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An Introduction to Radical CV Phonology[1]

1. Introduction

Taking certain issues in feature theory involving redundancy as a point of departure, this article discusses an approach to phonological primes that is radically different from current models that find their roots in the feature theory proposed in Chomsky & Halle (1968; henceforth SPE) and its 'geometrical derivatives'. Redundancy provides the starting point because the fact that some specified feature A is predictable on the basis of some other specified feature B, so that B → A, may be an indication that A and B are fundamentally related. If A and B are entirely separate primes, the relation expressed in a redundancy rule is completely arbitrary. Hence theories that have to appeal to such redundancy rules are inadequate.

Enhancement Theory (ET), proposed in Stevens, Keyser & Kawasaki (1986) and further developed in Stevens & Keyser (1989) seeks to eliminate the arbitrariness of redundancy statements by appealing to forces that are external to phonology. DeJong (forthc.) examines certain aspects of ET and his results suggest that one of the best examples of this theory (involving

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[1] This article provides some background to a theory of phonological primes developed in van der Hulst (1994, forthc., ms., in prep.) and covers material that I discussed at the end of a phonology course (Helsinki, August 1993) that I taught in collaboration with John Harris (UC London) at the invitation of the Finnish Linguistic Association. I would like to thank the Association for extending the invitation and the audience for its attentive presence.

Because the subjects are closely related, this material is prefixed with an introductory section based on a comment on a paper by K. deJong (forthc.) presented at LabPhon 4 (Oxford, August 1993). The original comment was intended to be published in the LabPhon proceedings but I was unfortunately unable to find ways of conforming with the reviewers wishes in time. I would nonetheless like to thank these anonymous reviewers for their comments.

the relation between [back] and [round]) might actually not involve a redundancy relation between two independent primes. In section 2.1, I briefly discuss the central thesis of ET and in section 2.2 I summarize the results of deJong's study. Then, in section 3, I wish to support one of his interpretations of these results by pointing to phonological feature theories that combine "back" and "round" into a single phonological prime. In section 4, I then turn to a broader discussion of the issue of redundancy. My main goal in this section is to introduce (and advertise) an approach to phonological primes that attempts to eliminate the arbitrariness of all redundancy relations, simply by following the strategy that if it appears that "A → B" it must be the case that, in some sense, "A = B". By way of conclusion, section 5 offers some additional considerations concerning the relation between phonological atoms and phonetic properties.

2. Enhancement theory

2.1. What is it about (and what not about)?

The goal of ET is to provide a phonetic explanation for the existence of a certain type of redundancy rule, which is said to involve the notion of *enhancement*. One of the key ideas of ET is that feature values which are redundantly specified on the basis of *distinctive* feature values (sometimes) enhance the contrast which is created by the distinctive features. Enhancement can take place through adding extra acoustic cues or by strengthening the acoustic cues which are associated with the distinctive feature. In the first situation redundant values can support the acoustic effect of a distinctive feature by adding a new acoustic property that in principle bears an arbitrary relation to the acoustic properties of the distinctive feature. However, this is not what most cases of enhancement show. In most, perhaps all, cases of enhancement the second situation applies; the redundant features adds "more of the same" or, in any event, the

acoustic contributions of distinctive and redundant features arguably form a perceptual unity in the sense of Kingston & Diehl (forthc.).

The key example in ET, and also the topic of deJong (forthc.), involves the case of [back] and [round]. As is well known, many vowel systems do not "use" the feature [round] in the low vowel region and have a simple binary opposition in the non-low region, such that non-low vowels are either front and nonround or back and round. Every textbook in phonology discusses this case as a typical instance of redundancy, although it will usually be added that the question arises whether the specification for [back] is redundant or that for [round]. In a straightforward five-vowel system, there is simply no way of deciding the issue non-arbitrarily, unless one has reason to select one of the features as "primary" in some sense (cf. Schane 1973 for an extensive discussion of this issue).

In the case of [back] and [round], the proponents of ET take the position that backness is primary. In general, they say that the direction of redundancy is dependent on which choice maximally reduces the number of distinctive features in the system. It is then argued that back (non-low) vowels are redundantly specified as [+round] **because** roundness contributes to lowering the second formant, which by itself is the main cue of backness. Hence the presence of roundness **enhances** the main acoustic property of backness. Using the terminology introduced in Archangeli & Pulleyblank (forthc.), one might say, then, that the specific redundancy rule that applies in such cases is grounded in the phonetic notion of acoustic or perceptual enhancement.

The phenomenon of redundancy reveals that no language makes full distinctive use of all phonological features. The traditional point of view is that probably every language will fail to use some features (these feature are not **active**), will use some features only non-distinctively (these features are in all cases redundant), and use the rest distinctively, but never to the full.

The distinction between features that are inactive and those that are fully or partially redundant is not without problems. An instance of the former could be, for example, the non-use of tonal features in non-tonal languages, whereas the five vowel system mentioned above shows the case of full redundancy (of either [round] or [back]). The third case, that of partial distinctivity, can be illustrated with the feature [voice] in a system in which this feature is distinctive among stops but not among the other segments which are redundantly voiced (sonorants, vowels) or redundantly voiceless (fricatives; assuming no contrast in the latter category).

The question that arises, however, is why redundant features cannot be treated on a par with inactive features. Here two routes stand open. We could decide to specify at some late point in the derivation **in all cases** the values that segments have at the phonetic level (in that case we would specify tonal features even in non-tonal languages, just like we fill in the value for [round] in our 5 vowel system) or we could decide to leave both inactive and redundant features unspecified in the whole phonology.

The only sensible approach to this choice is to investigate whether any phonological generalizations remain unexpressed if specifications are left out, or, more generally, whether the phonology makes reference to specifications that are thought to be inactive or redundant? If not specifying these specifications does not "harm" the phonology, the whole matter could be left to the module of phonetic implementation. At that level, the issue of specifying or not specifying information returns, of course, since it turns out that to get the phonetics right, it is not necessary to assume specific targets in all cases (cf. Keating 1988), but in any event, the matter would be settled on the phonological side.

An issue that bears on the matter of specifying or not specifying feature specifications that are **not** redundant is whether phonological primes are unary or binary valued. Even where a contrast exist, such as between voiced and voiceless obstruents, the question can be asked whether both categories must be specified. The boldest position in this case is to assume that **all**

phonological primes are unary in the sense that in each opposition type only one value functions in the phonology. In the example at hand, this would probably be the positive value [voice]. A weaker position is held by proponents of 'radical underspecification theory' (Archangeli & Pulleyblank, forthc.). Here the claim is that in case of contrastive features 'typically' only one value is specified. The other value is either filled in 'late' in the phonology by so called complement or default rules, in the 'phonetics', or perhaps not at all.

ET, unfortunately, does not address fundamental questions regarding the nature of phonological feature systems nor are the distinctions that we make here between various types of redundancy or non-specification explicitly discussed. It could be, then, that phonological issues are not at stake and that ET is a theory that is intended to deal with "phonetic implementation". However, it is the case that the architects of ET employ a system of binary SPE-type features, which suggests that the theory is meant to apply in some sense to the realm of phonology. In that case, however, it would seem advisable that certain developments in feature theory are taken into account because otherwise the development of ET takes place in a historical vacuum. The conclusion I will draw from the study reported in deJong (forthc.) is that ET's prime example crucially depends on ignoring well-motivated feature theories in which [back] is simply not a recognized phonological prime.

It follows from what we have said so far that ET wishes to deal with cases in which redundant values can be predicted on the basis of another specified feature. Complement or default rules do not fall within the scope of the theory. But ET does not claim that **all** contextual redundancy rules are cases of enhancement. The architects of this theory carefully restrict their claims to 'certain types of redundancies', although they are equally careful in not providing an independent characterization of the relevant class. They only remark that there are redundancy statements which are not instances of enhancement, but hold 'simply because of constraints on the sound-generating system'

(Stevens, Keyser & Kawasaki 1986). It is not entirely clear what cases are subsumed under this category. Presumably we may think of the following examples:

(1)
a. [+nasal] -> [+sonorant]
b. [+strident] -> [–sonorant]
c. [+lateral] -> [Coronal] (or [+coronal])

Assuming that ET is correct in excluding these cases from the domain of the theory, it might have been instructive for proponents of ET to point out that in current approaches to feature geometry (Clements 1985, McCarthy 1988; for an overview cf. den Dikken & van der Hulst 1988), some of these redundancies (e.g. 2a, 2b and 3) are 'built in', by making the consequence a mother node of the antecedence:

(2) a.
A
|
B
(hence B → A)

b. [+sonorant]
|
[+nasal]

c. [–sonorant]
|
[+strident]

d. [Coronal]
|
[+lateral]

The dependencies in (2c) and (2d) are suggested (or at least implicated) in Avery & Rice (1989), where the nodes [+sonorant] and [–sonorant] are called "Spontaneous Voicing" and "Air Flow", respectively. The dependency in (2b) was proposed in Sagey (1986), but is problematical (cf. Shaw 1990).

It could have been suggested that all contextual redundancy rules that are **not** cases of enhancement could perhaps be expressed structurally, given that the tools to do this are available (geometrical organization: grouping and dependency). An attempt to reduce case of non-enhancement to "structure" would nicely complement the results of ET. Redundancies could then be said to be either grounded in the phonetic notion of enhancement or in the organization of features. The point I wish to make with this "suggestion" is **not** that Feature Geometry and Enhancement Theory indeed are, or could be, complementary theories. Rather

I want to reiterate the point made above, viz. that an attempt to "explain" redundancies cannot be fruitful if developments in feature theory are left out of consideration.

Summarizing, we have seen that the general heading of "redundancy" subsumes various types of cases in which features or feature values can be said to be not specified at some level of representation. ET homes in on a certain type of redundancy in which a feature that is in some sense "relevant" to a segment category C has a value that is predictable on the basis of another feature value that is truly distinctive. Other types of non-specification are presumably not within the scope of ET. These involve complement values and what we could call structural redundancies. ET could be understood as dealing with the complete set of redundancy rules, if it turns out that the former may turn out to be an artifact of binary valued theories, whereas the latter may fall out from theories that propose certain hierarchical organizations for features.

I will now first discuss the result reported in deJong (forthc.) and then, encouraged by his findings, propose another way of looking at the kinds of redundancies that ET seeks to deal with.

2.2. [Back] and [Round]

DeJong points out that ET attributes four properties to redundant features:

(3)
a. enhancement features phonetically increase the salience of the distinctive features to which they are redundantly specified.
b. enhancement features are informationally unnecessary
c. enhancement features may take over the role of the distinctive features
d. enhancement features are more variable than distinctive features

DeJong tackles property (3d). He takes this point to imply that enhancement features need not always be phonetically present and he then claims that in certain cases it is the distinctive feature that is **not** invariantly present, rather than the enhancement feature. The ultimate finding is that the phonetic properties of both features **jointly** express the phonological contrast. Neither can be said to be primary and depending on contextual co-articulatory factors either may be suppressed.

It is not so clear that the proponents of ET actually claim that only enhancement features can be absent. They remark that redundant features are more likely to come into play when the perceptual distinction signalled by distinctive feature is weak and also remark that the redundant feature introduces a new acoustic property which in some contexts exists **instead of** the property associated with the distinctive feature. An example of the latter situation involves the phonation of initial obstruents in English. Stevens, Keyser & Kawasaki (1986) point out that aspiration enhances the voicelessness of initial voiceless obstruents to such an extent that so called voiced obstruent are more non-aspirated than voiced.

This being the case, we could simply take deJong's case study as a clear and well-documented illustration of situations in which the full distinctive load is carried by the acoustic property of the redundant feature. I will briefly describe his study which concerns the feature [back] and [round].

In a variety of renditions of the mid-back diphthong [ow] in some northern midwestern dialects of American English it appears that the dorsal constrictions (the so called distinctive property of /w/) is **not** invariantly present, resulting in a situation that the presence of [w] is signalled mainly or exclusively by the acoustic effect of the labiality of this sound. In the test words examined by deJong, the [ow] occurs in a coronal context which, due to coarticulation, has a decreasing effect on the force of the dorsal constriction. In such cases, then, the presence of the glide is signalled by the labial rounding only. There are, however, also renditions of the [ow] diphthong in which the contribution of the

rounding or labiality is weak. Hence, deJong concludes, although it is true that the acoustics of the redundant feature is variable, the same holds of the acoustics of the distinctive feature.

DeJong's point is, then, that the acoustic properties which signal the presence of the back round glide are a truly joint effort of dorsal constriction and labial rounding, such that it is difficult to decide which of the two articulatory actions is primary.

What are the consequences of this observation? DeJong explicitly suggests the possibility of replacing the back/round pair by a single phonological feature. In support of this idea, he mentions other cases where distinct articulatory actions conspire to produce a configuration of the vocal tract such that a specific acoustic effect is produced. He mentions that labial closure combines activity of the jaw, and the upper and lower lip, and that coronal articulations likewise combine activity of the tongue blade and the jaw. To bring the active and passive articulators together, closure of the jaw adds to raising the lower lip or tongue blade, and in case of labial closure the passive articulator (i.e. the upper lip) can make a contribution too.

In these cases, he argues, we clearly deal with a single phonological feature corresponding to a set of articulatory events. The question is therefore whether these examples count as real precedents for a proposal to collapse [back] and [round]. According to DeJong, the back/round pairing is different from the other pairings just mentioned because in this case **two distinct phonological features** join forces, whereas in the other examples there are no independent features corresponding to the articulatory events which conspire to produce a certain result. Introducing a feature covering [back] and [round], while maintaining both as independent features would lead to the introduction of *cover features*, a possibility that Stevens, Keyer & Kawasaki (1986) also consider and reject, presumably implying that there is no independent motivation in this case for the relevant cover feature.

In his considerations concerning the replacement of back/round by one feature DeJong mentions the Jakobsonian feature [grave] (which was intended to generalize over this pair; I also

refer to Hyman (1973) who offers a defense of the feature [grave]), but he is reluctant to propound this position not only because he claims to be unaware of independent phonological motivation for such a feature, but also because he sees no ways of integrating such a feature in current feature geometry proposals, which are heavily articulatorily biased, whereas [grave] is primarily an acoustic feature.

The idea of making use of a feature "[round/back]" is not limited, however, to those that have proposed the feature [grave]. Various theories have integrated a feature like this in strands of so called AIU-systems (which incorporate [grave] as |U|). I refer to Dependency Phonology (Anderson & Jones 1974, Anderson & Ewen 1987, Lass & Anderson 1975, Lass 1976, Ewen 1980, van der Hulst 1988, 1989), Particle Phonology (Schane 1984, 1987), Government Phonology (Kaye, Lowenstamm & Vergnaud 1985) and various other proposals such as found in Rennison (1987).

In most of these AIU-system the acoustic nature of |U| is not an embarrassment, since the acoustic primacy of features is central to the whole system (cf. Anderson & Ewen 1987, Harris & Lindsey forthc.). Moreover, acoustic primacy of features is not adverse to the idea of feature grouping, a concept which in fact finds its roots in early versions of Dependency Phonology.

The important point to understand is this: if such a system is accepted there simply is no enhancement relation between backness and roundness as **phonological primitives**. In a theory which recognizes a primitive |U| (or [grave]) and no primitives like [back] and [round] there is no redundancy rule of the kind that ET seeks to ground in the phonetic notion of enhancement. This is not to deny that backness and roundness can form part of a theory of phonetic interpretation if such theories aim at spelling out the articulatory events which correspond to acoustic events (perceptual units) which are associated with phonological primes (cf. Kingston & Diehl (forthc.) and Nearey (forthc.)).

Proponents of AIU-systems have been confronted with analyses that make crucial reference to a unit [+back]. This could imply that collapsing [back] and [round] into one prime is

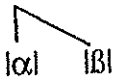
unjustified and thus that ET is about the relation between **phonological** entities after all. We must be careful, however, in deciding that reference to [+back] is crucial and that no reasonable analysis can circumvent this unit. A central claim of the AIU-sytem which is that the front-back dimension is expressed in terms of the unary element |I|. In this view backness results from the absence of |I|. Pending the outcome of the ongoing discussion concerning the claim that no phonological reference to backness is ever needed (cf. Kiparsky 1991, van der Hulst & van de Weijer, forthc.), I wish to maintain here that "back" is not an active phonological element. Cases involving palatal (or front-back) harmony turn out to be analyzable in terms of an active unit "front" (or |I|) in most and perhaps all cases. In this article I do not wish to enter into this specific debate regarding the necessity of [+back]. Rather I would like to take the opportunity to further pursue the idea that redundancy relations point to the possibility of reducing the system of primes.

3. Principles of Radical CV Phonology

3.1. Background Ideas

In the previous section we have seen that a redundancy relation between two phonological primes evaporates if these primes are collapsed into a single prime. In this section I will show how other cases that in traditional feature systems involve relations between completely independent features may be dealt with, using a reduction strategy that is **similar** in that two (or more) traditional features are subsumed under a single prime whenever these 'features' show a strong affinity (which, may come out because they stand in a redundancy relation), but also **different** in that the traditional distinctions are reconstructed by allowing primes, firstly, to belong to different 'gestures' and, secondly, to enter into dependency relations.

I take as my point of departure dependency-based models such as Dependency Phonology and Government phonology in which phonological primes are unary elements that may enter into combinations involving a head-dependent relation:

(4) 

The head-dependency relation postulated at this level of phonological representation is an instantiation of the general principle, which forms the cornerstone of Dependency Phonology, i.e. the idea that all constituent structure is headed, as in syntax, morphology and all phonological levels above the segment.

Given that primes may occur in two "roles", it is intuitively natural to expect that the occurrence as either a head or a dependent has some impact on the phonetic properties of an element. In a very general sense one might expect to find that the acoustic impact of the head occurrence of an element is stronger than its occurrence as a dependent. This phonetic effect of the head - dependent asymmetry has certainly been implicitly assumed in standard DP, as the following example will illustrate. Assuming an element |I| and an element |A|, these two may occur jointly in two ways:

(5) a. 

b. 

Details aside, (5a) represents a vowel that is essentially a somewhat lowered high front vowel [e], whereas (5b) is a fronted, somewhat raised low vowel [æ]. Put differently: in (5a) the phonetic properties of |I| are more **prominent** or acoustically **salient** than in (5b) and vice versa for the properties of |A|. The elements |I| and |A| on their own represent a high front [i] and low vowel [a], respectively.

In van der Hulst (1988a,b) I propose that the difference in interpretation may be connected to the fact that the head and

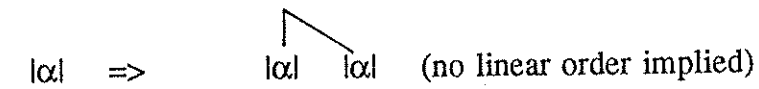
dependent occurrences of the elements do not involve the same **articulatority** activities. I suggest, for example, that the articulatory activities associated with |U|, dorsal constriction and lip-rounding, are typically connected to the head and dependent occurrence of this element, respectively. Similar pairs were proposed for the other two element, |A| and |I|:

(6)

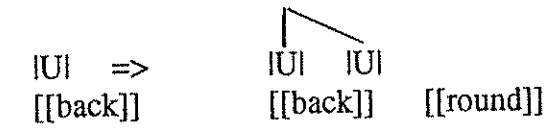
	Head	Dependent
|U|	dorsal	round
|I|	palatal	ATR
|A|	pharyngeal	open

I also suggested that (8) is an instantiation of a single universal "redundancy rule", as in (7), which says that a **head** prefers to have **itself as a dependent** if nothing else. We might actually refer to (7) as an enhancement rule since it basically says that unless a contrast is at stake, segments like to have more of the same:

(7)



(8)



The labels between "[[ ]]" represent the phonetic (in this case articulatory) interpretation of the phonological primes.

This proposal was motivated by an attempt to relate backness and roundness in a principled way. The redundancy relation that typically holds between these phonetic properties follows from the basic architecture of the model.

The major drawback of the proposal in (6) is, however, that [back] is made available as a phonological primitive, thus under-

mining a central claim of the AIU-system which is that the front-back dimension is expressed in terms of the unary element |I|. In addition, it is not entirely clear that the two interpretations that are made available for the other two elements are both necessary (as in the case of |A|), or indeed as closely related as the original proposal suggests. These problems motivated the developments in van der Hulst (1989).

But even though the specifics of the proposals in van der Hulst (1988a,b) may turn out to be wrong, it still seems attractive to pursue the idea that the head and dependent occurrence of elements may express phonetic properties that in traditional feature systems correspond to separate features. Also it seems reasonable to expect that those phonetic properties that are attributed to the same element (in different structural positions) are somehow related in that they contribute to the same acoustic event (or, less strictly perhaps, the same perceptual units), perhaps even with different degrees of strength and/or involving different articulatory actions. Finally, given that a dependency approach is taken, rule (7) seems a natural way of building in redundancy that is motivated by enhancement in terms of one single statement.

In van der Hulst (1994, forthc.) I therefore developed a dependency-based model of segmental structure that does not have the drawbacks of the earlier proposal and at the same time more fully explores the idea that a single element may express several phonetic properties (corresponding to separate and unrelated features in traditional systems) depending on its position in the segmental structure. This model is called "Radical CV phonology". The symbols C and V do **not** refer to skeletal units in the sense of Clements & Keyser (1983), but to two phonological elements, that play a pivotal role in theory.

As stated above, 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*. 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) or more neutral terms such as 'prime' or 'unit'. 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 & Vergaud 1985, 1991, Harris & 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 van der Hulst (1994) with respect to locational properties and more fully in van der Hulst, in prep).

The central DP ideas that I adopt, then, are:

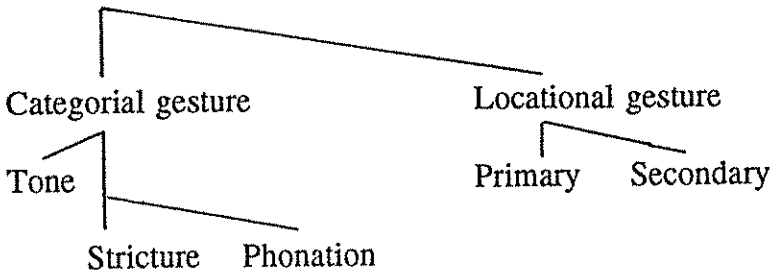
(9) a. Phonological elements are unary
b. Phonological elements are grouped in classes
c. Phonological elements and classes of elements enter into dependency relations

The model that I propose primarily differs from DP in the rigid reduction of the number of elements, in fact a reduction to just two elements, viz. C and V. Because of this radical reduction, RCVP must be much more explicit on the ways in which elements my be combined to form phonological categories; the "CV-syntax" is spelled below. 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. A fuller discussion of differences with dependency phonology is offered in both van der Hulst (1994) and van der Hulst (forthc.).

3.2. The Proposal

In this section I will discuss the architecture for gestural organization of segments, according to RCVP. The overall segmental structure is given in (10):

(10)



In (11) I indicate informally what kinds of phonological distinctions are expressed with each subgesture. The list is not complete, but it should give the reader an idea of the way these subgestures correspond to "classes of features" that have been proposed in various versions of Feature Geometry:

(11) CATEGORIAL GESTURE

a. Tone:	-High, High-mid, Low-mid, Low (i.e. Melody versus register)
b. Phonation:	-Nasal (voice), (oral) voice, constricted and spread glottis (i.e. phonation types such as aspirated, voiced, creaky and breathy voice)
c. Stricture	-stop, continuant, approximant, lateral, strident etc. (i.e. manner distinctions)

LOCATIONAL GESTURE

a. Primary	-labial, coronal, dorsal, pharyngeal, uvular, laminal, emphatic, high, low (i.e. place of articulation and aperture)

b. Secondary	-labialization, palatalization, pharyngealization, retracted ([-ATR]) (i.e. secondary articulations and harmonic vowel properties)

The reduction that RCVP achieves is taken in two steps:

STEP ONE

Firstly, it is argued that each subgesture makes use of exactly **four** basic units which are the same in all cases. If we would home in on the locational gesture first we could refer to these units as AIU plus a fourth unit that was not recognized in DP; it would not be inappropriate to refer to this unit with a symbol representing a "neutral" high vowel, e.g. [i̇]. We would then argue that the set {A,I,U,i̇} can be used to represent all primary places of articulation of vowels and consonants, allowing them to stand alone or combine. Then, we would show how the set {A,I,U,i̇} can also be used to represent secondary places of articulation for consonants and additional vowel properties such as retracted tongue root. So far we would be pursuing the idea that a single set of place elements can be put to use to represent **all** aspects of place in both consonants and vowels. This idea is in the spirit of pre-SPE feature systems, standard DP and shared with proposals in Feature Geometry, most notably in Clements (1993) and Selkirk (forthc.). We would then argue that the set {A,I,U,i̇} can also be used to represented categorial distinctions, thus arguing that one set of four units occurs in **all** subgestures. This dramatic reduction raises the question as to whether the element "A" in the primary locational subgesture shares **real** properties with the element "A" in the, say, stricture subgesture. Even if it were true that all subgestures make use of exactly four elements, it would not follow that the same set of elements occurs in all subgestures. In RCVP the claim is that there is

indeed a real sense in which "A" is both a locational and a stricture unit.

Accepting this claim, one would perhaps like to argue that the labels we use for the set of elements ought not to show any bias and be completely neutral, perhaps {1,2,3,4}. As it turns out, RCVP adopts the idea that the four units can be represented in terms of **two** elements, C and V, which leads us to the second step in the reduction process.

STEP TWO

Anderson and Ewen, in their proposal for the subgesture that corresponds to our stricture subgesture adopt the idea that all stricture distinctions can be represented in terms of combinations of just two components: |C| and |V|. The four simplest structures which can be composed from C and V are those in (12):

(12)	a.	|C|	|C=>V|	|V=>C|	|V|
	b.	C	C_V	V_C	V

(12a) is the standard DP notation, while (12b) gives a simplified notation which I will henceforth use. The choice for the set in (12) implies that the CV-syntax will not allow elements to enter into a dependency relation with themselves within a subgesture, i.e. there is no combination like C_C or V_V. I will call the structures in (12) *simple structures*.

In RCVP the proposal is advanced that **all** subgestures contain exactly these four simple structure. Thus the structures in (12) replace sets like {A,I,U,ɨ} or {1,2,3,4}. The idea behind generalizing the structures in (12) is that phonological categories (i.e. categorial or locational features) can be classified along two dimensions. On the one hand features (or the properties they stand for) may have a consonant or vowel **bias**, whereas on the other they may be marked or unmarked:

(13)

	Consonant	Vowel
Unmarked	C	V
Marked	C_V	V_C

The phonetic interpretation of the two elements C and V 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 & Lindsey (forthc.) who claim that the primary 'meaning' of elements is a mental acoustic image.

The phonetic 'meanings' just given might appear to show a bias toward categorial of even strictural distinctions. It will be clear, however, that degrees of closure also apply in the domain of glottal distinctions and vowel height. The least clear case probably involves places of articulations such as coronal and labial (which are represented as C and Cv, respectively, as shown below). What our proposal implies is the claim that coronal forms a more "ideal" kind of stricture than labial, even though both can be complete (as in stops) or partial (as in fricatives). The claim that coronals are unmarked is not, of course, really controversial.

The point of van der Hulst (1994, forthc.) is to show how the four structures (12) and (13) can be associated with tradition-

ally recognized phonological categories (i.e. features) in each of the various relevant dimensions (i.e. place, stricture, tone and so on). This shows that the main goal of the reduction strategy 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. 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.

I now turn to a further discussion of the syntax to form CV-combinations. First of all, simple structures may combine to form complex structure **within a subgesture** (although, as we will see, not all subgestures exploit this option to the full):

(14)

C-headed				V-headed			
C	C	C_V	C_V	V_C	V_C	V	V
|	|	|	|	|	|	|	|
V	V_C	V	V_C	C	C_V	C	C_V

In van der Hulst (fortc.) I refer to the dependency relation in (14) as *daughter dependency* and to the dependency relation in (12) 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 (12) come close to traditional features, which are phonological atoms, whereas combinations of these, as in (14) correspond to combinations of features. I expect that the ingredients of the simple structures (in the case of C_V and V_V) cannot be accessed in the phonology.

In van der Hulst (1994) I adopt for the dependency relation in (12) the term level-0 dependency (which produces simple structures), and for that in (14) level-1 dependency (which produces complex structures). In line with this I refer to dependency relations between subgestures and gestures (cf. 7) as level-2 and level-3 dependency. As we see in (10) for the categorial, but not for the locational gesture, level-2 dependency comes in two forms, level-2a (complement) and level-2b (specifier); but see below for a possibility to eliminate this distinction.

In (14) we distinguish C- and V-headed complex structures. In van der Hulst (forthc.) it is assumed 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.10). For the two dependent Categorial subgestures a total of four complex structures appears to be sufficient, but no arguments were found to decide as to whether these are the C- or the V-headed ones. I return to this point below.

We will see that the Locational gesture, like the categorial gesture, makes use of all complex structures in (14) 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 & 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. (10). 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.

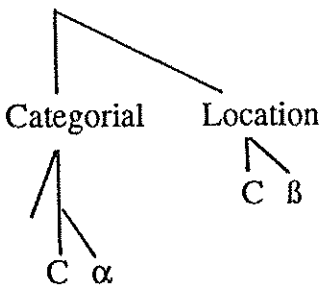
The argument for taking the categorial gesture to be the head is the fact that categorial distinctions (and specifically stricture distinctions) determine the distribution of segments in

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 types of level-2 dependency in (10) 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.

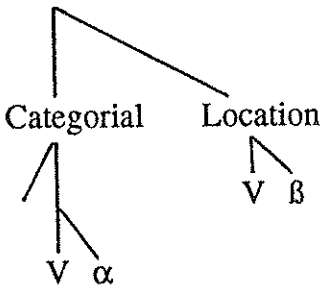
To constrain the inventory of possible segments I postulate a high degree of 'harmony' between the two gestures: if the manner gesture has a C-headed head, so will the location gesture (cf. 15a), and vice versa (cf. 15b):

(15)

a.



b.

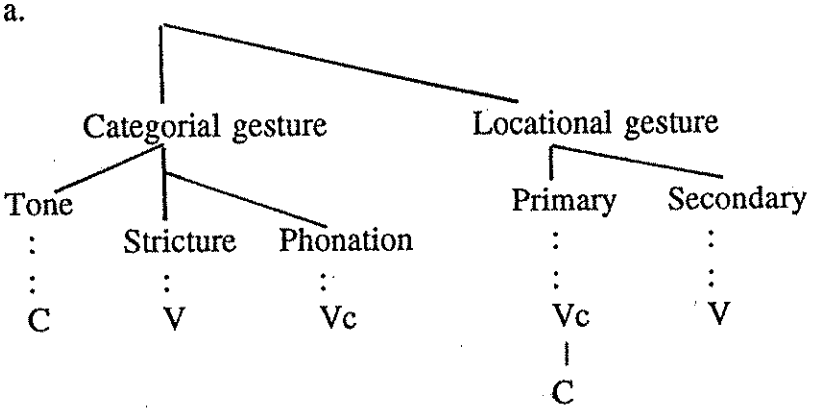


The diagrams given here are **not** meant to express **linear order** of units within the segment. I will assume that linear order is specified at the root level; I will briefly discuss 'supra root' structures in section 4 (cf. van de Weijer & van der Hulst, in prep.). Assuming that linear order must 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

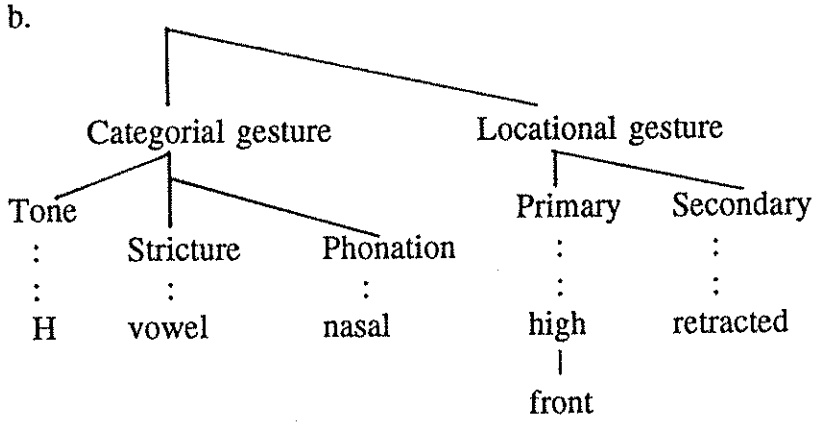
lexical representations we must assume that root nodes are linearly ordered. A radical CV view on syllable structure is developed in van der Hulst (ms.).

By way of illustration let us represent a very complex segment, which has simple or complex structure in all of its subgestures, for example:

(16) a.



b.



(16), then, represents a retracted, high front (unrounded), nasalized vowel with a high tone.

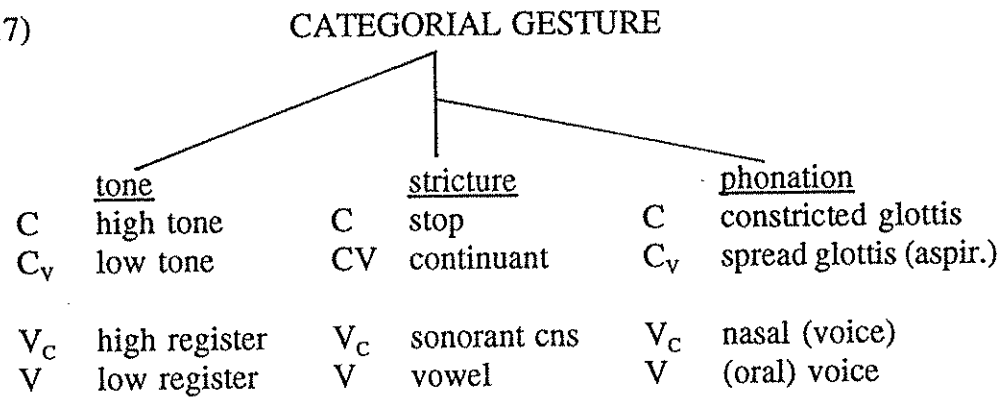
The diagram in (16b) uses traditional feature labels instead of the CV-"codes". One could imagine using such more user-friendly and familiar labels. An "Alt-F3" option (known to Word

Perfect users) could then be used to call upon the "CV-codes" in cases where a certain affinity strikes one as unexpected.

In van der Hulst (1994, forthc.), I discuss whether there is a reasonable match between the structures allowed by our 'syntax' and the featural distinctions which are generally considered contrastive in the analysis of segment inventories. In this enterprise, I relied 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. I conclude this introduction to RCVP by simple listing the matches that are proposed in these works and adding just a few comments for clarificationary reasons. For a more extensive discussion and justification I must refer the interested reader to the other publications.

The following diagram represents the proposals regarding the match between the simple structures in the Categorial gesture and traditionally recognized distinctive features in the domain of tone, phonation and stricture:

(17)



Complex stricture structures are given in (18a):

(18) a. Complex stricture gestures

C | V_C	C | V	C_V | V_C	C_V | V	V_C | C_V	V_C | C	V | C	V | C_V
lat. stop or lat. affr.	strid. stop or affric.	lat. fric.	strid. fric.	fric. rhotic	lat. liq.	flap, tap	ap-prox.

b. Complex tone structures

C | V_C	C | V	C_V | V_C	C_V | V	V_C | C_V	V_C | C	V | C	V | C_V
				high	high-mid	low-mid	low

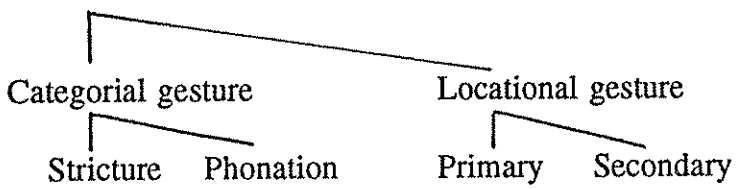
c. Complex phonation structures

C | V_C	C | V	C_V | V_C	C_V | V	V_C | C_V	V_C | C	V | C	V | C_V
creaky nasal voice	creaky voice	breathy nasal voice	breathy voice				

The need for a distinction between oral and nasal complex phonation is not very great, but more importantly it would seem that a case could be made for collapsing the tone and phonation gesture, given that both are almost complementary, an option that is not considered in van der Hulst (forthc.), where I say instead that within both subgestures headedness is not distinctive, reducing the eight-way distinction to four. But since it is clearly the case that tonal and phonation distinctions are typically (if not

exclusively) vowel and consonant properties, respectively, it seems reasonable to explore the merger of the tone and phonation gesture, as in (19), where I arbitrarily label the resulting subgesture "phonation":

(19)



The consequences, and in fact the tenability of the structure in (19), will be explored elsewhere (cf. van der Hulst, in prep.). To contemplate on theoretical changes of this type is typical of an approach like RCVP and it is therefore instructive to mention it here.

Let us now briefly 'check' whether there is some content to the claim that an identical set of phonological primes (i.e. {C, C_V, V_C, V}) occurs in the different categorial subgestures. Here I will limit myself to calling the reader's attention to the 'better' cases. In (17) we claim, for example, that high tone, stop-hood and constricted glottis are three faces of one and the same prime. Clearly, a connection between the latter two is highly desirable, given the well-known fact that debuccalisation (i.e. loss of place features) in stops produces glottal stops. Cases of tonogenesis should make it clear that the connection with high tone is also motivated. I discuss a good case in van der Hulst (forthc.). We also see that in (17) low register is connected to voicing. This is again desirable given the well-known phenomenon of so called "depressor consonants", i.e. voiced consonants that lower the tone of neighbouring vowels. Duanmu (1991) argues that what is affected in vowels in these cases is their 'register', a position that supports the claim made here. Further strong support involves the identification of stop-hood and laterality in liquids. To represent lateral liquids with a dependent C unit explains their [-continuant] behaviour immediately without appealing to unmotivated

rules that appeal to non-distinctive properties of these segments (such as [-continuant] in a traditional system.).

I now turn to a brief overview of the locational gesture:

(20) LOCATIONAL GESTURE

Primary location		Secondary sublocation	
C	coronal	C_C	palatalized/front
C_V	labial	C_V	labialized/round
(V_C	high	V_C	dorsalized/advanced)
V	low	V	pharyngealized/retracted

With respect to the primary location subgesture, we allowed the option of complete emptiness. An empty primary location node represents dorsality (when we deal with a consonants) and centrality (when we deal with a vowel).

With respect to the locational gesture as a whole, we need a further stipulation: the structure V_C is not allowed to occur as a head without a dependent. This implies that it can be part of the primary subgesture only if it has a dependent C or C_V, whereas it cannot occur as a secondary subgesture at all (given that no complex structures occur in that subgesture).

(21) a. Complex stricture gestures

C	C	C_V	C_V	V_C	V_C	V	V
|	|	|	|	|	|	|	|
V_C	V	V_C	V	C_V	C	C	C_V
coronal	coronal	xxx	xxx	high	high	low	low
laminal	posterior			round	front	front	round

The structure marked "xxx" would be labials (i.e. C_V) with various tongue body features (like laminal and posterior). It would seem that such options are uncalled for presumably

because the tongue body properties are unsuited to produce subcatergories of labials.

In (21) we express that only coronals are subcategorized within the primary location subgesture. Subcategories of dorsals come under the heading of secondary articulations.

In the case of the locational gesture, we need not go into arguments that support the identification of the properties that are subsumed under the four simple structures. Most work in feature theory (except SPE) is based on such identifications. More interesting would it be at this point to go into the "cross-gestural" identifications that we make. In what sense, for example, is it meaningful to identify stop-hood with coronality (both C), or continuancy with labiality (both C_V). The best I can say for the moment is that, firstly, all four are primarily consonantal properties (thus motivating that they are all of the C-type) and, secondly, that the former two are unmarked with respect to the latter two (thus motivating that continuancy and labiality have C_V).

The above overview gives a fair introduction to the background, goals and proposals of Radical CV phonology. Many details have been ignored for which I refer to van der Hulst (1994, forthc.). These works also leave many questions unanswered, however, which (hopefully) will be dealt with in van der Hulst (in prep.).

I hope, however, that it has been demonstrated how in a model of this type affinities between phonological categories, i.e. those that are expressed in redundancy rules in more familiar feature systems, are 'built' into the basic architecture by representing them as realizations of the same phonological primes. The different categories still 'come out' since primes can occur in different structural positions.

To illustrate the relevance of our proposals vis-a-vis a desire to eliminate or build in redundancies, let us return briefly to the redundancy rules given in (1), repeated here for convenience:

(1) a. [+nasal] -> [+sonorant]
b. [+strident] -> [-sonorant]
c. [+lateral] -> [Coronal] (or [+coronal])

(1a) falls out since nasality is a V-type property, and thus subsumes V, which represent sonorancy. In (1b) we express that stridency can only be a property of obstruents. Our model expresses this since stridency is a V-type property which therefore can only be dependent on a C-type segments. The third redundancy finds no expression in our model. In fact, we fail to express the more general point that coronals have a wider array of possible subcategories (place- or mannerwise) than other place of articulation. Clearly (1c) also fails to express such a more general fact, which seems to suggest that we are not dealing with a redundancy relation in the first place. What we **are** dealing with is not clear to me at this point, let alone how we can express "it" in the model (cf. van de Weijer 1993 for discussion of this point).

A more general point also deserves mentioning. The model that RCVP proposes allows one to do justice to the notion of enhancement in the general fashion that was intended in rule (8) above. We might assume that segments that have no distinctive properties in some subgesture or other might still have properties in these gesture, but only those that are "copies" of distinctive properties. This option would allow us to attribute, for example, glottal state properties to stops and fricatives, even though these would not be distinctive. It might in fact be argued that this strategy provides the missing link in explaining why debuccalisation of stops leads to glottal stops, and that of fricatives to /h/. Also in accordance with this general conception of enhancement is that nasal consonants are the unmarked type of sonorants. In our model nasality is represented as V_C under phonation. This property, then, enhances the more general property of being a sonorant consonant which is represented as V_C under stricture.

Finally let me address a question that regards the monovalency of phonological elements. The present model makes use

of just two elements, C and V, which can occur in a well-defined number of combinations. Thus, we reconstruct or represent a number of *pairs* of phonological categories, which might strike some readers as two opposite values of features. Clear examples are *stop* versus *continuant*, *H* versus *L*, *constricted glottis* versus *spread glottis*, *high* versus *low* (in vowels) and so on. Note also that our model does not appeal to combinations of these opposite categories, since in each case they have the same C- or V-bias. It would seem then that ultimately the problem with binary valued features theories does not lie in the use of binary valued features (which seems like an adequate notational system for pairs of opposite properties) but rather in the randomness of the list of features. It is moreover crucial to note (as observed in Pulleyblank, forthc.) that this same randomness applies to theories that employ unary features. The model proposed here generates a non-random set of opposite categories in the sense that one simply could not simply 'add' a feature to the phonation class without changing the CV-syntax, but this, of course, would have consequences for the system as a whole. It is the structure of the set of phonological categories that we have given a rationale and not its extension. As far as RCVP is concerned there could have been more categories, e.g. by adding a further layer such as

$$C_{V_C}$$

which would produce 6 categories per subgesture instead of 4.

5. Conclusion

In this article I first argued that the findings reporting in de Jong (forthc.) with respect to Enhancement Theory support a view on enhancement which does not express this phenomenon as a relation between two independent features, but rather as a relation between two articulatory interpretations of a single phonological prime.

relation between two articulatory interpretations of a single phonological prime.

I then discussed a theory that makes use of four units ({C, C_V, V_C, C}) which appear to show an even stronger form of phonetic multifunctionality. I then pointed out that the dramatic reduction of phonological primes which results from collapsing all "features" into a small set of primes must be counterbalanced by appealing to different gestures and, within these, a distinction between head and dependent occurrences of elements. I then showed how such a reduction strategy can be executed in a rather extreme (or radical) way.

It seems clear that theories such as DP and especially RCVP increase the distance between phonological primes and "phonetic primitives", especially articulatory primitives. Where traditional feature systems (since SPE) are typically rather concrete in this respect, culminating in the articulatory phonology model advocated in Browman & Goldstein 1986), we note that AIU-models are abstract: a single phonological prime corresponds to a variety of articulatory distinctions serving a single perceptual unity, or, as Harris & Lindsey (forthc.) put it, a single mental acoustic image.

As a final note, I would like to support the claim that phonological categories **must** be rather abstract (or rather: abstract in principle) with an argument that is based on the existence of sign languages. It has now been firmly established that sign languages have a phonology, which, as most researchers would like to claim does not appeal to features like [continuant] and [constricted glottis]. The point of choosing these examples should be clear. The phonetics of these features is entirely dependent on the spoken modality and it would seem obvious then that "UG" does not supply the language learner with an innate set of phonological features. This simply makes no sense, assuming that hearing and deaf language learners have the same UG. It would seem to me that therefore UG must come up with something much more abstract than a list of features and I would like to believe at this moment that the radical CV perspective is

phonetic space, be it in the acoustic or the visual domain. Some preliminary steps in applying a dependency approach to sign language phonology are offered in van der Hulst (1993).

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