Structure in Melody, and vice versa[*]

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In this paper we argue for a slightly modified conception of phonological representations along the lines of Government Phonology. Releasing C and V from their traditional, phonetically oriented connotations as consonants and vowels and promoting them into abstract phonological primitives, we show that phonological elements, melodic expressions and phonological structure can be viewed in a unfied way: they must obey shared, minimal structural requirements. Special focus is put on the question what it means when a certain structural position is empty, concerning the representation of consonants we will argue that this is the way how 'stops' are dealt with. Following this path we show how a series of longstanding problems of phonology can receive a new and coherent treatment, finishing with an analysis of the consonant inventory and consonant mutation processes in Venda.

1. Introduction: the status quo[1]

The traditional phonetic terms "vowel" and "consonant" comprise both structural and melodic properties. A vowel is normally structurally in a nucleus position and a consonant in either an onset or a "coda" position; a vowel can be located anywhere within the vowel space, with or without lip rounding, and a consonant can be articulated at any of the eleven places of articulation with any of the permitted (and physiologically feasible)[2] manners of articulation.

An early achievement of Government Phonology (henceforth GP) was to postulate that the same melodic elements are used both in consonants and in

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[1] We would like to thank the organisers of the Leiden Government Phonology Workshop 2004, Nancy C. Kula and Jeroen van de Weijer, for giving us the possibility to present as well as the obligation to develop our new ideas. We also want to express our deep gratitude to Jonathan Kaye, who on his stay in Vienna forced us to proceed, perhaps not exactly in the direction he wished, but without his criticism and inspiration this paper would not exist. Last, but not least, many thanks to Markus Pöchtrager, whose (de-)constructive help with various versions was indispesible for having reached the point where we are now.

[2] We prefer the term "feasible" rather than "possible" here because some sounds are physiologically possible but are never used in languages – for example a labiodental fricative using the upper lip and bottom teeth.

vowels, and that the difference between the two types of sound was largely structural. In particular, the elements I and U were seen to play a role in vowels (both statically, in vowels like /i/ and /u/, and dynamically, in I and U-harmony processes) and in the consonants, e.g. the glides /j/ and /w/. However, it seems that only these two elements (so far) have a clear melodic independence from structure. Other elements have always been problematic to some degree. As the most notorious case in point, consider the stop element ʔ, which various phonologists have tried to handle in different ways (e.g. Harris 1994, Jensen 1994, Rennison & Neubarth 2003). Of these, only our own 2003 article seriously proposes an element which induces "stopness" in consonants and is also used in vowels. We will return to some of the remaining problems with the stop element below.

Both the number of elements and the complexity of phonological structure are responsible for the over-generation of sound inventories of languages. The tendency in GP has therefore always been to reduce both of these. The set of elements and the phonological structures postulated in Kaye, Lowenstamm & Vergnaud (1989)[3] represent the starting point for most such attempts at reduction.

For the moment let us postpone questions of structure to §1.2 and first consider melody (in §1.1). In order not to pre-empt the question of whether constituents branch or not, we will refer to "nuclear" and "non-nuclear" positions.

1.1. Melody

It is legitimate to ask whether it is desirable, practical and apt (if, indeed, it is even possible) to use the same set of elements for both nuclear and non-nuclear phonological positions. After all, the majority of natural languages have considerably more non-nuclear than nuclear melodic expressions (henceforth ME's). The answer to this question can in part be arrived at inductively: obviously, we need the same elements in all cases where melody is transmitted (spread, assimilated) from a nuclear position to a non-nuclear one or vice versa. The problematic cases are those where an element never obviously or unequivocally crosses the nuclear/non-nuclear border. A case in point is the stop element ʔ mentioned above. No known phonological evidence points convincingly to the spreading of stopness to a nuclear position. Other cases of elements used only in nuclear or only in non-nuclear positions were discussed in Rennison & Neubarth (2003).

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[3] The full set of phonological elements of classical GP (including those for consonants) is given only in Kaye, Lowenstamm & Vergnaud (1989), and not in the **earlier** English version of that paper, which was published a year later as Kaye, Lowenstamm & Vergnaud (1990).

1.1.1. The structure of melody

Since Kaye, Lowenstamm & Vergnaud (1985) it has been assumed that every non-empty melodic expression (i.e. the set of phonological elements that are associated to a particular skeletal point) consists of a head (which can be either a real element or the "identity element", i.e. nothing) and optionally any number of operators. No element can be present twice in a melodic expression – or at least, if an element apparently occurs twice, this has no effect on the phonetic interpretation of the ME.[4] The term "identity element" precludes the question whether there is any difference between a position with no melody and a position with only the identity element as its head, because the two are effectively the same object ("nothing" and "the same thing as nothing").

However, the identity element is still problematic in the case of "ATR" in nuclear positions. We see no reason why ATR should be anything different from any of the other elements commonly found in vowels (i.e. I,U,A). In particular, ATR can spread between vowels (either directionally or in both directions), just like I, U and A, and in some languages (e.g. Akan, Mòoré) shares a tier with the A element (Rennison 1986; 1996).

A second aspect of the "structure of melody" is precisely this sharing or collapsing of tiers. The general approach in GP is to start out with each element on its own autosegmental tier (or even on two tiers: one linking to nuclear positions and the other to non-nuclear ones), and then to collapse pairs of tiers as needed to obtain (roughly) the right segment inventories. As an example, let us take the I and U elements, which remain on separate tiers for languages like Turkish or French because these languages have honest-to-goodness front rounded vowels. For languages like English, the absence of front rounded vowels is formally catered for by collapsing the I and U tiers to a single I/U-tier. Very little has been said about collapsing other tiers, except by the present authors (see e.g. Rennison 1987; 1996), and this might be a fruitful area for future thought.

A third and probably the least understood aspect of the structure of melody is "licensing constraints". These were introduced when it became clear that "charm" could not be made to work satisfactorily. Unfortunately, there seem to be no restrictions on what licensing constraints can be formulated, and so this is a part of GP theory which clearly needs attention. The job that licensing constraints have to do is to rule out (quite generally) segment inventories that are impossible, and to provide a principled way in which the segment inventories of language can be constrained yet remain largely idiosyncratic.

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[4] In some phonological processes it is convenient to assume that two instances of an element (one lexical and one acquired e.g. by spreading) can be associated to the same skeletal point even though this has no phonetic effect. For example, throughout the history of German i-umlaut the lexical vowel /i/ never changes, even though in words like *billig* 'cheap' we would expect leftward spreading of the I element of the second vowel (since the I of the suffix *-ig* originally always spread leftwards).

1.2. Structure

From the outset, GP constrained phonological structure ("syllable structure") to a minimum. Originally, only strictly binary branching structures were permitted (where "strictly" means that maximally two adjacent skeletal points were included in any such structure), and right-to-left intra-constituent government precluded any unit higher than onsets or rhymes (such as the syllable). Later, the CVCV school of GP disallowed even binary branching and postulated that each onset or nucleus constituent comprised only a single skeletal point. In our 2003 paper we showed that the resulting structures are formally equivalent (in x-bar theory) to a single, binary branching "syllable" constituent, which we termed a "syll" because of its shortness as compared with what have traditionally been regarded as single "syllables". All governing and licensing relations were postulated to act from right to left, since only that direction makes sense for phonological parsing.

1.2.1. Branching onsets

Formerly branching onsets turn out to be reanalysable as contour segments. And since contour segments such as [p^f], [k^w] etc. need to be accounted for anyway, the same mechanism can fruitfully be used for former branching onsets within a CVCV approach. Interesting corroborating evidence from Semitic languages was provided by Lowenstamm (1999).

1.3. Melodies in "branching" structures

The central idea behind our approach to contour segments (formerly branching onsets or rhymes) is that one or more elements is realised later than the others. Several basic assumptions underlie this approach. Firstly, the two parts of a contour segment most often (though not always) involve melodies which are incompatible. For example, if all the elements involved in [p^f] were realised simultaneously, the result would be [f]. Similarly, [k^w] would be [p]. In other cases, it seems that the language uses late or "lazy" elements to indicate that their source is not lexically within the morpheme concerned. Thus, for example, in the Yaadre (=northern) variety of Mòoré the short diphthong [aʊ] in [páʊ́kʊ́] 'shell' never coalesces to [ɔ]. The first [ʊ] of this word is in fact a copy of the second (by the process of vowel capture); the second [ʊ] drops in phrase-medial positions, hence its late realisation in the short diphthong [aʊ] is an aid to parsing the first morpheme correctly. (Lexically this word is, roughly, /pág´ + gʊ/, where the second morpheme is a noun-class suffix.) On the other hand, this "use" of late elements to aid parsing is not universal; in the central variety of Mòoré it is quite usual (though not obligatory) to coalesce [páʊ́kʊ́] to [pɔ́kʊ́].

In the rest of this article we will

- discuss various possible innovations to segmental representations (element theory);
- consider how the proposed representations are linked to higher prosodic structure;
- revisit the question of the stop element, and
- (related to the last) test our current representations against the complex consonant system and consonant mutations of Venda (a Southern Bantu language).

2. Melody

Let us begin our treatment of melody with a brief discussion about the structure of MEs and what objects they can be made of. The principal achievement of GP theory is to claim that all phonological objects are compositional.[5] The primary building blocks are elements, which are privative, monovalent and (as an ME also in isolation) interpretable. Historically, when it came upon consonants, the set of elements started to become quite large, although certain redundancies and incompatibilities were immediately obvious. Consider the set of elements proposed in Harris (1994): A, I, U, L, H, R, N, ATR (=Ɨ), h, ʔ. Certain attempts have been made to reduce this long list of elements. "N" (for representing nasals) can be merged with "L" (see Ploch 1999), "R" (coronal, liquids) with "A" (Kaye, 2000), "ATR" can be related to headedness in nuclei (Charette 1994), "h" can be subsumed under "H" or totally dispensed with. The "ʔ" element has come under fire as well (cf. Jensen 1994, Rennison & Neubarth 2003, Szigetvári to app., Bachmaier, Kaye & Pöchtrager 2004). In Kaye 2000 we find a comprehensive summary of these developments. The number of elements needed for the representation of MEs is 6 (+1, the identity element). Notice, however, that nothing is said about the relation between the elements. Moreover, the definition of how to represent specific phonological objects (speech sounds) with these elements is still a question under debate.

The Users' Guide's definition (Kaye 2000) makes some important basic assumptions: heads – are fundamentally distinct from operators, and they can contain only one element. Regarding orperators – i) the set of elements in operator position is unordered and optional, ii) the identity element can occur in the head of an ME (only), and iii) elements can occur only once in an ME. Particularly interesting is the status of the 'identity element'. Although it is named an element, it is not contained in the set of elements. Apparently it is not regarded as an element like the others, rather it takes the function of the empty set in set-theoretic terms. Hence an ME not containing any material (elements)

[5] This by itself is not confined by GP. Compositionality as a basic feature of phonological objects can equally be found within Dependency Phonology or Particle Phonology.

and an ME with only the identity element as head should be regarded as formally equal. An interesting consequence, a bit blurred by the special status and name of the identity element, is that both the head and the set of operators of an ME may be empty.

In Standard GP theory and subsequent approaches, there is a hidden assumption regarding the concept of MEs in connection with their interpretation: the interpretation of an ME is solely determined by its building blocks (the elements) and by the constituent immediately dominating the skeletal point the elements are attached to (e.g., nucleus vs. non-nucleus). Hence, the interpretation of an ME can be 'read off' from the set of elements only together with its association to a certain structurally defined type of (skeletal) point. We will call this premise the 'hypothesis of strictly local phonological interpretation'. All the properties determining a phonological object (a 'speech sound') are strictly local, hence no constituent external relations such as government or licensing affect the interpretation of an ME.[6] We think that the concept expressed by this hypothesis is indispensable: a phonological object is the manifestation of an ME anchored within phonological structure, but not determined by structural relations.

Before going into further detail, which combinations of elements represent which phonological objects in a given language, let us consider the possibility of exploiting some internal structure of elements in order to arrive at a more profound definition of the set of elements. Two pairs of elements rather undisputedly display some similarity among them: L/H, and U/I. The motivation to conceive them as being organised in pairs is indirect, however, we do think that there is a point in it: 'L' and 'H' represent tone in V-positions (nuclei) and 'source contrast' with plosives in C-positions. Their co-occurrence is often restricted by licensing constraints: both L and H together as operators expressing source contrast is very rarely found in a language. However in Hindi, and presumably in some related languages, we find a contrast between [b, b^h, p, p^h]. 'I' and 'U' manifest as glides in C-positions and in V-positions (nuclei). Their co-occurrence is constrained in many languages (no [y] or [ø]), but obviously there are languages exploiting this option. Speaking a bit metaphorically, both pairs of elements express properties which can be located on a scale or regarded as sharing a certain dimension. L and U represent the low edge, whereas H and I represent the high edge of the respective dimension.[7] In order to be able to provide a formal account to the "sub-elemental structure" of elements, let us introduce some notion to discern the respective members of the pairs mentioned above and call these features "up"

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[6] It has to be mentioned that the proposal of Bachmaier, Kaye & Pöchtrager (2004) challenges this hypothesis and includes structural relations between positions as primitive notions for the representation of MEs crucially affecting their interpretation.

[7] Cf. Harris & Lindsay's (1995) correlates of the 3 elements 'U', 'A' and 'I' in nuclei with spectral energy shapes. Although they formulate the significance of the respective shapes in terms of 'shape recognition', one could alternatively view these shapes as energy distribution characteristics of vocalic sounds.

and "down". In addition to this a binary distinction is needed in order to distinguish the two pairs L/H and U/I themselves. Inspired by works of Harry van der Hulst (2000, to app.) we suggest that it is the primitive notions of C and V we have already encountered that distinguish between the two sets of elements. The labels C and V now have a double function: they are used to discern structural positions (on the base level) and they are used as sub-elemental properties of elements.

The other elements, A, the stop-element 'ʔ' and the identity elements apparently share no common characteristics. Regarding the stop-element 'ʔ' there have been various suggestions to subsume it under the substantive properties of a C-slot. We would like to propose that an empty/identity-headed C-slot (or onset in standard terminology) will be interpreted as a plosive; hence there is no need to assume an independent stop-element.

In Rennison & Neubarth (2003) we suggested that the identity element '_' is a real element, and for discreteness we labelled it the "functional" element ('F'). This shift made it possible to treat it in on a par with the other elements, hence it could also occur as an operator.[8] However, for reasons which will come clear immediately below, we would rather want to return to the original definition of the User's Guide: the functional/empty/identity element is the manifestation of "no content" in a certain configuration of an ME. Regarding the C/V distinction, it clearly has neither the property C nor V.

For the 'A' element we want to assume that it has both properties, C and V. This makes sense, since the 'A' element now merges the functions of the original vocalic A-element of KLV 1985 as well as of the later introduced R-element for coronals and liquids, which are clearly correlates of consonantal properties. If we want to schematize the suggestions made so far, we arrive at a rather novel picture: C and V as independent sub-elemental properties, which means that they are also privative, like the elements themselves. Only elements that have either a V or a C particle, but not both, can be further discriminated by the "up"/"down" property. If we take "up" and "down" as functions operating on the C or V property then the restriction that neither '_' nor 'A' may have an "up"/"down" specification comes out naturally. For illustration let us arrange the elements in a table where the rows correspond to the C-property and the columns correspond to the V-property. (Dots are used to indicate the absence of the relevant property.) Cells which have only one of the two properties are split, and the secondary specification by "up" or "down" is indicated by an arrow above the element symbol:

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[8] In Rennison & Neubarth (2003) the 'F'-element as a head in a V-position was used to comprise the functions the 'A' element has. Under this definition, it was indispensable to retain the 'R'-element independently. Additionally, the 'F' element comprising 'A' was confined to heads of MEs, a move which proved to induce severe emprical problems (E.g., vowel harmony in Finnish and Turkish, cf. Kaye 2001a). 'F' as a head in a C-slot was used to represent obstuents (plosive and a certain class of fricatives). 'F' has no independent content but is interpreted according to its function as head or operator depending on the structural configuration (C- or V-position).

(1) Elements schematised according to their internal properties

	V		.
C	A	↑ H	↓ L
.	↑ I	↓ U	–

Contrary to what is often assumed, our claim is that the element which is the head of an ME in a C-position corresponds to what is descriptively referred to as the manner specification of a speech sound. Before we can consider the question how specific phonological objects are represented with elements, we have to introduce one further modification to the definition of MEs.

Regarding the difference between heads and operators we want to pose the question whether ordering of elements within an ME is confined only to the relation between the head and the set of operators. If we strictly discern heads and operators as independent sets by definition, the fact that no element may occur twice has to be stipulated (part iii. of the definition in the Users' Guide). Here we would like to propose a slightly different conception of ME's based on the assumption that the elements of an ME are in fact (partially) ordered, but the ordering within an ME does not pertain to the elements per se, but to slots, i.e., sets of elements. The element that occurs in the structurally highest position – or better, in the first slot – is the head of an ME, all other elements are dependent successively. Moreover, the elements have to obey an intrinsic ordering, best formulated as a set of universal licensing constraints. Using the sub-elemental features C and V we can formulate such licensing constraints for C- and V-positions respectively.

Elements can be viewed as cognitive dimensions. Accessing a certain dimension is a binary decision between true and false, so it is obvious why elements can only occur once in an ME. Under such a perspective this constraint is not stipulative at. However, we have seen that the identity element does not correspond to any dimension (it has none of the sub-elemental properties C or V). So, we might speculate that the exclusiveness of elements within an ME may in fact be relaxed for the identity element. The ordering or elements must not be arbitrary, but it can be formulated with recurrence to the sub-elemental properties. If there is no specification for C or V (which translates into the identity element), the specification of the next higher slot or position will percolate through. And the features "up" and "down" should be read as promoting and demoting the property they are attached to. Finally, C and V are orthogonal to each other. Therefore the accessibility of one specified property reduces the accessibility of the other property, and even more so if it is not specified. The new definition of ME's then reads as follows:

(2) *The structure of ME's*: (vicarious to Kaye 2000)

Elements: are defined by sub-elemental properties: C / V. In isolation, these are further specified by the features 'up' and 'down'.

E = { CV(A), C↑(H), C↓(L), V↑(I), V↓(U) } and an identity element ('_') reflecting the absence of any specification.

Melodic Expressions: All speech sounds correspond to ME's anchored unequivocally to phonological structure.[9]

An ME is defined as an ordered set:

Melodic Expression = (E_1, E_2, …), where E_1 corresponds to the "head".

such that:

i. An ME dominated by a C-position has an intrinsic ordering (>>) of elements defined by an increase of the presence of the V-property (markedness criteria (>) are defined by a decrease of the accessibility of the C-property):
   ∅ >> {C↑ > C↓ > CV} >> {V↓ > V↑} , which corresponds to:
   _ >> {H > L > A} >> {U > I}

ii. An ME dominated by a V-position has an intrinsic ordering of elements defined by a decrease of the presence of the V-property (markedness criteria are defined by an increase of the accessibility of the C-property):
   {V↑ > V↓ > CV} >> ∅ >> {C↓ > C↑}, which corresponds to:
   {I > U > A} >> _ >> {L > H}

From this definition it follows that only in C-positions we expect the identity element to occur as head; and only in that case, i.e. if the first slot in the ME (head) is empty, we expect a second occurrence of the empty/identity element to be possible. Furthermore certain complexity restrictions fall out quite naturally: we expect to find more variation among speech sounds with a '_' element in the first slot of their corresponding ME in a C-position (obstruents) than for example among ME's with A (liquids), I or U (glides) as the head. Finally, as we will see in the next section, the ordering of elements does not only play a role in the vertical structuring of an ME, but also in the horizontal organisation, which is important for complex ME's, sometimes referred to as contour segments.

This seems to be the right moment to present some examples. The following representations are taken to correspond to speech sounds in Standard German, which is taken to express source contrasts with a H-operator. The notation of MEs departs from the conventions used in Standard GP theory in the following aspects: the positions/slots within an ME are separated by

[9] Apparent multiple associations of MEs to phonological structure / the skeleton can solely arise through spreading or copying, and do not have interpretative effects on the ME per se, although clearly the phonological structure is different and with respect to phonetic interpretation we certainly expect differences (e.g., geminate vs. simplex consonants).

commas, ordering proceeds from left to right, the head of the ME therefore corresponds to the first (set of) elements.

(3) *Representation of speech sounds in C-positions (Standard German)*:

speech sound	*melodic expression*
b	[_,U]
d	[_,A]
g	[_]
p	[_,H,U]
t	[_,H,A]
k	[_,H]
f	[H,U] or [_,_,H,U]
v	[_,_,U] or [H,L,U] (or [U])
s	[H,A]
ʃ	[H,A,U] or [H,A,I]
h	[H]
x	[_,_][10]
ç	[_,_,I]
m	[L,U]
n	[L,A] or [L,A,I]
ŋ	[L]
l	[A,U] or [A,U,I]
r	[A]
j	[I]
w	[U]
ʔ	[]

Certain representations have more than one variant. With fricatives this should indicate that it is not always straightforward whether the respective sound is to be represented with a H-element in head position or with '_' as head and additionally as operator. This may look like a flaw in the setup, but actually, due to the rather restrictive definition of how speech sounds are to be represented, we are forced to implement this option – especially with fricatives: we often find too many different sounds in a language than could be expressed with for example just H as the head (E.g., English /h v f ð θ s z ʃ ʒ/, Polish /x f

[10] In German, one could argue that [h] and [x/ç] correspond to identical phonological objects and are only discerned by position: [h] surfaces solely domain-initial (with the exception of a few mono-morphemic words, but which could receive a traetment like composita: *Uhu* – 'eagle owl', *Ahorn* – 'maple') [x/ç] on the other hand will never occur in domain initial position. In a language like Czech, however, [h] resulting from lenition of Slavonic [g] and [x] are in fact distinct phonological objects.

v s z ʂ ʐ ɕ ʑ/ or Toda[11] /f θ ʂ ɕ ʃ ʂ x/, but see also footnote 10.) The point is that if we take all coronal fricatives as H-head plus A-operator, then it is impossible to express the relevant differentiations with the additional (remaining possible) elements I and U alone.

One question often addressed is the expressive power of formal systems. With the proposed universal licensing constraints (the intrinsic ordering of elements) we arrive at a maximum number of 96 combinations of elements in C-positions. This number is low enough to appear plausible, although we have to admit that when contour segments are concerned, it has to be revised upwards.

3. Structure

Since structure determines the interpretation of particular ME's, it has to be asked what phonological structure looks like, and what properties it has. Standard GP assumes 3 structural constituents: onsets, nuclei and rhymes, all of which may branch, but only binary. Binary branching is further constrained by the restriction that either the rhyme or the nucleus may branch, but not both. Apart from this the question arises how larger structures can be formed upon phonological structure, since the onset and the rhyme do not form a constituent on their own. In Rennison & Neubarth (2003) we proposed that phonological structure is more minimalistic than proposed by Standard GP. We suppose that all structural relations are defined by the x-bar theoretic principle that heads project and stand in an asymmetric relation to their specifiers or complements. The head of the minimal phonological structural unit is what corresponds to the nucleus, a V-position. Together with its specifier, a C-position, it forms a structural unit, which enters higher prosodic structuring.

There are no special objects in phonology expressing constituent structure, such as onset, nucleus or rhyme. There are only positions, which project (V) and take a specifier (C).[12] Using the labels C and V is rather neutral and does not pertain to 'vowels' or 'consonants'. The projection dominating both positions, but which has to be regarded the immediate projection of the V-position, forms a unit linking melodic expressions to higher phonological and prosodic structure (the 'syll' in Rennison & Neubarth 2003, comprising the x-bar level, if one wants to use this terminology). Notice, however, that the role of the skeleton is drastically reduced under this account. In fact the skeleton is incorporated into the C/V distinction on the base level.

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[11] Toda is a Southern Dravidian language of the Tamil-Kannada branch, data taken from Ladefoged: see http://hctv.humnet.ucla.edu/departments/linguistics/VowelsandConsonants/appendix/languages/toda/toda.html

[12] This formulation is inspired by Kayne's Linear Correspondence Axiom (Kayne 94), but perhaps motivated by more independent considerations about structural relations. We have to assume that phonological structures are binary branching and directly projecting higher structure. (This idea was already formulated by Martina Wiltschko back in 1993.)

Our definition of the 'syll' as the minimal phonological structure has some further reaching consequences. Inter-constituent government between a nucleus and its preceding onset is not necessary and non-existent in our framework. A C-position need not be independently licensed, it is present by projection as part of the structure. Other licensing relations such as proper government can now apply locally – on the $\bar{x}$ level. Standard theory assumes that nuclei automatically project into the rhyme, and therefore are generally somewhat 'higher' than onsets, so nuclei can 'see' each other. Recent developments in GP theory, basically adhering to the CV-doctrine, must assume that in certain cases onsets can relate to each other in a similar way when an intervening nucleus is empty. However, the problem of locality has to be handled with additional assumptions, whereas in our $\bar{x}$-inspired account it is an integral part of the design. A further difference is that there are no syllabic constituents that may further branch. The two positions with the labels C and V are terminal in the sense that melodic material (elements) are linked exclusively to them. However, in the following we will explicate how certain consonant clusters can be integrated into the theoretical formalism in a straightforward way.

3.1. Branching onsets

Before going into more detail about licensing, we have to say something about what is defined as branching constituents in Standard GP theory, in particular branching onsets. As we indicated before, there are no branching constituents save the $\bar{x}$-syll. However, we do not want to pursue the line of argumentation that branching onsets are two CV pairs lexically marked for opaqueness. Rather we want to propose that what results in the description of a branching onset is in fact complex melodic material linked to a single C-position. 2 (or perhaps even more) elements as a head can be associated with a single C- (or V-) position, but these must also follow an intrinsic ordering, closely resembling the ordering we have already proposed for the ordering of elements within an ME. The difference is that we want to treat pre-nasalised stops as contour segments with a head consisting of an L-element followed by the identity element ('L_'). In terms of the sub-elemental properties the ordering would be as follows: C↓ >> ∅ >> C↑ >> CV >> V↓ >> V↑, in terms of elements this amounts to: L >> '_' >> H >> A >> U >> I . Hence, the ordering of elements (which can be viewed as a universal licensing constraint) seems to play a role not only in the vertical organisation of MEs, but also horizontally with complex MEs. Additionally, we do not want to preclude that there may be also structural requirements involved (e.g., head of foot/domain for complex heads branching onsets).[13] Let us look at some cases where we would argue that they are instances of multiply-headed C-positions.

[13] The cases we have in mind are attributed to Indirect Gornment Licensing in Standard Theory. Government Licensing does not exist in our account; its internal consequence, that a nucleus

3.1.1. Labialised and palatalised consonants

Consider Mandarin, a language with a very rigid template for possible syllables. In traditional grammar, there is a distinction between 'initials', which comprises a set of onsets, including affricates, and 'finals', which are rather complex entities and which can be claimed to consist of at least three slots: certain glides /j/, /w/, /y/, vocalic material and a third slot for the nasals /n/, /ŋ/ and arguably also for /j/ and /w/ as part of diphthongs. Of interest here is the first slot of 'finals': in our view, these are part of the onset, and lexically not belonging to the nucleus.[14] There are interesting gaps in the combinatory possibilities of 'initials' (like /t/, /r/, /b/) and the first slot of 'finals' (/j/ and /w/): some are attested, while others are systematically impossible: *tian* [tʲjɛn] vs. **rian*; *tuan* [tʷan] vs. **buan*. In our proposal, the melodic material of the 'initial' gets an additional I or U head. In Mandarin the first C-position of *tian* has the identity element '_' plus 'I' as head [_+I] (and [H, A] as operators, however, due to the intrinsic licensing constraints, these structurally only relate to the first part of the head, the identity element).

The reason why we must assume that these are complex melodic expressions linked to a single C-position rather than onset plus light diphthong is that there are systematic co-occurrence restrictions with the initial part of the onset: /ʷ/ never occurs after labial consonants, /ʲ/ does not occur after velars, non-palatal fricatives and /r/. The exact formulation of a licensing constraint excluding **buan* and other cases is not of concern here, but we do think that it is much more plausible to expect licensing constraints being at work within (complex) MEs than constraints working on co-occurrences of adjacent phonological objects.

3.1.2. homorganic affricates

In German there are 3 affricates: /pf/, /ts/, /tʃ/. Interestingly */kx/ does not exist (or at least, as in Tyrolean, does not contrast with /kʰ/). We suggest that they have a complex head consisting of '_' plus 'H' with "shared" operators. /pf/ therefore can be represented as [_+H, H, U].[15] /ts/ has an A-operator instead of U and /tʃ/ has both A and U (or I, depending on the analysis). The (second) H-

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which government licenses its onset looses its capacity to properly govern a preceding empty nucleus has to be re-tailored as conditions on proper government across prosodic domains.

[14] See Neubarth & Rennison (2001) for further details and arguments. Kaye (2001b) argues for a somewhat different conception, where depending on the type of onset, the 'glides' – an I or U element – in the first slot of 'finals' either forms a genuine unit with the onset, or results in a light diphthong, hence is attached to the nucleus..

[15] Complex ME's are notated as follows: the whole expression is within square brackets, the head(s) take the first position, additional elements in the head slot are prefixed by a '+' sign. If the heads share a different set of operators, we separate the sets of elements constituting a sub-ME with a single slash and the plus sign '/+'. 'Lateness' of elements (cf. Rennison 1998) is expressed by a '»' symbol.

operator we assume would not be in conflict with the H-head, since it is structurally only related to the '_' element of the first slot within the ME. However, considering the lack of source contrasts in German affricates it is not entirely clear whether it is present at all, or on the contrary required.[16] Notice that in Mandarin we find the same source contrast not only with plosives, but also with affricates: [t, t^h, s, ts, ts^h, ʃ tʃ $tʃ^h$, ɕ, tɕ, $tɕ^h$].

3.1.3. Non-homorganic contour segments with /s/

The difference to the homorganic affricates is that they involve an additional A-element. In German (word-)onsets they are generally of Greek origin: /ks/, /ps/. Since the A-element is only part of the second slot or the ME (the slot which has the H-element as head) one is forced to discern two independent melodic structures with no shared operators. We will express this with the '/+' separator. Crucially, the whole (complex) melodic structure is linked to a single $x_{(C)}$ node. /ks/ would be represented as [_, H /+ H, A], /ps/ as [_, H , U /+ H, A]. Or if we exploited the "lateness" of operators, we would not have to strictly discern 2 independent slots: /ks/ = [_+H, H, »A]. Even more intricate is the case of /ps/, since the U-element of /p/ would have to be replaced by the additional A-operator: [_+H, H, U»A]. An argument in favour of the 'lateness'/'replacement' of operators hypothesis seems to be that an A-element is easily added and may even replace an U-element as an operator, but never the reverse: */tf/, which would be represented as *[_+H, H, A»U] appears to be unattested in contexts where it must be analysed as a contour segment.

3.1.4. stop–liquid sequences

These clusters, which are quite common among Indo-European languages, were the primary reason to assume branching onsets in Standard GP theory, and to invoke some additional licensing mechanisms in CV-based theories. These clusters display an interesting asymmetry: in German, and many other languages we find /gr/, /gl/, /br/, /bl/, /dr/, but no */dl/ (the same for the 'fortis' variants), in addition also /pfl/ and /pfr/, but no */tsr/, */tsl/ whatsoever. We assume that these are also contour segments and involve a complex [_+A] head, respectively [_+H+A] for /pfl/ (or [_+A] with a late '_' operator, perhaps reflecting the fact that we find these complex structures only with /p+f/, but not with /t+s/ or with non-homorganic contour segments like */psr/.)

Something has to be said about the absence of /dl/ or /tl/ clusters. These would have an A-element as an operator in the first part and as the head in the

[16] Matters are more complicated: the lack of source contrast is mirrored by s+C-clusters in German. Interestingly, a language which purportedly expresses source contrast with an L-operator, such as Italian, also expresses a source contrast both in s+C clusters and in affricates.

second part of the complex ME, plus an U-element as operator coming to the A-headed part of the structure. Let us just compare this configuration with the existing clusters /gl/ and /br/. Assuming that they do not share the same set of operators, the representations would be: /gl/ = [_ /+ A, U(, I)] vs. /br/ = [_, U /+ A]. The minimal configuration we want to exclude is */dl/ = [_, A /+ A, U], but it is not entirely clear how to express the extreme markedness – or even impossibility – of */dl/ or */tl/ under this account. If we assume that the complex expressions form a tighter unit, and that certain operators may come in late (or be replaced) in addition to the secondary A-head, then the representation would look a bit different: /gl/ = [_+A, »U], where a U-operator comes late. And /br/ = [_+A, U»] is the reverse, the U-operator is structurally related only to the first part of the conglomerate. But in */dl/ = [_+A, A»U] an U-element is supposed to replace an A-element – a constellation we already wanted to rule out for non-homorganic affricates. A candidate for a licensing constraint on complex MEs would be that "an U element as operator can never replace an A-operator, hence *[…, A»U]".[17] No such problems arise with /pfr/ = [_+H+A, H, U»] or /pfl/ = [_+H+A, H, U].

3.2. Licensing

The discussion about the representation of the phonological inventory of languages would be misguided if it were not simultaneously linked to relations between structurally defined positions. There are two components of licensing: when a constituent has a certain shape (i.e., branching constituents) and when a constituent is licensed to remain phonetically silent (not being interpreted). Since branching constituents in the standard sense do not exist in our approach, what has to be said about these phenomena (complex MEs in certain positions) has to be reformulated as conditions on sylls at the $\overline{x}$-level. A welcome consequence is that the relation between the base level of phonology (the minimal structure and its content) and higher structure, in particular prosodic structure receives more attention. In fact, certain phenomena attributed to relations between certain positions at the skeleton now have to be reformulated in terms of prosodic domains.[18]

As far as un-interpreted positions are involved, we are strongly inclined to confine the discussion about them to V-positions. Because they are the heads of the minimal structural units ($\overline{x}$) it is intuitively clear that empty heads will call

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[17] We would not like to formulate a universal constraint, yet. /dl/-/tl/ clusters can be found word initially in languages like Czech, but it could also well be that these must be analysed as two separate sylls where the V-position between them is licensed to remain empty.

[18] Branching onsets are cases where government licensing is involved in Standard GP. See Charette 1990, who accounts for the obligatory occurrence of schwa in *librement* in both Standard and Quebec French by government licensing: a licensed (uninterpreted) nucleus cannot itself license a branching onset. In our account we have to state that a complex ME in C-position (with a secondary A-head) has to be initial to a minimal prosodic domain, which in turn has to have an interpreted nucleus. Exceptions may be found at edges of larger domains.

for a special treatment. Empty C-positions are empirically rather unconstrained, sometimes they will get a default interpretation as a glottal stop (as for prosodic domain initial C-positions in German, English), but no special licensing seems to be involved other than that the V-position must be realised. Our definition of licensing is confined to restrict the availability of uninterpreted V-positions:

(4) Licensing
The head of a syll $\bar{x}$ is licensed to remain phonetically uninterpreted iff at least one of the three following conditions is parametrically enabled and obtains:
1. $\bar{x}$ is governed (by C– or V–government);
2. $\bar{x}$ has a melodically empty nucleus and is at the right edge of the phonological domain (FEN = Final empty nucleus licensing)[19]
3. $\bar{x}$ forms a geminate structure with its right neighbour.

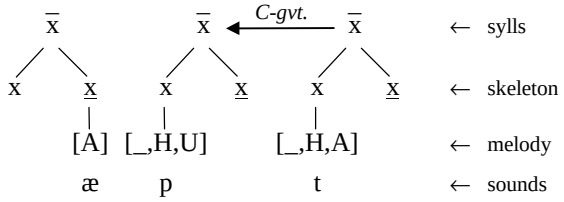
Government in our approach is split into two components: proper government is retained from Standard GP, but government has also a C-oriented side, which comprises certain cases of inter-onset government or coda-licensing. The definition of C-government crucially hinges on the notion of strength. Under the new conception of elements, it seems impossible to keep Harris' notion of complexity, which simply counts the number of elements in an ME. In Rennison & Neubarth (2003) we proposed a calculus for (C-)strength. For the time being, let us assume that the element which is the head of the ME in C-position is the primary determinant of strength. It seems empirically correct to assume further that strength is regulated in exactly the reverse order we find with complex heads or within an ME in a C-position; the ordering then is: I << U << A << L << H << '_', where a C-position headed by 'I' corresponds to the weakest, and a C-position headed by the identity element '_' corresponds to the strongest. If the C-positions of two sylls in a C-government relation are identical, then operators come into play as well. As a basic claim it seems undisputed that an A-operator definitely adds more strength to an ME than a U- or I-operator, and presumably H and L also add to strength, but for the latter two elements things are more complicated due to processes like voice assimilation (spreading) or final devoicing. The formal definition of government is cited from Rennison & Neubarth (2003):

[19] van der Hulst (to app.) strongly argues to separate inter-constituent and edge-licensing. Furthermore he uses edge-licensing at the beginning of a domain to allow for an empty nucleus (in his terms a head-less rime) between the first two onsets of that domain in languages such as Polish or Georgian. Although we have a story for edges at the beginning of a domain (see Rennison & Neubarth 2003), we would rather formulate constraints on this site as a demand for a certain licensing capacity of the first syll to C- or V-govern a virtual syll of default strength before the domain.

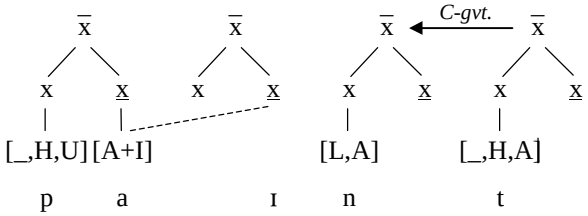
(5) Government
A syll $\overline{x}_i$ can govern its left neighbour $\overline{x}_{i-1}$ iff at least one of the two following mechanisms is parametrically enabled and obtains:
1. $\overline{x}_i$ is unlicensed (= proper / V-government), or;
2. the consonantal melodic strength of $\overline{x}_i$ is greater than that of $\overline{x}_{i-1}$ (= C-government).

As far as the cases of coda-licensing are concerned, we can now tackle 2 problematic cases: (6a) is deviating from the widely assumed constellation where the relevant cluster can be described as sonorant+obstruent. Theories that build upon the sonorant property as part of the characteristics of a rhyme-complement (see for example van der Hulst to app.) must assume that these structures (a sequence of two plosives differentiated by elements in operator slots U << A) are different from well-behaved coda-licensing and lose an important generalisation. (6b) is a case of so-called super-heavy rhyme.[20] These structures are impossible with rhymal complements under Standard GP assumptions. In our approach rhymal complements do not exist. There is a demand to say something about the property of rhyme-complements that one never expects a nucleus to appear between the coda (rhyme-complement) and the following onset in any configuration, whereas this may well be for nuclei between two regular onsets; and secondly, why super-heavy rhymes are so "marked". We will try to find a new explanation for both questions invoking phonological domains below, but first consider the relevant examples:

(6) a. English *apt*



b. English *pint*



[20] It was pointed out to us by Markus Pöchtrager that the 'super-heavy rhyme' configurations always involve a /d/ or /t/ at the end of the cluster, hence in our terms they have an A-operator. While this corroborates our expectations (an A-operator is always stronger than plosives with an U-operator /b/ or /p/ or with no specification for place /g/ or /k/) we do not have any explanation for the obligatory presence of an A-operator in these configurations.

The V-position of the last syll of each of the examples is licensed to remain uninterpreted by virtue of edge-licensing, in GP terms the FEN parameter. The V-position of the preceding syll cannot be licensed by any V-licensing strategy, so C-government is the only mechanism which captures the fact that the structures are licit. Strength requirements are met in both examples. There is nothing more to say, except that /s/ seems to play a special role.[21] The benefit of this view of licensing is that domain final clusters of more than two C-positions are no longer a problem to the theory.[22] In German these clusters can grow up to 4 positions in monomorphemic words: *Ober* ('waiter'), *Obers* ('cream'), *Oberst* ('colonel'), *Punkt* ('point'), *Herbst* ('autumn').

In the remaining we want to speculate about the role of domains, phonological domains in the traditional sense, but also prosodic domains.

4. Prosodic domains

Licensing is bounded to phonological domains. We know that at edges of domains special licensing mechanisms are at work, parametrically enabled final empty nuclei (or V-positions) may remain uninterpreted with apparently no licensor present. In Rennison & Neubarth (2003) we have proposed a slightly different view, in particular that final positions are virtually licensed by either V- or C-government (by a virtual position with default strength). If a given language has the corresponding parameter fixed to C-government only, we expect to find only a restricted set of consonants at the final edge of a phonological domain. This prediction seems to be born out by languages like Fulfulde (only A,L,I,U-headed C-positions – liquids, nasals or glides), or Koromfe (only /l/ or L-headed C-positions – nasals). Edge licensing (FEN) has also been exploited to explain (domain final) clusters of C-positions which arise in connection with analytic morphology in languages like English. However, we think that there is compelling empirical evidence that these clusters can simply be subsumed under C-government. It cannot be a coincident that analytic morphology always involves the strongest ME's (with an A-operator): /d/ and (a bit magic) /s/. Despite the appealing capability to explain new data in a straightforward way, it is essential to incorporate insights Standard GP has made a major point of, but which our new proposal appears to be ignoring: coda-licensing. Remember that we were quite happy to dispense

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[21] In Rennison & Neubarth (2003) the algorithm we proposed for calculating strength of C-positions is quite complicated exactly because of /s/. It can C-govern lenis /bdg/ (in morphologically complex structures though: *legs*, *labs*, *lads*), but it can be licensed only by /d/ (*raised*, **raisg*, **raisb*). With fortis /ptk/ it can occur in either order, and – except for /ts/ – in monomorphemic structures: *lax*, *copse*, *cats*, *musk*, *wasp*, *last*.

[22] This is not to say that Standard GP would have a severe problem with these clusters: since in many of them we find an /s/, it is conceivable to analyse them analogous to magic licensing cases: /s/ as a coda licenses a preceding nucleic position to remain empty. Still problematic appears to be *Punkt*, an analysis in Standard terms will depend on what is said about the super-heavy rhyme structures.

with the branching rhyme conjecture (only with non-branching nuclei, behaving like onsets with respect to the interpretation of melodic content): super-heavy rhyme structures called for a special treatment (English *pint*, *mind*, German *Mond*). These examples are very rare, but indisputably existing. Under the x-bar conception of sylls nothing relates to branching rhymes, so what we have to find an answer for is why there never is a realised nucleus between the alleged post-nuclear rhyme complement and the following onset and why there also has to be a following onset; both being defining properties of codas.

We strongly believe that the answer to both questions is to be found in connection with prosodic licensing. This term has been used in standard theory only to account for interpreted, hence unlicensed nuclei under the assumption that every constituent or ME has to be licensed. Since licensing in our terms is restricted to uninterpreted nuclei, we better refer to prosodic structure instead of prosodic licensing. We want to propose that every syll ($\overline{x}$) with an interpreted V-position is the head of a minimal prosodic domain. This seems uncontroversial. We further want to parameterise the conditions on the size of a minimal prosodic domain: whether it may consist only of 1 syll, or 2 sylls and whether other sylls (with uninterpreted V-positions) may adjoin to the minimal domain. The crucial restriction we want to introduce is that minimal prosodic domains are opaque for certain types of licensing.

(7) Domain opacity hypothesis:

Licensing is bounded to phonological domains; V-licensing (= proper government and edge licensing / FEN) cannot apply from outside into a minimal prosodic domain.[23]

Corollary:

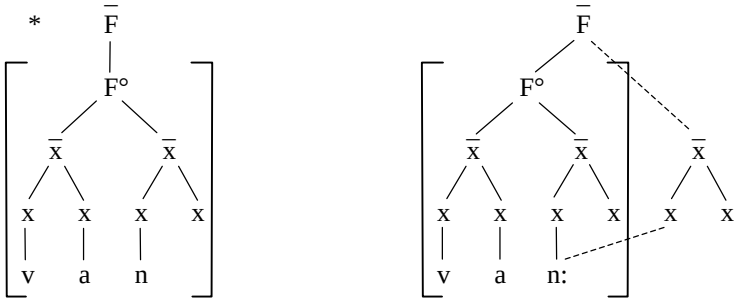
Since the head of a foot always forms a minimal prosodic domain (2 sylls, perhaps subject to parametric variation, cf. Harris 2000, Kühnhammer 2004), the syll(s) which constitute the head of a foot cannot be licensed by V-licensing, hence C-government must obtain when the second syll has a filled C-position and an empty V-position.

For a more detailed presentation of prosodic domains in German, the reader is referred to Rennison & Neubarth 2003. Here it is sufficient to discuss only one problematic constellation: a simple closed syllable with a short vowel (CVC). Provided that the only minimal prosodic domain of a word cannot consist of just one single syll, this configuration is simply ruled out on our account: the second syll is unlicensed, and being part of a minimal prosodic domain it also must not be phonetically interpreted as a schwa. However, if we add a third syll (with no melodic content), as in (8a), things change: the second and the third

[23] Due to this formulation it has to be argued that whenever the FEN parameter applies, the relevant syll is not part of a minimal prosodic domain. As we will see late in the examples, this prediction is borne out.

syll form a geminate, which is one component of C-licensing. Notice that under this account we have also made a further step towards an explanation of the templatic nature of Germanic word stems.

(8) German *wann* ‘when’



Let us conclude with 2 final remarks on super-heavy rhymes and another classical argument for branching rhymes. As far as super-heavy rhymes (a long vowel / diphthong with an apparent coda complement) are concerned they are marked because their structure involves 4 sylls, thus not conforming to the minimal word template. The C-government relation also holds not between the second syll of the head of the foot and its successor, but between the last two sylls, neither of them belonging to the minimal prosodic domain, i.e., the head of the foot. This tells us that it is indispensable to look at phonological licensing (between sylls exclusively) and prosodic structure separately.

5. The consonants of Venda

As a testing ground for our system of elements, we will show how it allows a quite natural representation not only of the complex consonant system of Venda (a Southern Bantu language), but also of the mutations which affect two slightly different subsets of the consonants.

5.1. The melodic composition of Venda consonants

The basic consonant inventory of Venda (without labiovelarisation and palatalisation) is given in Table 1.

Table 1. The basic consonants of Venda

	bilabial	*labiodental*	*dental*	*alveolar*	*post-alveolar*	*palatal*	*velar*	*"glottal"*
voiceless aspirated stops	p^h		$\underset{\sqcup}{t}^h$	t^h			k^h	
voiceless plain stops	p		$\underset{\sqcup}{t}$	t			k	
voiced stops	b		$\underset{\sqcup}{d}$	d			g	
nasal stops	m		$\underset{\sqcup}{n}$	n			ŋ	
prenasalised voiced stops	^{m}b		$^n\underset{\sqcup}{d}$	^{n}d			^{ŋ}g	
voiceless aspirated affricates	p^{fh}			t^{sh}	$t^{ʃh}$			
voiceless plain affricates	p^f			t^s	$t^ʃ$			
voiced affricates	b^v			d^z	$dʒ$			
prenasalised voiced affricates	$^mb^v$			$^nd^z$	$^ndʒ$			
voiceless fricatives	ɸ	f		s	ʃ		x	
voiced fricatives	β	v		z	ʒ			
prenasalised voiced fricatives[24]		^{m}v		^{n}z	^{n}ʒ			
trill				r				
laterals			$\underset{\sqcup}{l}$	l				
glides	w					j		ɦ

Before giving the melodic composition of these consonants, let us point out a few regularities and peculiarities of the inventory itself. Firstly, the dentals and post-alveolars seem to make up a single set; indeed, the dentals are thought to have originally been palatals. We will therefore give them the same melody as the alveolars, but with an I element instead of the A element. Secondly, there exist both bilabial and labiodental fricatives. We will treat the former as involving a '_'/F-operator, and the latter as being H-headed, since there are no labiodental affricates (which can only be represented with a complex [_+H] (or [F+H])-head). And finally, the /h/ of Venda is phonetically breathy-voiced, but will be treated here as a "normal" /h/ because it displays no special phonological characteristics.

The representations of the basic consonants are given in Table 2. For better readability, we will notate the empty/functional/identity element as 'F' (similar to Rennison & Neubarth 2003) without any further implications, and underline the elements in head position.

[24] In many, perhaps all, cases the prenasalised voiced fricatives are not distinct from the corresponding affricates.

Table 2. Representations of the basic consonants of Venda

p^h	F,HU	$\underset{\sim}{n}$	L,I	b^v	FH,LU	z	H,LA
$\underset{\sim}{t}^h$	F,HI	n	L,A	d^z	FH,LA	ʒ	H,LI
t^h	F,HA	ŋ	L	$dʒ$	FH,LI	^{m}v	LFH,LU
k^h	F,H	^{m}b	LF,U	$^mb^v$	LFH,LU	^{n}z	LFH,LA
p	F,U	$^{\underset{\sim}{n}}\underset{\sim}{d}$	LF,I	$^nd^z$	LFH,LA	^{n}ʒ	LFH,LI
$\underset{\sim}{t}$	F,I	^{n}d	LF,A	$^ndʒ$	LFH,LI	r	A
t	F,A	^{ŋ}g	LF	ɸ	F,FU	$\underset{\sim}{l}$	A,LI
k	F	$p^{ɦ}$	FH,HU	f	H,U	l	A,LU
b	F,LU	t^{sh}	FH,HA	s	H,A	w	U
$\underset{\sim}{d}$	F,LI	$tʃ^h$	FH,HI	ʃ	H,I	j	I
d	F,LA	p^f	FH,U	x	F,F	ɦ	H
g	F,L	t^s	FH,A	β	F,FLU		
m	L,U	$tʃ$	FH,I	v	H,LU		

A brief glance at Table 2 will show that the more marked consonants require more elements whilst the less marked ones need fewer. Let us now consider the labiovelarised and palatalised consonants, which are given in Table 3.

Table 3. Labiovelarised and palatalised consonants of Venda. Consonants in parentheses are extremely rare; starred consonants in parentheses do not occur.

	bilabial	*labiodental*	*dental*	*alveolar*	*post-alveolar*	*palatal*	*velar*	*"glottal"*
voiceless aspirated stops	p^{hw}, ($*p^{hj}$)		$\underset{\sim}{t}^{hw}$, ($*\underset{\sim}{t}^{hj}$)	t^{hw}, t^{hj}			k^{hw}	
voiceless plain stops	p^w, ($*p^j$)		($*\underset{\sim}{t}^w$, $*\underset{\sim}{t}^j$)	t^w, t^j			k^w	
voiced stops	b^w, b^j		($*\underset{\sim}{d}^w$, $*\underset{\sim}{d}^j$)	d^w, d^j			g^w	
nasal stops[25]	m^w, ($*m^j$)			n^w, ($*n^j$)			$ŋ^w$	
voiceless aspirated affricates				t^{shw}, ($*t^{shj}$)	$tʃ^{ɦw}$, ($*tʃ^{ɦj}$)			
voiceless plain affricates	none, but t^{shw} and $tʃ^{ɦw}$ are probably t^{sw} and $tʃ^w$ respectively							
voiced affricates				d^{zw}	($*dʒ^w$)			
voiceless fricatives				s^w	($ʃ^w$)			
voiced fricatives				z^w	($*ʒ^w$)			

[25] In many, perhaps all, cases m^w is not distinct from $ŋ^w$.

	bilabial	*labiodental*	*dental*	*alveolar*	*post-alveolar*	*palatal*	*velar*	*"glottal"*
trill				(*r^{w})				
laterals			(*l̪^{w})	l^{w}				
glides	(*w^{j})					(*j^{w})		ɦ^{w}
prenasalised voiced stops	^{m}b^{w}, (^{m}b^{j})		(*$^{n̪}$d̪^{w})	^{n}d^{w}, (^{n}d^{j})			^{ŋ}g^{w}	
prenasalised voiced affricates				^{n}d^{zw}	(*^{n}d͡ʒ^{w})			
prenas. voiced fricatives[26]				^{n}z^{w}	(*^{n}ʒ^{w})			

The two consonants in Table 3 which are traditionally transcribed as aspirated voiceless affricates, namely t^{shw} and t^{ʃhw} do not contrast with a plain counterpart; we will therefore, by Occam's razor, treat them as plain consonants – although nothing hinges on this.

We have no explanation to offer as to why it is these particular two sets of consonants that are labiovelarised and palatalised. Indeed, the sets given here may not be complete since Venda allows morpheme-initial empty onsets and therefore additional labiovelarised and palatalised consonants may be created at morpheme boundaries. However, again, nothing hinges on this.

The representations of the labiovelarised and palatalised consonants are so simple to derive from the corresponding basic consonants that they do not need to be listed. All labiovelarised consonants have an additional U-head, and all palatalised consonants have an additional I head. So for example /b/ is (F,U), /b^{w}/ is (FU,U) and /b^{j}/ is (FI,U).

5.2. The consonant mutations of Venda

Historically, the consonant mutations of Venda are the result of the phonological influence of prefixes which today have no independent phonological manifestation except for their effect on the first consonant of a word. In some cases, the mutation spreads to the second consonant of a word (in the position #CV_), but this is quite rare. The surviving regular alternations are of two types, which we here call Mutation 1 and Mutation 2 respectively. Mutation 1 occurs with many nouns of class 5, and Mutation 2 affects nouns of classes 9 and 10. Both mutations also occur sporadically in other words, and there exist words of classes 5, 9 and 10 which do not undergo mutation.

[26] In many, perhaps all, cases the prenasalised voiced fricatives are not distinct from the corresponding affricates.

However, the mutations themselves are quite regular: if a noun stem begins with consonant X, then the mutated form of that consonant, X′, is always predictable.[27]

5.2.1. Mutation 1: Noun Class 5

One way of forming Noun Class 5 in Venda is by applying Mutation 1 to the first consonant of the stem. Mutation 1 precludes the use of a noun-class prefix; indeed, historically it arose from a prefix (or, in some cases, arguably more than one prefix). Apart from prefixation, there is a further way of forming words of Noun Class 5 which will be relevant later: doing nothing. The bare noun stem suffices for many words of Class 5.

Here we will only deal with the most common cases, i.e. mutations which either a) occur more than four times in unrelated words or b) occur four or less times but are consistent with the general picture. The data given here are taken from Murphy (1999), which in turn is based on van Warmelo (1989), and from JR's field notes. Consider the examples in Table 4.

Table 4. Examples of Mutation 1.

unmutated			*Mutation 1*		
word	*class*	*gloss*	*word*	*class*	*gloss*
mupani	3	mopani tree, ironwood tree	bani	5	plain covered mostly w/ mipani trees
bʷerepʷere[28]	5	coward	bʷerepʷere	5	coward
maṯalerʷa	6	wild dogs	ḏalerʷa	5	wild dog
matemba	6	big, wide-mouthed calabashes for flour storage	demba	5	wide-mouthed calabash for storing flour; xylophone resonator
makumba	6	eggs	gumba	5	egg
mukʷama	3	large pocket, satchel	gʷama	5	big pouch, satchel
muramba	3	wild orange	ʃamba	5	fruit of muramba
maluβa	6	flowers	dᶻuβa	5	flower, blossom
maβemba	6	pieces of cloth	vemba	5	piece of cloth

The alternations exemplified in Table 4 are summarized in Table 5.

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[27] In a small number of cases, there exist two possible mutated variants of one consonant. These will be dealt with individually below.

[28] Reduplicated words in which the first consonant is mutated but the second occurrence of that consonant is not are quite common in noun class 5. This is the only example of /pʷ/→/bʷ/ in our corpus.

Table 5. Changes effected by Mutation 1

unmutated	↓	p	p^w	t̪	t	k	k^w	r	l	ß
Mutation 1		b	b^w	d̪	d	g	g^w	ʃ	d^z	v

We can summarize the majority of the changes in Table 5 by stating that all obstruents become voiced. The two cases to which this generalisation does not apply, i.e. /r/ and /l/ will be considered after we have introduced Mutation 2.

5.2.2. Mutation 2: Noun Classes 9 and 10

Words of Noun Classes 9 and 10 can be formed by applying Mutation 2 to the word stem. As with Mutation 1, the use of this mutation precludes the use of a noun-class prefix.

Table 6. Examples of Mutation 2

unmutated			*Mutation 2*		
word	*class*	*gloss*	*word*	*class*	*gloss*
mupimo	3	measure	p^himo	9	measure
mut̪ovuma	3	Ekebergia Meyeri Presl. tree	t̪^{h}ovuma	9	fruit of the mut(tm)ovuma
mut̪^{w}ari	3	Croton gratissimus Burch. tree	t̪^{hw}ari	9	fruit of the mutwari
matu^{m}ba	6	ruins of huts	t^hu^{m}ba	9	temporary hut
lukena	11	notch	k^hena	10	notches
luk^{w}ea	11	sickle w/ long handle	k^{hw}ea	10	sickles w/ long handles and small semi-circular blades
tʃ^{h}iboɲo	7	certain note in Venda reed-flute ensemble; certain counter in mafuvha game	^{m}boɲo	9	bull or other male animal; certain star in East; certain counter in mufuvha; certain note in reed-flute ensemble
mud̪alo	3	abundance; feast after a victory	^{n}d̪alo	9	plenty, abundance
mada^{m}bi	6	misfortune sent to an enemy by sorcery	^{n}da^{m}bi	9	calamity, disaster
ged̪ane	5	chain	^{ŋ}ged̪ane	9	chain
lufuko	11	light dust	p^fuko	9	molerat; tuberculosis in glands
musen^{3}e	3	cabbage tree	t^{sh}en^{3}e	9	marrow of horn; cabbage tree fruit

unmutated			*Mutation 2*		
word	*class*	*gloss*	*word*	*class*	*gloss*
muʃato	3	sausage tree	tʃʰato	9	fruit of mushato
luvi	11	single grey hair	n̥ᵐbᵛi / n̥ᵐvi	10	grey hair
murapᶠa	3	Grewia flava DC shrub; Grewia villosa Willd. shrub	tʰapᶠa	9	fruit of murapfa
mulolo	3	wild banana tree	ⁿdolo	9	fruit of mulolo tree
lufiaɖ̥a	11	half a wooden knife sheath; mussel, oyster	kʰaɖ̥a	9	mussel; wooden sheath for knife
lufiʷiɖ̥a	11	(archaic) sickle	kʰʷiɖ̥a	10	(archaic) sickles
luɸalaɸala	11	horn used as a trumpet	pʰalaɸala / pʰalapʰala	9	sable antelope; sable horn, used as trumpet
luβone	11	candle	ᵐbone	9	candle

The alternations exemplified in Table 6 are summarized in Table 7.

Table 7. Changes effected by Mutation 2

unmutated	↓	p	t̥	t̥ʷ	t	k	kʷ	b	ɖ̥	d	g
Mutation 2		pʰ	t̥ʰ	t̥ʰʷ	tʰ	kʰ	kʰʷ	ᵐb	ⁿ̊ɖ̥	ⁿd	ᵑg

unmutated	↓	f	s	ʃ	v	r	l	ɦ	ɦʷ	ɸ	β
Mutation 2		pᶠ	tˢʰ	tʃʰ	ᵐbᵛ/ᵐv	tʰ	ⁿd	kʰ	kʰʷ	pʰ	ᵐb

Here the phonological effects of the mutation cannot be summarised quite so succinctly. Voiceless stops become aspirated; voiced stops become prenasalised; the voiceless fricatives /f,s,ʃ/ become aspirated affricates,[29] but /ɦ,ɦʷ,ɸ/ become aspirated stops; the voiced fricative /v/ becomes a prenasalised affricate, but /β/ becomes a prenasalised stop. /r/ behaves as if it were /t/, and /l/ as if it were /d/.

In Table 8 we see both mutations side by side, along with their representations according to our theory.

[29] It is not clear at the moment whether an aspirated [pʰᶠ] exists in Venda. If it does, then we are confident that /f/ will be mutated to it. If not, then the representation of /pʰᶠ/ will result in phonetic [pᶠ]. In either case, the generalisation stated here still holds.

Table 8. Mutations 1 and 2 schematically, with representations

Mutation 1	*repr.*		*unmutated*	*repr.*		*Mutation 2*	*repr.*
b	F,LU	←	p	F,U	→	p^{h}	F,HU
b^{w}	FU,LU	←	p^{w}	FU,U			
d̪	F,LI	←	t̪	F,I	→	$t̪^{h}$	F,HI
		←	$t̪^{w}$	FU,I	→	$t̪^{hw}$	FU,HI
d	F,LA	←	t	F,A	→	t^{h}	F,HA
g	F,L	←	k	F	→	k^{h}	F,H
g^{w}	FU,L	←	k^{w}	FU	→	k^{hw}	FU,H
			b	F,LU	→	^{m}b	LF,LU
			d̪	F,LI	→	$^{n̪}d̪$	LF,LI
			d	F,LA	→	^{n}d	LF,LA
			g	F,L	→	^{ŋ}g	LF,L
			f	H,U	→	p^{f}	FH,HU
			s	H,A	→	t^{sh}	FH,HA
			ʃ	H,I	→	$t^{ʃh}$	FH,HI
			v	H,LU	→	$^{m}b^{v}$ / ^{m}v	LFH,LU
ʃ	H,I	←	r	A	→	t^{h}	F,HA
d^{z}	FH,LA	←	l	A,L	→	^{n}d	LF,A
			ɦ	H	→	k^{h}	F,H
			ɦ^{w}	HU	→	k^{hw}	FU,H
			ɸ	F,FU	→	p^{h}	F,HU
v	H,LU	←	β	F,FLU	→	^{m}b	LF,U

Perhaps the most striking aspect of Table 8 is the large number of gaps in the first column. Even if we accept some form of the "free ride" principle, which would count words of Class 5 with an initial /b, d̪, d or g/ as having undergone Mutation 1 without any change, we are still left with the fricatives (except /β/) which do not become voiced (pace a possible free ride for /v/), and the strange change of /β/ to [v].

Mutation 2 seems to be more homogeneous than Mutation 1. It is one of the rare cases of a phonological process which introduces a stop component to its output, and might be considered strong evidence for Jensen's (1994) analysis of stopness, if the representation of the mutated forms has a melodically empty structure (possibly a historical remnant of the original noun-class prefix). In short, every output to Mutation 2 will have an F(or '_')-head. Notice that this operation will force an A-head of the input out to become an operator.

Also, every output of Mutation 2 has precisely one tone element. If L (or H) was already present in the input, nothing is added; otherwise H is added to the representation. Additionally, an L-operator in the input will be copied into the head. And finally, the constellation of F-head plus F-operator is confined to

structures with a non-complex head, i.e. when there is an additional (tone-) element in the head, the F-operator must disappear..

Thus we can summarise the basic processes underlying the Venda mutations as follows:

Mutation 1: – add an L operator (if not already present or head is A).
Mutation 2: – add an F head (if not already present), which forces A out,
– add an H operator (if neither H nor L is already present),
– copy[30] any L-operator into the head,
– delete any F-operator if the head is complex.

These processes account for all mutations except for the last three cases of Mutation 1 ([ʃ, dz, v]) in all of which additional elements are introduced to the representation. However, these three cases are also not overwhelmingly common in the language, and certainly far less frequent than the other, more regular cases. So we can happily commit them (or at least their irregular additional elements) to the lexicon.

6. Conclusion

Starting with elements, we assume that the number and characteristics of elements as the basic primitives of phonological theory is not a coincidence. We take them as a consequence of their internal structure: in particular we suppose that they can be viewed as consisting of the sub-elemental properties, V and C plus a further distinctive property we labelled "up" and "down" for elements which contain only one of the properties C and V. Assuming that having none of these features results in a specification very much akin to Jonathan Kaye's (2000) identity element, we arrive at a number of elements 5+1. The major changes to the theory are concerned with structure in melody: we propose that elements within one melodic expression are structured as well: they universally obey an intrinsic (partial) ordering. This is necessary in order to keep the expressive power of the theory within plausible limits. Structuring may obtain vertically (ordered sets in melodic expressions) as well as horizontally (complex melodic expressions). Phonological structure at higher levels is radically minimal: the only function the skeleton fulfils is to provide anchoring points to melodic material, and it is confined to C and V-positions, both together forming a unit. Phonological structure is defined according to the x-bar theoretic principle that the head projects and takes a specifier position to its left. By definition these two positions have different characteristics; referring to the two basic sub-elemental properties we again label them C and

[30] Actually, we would prefer to assume that the stop part of the prenasalised stops of Venda is in fact neutral (not voiced), then this should read "move" instead of "copy". However, the analysis of these consonants is not at issue here, and so we have given the analysis that is easier to follow.

V. The resulting constituent ($\bar{x}$) enters higher prosodic structure. Reference to branching rhymes / rhyme complements is impossible in our account. These phenomena have to be re-interpreted in terms of prosodic structure. Regarding alleged coda-onset configurations we give some examples to show how this move could be pursued. As a result, we are forced to give a new definition of licensing, especially when apparent inter-onset relations seem to play a role. Abstracting away from standard branching onsets, which we retain as complex melodic expressions, we formulate an extended definition of government. Government is a relation between two $\bar{x}$-constituents and operates strictly from right to left. It comes in two manifestations: V-government, which is equivalent to standard proper government, but which is precluded from minimal prosodic domains; and C-government, which is sensitive to the melodic content of the specifiers (C-positions) of a phonological $\bar{x}$-constituent. Certain other phenomena like templatic properties of word stems in Germanic languages, the minimal word stem, super-heavy rhymes, domain final consonant clusters find a natural explanation in this new framework.

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