Mike Davenport, Rob Goedemans, John McCarthy, Michael Kenstowicz, Jacques Koreman, Aditi Lahiri, Simone Langeweg, Iggy Roca, Wendy Sandler, Keith Snider and Moira Yip. I am grateful to Marcel Den Dikken, Colin Ewen, Helga Humbert, Norval Smith and Jeroen van de Weijer who discussed with me some of the material presented here, although they may not recognize it in its present form.

[1]The gestures are comparable to 'feature classes dominated by class nodes' in Clements (1985), but not to the 'gestures' in Browman and Goldstein (1989) which are defined as the primitive actions of the vocal tract articulators.

6 contains a summary of the main points of my proposal and specifies areas for further research.

2 An introduction to Dependency Phonology

The most fundamental principle of Dependency Phonology (henceforth DP) is the idea that units which are combined to form higher level units enter into a head - dependency relation. With specific reference to the level of segmental organization, we can formulate further leading ideas of DP as follows: the primes of phonology ('components' as AE call them) form constituents **within phonological segments**, which are called **gestures**.[2] The components are **privative** (or 'unary', 'monovalent'). The term **component** will not be used here, however, and instead I will use the term **element** (borrowed from Government-based Phonology; cf. Kaye, Lowenstamm & Vergnaud 1985). Radical CV phonology shares properties with other models than DP, such as Particle Phonology (Schane 1984, 1987, De Níce 1991) and Government-based Phonology (cf. Kaye, Lowenstamm and Vergnaud 1985, 1991, Harris and Lindsey forthc., Brockhaus forthc.). A discussion of the major differences with these models, as well as with the model called 'Feature Geometry' (Clements 1985, Sagey 1986 and subsequent work discussed in McCarthy 1988, Den Dikken & van der Hulst 1988 and Pulleyblank forthc.) is offered in section 5.

DP recognizes two major gestures, the **categorial** and the **articulatory** gesture, and, in addition, a **tonological** gesture. Both major gestures contain two subgestures and all four subgestures may contain members from specific sets of elements. The topic of this article will be on the locational gesture, which in standard DP is a subgesture of the articulatory gesture. The other subgesture of the articulatory gesture is the **oro-nasal** subgesture, which contains just one element (viz. nasal). The categorial gesture contains a **phonatory** subgesture (for elements expressing manner or stricture properties) and an **initiatory** subgesture (for elements expressing airstream properties and glottal states). The proposals which AE make for the tonological gesture are very tentative:

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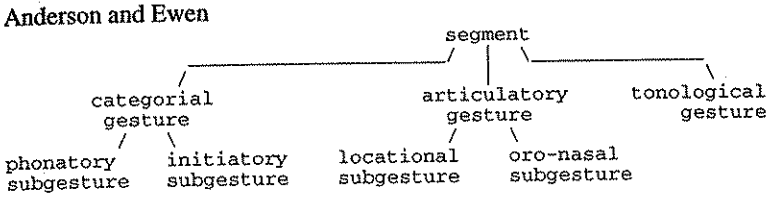
[2]This section draws on a similar section in den Dikken and van der Hulst (1988) and section 2 in van der Hulst (forthc.).

(1) Anderson and Ewen



The relevance of a grouping of phonological primes has long been recognised in DP. Already in Lass and Anderson (1975) and Lass (1976) a number of specific arguments are put forward that support the view that the matrix characterising the segment should be split up into at least two submatrices, or gestures, the phonatory and articulatory gestures of Lass and Anderson (1975), or the laryngeal and oral gestures of Lass (1976). This subdivision into phonatory/laryngeal and articulatory/oral feature sets reflects the fact that phonological rules and processes can refer precisely to (e.g. delete) either of these gestures, the other gesture being unaffected (cf. the so-called 'stability effects' of Autosegmental Phonology). Lass (1976) discusses cases of reductions of full consonants to the glottal consonants [h] and glottal stop, [ʔ], as occurring for instance in many varieties of Scots (cf. also Lass 1984:113-5), which show the independence of the laryngeal features vis-à-vis the oral features, a proposal also made in Thrainson (1978) on the basis of Icelandic preaspiration data and subsequently in various versions of Feature Geometry. It is these two gestures which, together with the latter added initiatory and oro-nasal subgestures, and the recently introduced tonological gesture, are the primary ingredients of the most recent DP feature tree, defended in AE, and represented in (1).[3]

We will now take a brief look at the content of the categorial and locational gestures, starting off with the phonatory subgesture. This gesture contains two elements, |V| and |C| which AE define as follows (recall that DP uses the term component instead of element):

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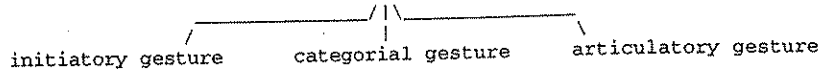
[3]The tree in (1) is the, at present, final stage of a discussion within the DP framework about featural hierarchitecture, beginning with Lass and Anderson (1975), whose phonatory gesture was later on renamed categorial gesture, and whose bipartite division was extended with a third main gesture, the initiatory gesture, introduced in Anderson and Ewen (1980) and Ewen (1980):



This tripartite split was not felt to suffice either, however, essentially because it was considered to be 'somewhat understructured' (Ewen 1986:205). As a result, DP introduced subgestures within gestures, and eventually developed the tree in (1).

> |V|, a component which can be defined as 'relatively periodic', and |C|, a component of 'periodic energy reduction.[...] |V| and |C| differ from the [Jakobsonian] vocalic and consonantal distinctive features in that the presence of, say, |V| in a segment does not necessarily imply that the segment is in a simple binary opposition to an otherwise identical segment not containing |V|. Rather [...] the more prominent a particular [...] component [...] the greater the preponderance of the property characterised by that component. Notice too that |V| and |C| can characterise segments either alone or in combination (p. 151).

'Prominence' of elements is expressed in terms of a head-dependent relation. In DP, when elements that belong to the same subgesture are combined cannot they enter into a relationship in which either element is more important, the other element being dependent on it. In addition, two elements can entertain a relation in which neither feature is dominant, a relationship which DP call 'mutual/bilateral dependency'. The option of mutual dependency comes into play only if it is contrastive with dependent combinations. Thus we arrive at the set of dependency relationships in (2).[4]

(2) a. {|X;Y|} or {|X==>Y|} — Y is dependent on X
b. {|Y;X|} or {|Y==>X|} — X is dependent on Y
c. {|X:Y|} or {|X<=>Y|} — X and Y are mutually dependent

These dependency relations hand DP the tools to express a number of major segment classes in terms of combinations of |V| and |C|, as in (3).

(3)

{|C|}	{|V:C|}	{|V:C=>V|}	{|V=>C|}	{|V=>V:C|}	{|V|}
vcl. stop	vcl. fric	voi fric	nasal	liquid	vowel
	{|C=>V|} voi stop				

[4] In the notational system of DP, an element enclosed between vertical lines represents just the element in question, while the representation {|x|} is used to exhaustively characterise a particular subgesture of a segment. DP also employs the notation {x}, which is used to express that the segment class in question is characterised by the element |x|, but not exhaustively so. A DP representation such as x;y denotes that |x| governs |y|, or that |y| is dependent on |x|. This representation is equivalent to the alternative representation with double arrows or the vertical notation used below. Thus the following notations are equivalent to one another:

x;y x=>y x
|
y

Underneath the actual representations I have indicated what classes of segments are meant to be represented. AE argue that the representations reflect a sonority ranking, going from left to right, in which the classes of voiceless fricatives and voiced stops are claimed to have equal sonority. Further manner distinctions (leading to separate representations for laterals, strident fricatives etc.) are not discussed here (cf. section 3 in van der Hulst, forthc.).

We see here that, as stated in the above quote, the precise phonetic interpretation of the elements |C| and |V| is determined by their status in a structure. Roughly, the phonetic impact of the dependent occurrence of an element is less than the impact of that same element as a head. Note also that we can, if we wish, associate traditional feature names to these interpretations instead of labels that are taken directly from phonetics (as in 3). For example, in the above array of structures, an ungoverned |V| can be glossed as [(+)sonorant], whereas a governed |V| forms the equivalent of [(+)voice]. This particular example reveals that DP manages to express distinct but **clearly related** phonological categories in terms of a single primitive appearing in different structural positions, where traditional feature systems must stipulate a relation in the form of redundancy rules like [+sonorant] -> [voice]. In DP [+sonorant] and [+voice] are manifestations of one and the same element, viz. |V|. Thus the relation between these two phonological categories is 'built in' into the basic vocabulary.

In order to characterise the segment classes in (3) in a feature system of the SPE type (Chomsky and Halle 1968) we would need the features [voice], [consonantal], [continuant] and [sonorant] (Clements 1990), where DP uses just two unary primes, the elements |C| and |V| and their interdependencies. However, pure reductionism has not been AE's only, or even primary, motivation for replacing major class and manner features by CV-complexes. They foremost claim that their approach is more adequate than traditional binary theories in at least three respects.

Firstly, by replacing binary features with structures of varying complexity, representations more adequately reflect the relative markedness of phonological major class and manner categories. In (3), the categories **vowel** and **voiceless stop** are the least complex and this adequately reflects their relative unmarked status. Fricatives are more complex than stops and voiced obstruents are more complex than voiceless obstruents. This again reflects well-known and widely accepted claims regarding the relative markedness of these categories.

Secondly, as stated earlier, AE also claim that the array of structures provides an adequate characterization of the notion relative sonority. Degree of sonority (or its

inverse **strength**) corresponds to the amount of 'V-ness' and 'C-ness' that a representation contains.[5]

Thirdly, the structures composed of |C| and |V| provide a more adequate basis for the expression of certain phonological processes. With reference to (3), for example, We may note that these structures reflect an asymmetry in the behaviour of 'voicedness', as opposed to 'voicelessness'. If we assume (as most phonologists do) that phonological rules can only manipulate what is present in a representation and not what is absent, the structures in (3) express that languages can spread 'voicing' but not the absence thereof. If this is empirically correct, representations as in (3) are superior to binary feature systems in which [+voice] and [-voice] have the same status.[6]

A final note on the elements |C| and |V| is in order. One might argue that even though these are unary primes, they are still in some sense 'opposites', much like the values of binary features are opposites. This is evident from the way we see their role in defining degrees of sonority. In my view it is entirely correct to refer to |C| and |V| as opposites, each representing extremes on a scale. In fact, the central claim of RCVP is that the polar C/V opposition is absolutely central to the architecture underlying the system of potentially distinctive phonological categories. It would, however, not be possible to replace the two elements by a single binary feature since one cannot build complex structures such as those in (3) by using two opposite and thus incompatible specification of a single prime.

I now turn to the second subgesture of the categorial gesture, viz. the initiatory subgesture. This subgesture contains the 'glottal opening' element |O| and two elements used for the representation of differences that involves airstream mechanisms, |G| (for 'glottalicness') and |K| (for 'velaric suction'). These three elements can each enter into a dependency relation with an element or elements of the phonatory subgesture, as in (4), in which the contrast between aspirated and unaspirated voiceless stops is represented in Dependency terms (cf. Ewen 1980:9.4; Ewen 1986:204).

(4) a. |O| / |C| — [p^h t^h k^h] b. |C| / |O| — [p t k]

[5] In the next section I will call this claim into question with respect to the representation of nasals.

[6] This discussion gets more complicated once we allow rules which may delete elements.

We observe that DP allows that representations of the two subgestures display variable dependency relations, by which I mean that there is not a universally fixed dependency relation between them. A similar relationship can also be observed between the |G| element of the initiatory subgesture and the |C| of the phonatory subgesture, used to differentiate between glottalic ingressive ({|C;G|}) and egressive ({|G;C|}) sounds. AE also allowed variable dependency relations in the articulatory gesture between the nasality element |n| and the features of the locational subgesture to express various degrees of nasality. So, in addition to variable dependency between individual elements DP allows variable dependency between representations of subgestures belonging to the same gesture.

In van der Hulst (forthc.) I critically review the manner in which AE have designed their categorial gesture and I offer a complete alternative proposal, which accommodates stricture distinctions (AE's phonatory distinctions) as well as the distinctions which AE represent in their initiatory and tonological subgestures. I generalize the use of |C| and |V| and argue that **all** categorial distinctions are represented in terms of these elements, including all distinctions which traditionally are classified under phonation and tone.

Proceeding with this sketch of DP, let us turn to the daughters of the articulatory gesture, which are the locational subgesture and the oro-nasal subgesture. The oro-nasal subgesture contains precisely one element, |n|, for 'nasality'. Recall that there also is a phonatory characterization of nasality: {|V=>C|} (cf.3).

Noting that DP expresses nasality in two ways, Davenport (1994) proposes to dispense with this duality. He rejects both the oro-nasal subgesture and the categorial C/V representations of nasality and represents nasality as a separate element in the initiatory subgesture. I refer to Davenport who shows that the dual representation of nasality leads to unsatisfactory results in DP, but whatever his arguments are, it will be clear that if we can demonstrate that a single expression for nasality (in whichever subgesture) is sufficient, one of the ways nasality is expressed in DP must be eliminated, whether the dual representation creates 'problems' or not. My own proposals regarding nasality are in agreement with Davenport's. In van der Hulst (forthc.) nasality is represented only once, in the categorial gesture.[7]

The locational elements, proposed by AE are listed in (5):

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[7]Proposals within Feature Geometry have sometimes also adopted a separate node for the feature nasal (cf. Sagey 1986, 1988). Piggott (1990, 1992) proposes a 'velic class node' dominating only [nasal]. In addition, he adopts a node 'spontaneous voicing', which also may dominate a feature nasal. The duplication of nasality in Piggott's model clearly bears a resemblance to the way DP treats nasality.

(5) DP location elements

|i|	'palatality, acuteness/sharpness'	|l|	'linguality'
|u|	'roundness, gravity/flatness'	|t|	'apicality'
|a|	'lowness, sonority'	|d|	'dentality'
|@|	'centrality'	|r|	'retracted tongue root'
|T|	'Advanced Tongue Root (ATR)'	|L|	'laterality'

The heart of this set is formed by the familiar 'AIU' subset, which plays a key role in the representations of vowels and consonants. Two further elements are added specifically for vowels, **centrality** and **ATR**, as well as a set of elements which are mainly or exclusively used for consonants.

The DP proposals for locational properties are somewhat arbitrary. The heart of the system is formed by the three elements |a|, |i| and |u|, but when the discussion goes beyond fairly simple vowels and consonant systems the number of elements is rapidly expanded. The main thesis of the proposal I make here is that such proliferation of elements is unnecessary. The central point of my alternative proposal will be that the set of place or locational elements is, like the set of categorial elements, **not** a random list. I will show that we can define a 'reasonable' set of locational elements in terms of a set of CV- combinations which closely resembles what we have used for the categorial gesture in van der Hulst (forthc.). This implies either of two things. It may be the case that the set of locational elements can be derived from two more elementary units X and Y which, like |C| and |V|, represents opposites, one being more 'consonant-like' and one being more 'vowel-like'. It may also be the case, however, that these two elementary locational units X and Y are in fact the same |C| and |V| that underlie the categorial distinctions. The second possibility is, of course, more interesting since it allows us to explore the existence of 'cross-gestural' generalizations, but it is important to realize that the present proposal does not crucially depend on the identity of categorial and locational elements. If support for cross-gestural identity is considered to be too weak, the claim still stands that both categorial and locational distinctions are based on combinations of one consonantal and one vocalic.

Interestingly, AE themselves contemplate the possibility of using certain elements in different (sub)gestures. I mention two of their suggestions.

In their excursus on representations for tonal distinctions, AE make the intriguing suggestion that the elements |i| and |u| (in origin locational elements) could be employed for high and low tone, respectively.

> ...we propose that the appropriate representations for the two tonal components are [...] |i| and |u|. In other words, we are suggesting that |i| and |u| in the tonological gesture bear the same relation to |i| and |u| in the articulatory gesture as |V| in the categorial gesture does to |a| in the articulatory gesture [...] That is, |i| involves (relatively) 'high frequency' and |u| (relatively) 'low frequency'; whether this is interpreted as high (of low) F_0 or as concentration of energy in the higher (or lower) regions of the spectrum depends on the context — i.e. gesture — in which it occurs (p. 273).

What is most noticeable in this proposal is the idea to use the same elements, viz. |i| and |u| in two different gestures. I am not commenting on the parallelism that is implied by AE's idea.

A second example concerns the identity of the locational component |a| and the categorial component |V|.

> ...there is clearly a relationship between |a|, as a component within the articulatory gesture, and |V|, as a component of the categorial gesture. Consider the acoustic glosses which we have given the two components: |V| corresponds with maximal periodicity, and |a| with maximal sonority. Vowels, by virtue of their periodicity are the most sonorous of the categorial segment-types, while open vowels are the most sonorous within the class of vowels. [...] The open unrounded vowel, then, might have {|V|} both as the representation of the categorial gesture and of the articulatory gesture (p.215).

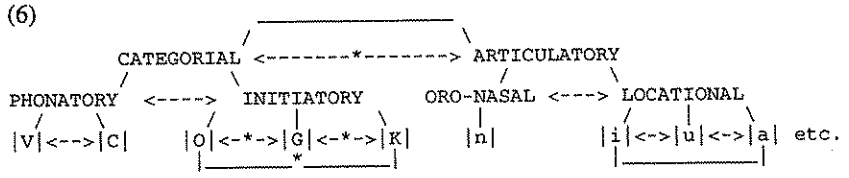
The relevance of these quotes is to show that AE themselves suggest the strategy to employ the same elements in different (sub)gesture, thus deriving similarities in phonetic interpretation, while attributing the differences to the fact that the '(sub)gestural location' of a element has a bearing on the phonetic interpretation as well. Elements, then, are interpreted taking into account not only their identity and position in the head-dependent relation but also taking into account the subgesture they are part of. It is precisely this line of reasoning that I fully explore and push to its limits in Radical CV Phonology.

3 Some further differences between DP and RCVP

The model that I propose primarily differs from DP in the rigid reduction of the number of elements. Because of this radical reduction, RCVP must be much more explicit on the ways in which elements may be combined to form phonological categories; the syntax is spelled out in section 4. In this respect, RCVP differs from DP at what we may call the 'micro' level, i.e. the level where we are concerned with the choice of elements and their combinatorial possibilities.

There are also important differences at the 'macro' level. We have seen that DP explores the possibility of allowing subgestures to enter into variable dependency relations. The possibility of entering elements of the initiatory and phonatory subgestures into a dependency relationship is not, however, fully exploited: while it is apparently necessary for |O| and |G| to be able to entertain variable dependency relations with |C|, |K| cannot 'look beyond' the initiatory subgesture, there being no DP representations in which (combinations of) |C| and/or |V| entertain non-symmetrical relations with |K| alone. In addition, intra-subgestural relationships are not exhaustively employed either, since we do not find dependency relations between the features contained in the initiatory subgesture. Schematically, all this is summarised in (6); a '*' indicates that no dependency relations are proposed between the units connected by the bidirectional arrow:

(6)



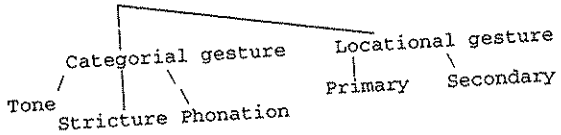
In (6) I also encode that there are no dependency relationships between the two main gestures: there are no circumstances under which segment-types are distinguished by means of a difference in the dependency relation holding between the elements of the categorial and articulatory gestures.

It is unclear why AE use precisely the dependencies illustrated in (6) and no others. In an attempt to restrict the DP model, Davenport and Staun (1986) have argued to dispense with variable **inter**subgesture dependency. They show that once the glottal opening element |O| is assigned to the phonatory subgesture and a new element |I| ('initiator velocity', expressing the direction of airflow) is assigned to the initiatory subgesture, no need remains for dependency relations between the phonatory and the initiatory subgestures. RCVP agrees with the proposals of Davenport and Staun in disallowing variable intersubgestural dependency, although the model that I propose

is very different from that of Davenport and Staun. AE also exploit the possibility of allowing variable dependency between the two subgestures of the articulatory gesture, cf. (4). Again, RCVP does not adopt this possibility. I refer to van der Hulst (forthc.) for demonstrating that this option is not necessary. The upshot of the above points is that in my own model I will dispense with variable dependency relations between subgestures.

In the next section I will propose a different architecture for the locational gesture, arguing that this gesture comprises two subgestures (which I will call: **Primary location** and **Secondary location**). The Categorial gesture has a slightly more complex design, having a Tonal 'adjunct', so that the overall segmental structure looks like in (7):

(7)



To summarize: a crucial aspect of my proposal concerns the choice of elements. In standard DP, each subgesture has its own set of elements. The use of the same elements in different subgesture is hinted at but not worked out in any amount of detail. In RCVP the proposal is advanced that **all** subgestures contain exactly two elements, viz. |C| and |V|. In van der Hulst (forthc.) I demonstrate how traditional Stricture, Tonal and Phonation features can be defined in terms of CV-combinations. In this article I execute the same idea for **all** locational properties.

The main goal of this exercise is not to arrive at a totally new set of distinctive categories. To a large extent I simply reconstruct a more or less accepted set of phonological categories, which in feature systems are labelled with distinctive feature names. Of course it not my **goal** to reconstruct any specific set. The goal is to derive a set of necessary categories and it may well be that not all traditional categories (often closely matching phonetic distinctions) are really necessary from a phonological point of view. The resulting set differs from traditional features lists in that (a) the set is not a random list but instead a well- defined subset of the logically possible |C|/|V| combinations and (b) relations between members of the set do not have to be expressed in arbitrary redundancy rules since they turn out to involve (partially) identical |C|/|V| combinations occurring in different subgestures.

4 Principles of Radical CV phonology

4.1. Outline

In this section I will propose a strict and uniform syntax to form CV- combinations. The phonetic interpretation of the two elements is, as can be expected, fairly general. Nonetheless, I will suggest that these elements do have a phonetic (i.e. acoustic and articulatory) interpretation: C denotes articulatory events which involve a relative high degree of **closure**, **stricture** or **contraction** (and their acoustic effects). The phonetic interpretation of V involves the opposite or the absence of these C-type events, leading to a relative high degree of **sonorancy**. Depending on the structural position of C and V (in terms of dependency and 'hosting' subgesture) specific interpretations (compatible with the general interpretations) arise. By mainly using articulatory glosses I do not intend to disagree with Jakobson, Fant & Halle (1952) that features are primarily acoustic in nature, or with Harris and Lindsey (forthc.) who claim that the primary 'meaning' of elements is a mental acoustic image.

I will propose that the locational gesture consists of two subgestures which enter into a fixed dependency relation:

(8)

In each of these we find the four simplest structures which can be composed from C and V:

(9) a. {|C|} {|C=>V|} {|V=>C|} {|V|}

b. C C_v V_c V

(9a) is the standard DP notation, while (9b) gives a simplified notation which I will henceforth use. The syntax does not allow that elements enter into a dependency relation with themselves within a subgesture, i.e. there is no combination like C_c or V_v. The structures in (9) are called **simple structures**.

In my proposal for the Categorial gesture (van der Hulst, forthc.) the syntax produces combinations of the structures in (9), provided heads are opposite. This generates the eight **complex structures** in (10):

(10) C-headed V-headed

In van der Hulst (forthc.) I refer to the dependency relation in (10) as **daughter dependency** and to the dependency relation in (9) as **sister dependency**. In both cases we deal with the same asymmetrical relation. What the notational distinction intends to express is that in the case of daughter dependency head and dependent form a less integrated unit than what is the case when a sister-dependency relation holds. In fact, the structures in (9) come close to traditional features, which are phonological atoms, whereas combinations of these, as in (10) correspond to combinations of features. I expect that the ingredients of the simple structures (in the case of C_v and V_c) cannot be accessed in the phonology. Later I will argue that the combinations of properties expressed in different subgestures are even more loose than those between the simplex structures in (10).

Henceforth I will refer to the dependency relation in (9) as level-0 dependency (which produces simple structures), that in (10) as level-1 dependency (which produces complex structures), that between subgestures and gestures (cf. 7) as level-2 and level-3 dependency. As we see in (7) for the categorial, but not for the locational gesture, level-2 dependency comes in two forms, level-2a (complement) and level-2b (specifier).

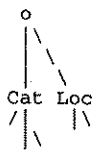
In (10) we distinguish C- and V-headed complex structures. In van der Hulst (forthc.) it is shown that the distinction between C- and V-headed complex structures is distinctive in the Stricture subgesture only; the Stricture subgesture forms the head of the categorial gesture (cf.7). For the two dependent Categorial subgestures a total of four complex structures appears to be sufficient, but no arguments were found in van der Hulst (forthc.) to decide as to whether these are the C- or the V-headed ones.

We will see that the Locational gesture, like the categorial gesture, makes use of all complex structures in (10) in the head subgesture and that the secondary subgesture makes no use of complex structures (i.e. level-1 dependency) at all. The difference between admitted complexity of head and dependent subgestures forms an instance of the more general complexity asymmetry that exists between heads and dependents; cf. Dresher and van der Hulst (1994) for a general discussion of head-dependent asymmetries (HDAs). The difference between the dependent subgestures in the categorial and locational gestures may also be seen as an instance of this asymmetry in so far as the locational gesture as a whole is a dependent of the categorial gesture; cf. (11). Given this, we may interpret the fact that the dependents

in the locational gesture are less complex than the dependents in the categorial gesture as a HDA.

Finally, that the Locational gesture makes use of less complexity (in having only one level-2 dependent) is again not again surprising in view of the fact that the location gesture is a dependent of the categorial gesture:

(11)



The argumentation for taking the categorial gesture as the head is based on the fact that categorial distinctions (and specifically stricture distinctions) determine the distribution of segments in the syllabic organization. Being head properties we expect them to be 'visible' in the root node. A further indication comes from spreading behaviour. We expect the head-dependent asymmetry to be manifested in spreading processes in such a way that dependent properties can spread independently, while heads can only spread together with their dependents. It is well-known that stricture properties do **not** spread, while location properties do. This confirms the head status of the categorial gesture. Notice, however, that I do not claim that the dependent categorial subgestures Tone and Phonation are incapable of spreading. In fact, the two type of level-2 dependency in (7) are meant to reflect that Tone properties are more likely to be 'prosodic' (i.e. autosegmental) than Phonation properties. Tone elements form, so to speak, the outermost shell of the categorial gesture.

The diagrams in (7), (8) and (11) are **not** meant to express **linear order** of units within the segment. I will assume that linear order is specified at the root level; I will briefly discuss 'supra root' structures in section 4 (cf. van de Weijer and van der Hulst, in prep.). Assuming that linear order must come in at some point, there is no **higher** level where our theory could locate this information. I accept the idea that root nodes are associated to **skeletal positions**, but since these are not themselves part of lexical representations we must assume that root nodes are linearly ordered. A radical CV view on syllable structure is developed in van der Hulst (ms, a).

Concluding this section, let us note right away that a structure as in (11) is not unlike the kinds of structures which have been proposed within **Feature Geometry**. My approach differs from that line of work in that I assume that the adoption of structural relations can, and if possible **must**, be counterbalanced by a reduction of the number of phonological primes. Implicit in this point is of course the criticism of Feature Geometry that this approach has taken for granted that the hierarchical

relations must simply be **added** to the set of features which stems from the SPE tradition. This criticism is not undermined by the fact that certain changes vis-a-vis the SPE system have been adopted, since it seems that these changes are not at all determined by the adoption of (a specific) hierarchical structure. A more specific discussion of some geometrical proposals is offered in section 5.

The point that I make here is that the addition of hierarchical structure to the segment allows us to recognize different traditional features as 'allofeatures' of the same 'featureme' (in this model a level-0 structure). Obviously, in order to explore the reduction strategy suggested here we need independent support for the particular grouping we assume and both phonetic and phonological constraints on assigning 'allofeatures' to a single 'featureme'. I suggest the following criteria. Firstly, the allofeatures must be in complementary distribution in the sense that they occur in different subgestures. Secondly, one has to show that the phonetic events corresponding to allofeatures are be related. Thirdly, we must be aware of (historical and synchronic) phonological processes which reveal their affinity.

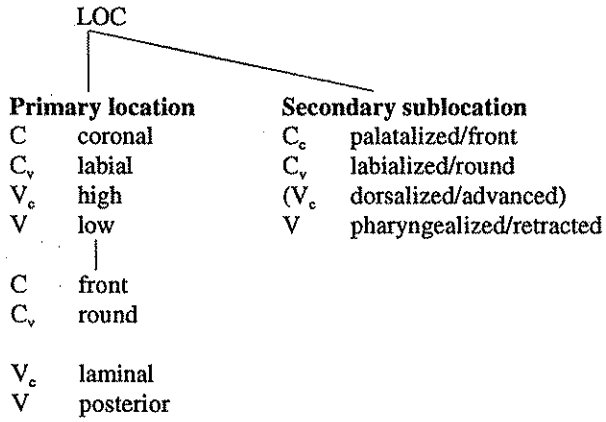
For a phonologist, the reduction strategy and the constraints I mention here must have a familiar ring. After all, it is common practice to argue along similar lines when we try to establish the minimal set of phonemes for a particular language. Two sounds will be attributed to a single phonological category (a single phoneme) if they occur in complementary distribution (i.e. occur in different structural positions) and if, in addition, there is phonetic similarity, and, furthermore, both are involved in phonological alternations.

In the next subsection, I will discuss whether there is a reasonable match between the structures allowed by our 'syntax' and the locational distinctions which are generally considered contrastive in the analysis of segment inventories. In this enterprise, I must rely on a certain consensus with respect to which phonetic properties are potentially distinctive. Such a consensus is apparent from the fact that certain features appear to be widely accepted, or that certain relations between features have been taken to be well-established. Despite consensus there is, of course, a lot of uncertainty as well. In the model proposed here I will be forced to make decisions which await further empirical underpinning.

4.2 The locational gesture

In this section I propose the following interpretations for the CV-structures in the various positions:

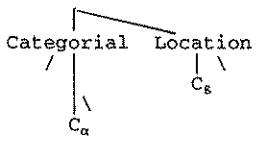
(12)



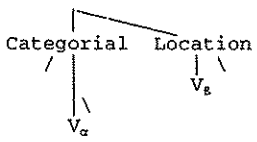
This diagram must be read as follows. A primary location may be a C- or V- level-0 structure, which may have V- or C- **direct** or **daughter-dependent** producing a level-1 structure. This gives us eight combinations (cf. 9), which accounts for the bulk of 'primary place articulations' for consonants and vowels. The C-headed ones give the consonantal primary place distinctions, while the V-headed ones are for vowels. Then, a secondary location may be added, producing a level-2 structure. The overall complexity of the locational gesture is simpler, then, than the complete categorial gesture which differentiates between two types of level-2 dependency (cf. 7). The parentheses around 'dorsalized/advanced' will be explained below.

To constrain the inventory of possible segments I postulate a high degree of 'harmony' between the two gestures: if the manner gesture has a C-headed head, so will the location gesture (cf. 13a), and vice versa (cf. 13b):

(13) a.



b.



I will now proceed with a discussion of the distinctions that we make in terms of each of the two locational subgestures. We start off with the Primary location subgesture.

4.2.1 Primary location. We begin with the simple, level-0 structures:

(14) [V] [V_c] [C_v] [C]

In van der Hulst (forthc.) I propose the following very general characterization of the elements |C| and |V|:

(15) C = relatively high degree of stricture (as in consonants)
V = unimpeded **oral** outflow of air (as in vowels)

This definition is first of all based on the occurrence of these elements in the locational stricture subgesture, but it seems adequate throughout the categorial gesture and, I would argue, for the locational gesture as well.

A dependent V differentiates between two types of 'high degree of stricture' and a dependent C between two types of 'unimpeded oral outflow of air':

(16) [C] = stricture **in** oral cavity (as in coronals)
[C_v] = stricture **outside** oral cavity (as in labials)
[V] = broad outflow of air (as in low vowels)
[V_c] = narrow outflow of air (as in high vowels)

A fundamental idea in this section is that the 'location space' is divided into a Consonant subspace (coronal and labial) and a Vowel subspace (high and low). Coronal and low are the unmarked choices in each subspace which is reflected by the fact that the are fully simple. It is not so difficult to see why high is represented as the more consonantal pole of the height dimension: high vowels in fact have a greater degree of constriction than non-high vowels. The greater degree of consonantality of vowels such as /i/ and /u/ is furthermore evident from their ability to occur in consonantal positions in the syllable.

To represent labiality as the more vowel-like consonantal stricture is less obvious, although it seems true that consonants and vowels share labiality more often than other places of articulation. The choice we have here is to select dorsality rather than labiality as the interpretation of [C_v]. This option may seem more obvious since the dorsal constriction area is more closely related to the world of vowels than the labial constriction. As will become apparent, the labiality option partly depends on the internal 'logic' of the system we propose here. When discussing consonantal place in detail I will come back to this point and show why the choice for dorsality leads to inconsistencies in the system.

I furthermore propose that an **empty** primary subgesture represents **high-centrality** (for vowels) and **dorsality** (for consonants). The interpretation we assign to the empty locational gesture resembles the interpretation which Anderson & Ewen (1987) have in mind for their centrality component |@|, which is restricted in use to vowels, and Kaye, Lowenstamm and Vergnaud (1985) for their element [v] (the 'cold

vowel'), which if applied to vowels represent high-back rather than central, and to dorsal consonants.[8] I stipulate that the head subgesture can be empty, but not the dependent secondary subgesture. A second stipulation is that an empty-headed primary subgesture cannot have level-1 dependents. We cannot represent dorsality and centrality in terms of an absent locational gesture, since it will be shown that dorsal consonants and central vowels can have secondary locational properties (i.e. level 2 dependents).

The interpretation of an absent locational gestures (to be distinguished from an empty locational gesture, which we have just discussed) will be 'schwa' if we deal with a vowel and 'a laryngeal' if we deal with a consonant.

We now turn to the proposed interpretation of complex, i.e. level-1 structures:

(17) a. V_c / C; V_c / C_v; V / C; V / C_v

b. high / front; high / round; low / front; low / round

The structures in (17a) are the 'official' ones. In practice I will also use the informal 'interpretation' structures in (17b). The labels **high, front** etc. stand for the complex of acoustic and articulatory properties that are usually attributed to traditional features like [+high] and [-back].

Complex C-headed structures are interpreted as follows:

(18) a. C / (V_c); C / V; C_v / (V_c); C_v / V

b. coronal / (laminal); coronal / posterior; labial / (?); labial / ?

The parentheses around $[V_c]$ and its interpretations require a comment which will lead up to a major point, viz. a ban on the occurrence of $[V_c]$.

An apical articulation is the result of targeting a specific point in the coronal area with the tip of the tongue. To do that the whole tongue body must be in a relatively retracted position compared to a laminal articulation which targets the same

[8] A feature like **central** does not occur in 'standard' feature inventories, although occasionally it has been proposed to adopt a feature [peripheral].

point, i.e. laminality comes with an advanced tongue position (cf. Ladefoged & Maddieson 1986). I will assume that the second structure represents the apical option, although the present system suggests that posteriority is the more fundamental property.

If we allow level-1 dependent [V_c] to occur we expect to find a three-way distinction among coronals: plain, laminal and apical/posterior. This three-way distinction has never been reported. This is the first indication that [V_c] is not required. I will return to this point below.

It is not clear how to interpret the retraction expressed by level-1 dependent [V] when combined with labiality, for which the tongue is not 'in use'. One proposal would be that such tongue body activity produces the so called multiply-articulated segments [pt] and [kp]. The infrequent occurrence of multiple-articulated segments argues against this proposal. Multiple- articulated consonants are discussed in section 4.3. The suggestion is, then, that the gap in (18) finds its explanation in the fact that labial constriction 'hides' tongue body activity.

In (19) I give a summary of the primary location structures, including the interpretation of the empty locational subgesture. Recall that empty- headedness excludes level-1 complexity:

(19) **Primary location structures**

a. V_c — high; V — low; - — high-central

b.

V_c	V_c	V	V
|	|	|	|
C	C_v	C	C_v
high	high	low	low
|	|	|	|
front	round	front	round

c. C — coronal; C_v — labial; - — dorsal

d.

C	C_v
|	|
V	V
coronal	labial
|	|
posterior	?

The representations in (19) represent the segment types that most languages 'choose' from before more complex structures are 'considered for which, in this system, we need secondary structures, i.e. level-2 dependency. The proposal for consonants provides a basis for explaining why coronal (rather than labial or dorsal) consonants are the ones to show sybtypes in systems that are relatively simple, coronals being formally the least marked category.

Note that we come very close to the possibility of eliminating level-1 dependency for consonantal place. This would merely require expressing posterior coronals in terms of a secondary articulation. I will return to this point in section 4.2.2.2.

For vowels, we predict that a distinction between high and low vowels precedes the emergence of front and round vowels or central vowels, both typologically and in the acquisition process (just like we predict that the dorsal place is not favoured in early acquisition; cf. Levelt 1994). It may seem that central vowels are the simplest of all, but I would like to suggest that empty structure is not at all unmarked. There is simply no formal measure for expressing the markedness of empty structure, which will therefore have to be taken as an independent markedness criterion.

To represent high-centrality and dorsality in terms of empty structure suggests a major difference between these two options and the two non-empty choices in each domain. This may seem advantageous for the vowels; central vowels are often the product of reduction processes and relatively infrequent as part of the phonemic inventory. It may be questioned, however, whether dorsality is significantly different in any way from coronality and labiality. In support of our view, let us bear in mind that references to dorsal as the 'weakest' place of articulation are too numerous to cite. Like central vowels, dorsal place often forms the last phase in reduction processes before total debuccalization occurs, or the easiest target for weakening (cf. Foley 1978). I will return to this issue in section 5, where I compare the present proposal with feature geometry proposals in which dorsality is **not** regarded as in any way special.

We now return to an issue raised before, i.e. the use of [V_c]. The biggest departure from standard DP lies in the shift from the triangular AIU model to a rectangular high-low/front-round view of the vowel space. This shift is forced upon us by the 'symmetrical syntax' introduced in section 4.1.

A consequence is that we will have access to the natural class of high vowels and to the spreading of **high**. A drawback is, however, that we have lost AIU insight into the prototypical triangular shape of vowel systems involving an asymmetry between high and low vowels:

(20) a. i u i

a æ ɒ

b. V_c V_c V_c

C C_v

V V V

C C_v

The second system in (20a/b) represents a completely unattested three-vowel system, but there is no significant difference in overall complexity between both systems.

The question as to whether $[V_c]$ is a legitimate independently occurring phonological category must therefore be raised. It is entirely clear that the present system generates this category. To 'correct' this I have no choice but to add one stipulation to the system:

(21) $[V_c] \Rightarrow [V_c]$ with $[C]/[C_v]$

(21) effectively states that $[V_c]$ only occurs in the combination with a level-1 dependent. We have already seen that $[V_c]$ is **not** required to subcategorize consonantal places. We will see below that $[V_c]$ is barred not only from representing a vowel by itself but also from representing a secondary articulation.[9]

The proposal to split up location in a vocalic and consonantal part resembles the Jakobsonian T-model in which the horizontal dimension represents colour and the vertical dimension sonority or aperture. The suggestion of this model is also that one axis, the horizontal one, is primarily consonantal, whereas the other, the vertical one, is primarily vocalic. A second resemblance between Jakobson's model and the one proposed here is that despite their biases all distinctions apply to consonants **and** vowels. In (22) this is demonstrated for the Jakobsonian model:

(22) t/i ——— p/u

|

a/k

[9] It is conceivable that the default option for high is front rather than round.

It cannot be a coincidence that the opposite pole of 'a/k' is the only node that is not 'terminal' or 'free' in this T-model; this node forms the counterpart of our [V_c], which, as we have proposed, is the least suited to occur on its own.

Finally, we observe that for Jakobson dorsal consonants for the counterpart of low vowels, which is not the case in our system. I will return to this point in section 5.

4.2.2 Secondary location. Dependent structures may not be empty and, in the locational gesture, not complex either. We have to reckon with three secondary locations only, since we exclude bare [V_c] (cf. 21):

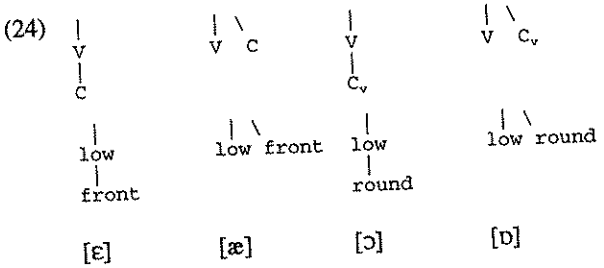
(23)

primary location		C-headed	V-headed
secondary location	[C]	palatalization	front
	[C_v]	labialization	round
	[V]	pharyngealization	retracted

We will first discuss secondary location for vowels and then turn to consonants.

4.2.2.1 Secondary location for vowels. For vowels the level-2 dependent [C] and [C_v] are glossed just like the level-1 dependent structures that we have discussed in the previous section. The consequence, then, is that vowels can be front or round **in two ways**:

(24)

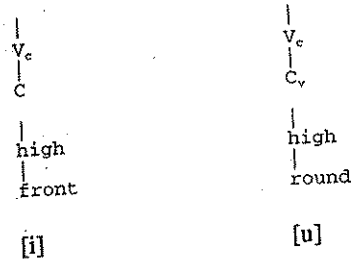


Level-2 dependents are 'looser' properties of the vowels; they are less 'integrated' with the head property. These are the properties, I suggest, that are involved in palatal and labial harmony systems, respectively.[10]

[10]The distinction we make here 'reconstructs' the distinction that standard Dependency Phonology makes in terms of variable dependency among elements:

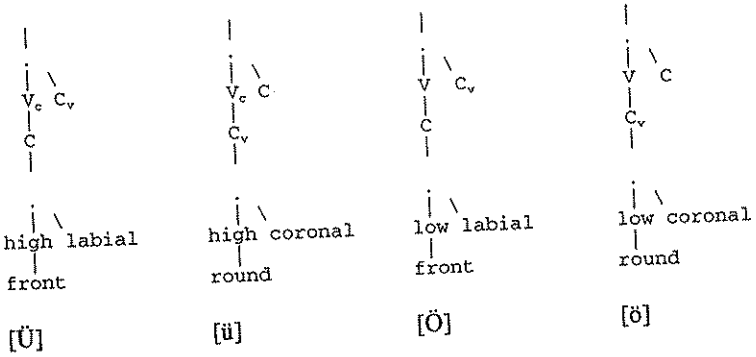
For high vowels we have fewer structures, since we exclude bare [V_c] headed structures:

(25)



Clements (1992) also argued that front rounded vowels can have the same properties in two ways, viz. as V-place properties and as C-place properties. He puts this distinction to use in the representation of the so called inrounded and outrounded distinction in Swedish. His C-place occurrences correspond to my level-2 dependents.

(26)



The capital vowels represent more central variants, those in which roundness is less integrated. The distinction as such is predicted by the present system.

---

front	low	round	low
low	front	low	round
[ɛ]	[æ]	[ɔ]	[ɒ]

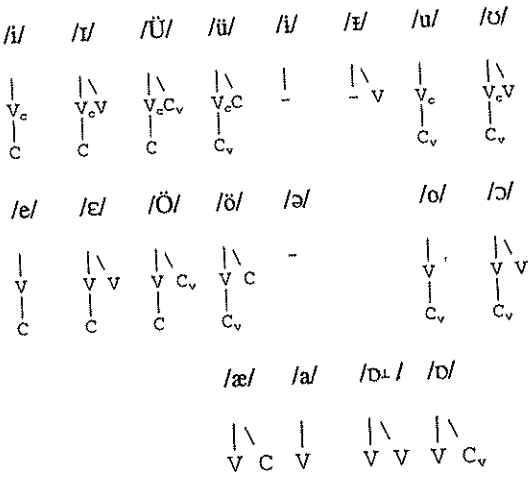
Where I have represented front as a daughter-dependent, DP has it as a head, and where I have front as a sister-dependent, DP has it as a dependent. I simply note this correspondence to facilitate theory comparison, not to point to specific advantages in one direction or the other.

Due to the similarities in interpretation, I will assume that no additional **distinctive** vowel types are produced by adjoining the same C-dependent at **both** levels.

Turning now to the option of having [V] as a secondary articulation on vowels, we derive that all vowel types represented so far can occur in a retracted. Since [V_c] has been excluded for secondary articulation (cf. 21), we derive the somewhat startling result that **ATR** is removed from the set of vocalic primitives and that all harmony systems formerly labelled 'ATR-harmony' must be reanalysed as involving RTR harmony. The claim that all tongue root harmony is retraction harmony is also, at least implicitly, claimed in Clements (1991), who reduces all height and tongue root distinction to his aperture node which dominates multiple occurrences of the feature [±open].

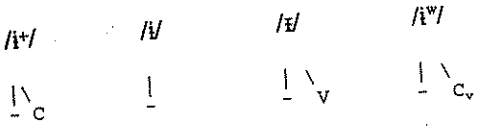
With these results in mind, we arrive at the following set of vowel representations; the structures without secondary location are included:

(27) The vowel structures



Recall that we differentiate between the absence of a locational gestures (representing the schwa in the centre) and a vowel that has an empty locational gesture (representing the high-central [ɤ] and [ɨ]). For the latter we actually allow a rounded and fronted variant as well:

(28) /i+/ /i̞/ /ɪ̈/ /i^{w}/

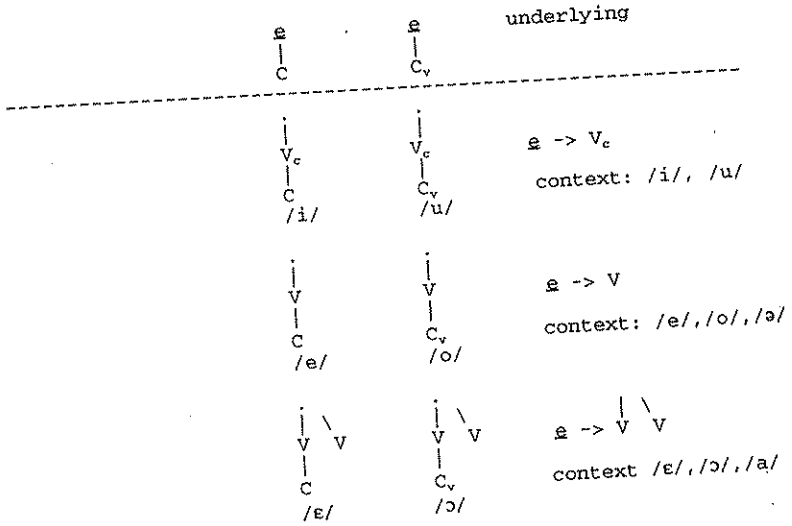


The need for the fronted and rounded high central vowels remains to be demonstrated. Perhaps the high-need colour rule must be formulated such that secondary colour needs a specified head. I leave this matter open here.

I will now consider some examples involving vowel harmony.

Esimbi. In Esimbi (Hyman 1988, Clements 1991), prefix vowels show a three way alternation. I leave out here the low vowel prefix which involves an extra complication:

(29)

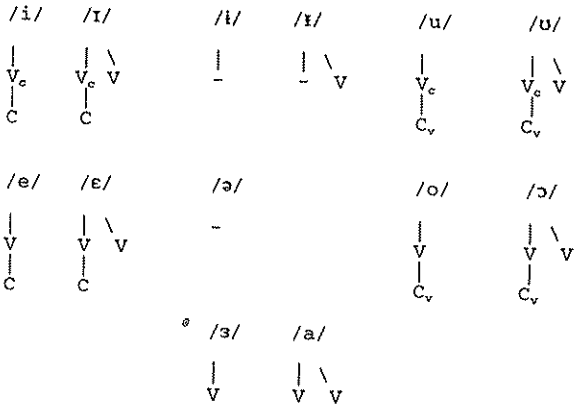


I use the symbol **e** for **unspecified**. In a unary system it would seem that such a symbol is called for to indicate that a certain representation is not complete and that some element must be added. In set-theoretic terms, e indicates that the set of elements representing a certain segment is **open**. A representation involving e cannot be used distinctively from a representation that has some element in the same structural position. I suggest that unspecification can be used in case of alternations (like in this case) or to represent a default option (of which I provide no example here).

The harmonic change in Esimbi, then, involves copying structure from the root vowel. (31)

Kpokolo. Kaye, Lowenstamm & Vergnaud (1985) analyze the vowel systems of Kpokolo which unlike many other ATR-systems contains a set of high and mid central vowels:

(30) The vowel system of Kpokolo

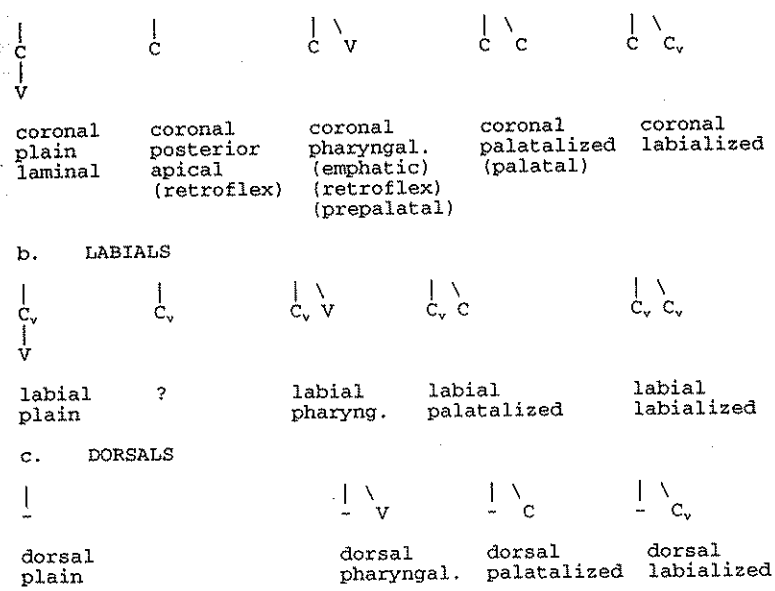


We correctly predict that the retracted version of /ə/ must collapse with the non-retracted low vowel.

Kpokolo, then, shows retraction or [V]-harmony. The other two types of harmony that are frequent involve [C] (**front**) and [C_v] (**labial**). I refer to van der Hulst (in prep.) for analyses of a variety of harmony systems.

4.2.2.2 Secondary location for consonants. We now turn to the secondary structures for consonants. Here we must consider the following representations; I include the structures that have no secondary place:

(31) a. CORONALS



b. LABIALS

c. DORSALS

Recall that dorsal has no level-1 dependents because dorsal is empty-headed, whereas for labial such structures are phonetically uninterpretable. This implies that, as we noted above, level-1 dependency only applies to coronals. We have mentioned the option of banning level-1 dependency from consonantal place, in which case the interpretations for the second and third category in (31a) are predicted to be non-contrastive. We then also eliminate a predicted set of secondary articulations on the second structure.

The simple 'coronal' in the upper lefthand position is non-laminal and non-post-alveolar, and thus apico-denti-alveolar. Ladefoged (1971) argues that the location distinction dental-alveolar (i.e. location at the passive articulator) and the distinction apical-laminal (i.e. location at the active articulator) are independent. His example of a minimal pair is clear (cf. also Ladefoged & Maddieson 1986, 9):

(32)

	dental	alveolar
Temne	apical	laminal
Isoko	laminal	apical

Isoko, however, represents the typical situation and this is exactly what we predict if we correlate a more retracted location with apicality.

Keating (1991) describes two types of retroflexes. Her 'type 4a' retroflexes have no tongue tip curling; they have an articulation point which is further back than that for dentals, but they are clearly non-laminal. We could say that the posterior coronal structure (i.e. the second structure in the coronal series) represents this type of retroflex. The third structure can then be used to represents the other type of retroflex, and furthermore for pre-palatals, a category that Keating too conflates with the second type of retroflexes, and for the so called emphatic coronals in Arabic languages (cf. 35 below).

The question remains whether the five types of coronals can co-occur. We are aware of one system that is said to have five contrastive coronal places. Ladefoged and Maddieson refer to the case of Toda (Emeneau 1984) which has a very rich array of 'coronals':

(33)

	C	C | V	C V	C C	V C
Lad&Mad	laminal dental	laminal alv.	apical post-alv.	laminal post-alv.	sublaminal palatal
Emeneau	dental	post-dental	alv.	alv.-pal	retroflex
here	neutral	posterior	retracted coronal	palatalized coronal	palatalized dorsal

Another issue that concerns coronals is whether palatals ever contrast with the articulation location which is often labelled pre-palatal here. Lahiri & Blumstein (1984) dispute this. They say that in stop systems one of the two is always affricated. In fricative systems, which may have a plain contrast, the feature [strident] can be used to make the distinction. But Ladefoged & Maddieson (1986, 19) argue that this contrast is used for nasals in Malayalam and for affricates in Komi. In our system pre-palatals and palatals can be distinguished.

With respect to labials we must in addition be able to represent a distinction between bilabial consonants and labiodental fricatives. We could adopt the often assumed position that this is not a distinction of location, but one of stridency. Selkirk (forthc.) shows in great detail how a 'labial' only theory can be put to use to represent all labial and round sounds.

Finally, we come to the dorsals. McCarthy (1991) shows that uvular **fricatives**, pharyngeals and laryngeals behave as a natural class, viz. the gutturals. Hayward &

Hayward (1988) make the same point. In this proposal all gutturals are non-occlusive dorsals with a dependent [V]. Uvular gutturals are continuant ([C_v]), whereas pharyngeals will be assumed to have an even weaker constriction, i.e. [V_c], the stricture of approximants. The dependent [V] explains why gutturals have a lowering effect on vowels.

The inclusion of laryngeals in the class of gutturals would involve claiming that laryngeals have the location component [V] as well. This is indeed what Pulleyblank (1989, 1990) claims. In the present system, however, this implies that laryngeals cannot always be represented in terms of the absence of a locational gesture, but rather as uvulars:

(34)

| \	|	| \
C V	-	- V
emphatic coronals	velar	uvular pharyngeal laryngeal

This implies that the distinction between uvulars, pharyngeals and laryngeals is one of **manner**. Effectively we say that the class of gutturals **is** the class of uvulars.

In Palestinian Arabic emphatic coronals and (all) uvulars have a lowering effect on vowels too. The relevant natural class is the set of obstruents with secondary [V] location.

4.3 Clicks and multiply articulated consonants

To conclude this section I briefly discuss the representation of two types of complex consonants, viz. clicks and consonants with multiple articulations. To get rid of a separate feature for clicks, Sagey (1986, 1988) proposed that these sounds are complex segments which differ from doubly-articulated segments like [kp] in that the dorsal articulation is the 'major' one. If this can be maintained, there is no need for an airstream feature [velaric suction]. This would be a welcome result since Halle & Stevens (1971) had already suggested that distinctions such as implosive and ejective are expressed in terms of phonation properties (creaky voice and glottal, respectively).[11] Sagey proposes something like (35) for clicks:

[11] Following Halle & Stevens (1971), airstream distinctions like ejective and implosive have been classified under the phonation subgesture in van der Hulst (forthc.). This leaves us with one 'loose end', i.e.

(35)

coronal click labial click

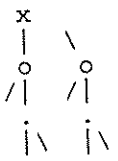
The dorsal part, the primary articulator in Sagey's terms, is called the efflux, the other part the influx. We know that coronal clicks can have different contrastive locations of articulation for the influx. Ladefoged & Maddieson (1989) mention that velar and uvular differences for the efflux also exist. For coronal clicks, then, there is variation on both closures, which suggests that something like (35) is right. But how can we 'translate' this into our notation?

Traill (1991) offers a cue by suggesting that clicks involve two timing slots. He offers a number of arguments:

- For clicks that are laryngeally complex there is no way of lining up the part of the laryngeal contour with the parts of the location contour. Yet this alignment is fixed and invariable.
- The efflux parts of clicks exist as independent segments in the click languages (and so does, I assume, the influx part).
- Phonological processes affecting effluxes also affect the corresponding separate segments.
- Phonetic evidence involving the duration of clicks which is more like clusters in most cases than 'real' complex segments.

Traill's proposal is an attractive one, but by suggesting that clicks are **two segments**, he might actually be pushing the independence of the two parts too far. A possible intermediary representation is possible in our model. We might think of clicks as the fusion of two complete trees into one skeletal position in the following way:

(36)



The structure in (36) is an instance of doubling at the root level. That complexity of this type (i.e. duplication of gestures under a single root) is called for has also been

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the airstream distinction which is needed for clicks.

argued in van Lit (1987) for consonant complexes in Georgian. Complexity of this type can also be put to use in many other cases as shown in Van de Weijer (1994). Van der Hulst (ms.) develops the notion of root complexity further in the context of a constrained theory of syllable structure, showing that the increase of expressibility that double root segments lead to can be counterbalanced by constructing a simpler model of syllabic structure.

Following Sagey, I will assume that doubly articulated segments are also double root segments, phonologically distinct from clicks only in the choice of which location forms the head. Ladefoged (1971) suggests that consonants like [kp] may freely alternate with clicks in certain cases or be in a historical relation with clicks, which suggests that their representation must be fairly similar.

5 Comparison with other models

In this section I will briefly discuss the relation between our approach and other current approaches. My goal here is merely to point to differences and resemblances. An attempt to demonstrate superiority would be too ambitious.

The unary primes |a|, |i| and |u| were introduced in Dependency Phonology (Anderson & Jones 1974a,b, Anderson & Ewen 1987) and later adopted in other, sometimes closely related, models (e.g. Schane 1984, 1987, Kaye, Lowenstamm & Vergnaud 1985, Rennison 1988). It is striking that in almost all these models, a **fourth primitive** appears at some point. Dependency Phonology adopted a **centrality component**, while Government-based Phonology (Kaye, Lowenstamm & Vergnaud 1985 proposed what is called the **cold vowel**. In the proposal made here the role of this 'fourth element' is taken over by the notion of 'empty locational gesture'.

The further use of 'absence of place' that we appeal to is also available, at least implicitly, in these other models.

In both Dependency and Government-based Phonology, the AIU-set of primitives has first been tested on vowel structure before it was applied to consonants, with the addition of certain other components. Smith (1988) and van der Hulst & Smith (1988), however, propose to make no use of special consonantal elements. The proposal made in this article is in that spirit and takes the extreme position that the three elements A, I, U (or rather their V/C definitions) and the notion of empty location are sufficient to represent all location categories of both consonants and vowels. It differs from earlier Dependency based work in deriving the three elements from more basic units (i.e. C and V) a consequence of which is that |i| and |u| are more complex than |a|.

Whatever the details, it is clear that the four-way distinction we adopt corresponds to the set of unary **class nodes** proposed in Sagey (1986, 1988) in the following way:

(37) |i| Coronal |u| Labial

|a| Radical - Dorsal

Whereas the Dependency elements were first introduced for vowels and then extended to consonants, we see that in the geometrical line of work the opposite has happened. The four features in (37), originally consonantal, have more recently been taken to also figure in the representation of vowels, although in this case too additional features for either vowels or consonants remain in the inventory.

In recent work, however, Selkirk (forthc.) argues that a single feature [labial] is sufficient to represent all labial sounds, both consonantal and vocalic. I would tend to include her work in the dependency tradition rather than in the geometrical line of work, since, like all dependency-based work, Selkirk makes use of a primary and a secondary occurrence of features, a distinction that she represent in terms a dependency relation. Selkirk refers to her theory as the 'labial-only' theory. The approach we take here is a generalization of Selkirk's programme and Selkirk's careful and detailed study ought to be replicated for the other three elements, i.e. [coronal], [dorsal] and [radical].

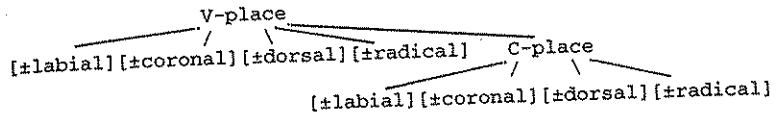
In recent geometrical work Clements further developed the idea of a single set of place features for both consonants and vowels.[12] His model comes close to proposing **one** set of place primitives for vowels and consonants, but it still uses properties like [posterior] and [distributed] to subclassify coronals. Clements makes

[12]We find different implementations of the idea that consonants and vowels are somehow parallel in their featural make-up. In one approach, (a), two parallel sets of features are proposed (Pulleyblank 1989, Mester & Ito 1990). This can be seen as an extension of Sagey's idea that [±round] was dominated by the Labial class node; the other features were dominated by the dorsal class node. In the other approach, (b) (found in Clements 1992), a single set of features is applied to both consonants and vowels:

a.	**E. Pulleyblank**	b.	**Clements**
	labial --- [±round]		[±labial]
	coronal -- [±front]		[±coronal]
	dorsal --- [±high]		[±dorsal]
	radical -- [±low]		[±radical]

a distinction between a V-place and C-place node and he represents all four properties under both nodes:[13]

(38)

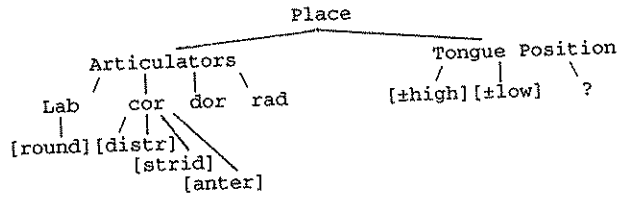


The distinction between V-place and C-place clearly partly captures the more general the distinction we make between primary and secondary articulation.

If we focus on the choice of primitive we note two differences with our proposal. Firstly, dorsal does not have a special status and, secondly, the primes are not unary. I will not discuss here the second matter and will return to the status of dorsality below.

In a number of respects, our proposal is in line with a recent proposal by Lahiri & Evers (1991), who suggest the following structure partly in response to the model in (38):

(39)



The Tongue position node resembles Clements' **aperture node**, which is a daughter of the V-place node in (38). The '?' represents other features that according to the authors may be part of this node.

Lahiri & Evers criticize the model proposed in Clements (1992) in which the four articulators occur twice, once under a V-place node and once under a C-place node. Essentially, Clements' main reason for doing this is to express secondary articulations. Doubling the occurrence of features is especially called for in cases where the primary and secondary articulations are the same. Since Lahiri & Evers do not appeal to primary and secondary nodes, they must use both Labial and [±round] for representing a segment such as [p^{w}] This shows that the distinction between head

[13]Clements assumes that the V-place node is dominated by the C-place node to explain why there is no consonant harmony.

(primary) and dependent (secondary) occurrence is crucial in getting away with a single set of primitives (cf. Selkirk forthc.).

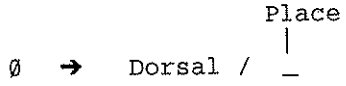
The model proposed by Lahiri & Evers approaches ours more closely than that of Clements. Recall that the primary place node in our model makes the following distinctions:

(40)

The main differences with the Lahiri & Evers model lie in removing a node Radical (we have Low, after all), in removing (independent occurrence of) high and the question mark from the tongue position node and in assigning interpretations to the empty locational node.

To conclude this section, I return to the special status of dorsals. Unlike Smith (1998) I do not use |a| for dorsals, which are represented in terms of an empty node. Working in a somewhat revised version of the Sagey-model, Trigo (1988) also assigns a special status to the node Dorsal, which, according to her, is the default place node. Trigo proposes a default rule which assigns the class node Dorsal to a consonant which is unspecified under the place node:

(41)



In regarding dorsal as special, Trigo's theory of consonantal place, then, comes very close to RCVP.

An issue that comes up here is the claim that coronal rather than dorsal consonants must often be represented as being unspecified for place. It will be clear that we cannot represent both coronals and dorsals as empty at the same time.[14] Paradis & Prunet (forthc.) criticize our treatment of dorsals for precisely this reason. They present evidence for the unspecification of coronals in Paradis & Prunet 1989 (cf. also Avery & Rice 1989 and the contributions to Paradis & Prunet 1991).

Now recall that we have acknowledged the unmarked status of coronals by representing them as C, which is the simplest consonantal structure unmarked.

[14]Trigo (1990) suggests that placeless onset consonants are coronals while placeless coda consonants are dorsal.

Although this in itself sets apart coronals, it will not account for transparency effects, if transparency calls for the total absence of intervening place information.

An option that I could take is to represent coronals (where this seems necessary) in terms of e or, like laryngeals, in terms of an absent locational gesture (but with manner properties other than those possessed by laryngeals). Assuming that one of these options leads to the correct result, I leave the decision for further research.

6 Conclusion and issues for further research

With its twin article which deals with non-locational properties (van der Hulst forthc.), this article presents an almost complete model of segmental structure. Needless to say, by focusing on completeness, coherence and notational precision we have neglected to supply much empirical support for those aspects of our model which differ from other models of segmental structure. It is for future work to supply further facts and more detailed analyses which support aspects of models that intersect with the present proposal.

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