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# *The Segment - Syllable Connection*

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## 1 Introduction*

Radical cv Phonology (RcvP) offers a theory of phonological categories at the segmental and syllabic level, i.e. of phonological features (such as [sonorant], [continuant], [round] and so on) and syllabic constituents (such as onset, nucleus, and so on), respectively. In most, and possibly all, other frameworks these phonological categories have been postulated as theoretical primes, i.e. as atoms that (as the term implies) have no internal structure. The central claim of RcvP is that these categories can be derived from two elements that may occur in isolation and in a variety of combinations. These two elements, then, are the real atoms, all other categories (i.e. features, syllabic constituent labels) are derived.[1]

The central goal of this article is to show how my approach is perhaps the first to establish an explicit formal relation between the representation of those segmental properties that are relevant to syllable structure (i.e. non-place, specifcially MANNER properties) and syllable structure itself.

The structure of this article is as follows. In section 2, I will briefly discuss the principles of Dependency Phonology (Anderson & Ewen 1987) focusing on those aspects that have inspired me to develop RcvP. In section 3 I will go over the segmental representations that RcvP proposes for non-place properties. In section 4, I advance a proposal for an RcvP-representation of syllable structure, which enables us to establish an explicit formal relation between manner properties and syllable structure itself. I conclude with a discussion of some general issues regarding phonological primes.

# 2 Dependency Phonology

## 2.1 Introduction

The most fundamental principle of Dependency Phonology (henceforth DP) is the idea that units (or constituents) which are combined to form higher level units enter into a head - dependency relation. Constituency and dependency occur at all levels of phonological organization and indeed in all modules of the grammar. Limiting the attention to phonology, constituency and dependency are claimed to be involved at the level of prosodic organization as well as at the level of syllabic and segmental organization.

Early presentations of DP are Anderson & Jones (1974a,b). The major survey work is Anderson & Ewen (1987), which I will henceforth refer to as AE. Collections of articles are Anderson & Ewen (1980), Durand (1986), Anderson & Durand (1987). All these collections contain overview articles. A critical overview is given in Den Dikken & van der Hulst (1988).

With specific reference to the level of segmental organization, further leading ideas of DP are the following: the primes of phonology (called components) are unary. They form constituents within phonological segments, which are called GESTURES. With these ideas, DP was the first model within generative phonology to promote and combine the use of privative features, feature classes and intrasegmental dependency.

I now turn to a brief discussion of the DP ideas that have inspired the development of RcvP; for more extensive discussions of these ideas I refer to van der Hulst (1994b, 1995a, in prep.).

## 2.2 Central ideas of Dependency Phonology

DP recognizes a specific hierarchical subgrouping within the segment. The specific choice of some of the components within each group prefigures and resembles in some cases the 'particles' adopted in Schane (1984, 1987) and the elements of Government Phonology; Kaye, Lowenstamm & Vergnaud (1985). Cf. Den Dikken & van der Hulst (1988) for a comparative discussion and van der Hulst (1994b, 1995a) for a critical assessment that paves the way for RcvP. The arguments for grouping components into classes (i.e. (sub)gestures) are essentially analogous to



the arguments that were later presented for feature classes in feature geometry; cf. Den Dikken & van der Hulst (1988), van der Hulst & van de Weijer (1995). The proposals which AE make for the tonological gesture are sketchy and most work has been put into the developments of the PHONATORY SUBGESTURE (for major class and manner) and the LOCATIONAL GESTURE (for place). In my discussion of DP I will concentrate on the phonatory subgesture.

The phonatory subgesture contains two components, |V| and |C| which AE define as follows:

> '|V|, a component which can be defined as "relatively periodic", and |C|, a component of "periodic energy reduction".' (p. 151)

The most interesting aspect of DPs segment theory is the idea to define all major class and manner distinctions in terms of combinations of the two components |V| and |C|. In van der Hulst (1994b, 1995a) I discuss the specific proposals that are advanced, criticizing the fact that the set of possible CV-combinations is not well defined. AE take the following five structures as a point of departure; suppressing some of the details of the DP notation, I use '⇒' to represent 'governs':[2]

| (1) | C | C⇒V | V:C | V⇒C | V |
|---|---|---|---|---|---|
| | voiceless stop | voiced stop | fricative | nasal | vowel |

The focus is here on the 'syntax' of the CV-combinations, so I will not try to motivate the interpretations that DP assigns to the 5 categories in (1). AE allow a number of combinations of these 5 constellations, i.e. the ones in (2) that are underlined:

(2)

| | | | | |
|---|---|---|---|---|
| V:C⇒V<br>voic.fric. | V⇒V:C<br>liquid | V:C⇔V<br>fric.trill | | |
| V:C⇒C<br>non-sib.fric. | C⇒V:C | V:C⇔C | | |
| V⇒V:C⇒C<br>lateral liq. | C⇒V:C⇒V | C⇒V⇒C:V | V:C⇒C⇒V | ... |
| V:C⇔V⇒C<br>voic.lat.fric. | V:C⇔C⇒V | V:C⇒V⇔C | V:C⇔V⇔C | ... |

Even though AE are careful in motivating the interpretations they wish to assign to the structures in (1) and (those underlined in) (2), they make no attempt to define the set of possible CV-constellations, thus exposing themselves to the criticism (justified in my view) that their theory is unrestricted. For example, it is legitimate to ask what segment types would correspond to many other conceivable CV-constellations, equal in complexity to the ones they propose; for example, the ones that are not underlined in (2). Assuming that a theory of segmental structure aims at characterising a closed and relatively small set of well-formed representations which matches the set of attested phonological distinctions, we must conclude that DP fails to meet this important requirement. Despite this criticism, I believe that the central CV-idea, as well as the proposed structures are extremely interesting. I draw special attention to the following four important characteristics of the DP proposal.

Firstly, given the idea to allow a variety of CV-combinations an impressive reduction in the number of primes can be achieved. This result is reinforced by the use of the dependency relation, which allows two possible combinations of all pairs of CV-structures. In order to characterise major classes and manner categories in a feature system of the *SPE* (Chomsky and Halle 1968) type one needs many more features (such as [voice], [nasal], [lateral], [strident], [consonantal], [continuant], [sonorant], and so on) where DP uses just two single-valued features, the components |C| and |V| and their interdependencies.

Secondly, the CV-constellations are constructed in such a way that affinities between the phonological categories that they represent are formally expressed. For example, in the structures in (1) and (2), 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 component, viz. |V|. Thus the relation between these two categories is 'built into' the basic vocabulary.

Thirdly, the CV-definitions provide a formal basis for the so called sonority (or strength) scale. Degree of sonority corresponds to the relative number of (headed or dependent) V's.

Fourthly, the CV-definitions allow us to establish a formal correlation between markedness and complexity. Categories that are relatively unmarked (such as stops) have relatively simple representations (i.e. plain C for stops).

We have seen, then, that DP needs less primes to represent phonological categories because it allows (dependency based) combinations to simple elements to represent categories (where traditional frameworks characterize every category holistically, i.e. with a separate prime).

A second property which also enables DP to reduce the number or primes is to use the same primes in different (sub)gestures. Thus one particular component (or package of components) may occur in different (sub)gestures, each time with a different phonetic interpretation and thus replace several traditional features. Anderson & Ewen (1987) make very limited use of this option, which I have proposed to fully explore in van der Hulst (1994b, 1995a). An example of this strategy is given in the following quotation:

'...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)

This quote shows that AE themselves suggest the strategy to employ the same components in different (sub)gestures.

The second strategy can and has been explored in Feature Geometry as well. We see this, for example, in the approach that takes one set of place features for consonants and vowels (cf. Clements 1993), or one set of features for tone and phonatory categories (cf. Duanmu 1991, Bao 1991 and Yip 1993, following the spirit of Halle & Stevens 1971).

### 2.3 Concluding remarks

DP proposes an internal organization of segments that involves a gestural partitioning (comparable to the class nodes of Feature Geometry). One of the gestures deals with major class and manner distinctions, which are all represented as head - dependent combinations of two unary primitives |C| and |V|. A consequence of this proposal is that, for example, the DP equivalent of the SPE-type feature [lateral] is a construct of (several occurrences) of |C| and |V|. The phonological category or property of laterality is not disputed and with a shift of perspective one might say that the DP view boils down to claiming that a feature like [lateral] is not an atom of phonological structure, but rather has an internal structure itself.

An immediate advantage of this theory is that relations between features, usually expressed in the form of redundancy rules, become non-arbitrary from a phonological point of view. For example: the relation between [sonorant] and [voice] follows from the fact that both categories have prominent occurrences of |V| as part of their CV-constellation. A redundancy rule like [sonorant] → [voice] is therefore not a primitive of the theory and to express that many other conceivable relations (like [nasal] → [round]) play no role in natural languages no appeal is necessary to the notion of phonetic grounding (cf. Archangeli & Pulleyblank 1995) or enhancement (cf. Stevens & Keyser 1989).

RcvP makes the (radical) claim that all traditional features can be decomposed into occurrences of the basic units |C| and |V|, not only in the case of major class and manner features, but also in the case of laryngeal (glottal state and tonal) features and place features; the extension to place categories is presented in van der Hulst (1994b). RcvP thus pushes phonological explanation as far as possible. An obvious consequence of this line is that ultimately |C| and |V| no longer have intrinsic phonetic content, a point that allows us to extend the notation to syllable structure.



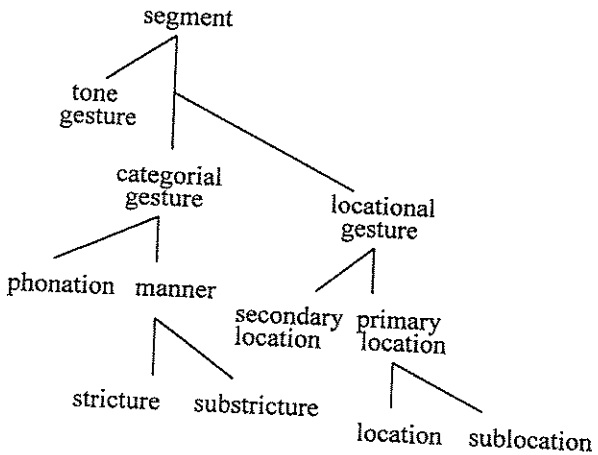
The rather abstract view on phonological primitives that we end up with seems a good result in view of the fact that the phonology of sign languages has little use for 'universal features' like lateral, round etc. I propose that UG indeed does not contain a list of features, but rather a more abstract set of categories (defined in terms of CV-constellations) that the language learner links with phonetic exponents of various (phonetic) sorts. Explorations of dependency-based structure for sign phonology can be found in van der Hulst (1993b, 1995b).[3]

## 3 Segmental structure in Radical CV Phonology

### 3.1 Preliminaries

In this section I will propose a different architecture for the categorial gesture.[4] The diagram in (3) includes the structure that I propose for the locational gesture in van der Hulst (1994b):[5]

(3) *Segmental structure according to RcvP*




The focus of this paper is on the manner node. I also include proposals for phonation, however, because this node contains properties that are closely related to manner properties (such as nasality and voice). I do not discuss the locational gesture here and refer the interested reader to van der Hulst (1994b, in prep.)

The argumentation for taking the categorial gesture as the head of the segment 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, then, confirms the head status of the categorial gesture. Within the gestures, we use the same diagnostic for dependency status. Thus, the properties that are expressed at the 'specifier' level are most likely to be involved in spreading processes. I assume that 'complement' properties are much less mobile. Thus closeness to the head entails resistance to spreading, the head itself being the champion of immobility.

A second point to note is that the diagram in (3) is not meant to express linear order of units within the segment. I will assume that linear order is specified at the root level. Root nodes are associated to skeletal positions, but since the latter are not themselves part of lexical representations we must assume that root nodes are linearly ordered. Another option is to assume that syllabic grouping is underlying. In that case linear order is predictable on the basis of sonority, cf. Golston & van der Hulst (in prep.)

Thirdly, let us note again that a structure as the one in (3) is not unlike the kind of structures that have been proposed within *Feature Geometry*. My approach differs from that line of work in that I assume that the adoption of structural relations like dependency and grouping can, and if possible must, be counterbalanced by a reduction of the number of phonological primes.

Turning now to the lowest level of organization (called the zero-level), RcvP proposes that in each subgesture a (phonetic) interpretation can be given to the following four CV-units:

(4) *Zero-level units*

| | | | | | |
|---|---|---|---|---|---|
| a. | C | C⇒V | V⇒C | V | (DP notation) |
| b. | C | $C_V$ | $V_C$ | V | (RcvP notation) |

This is the set in (1) minus the mutual dependency structure. I replace the arrow notation in (4a) by the subscript notation in (4b).



The central claim of RcvP is that for each subgesture (or 'feature class') in (3) the four units on (4) define four phonological categories ('features') of which two are consonant-like (C-headed) and two vowel-like (V-headed) (or rather non-nuclear and nuclear; cf. section 4). Within each pair one is unmarked (bare C or bare V), the other marked ($C_V$, $V_C$). Thus, for example, the unit C represents an unmarked non-nuclear category, whereas $C_V$ represents a marked non-nuclear category.

Zero-level units are PHONOLOGICAL ATOMS. Thus the parts of $X_Y$ units cannot be manipulated by phonological processes; cf. Humbert (1995) for an explicit statement of this point. I assume, however, that phonological statements can make reference to the parts that constitute $X_Y$. For example, C and $C_V$ can be referred to as a natural class, i.e. C-headed.

It is important to stress the two prime reasons for proposing a CV-'coding' of phonological categories:

(i) Postulating two distinct elements and the dependency relation gives us the number of four categories subclassified in two C-type and two V-type categories and, within each pair, one marked (complex; $X_Y$) and one unmarked (simple; X). Thus RcvP makes an attempt to explain (rather than stipulate) the number of categories as well as markedness asymmetries holding among these.

(ii) Using the same notation for each subgesture, we enable ourselves to formally express why categories (that are expressed in terms of formally independent features in traditional approaches) are related. For example, in this system both [continuant], [approximant] and [aspirated] are defined as $C_V$. The advantages of this should be obvious. I discuss some of the supporting (and wellknown) evidence in section 3.2. RcvP makes sense of (i.e. explains) such related sets and its ability to do this forms the second important motivation for its design.

In the next subsection, I will discuss whether there is a reasonable match between the structures allowed by the RcvP-syntax and the phonological distinctions which are generally considered contrastive in the analysis of segment inventories, so that features have been proposed to account for them. In this enterprise, I must rely on a certain consensus with respect to the universal set of distinctive features. Such consensus is apparent from the fact that certain features appear to be widely accepted. Apart from consensus there is, of course, disagreement as well. This is partly due to a lack of knowledge concerning the extent to which different phonetic events may be regarded as exponents of the same phonological category or simply concerning the nature of the phonetic properties. Also, we cannot

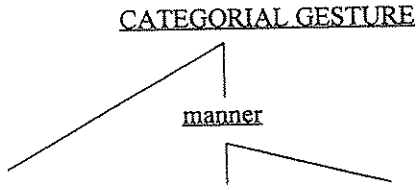
always be sure whether or not certain phonetic categories are mutually exclusive in a single language, or complementary in that one occurs only on nuclei whereas the other is a non-nuclear exponent.

The advantage of RcvP is that its predictions are quite specific. Hence, the model forces me to make decisions which await further empirical underpinning. Even in the more speculative cases, however, I will attempt to convince the reader that the decisions I adopt have some plausibility.

## 3.2 Categorial gesture[6]

The following diagram anticipates most of my proposals regarding the match between the categories in the Categorial gesture and traditionally recognized distinctive features:

(5)




| | | | |
|---|---|---|---|
| C | ejective/glottalized | stop | central closure |
| $C_V$ | implosive/creaky | continuant | approximant |
| $V_C$ | aspirated/breathy | sonorant cns. | lateral |
| V | nasal/voice | vowel | strident |

The interpretation of the phonation units will appear to be broader than I have indicated here.

### 3.2.1 Manner: Stricture and substricture

Although the elements C and V themselves are neutral with respect to specific phonetic properties, they have phonetic 'meanings' in their specific instances which I will indicate in articulatory terms, although in each case an identifiable acoustic event is supposed to correspond to the unit.

C-headed stricture involves a relatively high degree of stricture (as in obstruents), while V-headed stricture involves 'spontaneous voicing' (as in sonorants). A dependent V differentiates between two types of 'high degree of stricture' and a dependent C between two types of 'unimpeded outflow of air':

(6) *Stricture*

| | | |
|---|---|---|
| C | = | absolute stricture (as in stops) |
| $C_V$ | = | non-absolute stricture (as in fricatives) |
| V | = | unimpeded uninterupted oral outflow of air (as in vowels) |
| $V_C$ | = | unimpeded outflow but not necessarily uninterrupted or oral (as in sonorant consonants) |

In (6) I express directly that stops and oral vowels are unmarked with respect to their stricture: stops are unmarked non-nuclear segments (as opposed to fricatives) and oral vowels are unmarked nuclear segments.This is in accordance with the fact that the prototypical unmarked syllable consists of a stop followed by an oral vowel, two segments that are maximally opposed in terms of their stricture properties; cf. Jakobson (1941), Jakobson, Fant & Halle (1952).

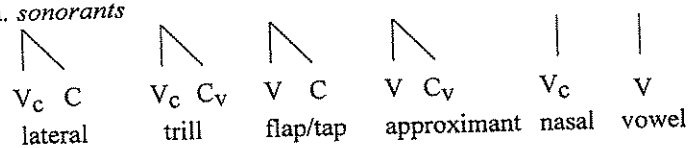
I now turn to the interpretation of substricture structures.

(7) *Substricture*

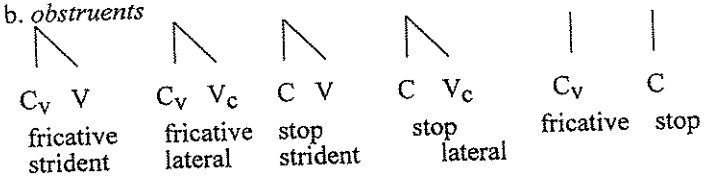
| | | |
|---|---|---|
| C | = | central closure (as in lateral liquids and approximants) |
| $C_V$ | = | non-absolute stricture (as trills and rhotics) |
| V | = | acoustic energy (as in strident obstruents) |
| $V_C$ | = | central closure (as in lateralized obstruents) |

In order to reduce the number of combinations, I assume, firstly, that stricture and substricture must have an opposite CV-bias[7]and, secondly, that the potential option of an empty stricture subgesture combined with substrictures is disallowed. Thus, we might say that the occurrence of complement units is restricted by two principles: one disallows the complement to agree (in terms of C- or V-headedness) with the head, while the second disallows complements to combine with empty heads. Below we will see that both restrictions do not apply to specifier units. Thus, specifiers may agree with the head and also may combine with an empty head. Both principles may be reduced to one if we say that the complement must disagree with the head. This excludes agreement, but also entails that a complement must have an actual head in order to disagree with it. I will refer to the relevant principle as the Head-Complement Polarity (HCP). This allows for 12 possible 'manners':

(8) a. *sonorants*




b. *obstruents*




c. *Example of bracket notation for head - complement unit (for 8a)*

(Vc C) (Vc Cv) (V C) (V Cv) (Vc) (V)

Let us note that the sets in (8) express a sonority scaling. More occurrences of V (or less of C) correlates with a higher degree of sonority. With respect to the two medial structures, one might argue that a clear sonority ranking is dependent on how we evaluate the impact of the subscript c/v and the substricture C/V. Although the proposed sonority ranking of the categories that gloss the structure seems plausible, it remains to be shown in specific cases whether the ranking is correct. I am not aware of arguments for the relative ranking of, for example, fricative trills or lateral obstruents (cf. Hankamer & Aissen 1974 on this issue).

We also may note that some of the finer distinctions in (8) (i.e. the ones represented by stricture-substricture combinations) are mainly relevant for coronal place. This fact, however, finds no formal expression in this model. It is not obvious that this correlation must or can be formally expressed. Geometrical proposals which make features such as [lateral] and [strident] formally daughters of the feature coronal run into problems, as has been pointed out in various studies (eg. Shaw 1990, Rice and Avery 1991). In this model, where the Location gesture is formally dependent on the Categorial gesture, we expect the latter to determine the former, but this geometrical relation does not exclude the other possbilities. Hence (as pointed out in Van de Weijer 1993) the implication: if lateral then coronal, or if tap/flap then coronal, reflects the dependency relation which I posit between the Categorial and the Locational gesture.



### 3.2.1.1 Motivation of sonorant structures

Substrictures C and $C_V$ are interpreted as (central) closure and approximation, respectively. These interpretations are quite close to the interpretations that these units receive as strictures (i.e. when occurring as heads).

The first structure represents a sonorant consonant with dependent central closure. I take this to represent laterals. The dependent C captures the fact that laterals may pattern with stops. Nasals may pattern with stops as well. In these cases traditional feature systems can only succeed in grouping stops together with nasals and laterals by attributing the redundant [-continuant] to the sonorant consonants (cf. Hegarty 1989). In this notation these segment types necessarily contain the element C that groups them with stops.

The second structure is a trill. Thus, trills are taken to be the continuant counterpart of laterals. In systems that have no lateral/rhotic contrast, the liquid can often vary from rhotic to lateral depending on contextual factors. The precise factors which condition this allophonic variation are not always clear (cf. Bhat 1974). In some cases the choice depends on the manner properties of surrounding segments: the rhotic occurs in intervocalic position and the lateral elsewhere. This suggests that rhotics have a weaker constriction than laterals since the environment V-V counts as a weakening or lenition context. The structures in (8) are adequate in this respect.

The third structure represents taps or flaps, highly sonorant sounds with a central closure. I follow Maddieson (1984) in the claim that taps and flaps (although different from an articulatory point of view) do not involve distinct phonemic categories. The term 'flap' is also used for intervocalic allophones of /d/ and /t/ in varieties of English. It is not inconceivable that these flaps are in fact weakened obstruents.The continuant counterparts of flaps/taps, the fourth structure, are approximants. I claim that approximants are categorially different from vowels and not just positionally different (i.e. in terms of syllabic position only). The approximants /y/ and /w/ in Dutch, for example, have traditionally always been analyzed as sonorant consonants and the phonology of Dutch seems to offer no reason to treat these sounds as vowels at any level of representation. Another classic case where a lexical distinction must be made between a vocalic and consonantal labial approximant is found in French in the pair *l'oiseaux*, *le whiskey*, where the shape of the definite

article reveals that in the former case the initial approxminant is a vowel, while in the latter case it must be analyzed as a consonant. The fourth structure can perhaps also be taken to represent various types of weak rhotics (cf. Lindau 1980).

$V_C$ is taken to represent nasals (as in the system proposed in Humbert (1995). The 'closure' in this cases is not central but complete, which implies that the V part expresses unimpeded outflow of air. By necessity, this outflow must be nasal.

The sixth structure represents a vowel. This seems to need little motivation. Van de Weijer (1994) argues that vowels have no categorial properties (no stricture, in his terms). We could only accomodate the sound intuition that is behind this decision by assuming that V can be left underspecified. In this presentation of RcvP underspecification is not appealed to at all. I refer to van der Hulst (in prep) for relevant discussion.

### 3.2.1.2 Motivation of obstruent structures

Substrictures V and $V_C$ are interpreted as stridency and lateral release, respectively. Strident fricatives and affricates are generally regarded as more 'sonorant' or vowel-like in having more acoustic energy. I express this by viewing stridency as the interpretation of the V-substricture. Jakobson, Fant and Halle (1952) motivate that the property of stridency is relevant for stops as well as fricatives. They characterize affricates as strident stops.

The obvious alternative, i.e. to interpret complement V as voicing is rejected because, firstly, that leaves stridency unaccounted for and, secondly, there is 'room' for voicing as the interpretation of the specifier V, as we will see in the next section.

Dependent $V_C$ is glossed as laterality, which in traditional terminology is associated with lateral fricatives and lateral stops, or laterally released stops, also referred to as LATERAL AFFRICATES (cf. Shaw 1990, Brown 1995). We obviously need laterality for obstruents and it seems that $V_C$ the common head stricture for liquids is a very plausible choice.

## 3.2.2 The phonation/tone subgesture

As said, the four specifier elements can occur on both V- and C-headed manner units. The interpretation of these elements involves rather broad 'phonetic fields'.



### 3.2.2.1 Phonation

When interpreted as phonation, our four elements represent the following categories:

(9) *Phonation (non-nuclear)*

| | | |
|---|---|---|
| C | = | ejective, glottalized, voiceless implosive, voiceless |
| $C_V$ | = | (voiced) implosive, creaky voice, laryngealized, preglottalized |
| $V_C$ | = | breathy voice, aspirated |
| V | = | oral voice, nasal voice |

Obstruents having no specifier gesture can be called neutral (cf. Kaye, Lowenstamm and Vergnaud 1985). Such obstruents may be clearly voiceless or come across as "voiced" when they are opposed to obstruent with a C phonation that is interpreted as voiceless.

I assume that glottalized obstruents and ejectives fall in the same phonological category (cf, Kenstowicz 1994). This point follows from the survey given in Ladefoged (1991, 1973) which tells us that these phonation types never contrast in a single language. Lombardi (1991, 1995) draws the same conclusion. In languages that have a contrast between voiceless and voiced implosives, I assume that the former category has C phonation, while the second had $C_V$.

$C_V$ represents the more 'sonorous' type of glottalization which may take various forms, as indicated. To regard implosivity (like ejectivity) as a phonation type is desirable. Ejectives have been analyzed as glottalized sounds and in van der Hulst (1994b), it is proposed (inspired by Traill 1991) that clicks are complex segments.[8] These proposals, then, make it unnecessary to assume separate 'airstream features'. To eliminate such a category was also the goal of Halle and Stevens (1971) and the present proposal shares some characteristics with their feature system. Following Ladefoged (1971, 1973), Lombardi (1991, 1995) proposes to place implosives in the same phonological category as consonants which are preglottalized or laryngealized consonants (cd. Greenberg 1970). I follow this idea.

$V_C$ is taken to represents both aspiration and breathiness. This is potentially problematic idea, given that languages have been reported to contrast these two categories. For those cases, I would have to maintain that the breathy phonation is the interpretation of $C_V$.

Voiceless sonorants are interpreted as being aspirated, i.e. as having the phonological property that aspirated obstruents have. This claim is also made in AE where they use |O| (aspiration) to represent voiceless sonorants. Cho (1991a,b) and Lombardi (1991, 1995) make the same claim in different models and provide a number of relevant examples.

V, finally, represent sonorancy. When attributed to obstruents this may either come out as voicing or as prenasalization. In the case of sonorants, it can only be nasalization. A system contrasting /b/ and /mb/ would have /b/ as a neutral obstruent (i.e. without phonation; cf. supra).

The interpretation proposed in this section differ from those in van der Hulst (1995a) and are tentative at this point.

### 3.2.2.2 The tonal gesture

We turn to the 'specifier' gesture Tone. Current proposals in the area of tonal phonology distinguish two 'ingredients': tone (proper), sometimes called 'melody' (Yip 1989), and register. This view goes back to Gruber (1964), and has been extensively supported in Yip (1980, 1989, 1993), Snider (1988, 1991), Inkelas et al. (1987), Hyman (1993), Bao (1991) and Duanmu (1991). In this section I will show that in this case (as in previous cases), such proposals fall out rather straightforwardly from the general principles which, in our view, underlie the inventory of distinctive categories.

In the simpler cases (more typical of African tonal systems) we find the following combinations of register and tone proper:

(10) *Tone*

| | | | |
|---|---|---|---|
| C | = | high register | high tone |
| $C_V$ | = | high register | low tone |
| $V_C$ | = | low register | high tone |
| V | = | low register | low tone |

The question arises whether tone and phonation are complementary so that we could remove the separate Tone gesture from the structure in (5) and claim that the "phonation" readings of the elements under Phonation (i.e. those in 9) occur when we deal with segments in non-nuclear position, whereas the tonal readings that the arise when the segment is in the nuclear position.



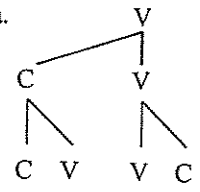
In order to explain patterns of tonogenesis Kingston & Solnit (1988) have made a proposal that involves representing tones on consonants, although they do not require that the 'tones' have audible properties. On the other, one often finds descriptions involving breathy and creaky vowels. Clearly more research on languages showing the relevant properties is required before we can decide on the complementarity of phonation and tone.

## 4 Syllabic Position is Manner

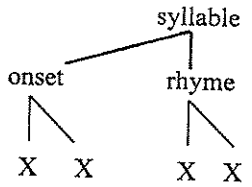
In this section I show how an RcvP of syllable structure has the possibility to establish a direct and formally non-arbitrary relation between the labeling of syllabic terminal nodes and the representation of manner (specifically stricture) properties of segments. For a more extensive discussion I refer to van der Hulst (in prep).

Starting from the syllabic organization in (11b), (11a) seems the obvious CV-coding of syllable structure:

(11) a.



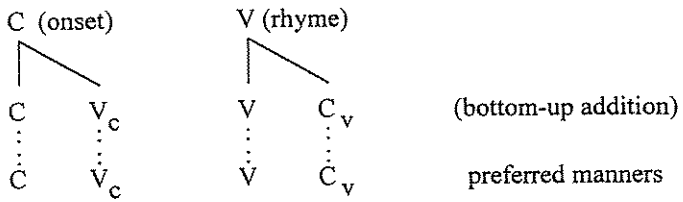

b.




I will now show how we can derive information from the syllabic CV-labeling regarding the types of segments that ideally appear in each syllabic position.

If any relation exists at all, we expect that the onset head favors C-type segments, i.e. segments with a simple C-manner (stops), whereas rhyme heads favor V-manner (vowels). This is obviously and uncontroversially the case.What about the two dependent positions? We know that sonorant consonants (liquids in particular) are preferred onset dependents. This suggest that we read the syllabic label 'bottom up': V (terminal label) + C (onset label) = $V_C$:

(12) *CV-labeling of syllabic terminals*

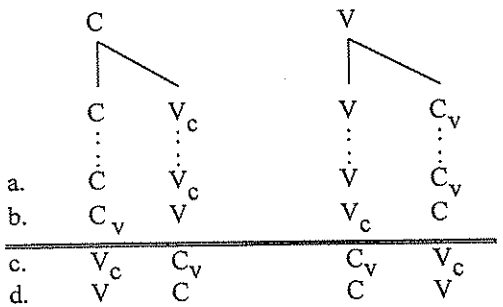



This means that we predict the following to be true:

(13) a. stops are ideal onset heads
b. sonorant consonants are ideal onset dependents
c. vowels are ideal rhyme heads
d. fricatives are ideal rhyme dependents

All these predictions, except (13d) strike me as fully correct. Before we address (13d) let us assume that 'less ideal' options must also be allowed:

(14) *CAT - SYL Matching*



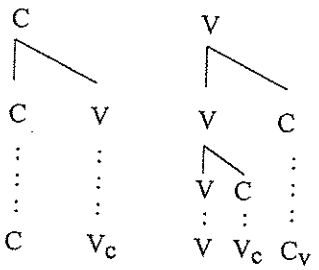

We could assume that the 'choices' below the double line are permitted for heads only. It follows from the Sonority Sequencing Principle (Selkirk 1982) that such heads are very limited in taking complements.

I now turn back to the problematic prediction in (13d). The solution to the problem that (13d) seems to pose lies in allowing a nucleus constituent. We can accomodate a nucleus by assuming that the rhyme has a complement - head - specifier structure, which, as one might add, is



exactly what we expect given the generality of this particular constituent type. The specifier position can be labelled 'coda':

(15)




Bottom-up construction of the category labels has to reckon with the following principle (cf. Anderson & Jones 1974a, Anderson & Ewen 1987):

(16) *Head Switch Principle (HSP)*
$A_b + B = B_a$ (i.e. $C_v + V = V_c$)

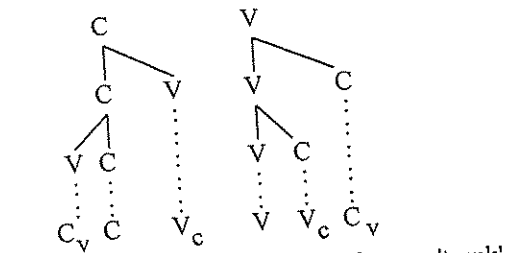
This principle gives us sonorants in the dependent nuclear position, which is what we want of course. We predict that $V_c$ sonorants are optimal nuclear dependents. With the exclusion of the second half of long vowels, this is probably correct.

We now predict that fricatives are preferred over stops in the 'coda' position. There is some evidence for the claim that fricatives (and more generally obstruents) are preferred rhyme specifiers. Fikkert (1994) shows that Dutch children have fricative codas in their first CVC words. Her analysis is that at this stage the nucleus is not yet a branching constituent. This finding receives a natural interpretation within the current proposal.

I follow Government Phonology in ruling out syllables to have both a branching nucleus and a branching rhyme (cf. Kaye, Lowenstamm & Vergnaud 1990). The relevant principle may be that a head cannot have two dependents at the same side.

We might expect that the onset also has a complement - head - specifier structure, which according to the bottom-up algorithm and principle (16) has fricatives as preferred complement:

(17) *The final proposal*




As is well known, many language allow an 'extra' fricative syllable-initially (usually an /s/, the optimal fricative). Therefore the structure in (17) gives us exactly what we want.

A further development of the model outlined here (suggested to me by Marc Oostendorp) would be to 'lift' the manner properties from the 'segmental structure' and attribute them directly to the syllable terminals. In this case we would have a different syllable structure for /pa/ and /fa/, for example. In the former case the onset head would be labelled with bare C, whereas in the latter case this label would be Cv. The properties of syllabic terminals would then partly be determined by the higher syllabic organization and partly be free, i.e. subject to choices with phonemic consequences. The advantage of this approach is that we do not have to duplicate information in the form of (near) identical specification of syllabic terminals and manner properties. The characterization of the syllabic terminals would directly determine the manner of articulation of the place of articulation properties that they dominate. Thus, the dependence of place of articulation on manner would also directly encoded. Similar ideas have been developed by Chris Golston (cf. Golston & van der Hulst, in prep.) and in work in progress by Sean Jensen (within the context of Government Phonology), who also replaces subsegmental manner elements by elaborations of the syllabic organization. This approach entails a view that takes syllabic organization to be 'underlying' (cf. Golston & van der Hulst, in prep.).



## 5 General conclusions

In spoken languages, most morphemes have a phonetic form, an acoustic event brought about by a complex articulatory activity. This phonological representation of morphemes is a set of discrete categories, organized in a particular way. These categories correspond to mental representations of the subevents of the phonetic form.

Virtually all theories of phonological structure are based on the assumption that there is a universal set of such categories which are basic, i.e. which cannot be decomposed in smaller subevents and which are called DISTINCTIVE FEATURES or ELEMENTS. From this set languages employ a subset to make lexical distinctions.

Currently there is no full consensus with respect to the extension of the set of elements, but the general view is that whatever the set is, its members must be enumerated. The extension of the set, then, is essentially random from a theoretical phonological point of view. The elements which are currently postulated have been established inductively, i.e. on a case by case basis. Whenever some language appears to make distinctive use of a previously unattested phonetic 'subevent', a new feature is added to the list. In Feature Geometry models the claim has been made that features are organized in 'second order' categories (like a laryngeal feature category, a place feature category and so on), but the number of such categories, and their extension, is again random, from a theoretical point of view (cf. Clements 1985, McCarthy 1988, den Dikken and van der Hulst 1988).

The central thesis of this paper is that the set of features and set of feature classes are not random.

Taking as a point of departure a common core of distinctive features which emerges from roughly half a century of phonological research, including more recent proposals regarding ways in which these features are organized in second order categories (i.e. place, manner, laryngeal etc.), I have shown that the set of 'phonological features' might have a quite specific structure.

Traditional models do not only stipulate the feature sets and the features, but also must adopt statements (redundancy rules) that express unexpected relations between the features. In the model presented here these rules find no equivalent, since in all cases we are dealing with differen interpretations of the same primes.

Implicit in my approach is the claim that there is no innate set of features. Rather what is innate is a capacity to parse a limited set of

discrete categories from the avaible phonetic 'scales', and a limited syntax for combining these categories.

This is a welcome conclusion in view of the fact that the innate capacity must also enable deaf people to acquire a phonological system. My preliminary investigations in the area of feature systems for signs indicate that the principles discussed in this paper can be fruitfully put to use in this domain. If these first attempts turn out to be on the right track, we may be able to establish the true universals of language at the lower levels of phonological organization.

The study of how to formalize phonological constraints and processes within RcvP will have to show which of these views on phonological categories is most profitable. These matters stand high on my agenda for (near) future exploration of RcvP.

## NOTES

* I am grateful to Rob Goedemans and John Harris for useful comments on an earlier version of this article.

1 Early presentations of RcvP have been distributed in 1991 in working documents called *The Book of Segments* and *The molecular structure of phonological segments*. These manuscripts have led to several articles on the theory, published or in progress. Van der Hulst (1994a) discusses certain issues in feature theory involving the notion of redundancy and enhancement and then shows how the basic ideas behind Radical CV Phonology evolved. Van der Hulst (1994b) and (1995a) offer a complete discussion of the segmental part of the theory.

2 In addition to one component being dependent on the other, AE allow that components entertain a relation in which neither feature is dominant, a relationship which DP calls 'mutual/bilateral dependency'. RcvP rejects this option. In addition DP allows variable dependency relations between (sub)gestures. RcvP replaces this option with fixed dependency relations.

3 Application to sign phonology reveals that the C and V labels are presumably biased toward spoken language, if it is true (as claimed in van der Hulst 1993b, 1995b) that it makes no sense to talk about consonants and vowels (or onsets and rhymes) in sign language phonology. Thus we might ultimately prefer to talk about 'A' and 'B', or 'yin' and 'yang'. I will maintain the CV-labelling, understanding it in such a way that C-type constellations will represent phonological categories that typically occur (and are unmarked) in non-nuclear positions in the syllable, whereas V-type constellations typically occur (and are unmarked) in nuclear positions; the notion (non-)nuclear will be defined in section 5, where I will show how our approach makes it possible to establish an explicit notational relation between segmental (especially manner) properties and syllabic positions.

4 Davenport & Staun (1986) and Davenport (1995) also propose a number of revisions of the proposals in Anderson & Ewen (1987)

5 I will mention one terminological difference between DP and RcvP here explicitly. DP used the term Phonation for what I call Manner. I use phonation in the traditional sense for what they call the Initiatory subgesture, i.e. for categories that involve glottal states and vocal fold vibration.

6 The interpretation that I propose for the CV-structures in this section differ in detail from those in van der Hulst (1995a).

7 This is reminescent of Charm theory of Government Phonology, cf. Kaye, Lowenstamm & Vergnaud (1985).

8 The proposal is that clicks are 'double-root' segments. Cf. van der Hulst (1994b) and van de Weijer (1994) for a discussion of other segment types that may require this marked option.

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