

## Chapter 6

# Skeletal and suprasegmental structure within Government Phonology

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## 1 Introduction

The purpose of this chapter is to give an overview of the skeleton and constituent structure in Government Phonology (GP),<sup>1</sup> along with licensing and governing relations, as provided for in the theory. It is intended as a critical overview (drawing heavily on work by other researchers in the field, as indicated by the references) which both extols the virtues of GP and points out possible shortcomings, in the hope that these will be addressed in future work.

The reader should be warned that my discussion may not always be completely impartial, as my own commitment is to GP, which (*pace* Coleman this volume and, perhaps, pending further developments in Declarative Lexical Phonology) I consider to be, at least potentially, the most highly restricted phonological theory currently available.

The discussion proceeds as follows. I begin with a comparison of different approaches to the skeleton itself (CV Phonology (Clements and Keyser 1983), X theory (Levin 1985, Lowenstamm and Kaye 1986) and Moraic Phonology (e.g. Hyman 1985, Hayes 1989, Bickmore, this volume, Zec, this volume)). This will lead on to the presentation of central aspects of GP in Sections 3 and 4, with Section 3 dealing with governing relations and constituent structure and Section 4 with the GP notion of licensing. The next section (Section 5) is wholly devoted to a comparison of GP and moraic approaches to specific phonological issues. Section 6 concludes the chapter.

## 2 The skeleton

### 2.1 Introduction: standard function and common ground

The skeleton provides a kind of hub which mediates between the melody, or segmental, tier (where feature bundles, autosegments, elements, or whatever other atoms of phonological representations are used in a particular theory, are located) and higher-level prosodic tiers (e.g. the syllable tier in the framework of Clements and Keyser 1983. See, too, Bickmore, this volume). What exactly are the units which are represented on the skeletal tier? The answer with probably the longest tradition in modern phonology is that these units represent time slots which correspond roughly to the duration of an individual segment. So, a short vowel (or light diphthong) or a single consonant would take up one of these units, while a long vowel (or heavy diphthong) or a geminate consonant would be associated with two. Conversely, a contour segment with linearly ordered internal structure (as described e.g. in Steriade 1982 and McCarthy and Prince 1986), such as an affricate or a prenasalized stop, for example, would be represented by two feature bundles (or sets of whatever phonological atoms are in use) being associated with a single unit on the skeletal tier. Theories based on this kind of skeleton generally consider what I have just described to be common ground. The picture becomes rather less harmonious, though, when the actual identity of the units of the skeletal tier is at issue. Essentially two approaches can be distinguished here.

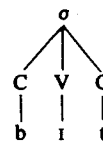
### 2.2 The CV tier approach

One of the two approaches to the skeletal tier is that adopted by, among others, Clements and Keyser (1983). This is often referred to as the CV approach and was first proposed by McCarthy (1979). It makes the claim that the units on the skeletal tier are of two distinct types and that the distinction between them plays a vital role in phonological representations. Cs and Vs are employed, together with an essentially flat syllable structure, which exhibits no internal hierarchy. The English word *bit* would be represented

(1) Syllable tier

CV tier

Melody tier



as shown in (1) in Clements and Keyser's CV approach. The representation in (1) indicates that *bit* is interpreted as consisting of a single closed syllable, with the vowel (marked as V on the CV tier) constituting the nucleus or peak of that syllable and the two consonants (marked as C) occupying non-peak positions within the syllable.

The advantage of the CV tier, according to Clements and Keyser (1983: 10), is that 'the units of the CV tier themselves define functional positions (peak versus non-peak) within the syllable'. Therefore, no hierarchical syllable structure is required. In other words, Cs and Vs can be daughters of the syllable node. There is no need for other nodes (such as an onset or rhyme node, see e.g. (5) on p. 184) to intervene and group them into constituents dominated by the syllable node. Whether a segment constitutes a syllable peak or whether it belongs to the syllable margin can be read off the CV tier itself. Hierarchical structure above the CV tier (but within the syllable itself) would only introduce redundancy.<sup>2</sup>

Assuming a framework which employs binary features, the CV tier further has the effect of 'subsuming' (1983: 10) the feature [ $\pm$ syllabic]. This is the case because Clements and Keyser equate a V on the CV tier with a [ $+$ syllabic] segment on the melody tier and a C with a [ $-$ syllabic] segment. Clements and Keyser's approach here is by no means uncontroversial. Marantz (1982), for example, makes a case for both a CV tier *and* the feature [ $\pm$ syllabic] to prevent vocalic segments from being linked to a C-slot and consonantal segments to a V-slot. This issue will be discussed in more detail in Section 2.3.

### 2.3 The X theory approach

An alternative to the CV tier is a skeletal tier where all units are of the same type. The most common representation of these units in recent work is as a series of xs (or Xs), so that theories employing this particular kind of skeletal tier are sometimes referred to as X theories (e.g. in Hayes 1989). The X theory approach to the skeletal tier was first argued for in Levin (1985) and in Lowenstamm and Kaye (1986).

Taking representations such as (2), which incorporate both a standard CV tier and a hierarchical prosodic tier (note that there is an additional node immediately dominating the V and the final C) as their point of departure, Lowenstamm and Kaye (1986) investigate whether there is any necessary information encoded on the CV tier which is not completely derivable from the shape of the prosodic tier (that is, Clements and Keyser's syllable tier and the

#### (2) Prosodic tier

Skeletal (CV) tier

Melody tier



constituents dominated by the syllable node). They come to the conclusion that, given this comparatively rich hierarchical structure on the prosodic tier (as opposed to the flat structure illustrated in (1)), the CV tier contains redundancies, since the functional positions within the syllable assumed by individual segments can be read off the prosodic tier anyway. So, in (2), for example, the onset is immediately dominated by the syllable node. It is followed by a branching constituent which dominates the nucleus of the syllable (left branch) and its coda (right branch). The Cs and the V on the skeletal tier have nothing to add to this information.

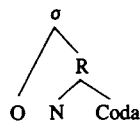
All this stands to reason, but it is not immediately obvious why we should dispense with the CV tier rather than the hierarchical structure of the prosodic tier. Or, to put it differently, does encoding this kind of information on the prosodic tier have advantages over encoding it on the skeletal tier? If it can be shown that there are phonological processes which make reference to information encodable only on the prosodic tier and not the CV tier, then we would have an argument in favour of abandoning the CV tier, and not the rich structure on the prosodic tier.

Such evidence is provided by Lowenstamm and Kaye (1986) in their study of gemination and compensatory lengthening (defined by Hayes (1989: 260) as 'the lengthening of a segment triggered by the deletion or shortening of a nearby segment'; see also the discussion in Bickmore, this volume) in Tiberian Hebrew. They begin by showing that all properties ascribed to the skeletal tier are in fact predictable from information encoded on the prosodic tier, which leads them to propose the syllable structure illustrated in (3a), the geometry of which is partially ambiguous. It is clear that the left branch of the syllable constitutes the onset (and would be represented by a C in a CV tier framework). As such, it dominates a [ $-$ vocalic] segment. The right branch of the syllable, by contrast, may constitute either a (branching) rhyme, dominating a non-branching nucleus and a coda (as shown in (3b)) or a branching nucleus (as shown in (3c)). In the former case, we are dealing with a closed syllable (containing a short vowel, defined as [ $+$ vocalic], followed by a consonant, defined as [ $-$ vocalic]) and in the latter,

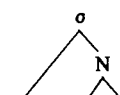
(3)



(a)



(b)



(c)

with a long vowel or heavy diphthong ([+vocalic] followed by [+vocalic]). They also introduce the universal principle in (4).

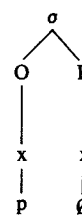
- (4) Null elements may not appear in branching constituents, where constituent refers to the prosodic constituent immediately dominating the null element.

This principle essentially states that the only licit null elements are null onset (5a), null rhyme (5b), null nucleus (5c) and null coda (5d). For greater clarity, I have inserted constituent labels (O for

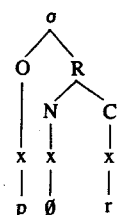
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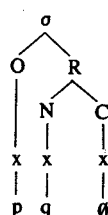
(a)



(b)



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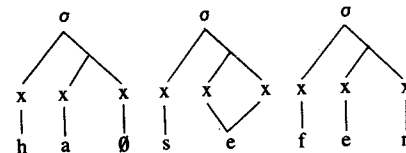


(d)

onset, R for rhyme, N for nucleus and C for coda) and a skeletal tier with xs. The constituent labels do, however, have the undesirable effect of implying that R dominates N and C. This in itself is perfectly reasonable, but I must point out that Lowenstamm and Kaye (1986) make no such claim. On the contrary, the partial ambiguity of their syllable structure (as illustrated in (3)) plays an important role in their argumentation. The variables p, q and r in (5) represent suitable segments. Given the restrictions on null elements illustrated in (5), certain structures can be excluded. For example, in (3c), the nucleus could not dominate a skeletal position without phonetic content, since the nucleus is branching (Lowenstamm and Kaye 1986: 103). The nucleus in (3b), by contrast, could dominate an empty position, as it itself is non-branching.

Now consider the Tiberian Hebrew word *seefer* 'book', which undergoes gemination of the initial consonant when the clitic definite article *ha* is added, yielding *hasseef* 'the book'. In my interpretation of Lowenstamm and Kaye (1986), *hasseef* would

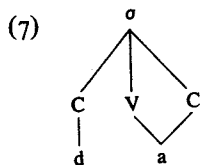
(6)



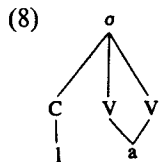
have the underlying representation shown in (6). The question is now whether the null element at the end of the initial syllable is part of a branching nucleus or whether it is within a non-branching coda. The prediction made by (4) is unequivocal. The null element cannot be dominated by a branching nucleus. Therefore, it must be dominated by a coda. A coda position can be filled by a [-vocalic] segment, so that the *s* should spread into it, resulting in gemination. This is indeed what happens, as witnessed by the form *hasseef*.

The same effect could have been achieved in a CV-tier framework by specifying the empty position as a C. However, this specification would have raised the issue of how to deal with related forms, where gemination is blocked and compensatory vowel lengthening takes place instead. To derive the correct forms one would probably have to posit a CVV... rather than a CVC... template for these cases, missing the generalization that compensatory lengthening is a direct consequence of the blocking of gemination. The flexibility of the skeletal tier employed by Lowenstamm and Kaye (1986), the authors argue, makes it possible for this generalization to be captured through a universal principle (but see Hayes 1988 for some critical comments on their argumentation).

Lowenstamm and Kaye (1986) also point out a problem with the interpretation of vowels which are attached to a C slot.<sup>3</sup> They observe that analyses within a CV-tier framework sometimes require vowel segments to be attached to a position which is specified as a C. This raises the question of how such a segment should be interpreted. Given Clements and Keyser's (1983: 10f.) definitions of C and V, as presented in Section 2.2, we should be dealing with a non-syllabic vowel which occupies a non-peak position within a syllable. To see whether this is the desired interpretation, consider the example of certain types of word-final long vowels in Turkish, for which Clements and Keyser (1983: 70) posit representations such as the one shown in (7). This representation is derived by a rule spreading /a/ to the final C, which has no segmental content in the underlying representation. It captures the fact that, with regard to suffixation, words ending in these particular vowels behave as if they ended in a consonant. Such words contrast with others which also end in a long vowel, but where a suffix allomorphy rule

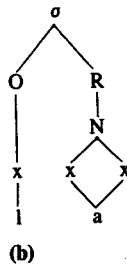
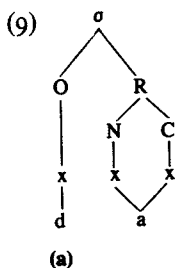


triggered by final consonants (and also by vowels of the type illustrated in (7)) fails to apply. The latter type would then be represented as in (8). This is an elegant solution. However, we have



to bear in mind that the second half of the [a:] vowel as represented in (7) is claimed to be [-syllabic] and non-peak by its association with the C on the CV tier. Therefore, we would expect it to have some special phonetic properties, perhaps a sudden drop in amplitude in the signal. Clements and Keyser discuss some of the phonetic implications of their analysis, but they have nothing unusual to report about the realization of structures such as the one illustrated in (7).

Let us now turn to a possible X theory approach to the same phonological phenomenon of Turkish and see whether it fares better. Dealing with the purely phonological aspects of this phenomenon is as straightforward in X theory as it is in CV Phonology. All that has to be done is to syllabify the final portion of the long vowel in (7) into, say, a syllable coda and the corresponding part of the long vowel in (8) into a nucleus, as illustrated in (9a) and (9b) respectively. (See Levin 1985: 188–96 for a very thoroughly argued analysis of the same data, which comes essentially to the same



conclusion.) As we have seen, Clements and Keyser's proposals predict that the vowel in [da:] should differ from the vowel in [la:] phonetically, if their claims about syllable peaks vs. non-peaks are to be meaningful. The same prediction is made by the X theory alternative, as shown in (9). As far as we can ascertain, this prediction is incorrect.

It seems that, although Lowenstamm and Kaye (1986) may well have a point in arguing that structures where a vowel is associated with a C slot should be ruled out, this is not necessarily a valid argument against the CV tier and in favour of X theory. On the contrary, the problems identified for the CV tier can equally well arise in frameworks employing an x skeleton with hierarchical prosodic structure.

Evidence which, in my view, does provide reasonably good arguments against the CV tier and in favour of X theory is contained in Levin (1985: 29ff.). Applying a CV-tier-based analysis to reduplication in Mokilese, a Micronesian language, Levin finds that 'encoding on the CV tier is vacuous, since whether a slot is C or V does not play a role in association' (p. 39). In fact, the CV tier analysis turns out not just to contain redundancy but to make incorrect predictions as well. Levin, therefore, concludes that 'the CV analysis is untenable' (p. 40), at least for Mokilese reduplication.

Her investigation of reduplication in Ponapean, another Micronesian language, provides further evidence that CV analyses only introduce redundancy. She observes that 'there is no sense to marking slots as C's or V's since ... association will proceed one-to-one left-to-right regardless of the skeletal specifications' (p. 47).

Levin (1985: 187–256) also tackles data from Turkish, Klamath (both dealt with in Clements and Keyser 1983), Hungarian (Vago 1987) and Ancient Greek (Steriade 1982), for all of which CV-based analyses have been proposed in the works cited. She argues, in my view convincingly, in favour of alternative analyses which make reference only to x slots, not Cs and Vs.

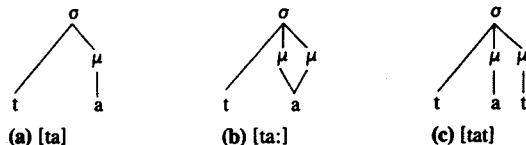
It seems, then, that X theories have a slight advantage in that they incorporate less redundancy (as shown by Levin 1985) and provide greater flexibility through the combination of unspecified timing slots and rich hierarchical syllable structure. Choosing a skeletal tier consisting solely of xs, together with such hierarchical syllable structure may then be the best course to follow. As observed by Durand (1990a: 265), 'this type of representation has now become extremely common in phonology and is accepted by most phonologists working within a multidimensional framework'. It is also the approach chosen in GP.

## 2.4 Dispensing with a segment-based skeleton: Moraic Phonology

Before moving on to structures above the skeletal tier, I would like to address a question posed by a phonological theory which dispenses with a skeleton representing segmental timing units altogether: Moraic Phonology (also referred to as Moraic Theory, e.g. in Tranel 1991). The question asked by this theory is this: is there any point in representing segmental timing units? After all, as McCarthy and Prince (1986: 2) put it, 'it is a commonplace of phonology that rules count moras, syllables or feet but never segments'. If that is indeed the case, then it would make sense to abandon the units represented by xs (or Cs and Vs) and to replace them with weight units, which essentially correspond to moras. Such an approach was first developed in Hyman (1985) and has received interesting modifications in Hayes (1989) (see also Bickmore this volume and Katamba this volume) for discussion as well as Itô 1989 and McCarthy and Prince 1986, 1990 for related work).

According to Hayes (1989), the syllable node immediately dominates moras, to which those units on the melody tier which carry phonological weight are linked. In other words, the mora has two functions. First, it encodes phonological weight inasmuch as a phonologically light syllable has only a single mora, while a heavy syllable has two. Second, it represents a phonological position. In this role it can be used to indicate length, just as xs or Cs and Vs can. For example, a single vocalic feature matrix linked to two moras would be interpreted as both long and phonologically heavy. An interesting prediction made by this interpretation of the mora is that no long vowel can ever be phonologically light, which, to my knowledge, is correct. Melodic units which are phonologically weightless (such as onsets, which play no role in the determination of syllable weight, e.g. for stress assignment) are directly linked to the syllable node, as illustrated in (10) (adapted from Hayes 1989: 254).

(10)



Let me return, for the moment, to McCarthy and Prince's (1986) claim about the absence of segment-counting rules (and thus processes), which sums up the motivation of Moraic Phonology. If this claim is correct, why have so many phonologists in the past wasted time and ink on CV tiers and x tiers, and still continue to do so?

My answer to this question is that McCarthy and Prince are only partially right. It does indeed seem unlikely that actual segment-counting processes exist. It may, however, be the case that there are processes which make reference to skeletal positions in some way other than counting. They may, for example, be sensitive to the presence vs. the absence of a skeletal position (as in the case of the distinction between words beginning in *h-aspiré* or a vowel in French; see Section 5.1). Similarly, there may be constituents derived from relations between skeletal positions (including onset positions) which have to be referred to in the context of processes such as reduplication (see discussion in Section 5.2).

Another aspect of McCarthy and Prince's claim about 'rules count[ing] moras, syllables or feet but never segments' which I would like to challenge here is that phonological processes count syllables. As far as I know, no evidence has been put forward in the literature to show conclusively that it is indeed entire syllables which are being counted, rather than rhymes. Still, the fact that, in their treatment of reduplication in a variety of languages, McCarthy and Prince (1986) make extensive reference to the syllable seems to suggest that the syllable plays an important role, at least for accounts of this particular phonological event. As has been shown by Kaye (1991), it is, however, possible to capture the same generalizations reasonably elegantly without invoking a syllable node. How this can be done will be illustrated in Section 5.2.

Whether moras are indispensable in phonological theory is a question which I will not address in this chapter. The reader is referred to Yoshida (1990, 1991) for a GP analysis of aspects of Japanese phonology which calls into question the claim that moras have to be invoked. Yoshida (1991: 70ff.) also provides some discussion of problematic aspects of Moraic Phonology.

Clearly, no further arguments in favour of the GP approach to the issues raised by Moraic Phonology can be put forward until a more complete picture of GP has been presented. So, let me move on from the discussion of the skeleton *per se* to prosodic levels above the skeleton and their specific properties in GP. This discussion will establish the background to the comparative section (Section 5) towards the end of this chapter.

## 3 Governing relations and constituent structure in GP

### 3.1 Governing relations define constituents

In this Section I provide a brief overview of the governing relations which apply in GP and of the constituents which they define. More

detailed discussion of their implications follows in Sections 4 and 5 below.

We have seen that GP employs a maximally simple skeletal tier containing only xs. These xs are not just arranged next to one another. Instead, they enter into asymmetric binary relations with one another which are known as governing relations. Governing relations define the prosodic constituents into which the skeletal positions are grouped.

The 'area' over which a governing relation extends defines a governing domain. In other words, two skeletal positions in a governing relation constitute a governing domain. A governing domain is sometimes called a phonological domain. The term 'domain', however, is used in GP not just to refer to governing (or phonological) domains, as just defined, but also to morphological domains.

A detailed discussion of morphological domains in GP would be beyond the scope of this chapter and what follows should be taken as a very brief sketch intended to provide some background for the discussion of licensing in Section 4 (see also Kaye, this volume, section 2.2).

Morphological domains (also known as analytic domains) would typically be delimited by #(word-)boundaries in an orthodox SPE-type framework. A morphological domain may contain a + (morpheme- or formative-)boundary, but the phonology is not sensitive to +-boundaries. In other words, +-boundaries are treated by the phonology as if they did not exist. For example, a denominal adjective such as #parent + al# is interpreted as a single morphological domain by the phonology. Morphology involving nothing stronger than a +-boundary is, therefore, known as non-analytic morphology.

There are essentially the following three morphological configurations which play a role in GP, most of which can, of course, be further expanded by concatenation.

The first configuration consists of a single analytic domain, e.g. [A] or [A + B]. (Analytic boundaries appear as single brackets [] and non-analytic boundaries as +.) An example of [A] would be a morphologically simple word such as [boy] or [go]. [A + B], by contrast, shows the morphological structure of a word such as the above-mentioned [parent + al]. Non-analytic affixation in GP corresponds very roughly to Level 1 morphology in the framework of Lexical Phonology (see Kaisse and Shaw 1985 for an overview). A suffix such as adjectival -al, for example, would be treated as non-analytic in GP because its presence affects the location of primary stress, with primary stress falling on the initial syllable in *parent* but on the penultimate syllable in *parental*. Apart from affecting

stress assignment, non-analytic affixes are typically unproductive and exhibit a good deal of lexical selectivity. They may also be associated with phenomena such as so-called closed-syllable shortening (e.g. *keep* vs. *kept* in English; see Section 4.1 for discussion). Analytic affixes, on the other hand, are usually stress-neutral, clearly productive and exhibit no lexical selectivity. No closed-syllable shortening effects are observed in the context of analytic affixation.

Analytic affixation characterizes both the second and third morphological configurations provided for in GP. The second involves cases such as [[A]B], which contains two analytic domains. This can be exemplified by words such as the regular past tense form [[*peep*]ed]. The root (*peep*) occupies a domain of its own, while the analytic suffix does not, which, among other things, makes the prediction that the suffix is unstressed.

Third, there is the three-domain [[A][B]]-type configuration, which is best illustrated by compounds, e.g. [[*black*][*board*]] or [[*tea*][*spoon*]]. Each term of the compound occupies its own domain, so that a full vowel and some degree of stress would be expected for each one.

In what follows I will not always distinguish phonological and morphological domains from one another explicitly. This is because it is either clear from the context what is meant or because the distinction is unimportant.

The fact that governing relations are asymmetric means that one position within a governing domain governs, while the other is governed. The former is usually referred to as the governor (or sometimes as the head), while the latter, i.e. the governed position, is known as the governee (or complement).

According to Kaye et al. (henceforth KLV) (1990: 221), governing relations are established at the level of lexical representation, where the level of lexical representation is defined as 'the level at which the stem is attached to accompanying affixes, if any' (KLV 1990, note 34). A principle of grammar, the Projection Principle (KLV 1990: 221), ensures that there is no change in governing relations (and thus constituent structure) from underlying representation to the final output of a derivation. So, according to the Projection Principle (11), the phonology cannot manipulate governing relations.

#### (11) Projection Principle

Governing relations are defined at the level of lexical representation and remain constant throughout a phonological derivation.

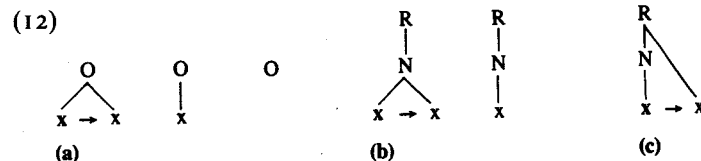
The Projection Principle precludes any changes in governing relations during the course of derivation, which means that resyllabification is impossible. This is desirable, because it makes the framework more constrained than any theory which countenances resyllabification. Note that the Projection Principle allows for governing relations to be *added* in the course of derivation, while *changing* or *deleting* existing governing relations is prohibited.<sup>4</sup> This interpretation of (11) is required for handling analytic morphology, i.e. analytic affixation and compounding. As far as analytic morphology is concerned, on the first cycle, governing relations hold within an analytic domain only. On the second cycle, however, additional skeletal points become available, and there is evidence to suggest that new governing relations are established which involve skeletal positions formerly separated by an analytic domain boundary (see e.g. Brockhaus 1992: 224 for a relevant representation). One piece of evidence to support this reading of (11) comes from stress assignment, which entails building governing relations at various levels of nuclear projection. These governing relations are first established within analytic domains and preserved on successive cycles, but, as further domains become available (until word formation has been completed) additional governing (= stress) relations are added.

To return to the discussion of government in GP, the theory recognizes government at three levels, viz. constituent government (holding between skeletal positions within a constituent and perhaps more aptly named intra-constituent government), inter-constituent government (holding between skeletal positions in two contiguous constituents) and government at a level of nuclear projection, which holds between heads of nuclear constituents. Government at the first two levels is strictly local<sup>5</sup> and strictly directional. In other words, positions which are in a governing relation must be adjacent (strict locality). Government is universally defined as being left-headed for constituent government and right-headed for inter-constituent government (strict directionality).

A direct result of these two principles (strict locality and strict directionality) is that constituents are maximally binary, as it is logically impossible for *both* strict directionality *and* strict locality to be respected in a branching constituent which is anything other than binary (see also Kaye 1987: 132, Kaye 1990a: 306f., or Charette 1991: 16f. for the proof). In a ternary constituent, for example, the governor is either the skeletal position in the centre, which means that it has to govern in more than one direction, or it is a position at one of the two edges of the constituent, with the result that it is not adjacent to one of its governees. At first sight,

restricting constituents to maximally two positions may appear to be an approach which is faced with numerous counterexamples, e.g. initial *s* + consonant sequences such as, say, *str* in Italian. As shown in KLV (1990), however, the members of this sequence are not syllabified into a single constituent, but *two* adjacent constituents. Further evidence regarding the syllabification of *s* + C clusters into two separate constituents is adduced in Kaye (1992b) for (European) Portuguese, (Ancient) Greek and English. To the extent that this analysis can be applied to other languages (and there is no particular reason why this should be impossible), such *s* + consonant sequences do not constitute counterexamples to the GP claim that constituents are maximally binary.

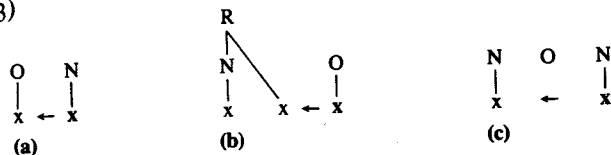
There are three prosodic constituents, viz. onset (O), nucleus (N) and rhyme (R). The nucleus is the head of the rhyme (left branch). In other words, the rhyme is the first projection of the nucleus, so that R can be understood as N'. Where the rhyme node dominates only a nucleus (as in (12b) below), the rhyme node is, therefore, frequently omitted, a practice which I shall adopt throughout this chapter. The three GP constituents take the forms shown in (12a-c) below. All three may or may not be branching, but the only constituent which may lack a skeletal point is the onset (as shown in (12a)). Note that the syllable and the coda are not among the GP constituents, a claim which I discuss in more detail in Section 3.4. All references to 'syllable structure', 'syllabification' and so on should, therefore, be interpreted as concessions to readers more familiar with syllable-based frameworks. Similarly, the terms 'onset', 'nucleus' and 'rhyme' should not be taken to indicate that the constituents to which they refer are parts of some larger unit, such as the syllable. Instead, to paraphrase Rennison's (1992) view of this issue, the constituents labelled by these three terms are primitives of the theory of GP, and the terms used are suggestive only of the historical derivation of these primitives from earlier work on the syllable.



The arrows in (12) indicate the direction of government. Heads are emboldened. GP allows for the inter-constituent governing relations illustrated in (13a-c). In (13a), a nucleus governs a preceding onset, and an onset position governs a preceding post-nuclear

rhymal position (or 'coda' for short) in (13b). The configuration in (13c) involves a governing relation between nuclear positions at the skeletal level. Such a governing relation can be established only where the intervening onset position has no skeletal point. Otherwise, a conflict with the principle of strict locality would arise. Like

(13)



constituent government and inter-constituent government, government at a level of nuclear projection is also local (but not strictly so), in the sense that, at the relevant level of projection, the two nuclear constituents concerned are adjacent, although other material may intervene at lower levels. Unlike constituent and inter-constituent government, government by nuclear projection is language-specific in its directionality. Directionality at this level of government is parametrically variable and is reflected in prosodic phenomena such as tone, stress and harmony. Both right-headed and left-headed government at this level are shown in (14) below.

(14)

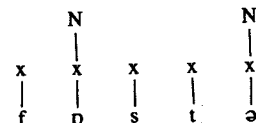


For governing relations to hold, the segments associated with the skeletal positions which enter into a governing relation have to fulfil certain charm or complexity requirements. These are discussed in the next section.

### 3.2 Governing relations depend on charm and complexity

We have seen that skeletal positions enter into governing relations which define constituents. Given a string of skeletal positions, how do we know exactly what sort of governing relations they contract with each other? Take the English verb *foster* (RP pronunciation [fɒstə]) as an example. As suggested by Charette (1991: 11f.), its underlying representation would take a form something like that shown in (15).

(15)



The two nuclear positions are lexically associated with a constituent nucleus, while the remaining positions still have to be projected to be incorporated in constituents. Clearly, some of them will be part of onsets, but which ones? The initial fricative is a clear-cut case. It simply has to be projected to a non-branching onset. What about the *s* + *t* cluster, though? Should this be treated as a branching onset? In spite of the fact that word-initial *s* + *t* sequences are attested, GP does not allow us to simply assume that such clusters are onsets. Recall that (initial) *s* + *C* clusters in languages such as Italian, Ancient Greek, European Portuguese and English have been shown not to form branching onsets (see KLV 1990 and Kaye 1992). For the sake of argument, let us assume, for the moment, that we are unaware of this evidence. The decision which has to be made at this point then boils down to the following question. Which of the two segments concerned (*s* and *t*) can govern the other? If it turns out that *s* can govern *t*, then left-to-right government applies, which means that the two positions are members of a branching constituent – a branching onset, to be precise. If, however, *t* can govern *s*, but not vice versa, then a right-to-left governing relation holds. Right-to-left government is inter-constituent government, so that the *s* would occupy a post-nuclear rhymal position, while the *t* must be in the governing onset. To determine this, we need to consider the segmental representations involved.

Let me begin with a general discussion of segmental composition and charm. As discussed in Harris and Lindsey (as well as Coleman), this volume, all segments are either elements themselves or consist of a combination of elements (see especially KLV 1985, KLV 1990, Harris 1990b and Kaye 1990c for further details). Each element is fully specified, which means that elements are pronounceable at all levels of derivation, by themselves or in combination with others. There is no underspecification in GP. One of the inalienable properties of each element is its charm value. Elements, by definition, are either charmed (positively or negatively) or charmless (also, somewhat misleadingly, referred to as 'neutrally charmed' or simply 'neutral'). Charm values are indicated by superscript <sup>+</sup> (for positive charm), <sup>-</sup> (for negative charm) and <sup>°</sup> (for charmlessness or neutral charm).

The combination of elements is carried out through fusion



operations, each of which involves a pair of elements, with one being defined as the head and the other as the operator. When elements fuse with one another to form complex segments, charm values impose certain restrictions on which elements can fuse with which. Elements with like charm typically repel one another, whereas elements with opposite charm values (+ and -) attract one another. Charmless elements, however, can freely fuse with one another, as well as with charmed elements.

Each element has a single salient, or marked, property. It is this property which is contributed by the operator in the process of fusion, while everything else (including the charm value) is normally taken from the head. The only element which does not have a salient property is the so-called 'cold vowel'  $v^\circ$ . The implication of this is that fusion with the cold vowel in the operator role results in no change to the head at all. The presence of the cold vowel only manifests itself when the cold vowel itself is the head.

All GP elements, together with their charm values and their phonetic realizations, as well as their salient and unmarked properties, are listed in (16) below. The unmarked properties are background properties which make it possible for elements to be realized even in isolation. Note that salient and unmarked properties are expressed in articulatory terms for the sole reason that full acoustic definitions of all elements are not yet available. See Lindsey and Harris (1990), Harris and Lindsey (1991), Harris and Lindsey, this volume, Williams (1992) or Williams and Brockhaus (1992) for some of the sort of definitions I would have liked to use here. (But see Harris and Lindsey, this volume for a less traditional account of GP elements.)

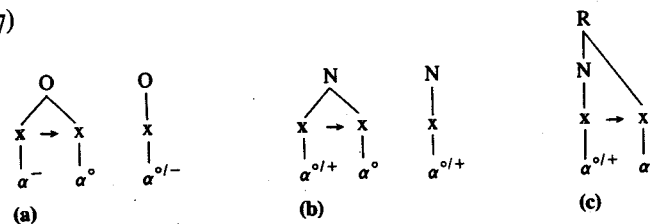
(16)

		Salient property	Unmarked properties
$U^\circ$	[u]	labial	back, high, lax ...
$R^\circ$	[r]	coronal	tap, ...
$I^\circ$	[i]	palatal	non-labial, high, lax ...
$A^+$	[a]	non-high	non-labial, lax ...
$I^+$	[i]	ATR-ness	non-labial, back, high ...
$v^\circ$	[ɪ]	none	non-labial, back, high, lax ...
$h^\circ$	[h]	narrowed	glottal, ...
$p^\circ$	[p]	occluded	glottal, ...
$N^+$	[ŋ]	nasal	nonlabial, back ...
$L^-$	L	slack vocal folds	
$H^-$	H	stiff vocal folds	

Elements are arranged on autosegmental lines in such a way that each element occupies its own line (labelled according to the salient property of the element).<sup>6</sup> Phonological representations consist of a two-dimensional grid where autosegmental lines and segmental positions intersect. According to KLV (1985: 308), 'the absence of a real element [i.e. an element with a salient property] at intersections has a specific interpretation: these "empty" intersections are in fact filled by the cold vowel'.

In the GP framework, charmed as well as charmless segments can govern, while only charmless segments are potential governees. Positively charmed segments may only occupy nuclear head positions, while negatively charmed segments are restricted to non-nuclear (head) positions (KLV 1990: 204). This is illustrated in (17), where the variable  $\alpha$  stands for any suitable segment.

(17)



Charmed segments are 'strong' governors in the sense that they can govern simply by virtue of their charm, while charmless segments are 'weak' governors which, according to the Complexity Condition (18) (closely following Harris 1990b and KLV 1990), can govern only if they are no less complex than their governees.<sup>7</sup>

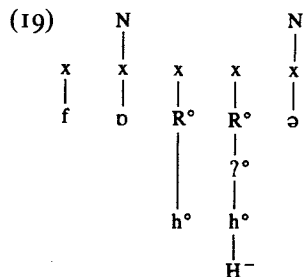
### (18) Complexity Condition

Let  $\alpha$  and  $\beta$  be charmless segments occupying the positions A and B respectively. Then, if A governs B,  $\beta$  must be no more complex than  $\alpha$ .

Complexity is calculated on the basis of the number of elements (excluding the cold vowel in the operator role) of which a segmental representation is composed. The more elements it contains, the more complex it is deemed to be.

We are now in a position to take a closer look at the segmental representations of *s* and *t*, as they occur in *foster* (see (19) below). The remaining segments are still in broad transcription. Also, the autosegmental element lines and the cold vowels at empty intersections have been omitted to keep representations as simple as

possible. The arrangement of elements on the representational grid has the additional effect of obscuring the fact that segmental composition involves pairwise fusion of elements. This property of segmental composition in GP is only visible when the matrix calculus introduced in KLV (1985) (and updated in Kaye 1990c) is employed, which would assign the expression  $(H^-(h^-(P^-(R^+)^-))^-)$  to the  $t^s$  in *foster*. The segmental representations in (19) indicate



that *s* has neutral charm, while *t* is negatively charmed (see note 8). Clearly, then, it is the *t* which is the governor, so that the representation of *foster* with all governing relations established and, consequently, a full constituent structure present, is the one shown in (20).



### 3.3 A special form of government: proper government

Before leaving this discussion of governing relations, let me introduce a special type of governing relation, that of proper government. This plays an important role in GP and will feature in part of the discussion of specific phonological events in Section 5. Proper government is defined by Kaye (1990a: 313) as follows.

#### (21) Proper government

A nuclear position  $\alpha$  properly governs a nuclear position  $\beta$  if

- (a)  $\alpha$  is adjacent to  $\beta$  on its projection,
- (b)  $\alpha$  is not itself licensed, and
- (c) no governing domain separates  $\alpha$  from  $\beta$ .

According to (21), proper governing relations hold between nuclear positions at some level of nuclear projection. Charette (1990) proposes that proper government applies at the level of licenser projection. To keep things as simple as possible for the purposes of the present discussion, I will, however, not introduce this level. Like all governing relations at a level of nuclear projection, proper governing relations should then be parametrically variable in their directionality. More research is required on this, but it seems that, until now, no clear-cut cases of left-to-right proper government have been discovered (see Kaye 1990a, note 21). It is possible that this is a universal property of proper government.

Proper government plays a vital role in the phonological version of the Empty Category Principle (ECP), which was first proposed in KLV (1990: 219). My version of this principle, which closely follows the spirit of Kaye (1990a: 314), is set out in (22).

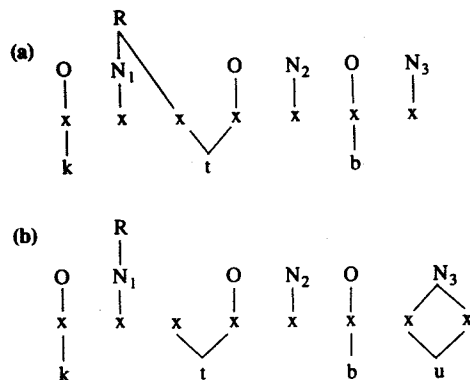
#### (22) Empty Category Principle

- (a) A licensed empty nucleus has no phonetic realization
- (b) An empty nucleus is licensed if (i) it is properly governed or (ii) it is domain-final in languages which parametrically license domain-final empty nuclei.

The details of licensing will be discussed in Section 4. What matters at this stage is that GP recognizes so-called empty skeletal positions. Strictly speaking, these positions are not empty, since they contain the cold vowel  $v^0$ , which, as mentioned in Section 3.2, is present at empty intersections between autosegmental lines and segmental positions. The distribution of such empty skeletal positions is very tightly constrained by the ECP. Apart from parametrically licensed domain-final positions, only properly governed positions may remain empty. As shown in a good deal of work in GP, especially Kaye (1987) and Kaye (1988), a range of vowel/zero alternation events can be accounted for quite elegantly if the ECP and proper government are invoked.

Consider the Moroccan Arabic radical [KTB] 'to write' (as discussed in Kaye 1987), for example. Its causative forms are [ktttɪb] (singular) and [ktttɪbu:] (plural) respectively. The structures Kaye proposes for the causative singular and plural forms are shown, with [KTB] applied to them and all governing relations established, in (23a) and (23b) respectively. Note that Moroccan Arabic parametrically licenses domain-final empty nuclear positions (see section 4.2 for discussion). Recall that the way empty nuclear positions are represented in (23) and elsewhere in this chapter is shorthand

(23)



for a representation containing the cold vowel  $v^\circ$ . In Moroccan Arabic, this vowel (realized as [ɪ]) is audible whenever an empty nuclear position is unlicensed. So, according to the ECP, we should expect to hear it, unless the relevant position is parametrically licensed (as in the case of the final position in (23a)) or properly governed. Which of the positions in (23) are properly governed? To answer this question, we first of all need to note that proper government applies from right to left in Moroccan Arabic. Now we can work our way through a morphological domain.

Let me begin with (23a). N<sub>3</sub> is parametrically licensed, so it can remain inaudible. Being itself licensed, N<sub>3</sub> is unable to properly govern (see (21b)), so N<sub>2</sub> is predicted to be unlicensed and hence audible. Being unlicensed, N<sub>2</sub> could properly govern N<sub>1</sub>. However, there is a governing domain (consisting of an empty coda position governed by a following onset and deriving its segmental content through spreading from this onset) intervening between the two nuclear positions. Therefore, no proper governing relation can be established (see (21c)) and N<sub>1</sub> remains unlicensed, which means that it has to be audible. The predicted realization is [kɪttɪb], which is correct.

The plural form in (23b) ends in an unlicensed nucleus (realized as [u:]), which is a potential proper governor. Indeed, all requirements for proper government to be able to apply are met, so that N<sub>3</sub> properly governs N<sub>2</sub>, which now remains inaudible. Being licensed itself, N<sub>2</sub>, however, cannot properly govern N<sub>1</sub> (see (21b)). (The governing domain intervening between N<sub>1</sub> and N<sub>2</sub> would have blocked proper government anyway, even if N<sub>2</sub> had not been licensed itself.) So, we predict that N<sub>1</sub> and N<sub>3</sub>, but not N<sub>2</sub>, are realized, which, again, is correct: we hear [kɪttbu:].

This example illustrates the operation of proper government, involving nuclear positions only. In recent work (e.g. Charette 1991: 91ff. and Cyran 1992), however, proper governing relations have been shown also to play a role in the licensing of non-nuclear empty positions. An example of this (from Charette 1991) will be discussed in Section 5.1.

Having seen how governing relations define constituent structure and how the establishment of governing relations (with proper government being a special case), in turn, depends on segmental structure, we can now consider one of the more striking implications of the discussion in this section, namely the absence of the syllable as a constituent.

### 3.4 There is no syllable in GP

As already observed, there is no such thing as a syllable (node) in GP. This may seem a surprising state of affairs. Dispensing with the syllable could even be interpreted as a retrograde step. After all, as Haugen pointed out in 1956, 'sooner or later everyone finds it [the syllable] convenient to use' (p. 213). To what considerable extent phonologists appear to have, at least tacitly, agreed with this statement can perhaps be gauged by the scale of protest resulting from Kohler's (1966) paper in which he rejects the syllable as being an 'unnecessary', 'impossible' or even 'harmful' concept in phonology (p. 207). His claims were countered by, among others, Anderson (1969) and Fudge (1969), with the latter providing very detailed arguments in favour of the syllable as a phonological universal. Chomsky and Halle (1968) excluded the syllable from the formalism of the SPE-theory (in spite of making frequent informal reference to it both in the text and in some rules, as pointed out by Fudge (1969: 216ff.)). When applying the SPE-formalism to a range of phonological events (final devoicing in languages such as German<sup>9</sup> or Russian being one of the most well-known), researchers were again and again forced to employ the conjunction {C, # (consonant or word boundary)}. Its recurrence suggested that a generalization was being missed in non-syllable-based analyses of such phonological phenomena. When, however, the syllable was adopted as part of the formalism of generative phonology (e.g. in Vennemann 1972 for final devoicing and other phenomena; and Hooper 1976, Kahn 1976 and Selkirk 1982b; see also the references in the latter), this conjunction appeared much less frequently in phonological work, and many of the hitherto recalcitrant events became amenable to comparatively simple and elegant analyses.

Over the years, more and more evidence in favour of the syllable as a crucial concept in phonological theory has been adduced, so

that authors of recent textbooks can feel confident in stating that 'the syllable is at the heart of phonological representations' (Katamba 1989: 153) and that 'today the place of the syllable [in mainstream phonology] is secure' (p. 164). However, the picture is actually not quite as harmonious as these quotes suggest: Kohler was by no means the only author who had doubts about the status of the syllable in phonology. In 1980 Halle and Vergnaud (1980a: 93), for example, reported that they had uncovered 'many phonological processes where the constituents of the syllable – in particular, the onset and rime – function independently of one another'. This led them to the conclusion that 'the superordinate unit, the syllable, plays a much more marginal role in phonology than do its constituents' (p. 93). To some extent, this view appears to be shared by at least one proponent of Moraic Phonology as well, since Hyman (1985) argues that certain languages (e.g. Gokana) do not have syllables, while others may do. His syllable formation rules are language-specific and do not apply in languages such as Gokana.

GP takes this approach one step further and dispenses with the syllable universally, which has the advantage of simplifying phonological representations. The claim being made is that alleged arguments in favour of the syllable can be reduced to arguments in favour of a potentially branching rhyme, with the potential for nuclear projection.

An argument against the syllable which is theory-internal to GP is that the syllable would be anomalous in being the only right-headed constituent, given that each N governs the immediately preceding O. Moreover, the principle of strict locality would have to be relaxed, since a maximally binary syllable would be too restrictive. If, however, the syllable node were to dominate three or more skeletal positions, the governor would not be immediately adjacent to one or more of its governees (but see note 5 for a problem with strict locality which exists in GP even in the absence of a syllable node). For a more detailed discussion of this and other arguments and for further evidence the reader is referred to, e.g. Charette (1991) or KLV (1990), where arguments against a coda constituent can also be found.

In the context of non-constituents in GP, recall that there is no coda constituent either. Detailed arguments against such a constituent can be found in KLV (1990), and Charette (1989 and 1991) as well as in Hogg and McCully (1987: 45ff.), so suffice it to say here that the presence of a maximally binary coda constituent could lead to the rhyme dominating no fewer than four skeletal positions (two in the nucleus and two in the coda). Since the rhyme is also a

constituent and the positions it dominates are subject to strictly local and strictly directional constituent government, the requirement of strict locality would, again, have to be relaxed, since adjacency of governor and governee would be limited to two out of the four positions. Therefore, a post-nuclear rhymal position is directly linked to the rhyme node, without an intervening coda node. The term 'coda', however, is considerably shorter and more convenient than 'post-nuclear rhymal position', which is why it features frequently in the GP literature. It should be noted, though, that this is simply shorthand and does not imply the existence of a coda constituent.

#### 4 Licensing as the motor driving phonology

##### 4.1 Licensing domains and government as a form of licensing

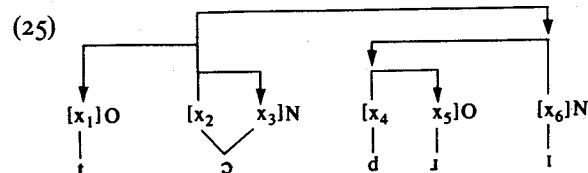
After this excursus on the absence of the syllable, let me now return to the existing constituents in GP. As already mentioned, these are defined by governing relations, and governing relations are an instantiation of a more general principle of phonology, the principle of licensing. It is particularly in relatively recent work in GP (e.g. Kaye 1990a, Charette 1991 and, especially, Harris 1992, where the rather vague notion of licensing to be presented here is made much more precise) that the importance of licensing in phonology is being more fully recognized.<sup>10</sup>

Licensing is the motor which drives phonology, and every skeletal position within a domain, except for the head, has to be licensed, as stated in the Licensing Principle (24) (Kaye 1990a: 306).

##### (24) *Licensing Principle*

All phonological positions save one must be licensed within a domain. The unlicensed position is the head of this domain.

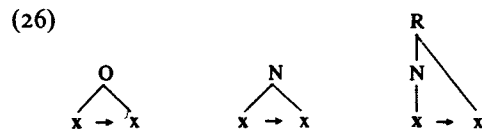
Consider the following representation (adapted from Harris 1992: 384), which illustrates how the head of the morphological domain licenses other positions within that domain. (25) is the representation of the English word *tawdry*, as pronounced in RP. As mentioned in Section 3.1, GP distinguishes between morphological



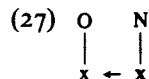
(analytic) and phonological (governing) domains. This distinction receives clear illustration in (25). Within the single morphological domain, there are five phonological domains, involving the following pairs of positions (governor first):  $x_2$  and  $x_1$ ,  $x_2$  and  $x_3$ ,  $x_2$  and  $x_6$ ,  $x_6$  and  $x_4$ , and  $x_4$  and  $x_5$ . Two of the five represent cases of constituent governing relations between adjacent positions, viz.  $x_2$  and  $x_3$  (branching nucleus), and  $x_4$  and  $x_5$  (branching onset). The governing relation between  $x_2$  and  $x_1$ , by contrast, is an inter-constituent governing relation (nucleus governing preceding onset). The heads of these three domains are unlicensed within each domain, but, with one exception, receive their own licensing from positions outside these domains. So,  $x_4$  is licensed by  $x_6$  (through the problematic inter-constituent governing relation discussed in note 5) and  $x_6$ , in turn, is licensed by  $x_2$  at a level of nuclear projection, to be precise, at the level of the foot. The only unlicensed position within the morphological domain is  $x_2$ , the head of this domain. The head of a domain bears primary stress in languages which exhibit stress.

So far I have merely implied that government is a form of licensing. Let me now make this view more explicit and discuss some particular cases of licensing which have far-reaching implications. It is worth recalling from the discussion of the ECP (22) in Section 3.3 that government is not the only form of licensing. Licensing by parameter setting is also countenanced in GP. This form of licensing, however, is available only for empty domain-final nuclear positions (to be discussed in detail in Section 4.2), while licensing through government accounts for the remainder of the licensing work within a domain.

Licensing within a branching constituent is effected by (intra-) constituent government, as shown in (26) below. Each onset is



licensed by an immediately following nucleus through inter-constituent government, as illustrated in (27). This is stipulated in the



Onset Licensing Principle, which has been an implicit assumption

in GP work for some time but was first formally stated as a separate principle by Harris (1992: 380).

(28) *Onset Licensing Principle*

An onset head position must be licensed by a nuclear position.

As observed by Charette (1991), a governor has to have a skeletal position. Consequently, nuclei, which always govern a preceding onset, can never lack an  $x$  on the skeletal tier. Onsets, on the other hand, which have no governing work to do may well lack a skeletal point, as illustrated in (12a). In her discussion of *h-aspiré* in French (see Section 5.2) she motivates onsets both with and without a skeletal point.

The Onset Licensing Principle (28) in itself has relatively little impact, as all it requires is for an onset to be followed by a nucleus (even an empty nucleus), which, on the face of it, is nothing unusual in phonology anyway. However, when combined with another principle of GP, the Coda Licensing Principle (quoted from Kaye 1990a: 311 in (29)), the Onset Licensing Principle has far-reaching implications both for the handling of the special properties of word-final consonants as well as for language typology. As mentioned in 3.4, the term 'coda' is used as shorthand for 'post-nuclear rhymal position'.

(29) *Coda Licensing Principle*

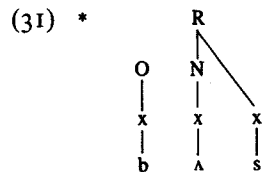
Post-nuclear rhymal positions must be licensed by a following onset.

A well-formed representation involving a rhymal consonant must then take the form in (30). The governing onset head, which provides the licensing for this rhymal position, is emboldened, as before.



As observed by Harris (1992), the unusual behaviour of apparently word-final consonants has not escaped the notice of many phonologists. Their extrametrical status in stress assignment has been observed by, among others, Hayes (1982) and Segundo (1990),

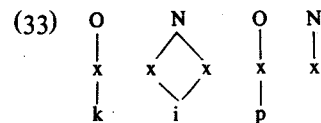
their failure to undergo closed-syllable shortening by Myers (1987)<sup>11</sup> and their tendency to contravene otherwise general sonority sequencing generalizations by Levin (1985). To see how this aberrant behaviour can be accounted for in GP, first consider the representation of the English noun *bus* in (31), which conforms to the widespread assumption that a word-final consonant is part of the rhyme. This representation is in accordance with the Onset



Licensing Principle, but it is in conflict with the Coda Licensing Principle. It is ill-formed, since there is no following onset position to enter into an inter-constituent governing relation with the coda position and thus license it. The well-formed alternative to (31) is shown in (32). Here the apparently word-final consonant occupies

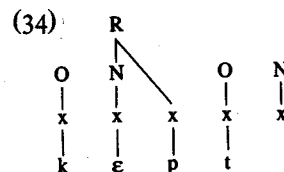


an onset position, which, according to the Onset Licensing Principle, has to be licensed by a following nucleus. (The empty nucleus which licenses the onset will be discussed in Section 4.2.) The *s* is not a member of the rhyme, which means that, for the purposes of stress assignment, the rhyme is non-branching. Coda Licensing achieves the same effect as extrametricality here. Second, the failure of closed-syllable shortening to apply also finds an explanation in Coda Licensing. Consider the representation of the verb *keep* in (33). The GP representation does not predict closed-syllable shorten-

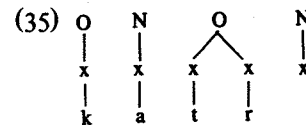


ing, as there is no consonant to close the syllable. The non-analytic past tense form of the same verb, by contrast, can only accommodate a short vowel, as the *p* is part of the rhyme. This is shown in

(34).<sup>12</sup> Incidentally, *keep* and *kept* have separate lexical entries, that is, *kept* is not derived from *keep*. Such a derivation would be in conflict with the Projection Principle, since it would involve a change in governing relations. Third, the tendency of word-final



consonants to contravene sonority sequencing generalizations in words such as French *quatre* [katr] or *table* [tabl] could be dealt with by interpreting the final consonant as extraprosodic. Quite apart from the inherent weaknesses of this approach, which receive detailed discussion in Harris (1992), extraprosodicity would be an unnecessary complication of the grammar from the point of view of GP, since an alternative is available. All that is needed is to interpret these consonant sequences as branching onsets rather than codas, which is what one would do word-internally anyway. *Quatre*, for example, would then have the structure in (35).



Continuing the survey of licensing relations, let me now turn to the licensing of nuclear heads. Every nucleus (bar the head of the analytic domain) is licensed either through being governed by another nucleus at a level of nuclear projection (see (36), which illustrates left- and right-headed government by nuclear projection) or, as already mentioned in the ECP (22), by parameter setting (if domain-final, see Section 4.2).



A post-nuclear rhymal position (e.g. the position occupied by *p* in (34)) appears to have a special status in the context of licensing in that, on the one hand, it is licensed (through constituent government) by the nucleus which c-commands it and, on the other hand,

it has to be further licensed by a following onset. It is the only skeletal position which requires this kind of 'double licensing'. This may be a function of the fact that, although the governing relation between a nuclear head and the post-nuclear rhymal position is a constituent governing relation inasmuch as both positions are sisters within the rhyme, it differs from the two remaining constituent government configurations. This difference lies in the fact that the two positions are not immediately dominated by the same node. The nuclear head position is immediately dominated by N, whereas the coda is immediately dominated by R. This suggests that the governing relation is less 'close' (for want of a better word) than it is in the cases of branching onsets and branching nuclei. The prediction derivable from this interpretation is that greater variation in terms of charm and complexity should be tolerated in both governor and governee. This prediction appears to be borne out by the facts, as charmless vowels are associated with the nuclear-head position with remarkable frequency (whereas positive charm typically seems to be required for branching nuclei; see KLV 1990: 207), and comparatively complex segments, such as nasals, frequently occupy the 'coda', whereas segments of such a high degree of complexity are excluded from the governed position in a branching onset or nucleus.

#### 4.2 Parametrically licensed domain-final empty nuclear positions

Let me now return to the Coda Licensing Principle (29) for a moment. We have seen that it can help provide solutions to traditional problems posed by apparently word-final consonants. Apart from this, the Coda Licensing Principle also has clear typological implications. These partly depend on the status of the domain-final nuclear position, which was simply taken for granted in representations such as (32), (33), (34) and (35). Clearly, the presence of this position is a necessary consequence of the existence of the Onset Licensing Principle and the Coda Licensing Principle. But how is it licensed and what are the predictions its presence makes? Under the ECP (22), an empty skeletal position can be licensed (that is, permitted to be present and remain inaudible) either by proper government (as discussed in Section 3.3) or by parameter setting, if it is domain-final. The relevant parameter is expressed in (37).

- (37) A domain-final empty nuclear position is licensed:  
YES/NO

We saw in Section 3.3 that empty nuclei manifest themselves phonetically when, for some reason, they are unlicensed. In Moroc-

can Arabic, for example, an [H] surfaces. What about parametrically licensed domain-final empty nuclear positions? In principle, such positions should never be audible (but see Kaye 1990a for discussion of an apparent exception to this in Turkish). There may, however, be other indications of the presence of such a position.

Segundo (1990) argues that domain-final empty nuclear positions affect stress assignment in Brazilian Portuguese (BP). BP has words with antepenultimate, penultimate and final stress, e.g. ['sintezi] 'synthesis', [batu'kada] 'noise of drums' and [zaka're] 'alligator', respectively. One could generalize that BP stress is restricted to one of the last three syllables of a word. Now consider the hypothetical words from Segundo (1990:45) in (38).

(38)

- |            |            |
|------------|------------|
| * 'patanal | * 'nitiron |
| * 'satidor | * 'natalis |

These items are judged impossible words by native speakers of BP, in spite of the fact that primary stress apparently falls on one of the last three syllables of the word. According to Segundo, this native-speaker judgement can only be squared with the generalization that BP stress falls on one of these syllables if the final consonant in each word is actually followed by a nuclear position, which, although inaudible, is taken into account for stress assignment. This is precisely what Coda Licensing and Onset Licensing would predict. The left-most [a] in [patanal], for example, would then be the fourth nucleus from the right (as shown in (39)) – a position which cannot bear primary stress in BP.

- (39)
- |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|
| O | N | O | N | O | N | O | N |
|   |   |   |   |   |   |   |   |
| x | x | x | x | x | x | x | x |
|   |   |   |   |   |   |   |   |
| p | a | t | a | n | a | l |   |

Having seen that there is at least some evidence from stress assignment in favour of the final empty nuclear position posited for apparently consonant-final words in GP, we now turn to the typological implications of the existence of this position. What has been said so far makes the prediction that there should be a four-way typological distinction, which cuts across the parameter in (37) and another parameter which controls whether rhymes are branching. A widespread assumption is that the absence of final consonants

in so-called CV or open-syllable languages is due to the absence of branching rhymes, since the final consonant is usually interpreted as part of the final rhyme.

Even a superficial glance at a language such as Italian, which exhibits both word-internal geminates and nasal + stop clusters but no word-final consonants, suggests, however, that this is too simplistic a view.<sup>13</sup> What appears to be required is the four-way distinction provided by GP. All that needs to be said about Italian is, then, that domain-final empty nuclear positions are not licensed, while branching rhymes are. In languages where words can end in consonant clusters, such as English, German and French, for example, both parameters are set to YES. Strict CV languages, such as Desano (Eastern Tucanoan; Colombia, Brazil), by contrast, have both parameters set to NO. Finally, if domain-final empty nuclear positions really are motivated, then we should also find a group of languages where the relevant parameter is set to YES, but where branching rhymes are prohibited. Luo (Nilo-Saharan; Kenya, Tanzania; see Harris 1992: 367) and, according to Kaye (1990a), some Gur languages of Burkina Faso belong to this group.

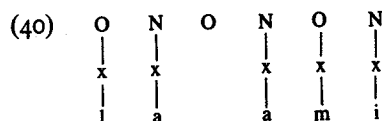
## 5 GP approaches to some phonological issues

In this Section I discuss GP approaches to two issues in phonology and compare them with weight-unit/mora-based alternatives. For this purpose I have chosen *h-aspiré* in French and reduplication in languages such as Sanskrit, Ancient Greek, Tagalog and others. The reasoning behind this choice is the following. In my view, *h-aspiré* provides quite strong evidence in favour of the skeletal tier, the existence of which is denied in Moraic Theory (see e.g. Hayes 1989, Bickmore this volume). Certain aspects of reduplication, on the other hand, point towards the need for constituent governing relations, as provided for in GP and, more generally, 'reduplication has now arrived centre stage as a testing ground for alternative theories of multitiered morphology and phonology' (Mutaka and Hyman 1990: 73; see also references there), so it is particularly relevant in the present context. For reasons of space it is not possible to give a comprehensive account of the treatment of *h-aspiré* or of the GP approach to reduplication. The aim is to provide an insight into the particular benefits which GP can bring to these issues. I will begin with Charette's analysis of *h-aspiré* in French.

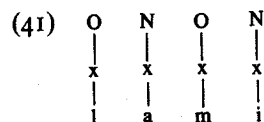
### 5.1 Charette's treatment of *h-aspiré* in French

In Section 3.1 I observed that an onset may or may not dominate a skeletal position (see 12a). Following Vergnaud (1982), Charette (1988, 1991) motivates both configurations in her discussion of the behaviour of the definite article (singular) in French preceding a vowel-initial noun and preceding a noun beginning with *h-aspiré*. In the former case, the vowel of the definite article is lost, so that *la amie* 'the (female) friend', for example, is realized as [lami]. Words beginning with *h-aspiré* (which is completely inaudible), by contrast, pattern with consonant-initial words, where the final vowel of the definite article is preserved. So, *le génie* 'the genius' is realized as [ləʒeni] and *le havre* 'the haven' as [ləavr]. This, of course, is a very simplistic account of the phenomenon, ignoring all the complexities which are mentioned, e.g. in Durand (1986) and which find detailed discussion in Tranel (forthcoming). Still, for the purposes of this section, it seems reasonable to put them to one side.

The underlying representation Charette (1991: 90) proposes for forms such as *la amie* is essentially that given in (40) (with governing relations established and morphological bracketing omitted).



The first two nuclear positions (both occupied by /a/) are treated as adjacent, since there is no skeletal position to separate them. Charette proposes that the Obligatory Contour Principle (OCP; see e.g. Goldsmith 1990: 307ff, McCarthy 1986, Odden 1986 and Yip 1988a for discussion), which prohibits two identical melody units from occurring adjacently, applies to eliminate the left-most nucleus (along with the empty onset to its right). The resulting representation is shown in (41).



This proposal is not without its problems. First, invoking the OCP in this way may seem a surprising move. Under a relatively standard interpretation of the OCP, one might have expected the





aside, there is a certain amount of indeterminacy in his analysis of *h-aspiré*. For example, it is not entirely obvious why the [+cons] should be floating. As (44) appears to suggest, the floating [+cons] feature will be attached to the WU of the initial syllable anyway. It might just as well have occupied its own WU in underlying representation. As Hyman himself observes, this WU would have been deleted and the [+cons] adjoined to the remaining WU of the first syllable by the OCR in any case. More importantly, though, what are the implications of the presence of the floating [+cons], other than the one it was introduced to capture in the first place? Besides, can such floating consonants with incomplete segmental representations be employed anywhere? As far as I can see, Hyman's approach has no clearly defined implications, and there are no restrictions on the use of this type of floating consonant.

The GP analysis put forward by Charette, by contrast, is more tightly constrained. Recall that she proposes the presence of an empty skeletal position. Like all other skeletal positions, empty skeletal positions may only be present if they are licensed. In addition to this standard licensing, as it were, empty skeletal positions have to be licensed in a special way in order to remain inaudible. This special licensing was introduced in the ECP (22) in Section 3.3, in the context of empty nuclear positions. The version of the ECP given in (22), however, is just one possible formulation of it. There is a more general alternative, which can be applied to non-nuclear positions as well. This is quoted from KLV (1990:219) in (45).

(45) *Empty Category Principle (general version)*

A position may be uninterpreted phonetically if it is properly governed.

Given (45), an empty onset position, as posited by Charette for *h-aspiré*, has to be properly governed. The only proper governor available is the following nuclear position. The definition of proper government in (21) requires a proper governor to be itself unlicensed. One of the hallmarks of an unlicensed position is that it receives phonetic interpretation, i.e. that it is audible. If the following nucleus properly governs the empty onset position, the prediction is made that this nucleus must have phonetic content. As Charette (1991: 95) points out, this is precisely what we find. In fact, not even schwa can occupy this particular nuclear position, since, in French, schwa is the manifestation of an empty nucleus,<sup>14</sup> so that no proper governing relation could hold between it and the preceding onset. She identifies further consequences of the presence

of the empty onset position (see pp. 91ff.), a detailed discussion of which would be beyond the scope of this chapter.

As we have seen, the use of empty positions is quite tightly constrained in GP, whereas Hyman appears to be able to invoke floating [+cons] features with incomplete segmental representations wherever they are needed. Furthermore, the presence of a licensed empty position has clearly predictable effects in GP, while the implications of Hyman's approach to *h-aspiré*, are not easily identifiable.

## 5.2 The GP approach to reduplication

In this subsection I will briefly outline some of the basic principles of the GP approach to reduplication, using Ancient Greek (AG) reduplication of the verbal paradigm to illustrate some of the predictions. For this purpose I will draw heavily on Pagoni (1993).

Following the spirit of Kaye (1991), Pagoni outlines the following assumptions (among others), which define the GP view of reduplication. (Some of these assumptions, of course, go back further than Kaye (1991) and are due to Marantz (1982), McCarthy and Prince (1986), Steriade (1982, 1988) and others.) First, reduplicative affixes resemble other types of affixes, the only difference being that the former generally lack segmental content. Second, the structure of a reduplicative affix is fixed and association takes place by aligning indexes from the base and the reduplicative affix. The algorithm for assigning indexes is simple. The count starts at the left-most onset, with an increment of 1 at each subsequent onset. Third, association is local, that is, there is no skipping over vowels or consonants. The implication of this assumption is the following. Where prespecified and invariant nuclear melodic material (i.e. a fixed vowel) is present, association cannot proceed beyond it. The first person singular present perfect form of the verb [teleo:] 'I execute' would then take the form in (46). The [e] of the reduplica-

(46) pref.	O <sub>1</sub>	N <sub>1</sub>	base	O <sub>1</sub>	N <sub>1</sub>	O <sub>2</sub>	N <sub>2</sub>	O <sub>3</sub>	N <sub>3</sub>
	x	x		x	x	x	x	x	x
	t	e		t	e	l	e	k	a

tive prefix is prespecified, as witnessed by forms such as [memak<sup>h</sup>e:mai] 'I have fought'.

Clearly, relatively straightforward cases such as (46) can also be handled quite easily by other approaches to reduplication (e.g. Steriade 1982, 1988), including those based on the principles of

Moraic Phonology (e.g. McCarthy and Prince 1986). It is where so-called simplification comes into play that GP can account for data posing problems for other frameworks. In a very detailed study of reduplication, Steriade (1988) discusses such simplification cases from a variety of languages, including Sanskrit, Tagalog, French, Klamath and Ancient Greek. The French hypocoristic forms from her study (p. 132) in (47a) are supplemented by further relevant data from Tagalog (McCarthy and Prince 1986: 16) and Ancient Greek (Pagoni 1993) in (47b) and (47c) respectively. The hyphen indicates a morpheme boundary.

(47)

- |     |               |                             |
|-----|---------------|-----------------------------|
| (a) | Claire        | keker, keke                 |
|     | (Al)fred      | fefed                       |
|     | Bri(gitte)    | bibi                        |
| (b) | ka-ta-trabaho | 'just finished working'     |
|     | ka-bo-bloaut  | 'just gave a special treat' |
| (c) | ke-klika      | 'I have reclined'           |
|     | ke-kri:ka     | 'I have judged'             |
|     | pe-pleuka     | 'I have sailed'             |

In all cases in (47), onset clusters are simplified in the reduplicated forms. The question is how to formalize this simplification. McCarthy and Prince (1986: 16) merely observe that the least sonorous member of the cluster is preserved. They point out that Steriade (1982) can achieve this with left-to-right mapping on the assumption that onsets are of strictly rising sonority. So, if only a single position is available for the onset of the reduplicative prefix, then only the left-hand member of the onset, i.e. the least sonorous position, will be associated with a skeletal position and thus be phonetically interpretable. To some extent this approach appeals to sonority scales, which, as Harris (1985) points out, are little more than taxonomic statements which can serve as look-up tables, but which cannot be directly encoded in phonological representations (at least not with binary features).

This view may even be shared by Steriade herself, since in her 1988 paper on reduplication, sonority considerations play a much less central role. Instead, she describes onset simplification as elimination of non-initial consonants. To my knowledge, there are no phonological events other than the onset simplification illustrated in (47) which make reference to non-initial consonants, so this seems to be very much an *ad hoc* description.

McCarthy and Prince (1986: 17), by contrast, entertain a third possibility (albeit in a footnote), namely that 'mapping is not really

LR but rather head-to-head on prosodic constituents. Then the head – least sonorous member – of the onset cluster would be chosen'. This suggestion would indeed capture the facts. What is surprising and problematic about it is the fact that it presupposes the existence of an onset constituent, which, if I understand the principles of Moraic Phonology, on which McCarthy and Prince (1986) is based, correctly, is non-existent. Onsets (let alone onset constituents) have no role to play in Moraic Phonology, so that head-to-head mapping is not an option here.

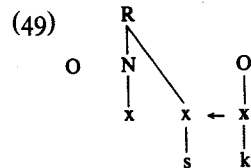
As shown in Section 3, GP, by contrast, operates with binary onset constituents, where the head is defined as the governing, and hence the left-most, position (recall that constituent governing relations are universally left-headed). Kaye (1991), in fact, proposes that only head projections of the stem melody can be reduplicated. This makes the prediction that governed members of a prosodic constituent can never be reduplicated. In other words, onset simplification is a universal property of reduplicative affixation (with the exception of 'echo cases', that is). To my knowledge, this prediction is correct.

A second problem for most accounts of reduplication is the behaviour of *s* + consonant clusters. As observed by Pagoni (1993), Kaye (1991) and Steriade (1988), these clusters are not subject to Steriade's (1988) rule that non-initial consonants are eliminated. On the contrary, it is the initial *s* and not the following consonant which disappears, as illustrated in (48a) for Ancient Greek (nominal reduplication) and in (48b) for Sanskrit (data from Steriade 1988).

(48)

- |     |                |                    |           |                    |
|-----|----------------|--------------------|-----------|--------------------|
| (a) | ka-skandiks    | 'wild chervil'     | skandiks  | 'spring onion'     |
|     | ko-skulmat-i a | 'leather cuttings' | skulmat-  | 'hair plucked out' |
| (b) | Root           | Intensive          | Gloss     |                    |
|     | stan           | tan-stan-          | 'thunder' |                    |
|     | skan           | kan-i-skand-       | 'leap'    |                    |

Steriade attributes this loss of an *initial* consonant to the fact that *s* + consonant clusters do not form onsets, a claim which is substantiated in Steriade (1982). KLV (1990) and Kaye (1992b) show that the principles of GP lead to the same conclusion and adduce empirical evidence to support it. The syllable structure proposed for an initial *s* + consonant cluster (*sk* in this case) is that shown in (49). This structure, of course, raises the issue of how the initial empty nuclear position is licensed. Kaye (1992b) provides detailed discussion of this point. The apparently word-initial *s* actually



occupies a post-nuclear rhymal position which is governed by a following onset. The head of this particular governing domain is this onset, occupied by *k*. On the assumption that only heads are reduplicated, the initial position of the reduplicated prefix necessarily has to be *k*.

I have left a considerable number of important aspects of reduplication out of this discussion (see also Katamba, this volume for an investigation of further interesting properties of reduplication), but I hope to have shown that some basic principles of GP can make a substantial contribution to the solution of some of the more intractable problems of reduplication, without making reference to the syllable (or the mora).

## 6 Conclusion

In this chapter I have presented an overview of the skeleton and suprasegmental (i.e. constituent) structure in GP. I have discussed some arguments in favour of the *x*-skeleton employed in GP and, moving beyond the skeleton, I have introduced the reader to the GP notions of government and licensing. I have explored some of the striking predictions made by GP and shown them to be borne out by the facts of a variety of languages.

Considerations of space have forced me to omit some important theoretical constructs (such as government-licensing, as developed in Charette 1988, 1990, 1991) and to keep comparisons with other theories to a minimum in Sections 3 and 4. In Section 5, however, I have briefly discussed different approaches to phonological issues such as the representation of *h*-aspire in French and reduplication in a range of languages. I hope to have shown that GP, in spite of having relatively restricted machinery at its disposal, can account for data which have proved problematic in other frameworks, by referring to independently motivated skeletal and constituent structures.

## Notes and Acknowledgements

I would like to thank John Harris, Monik Charette and Jacques Durand for their immensely helpful comments on earlier drafts of this chapter. Any remaining errors, inaccuracies and superficialities are, of course, my

responsibility alone. Many thanks also to Stamatoula Pagoni for much-valued practical help.

1. See Kaye et al. (1985) and Kaye et al. (1990) for basic GP policy statements. Further important work in this framework is contained in Charette (1988, 1989, 1990, 1991, 1992), Harris (1990b, 1992), Harris and Kaye (1990), Kaye (1988, 1990a,c, 1992b, this volume), Lindsey and Harris (1990) and in Yoshida (1991).
2. The existence of the nucleus display (see Clements and Keyser 1983: 16f.) in this framework seems to partially contradict this claim, as it could be interpreted as introducing an additional division of the syllable. However, Clements and Keyser adopt the view that this display is located on a different plane from the syllable display (as illustrated in (1)), so that the syllable node as such still has no subordinate nodes above the CV tier. In any case, the nucleus display is hardly ever invoked.
3. The basic point is theirs, but my argumentation is different. See also Durand (1990a: 264ff.) for yet another way of making the same point.
4. Coleman (this volume) provides examples of GP derivations where a conflict with the Projection Principle appears to exist. I share his concerns about the deletion of a skeletal position in the Yawelmani derivations discussed in Kaye (1990a: 309ff.). Regarding the derivations from KLV (1985), his criticism is less well founded, as the Projection Principle in its present form had not seen the light of day in 1985. After all, even phonological theories take time to hatch.
5. There is a reasonably common configuration which is actually in conflict with the strict locality requirement for inter-constituent government. This configuration involves a branching onset followed by a nuclear head. As we will see in Section 4.1, every skeletal position (bar the head of a morphological domain) has to be licensed, normally by being governed. Onsets are governed by a following nucleus (as shown in (13a)). If inter-constituent government is strictly local, how can the left-most position in a branching onset be governed by the following nucleus? After all, the two positions are not adjacent at the skeletal level. Government phonologists are well aware of this problem, but, to my knowledge, no definite solution to it has as yet been proposed.
6. Lines may be fused (parametrically variable) to prevent the elements occupying these lines from combining with one another and thus to account for the absence of certain segment types from particular languages, e.g. of front-rounded vowels from (conservative) RP (fusion of U<sup>-</sup> and I<sup>-</sup>-lines). It is physically impossible for the vocal folds to be stiff and lax at the same time, which is why the L<sup>-</sup> and H<sup>-</sup>-lines must be fused universally. Contour tones may involve either a sequence of separate nuclei, each with its own laryngeal element, or a contour segment, where two laryngeal elements are attached to a single skeletal point by separate association lines. In neither case would fusion of the L<sup>-</sup> and H<sup>-</sup>-lines be a problem.
7. Harris (1990b: 273f.) actually argues that 'any segment, be it charmless

or charmed, must satisfy certain complexity requirements before it can occupy a governing position'. It seems that this claim is too strong. The most spectacular counterexamples can be found in the context of branching rhymes, where it is quite possible for a simplex segment such as [a] (consisting only of the element A<sup>+</sup>) to govern a segment which is more complex, e.g. a lateral (composed of two elements) or a nasal (composed of three or four elements). Examples such as *Wald* ([valt], 'forest') or *Hand* ([hant], 'hand') are easy to come by, not just in German.

8. I assume that R<sup>o</sup> is the head of the expression. As a result, H<sup>-</sup> can only be an operator, and yet, I claim that the entire expression is negatively charmed. This, of course, conflicts with my earlier claim that the charm value is taken from the head. Two points have to be made here. First, the assignment of headship to expressions is an area which requires a great deal of further investigation. Second, the laryngeal elements H<sup>-</sup> and L<sup>-</sup> appear to differ from other elements in contributing their charm value to an expression even when they are not the head of the expression. Their special status is discussed in Brockhaus (1992: 133-7). In any case, charm considerations are not crucial for the present example, as the *t* is more complex than the *s* and would, therefore, be able to govern it on complexity alone.
9. See Brockhaus (1992: 53-72) for a detailed discussion of the drawbacks of the non-syllabic account of final devoicing proposed in Vennemann (1968).
10. This is not to say that GP is the only phonological theory to employ the notion of licensing. For other approaches to licensing see, for example, Selkirk (1978), McCarthy and Prince (1986), Nespor and Vogel (1986), Itô (1986) and Goldsmith (1989, 1990).
11. McCarthy and Prince's (1986: e.g. 21, 106) observations about word-finally well-formed CVVC syllables not being available word-internally in Mokilese refer to essentially the same phenomenon, and Borowsky (1989) discusses similar facts with regard to English.
12. The reader may wonder how words such as *child*, *wild*, *Christ*, *point*, *wield*, *mind*, etc. can be represented, as they appear to require a branching nucleus followed by a filled coda position and could, therefore, not be accommodated by a binary rhyme. This is another problem of which Government phonologists are well aware (see e.g. KLV 1990, note 5 and Kaye 1990a, note 20) and to which no solution has as yet been found. It may, however, be worth noting two things. First, as has been observed by a number of phonologists, including Fudge (1969) and Selkirk (1982b), the problematic forms invariably involve coronal clusters. Second, related forms with a short vowel exist for some of these words, e.g. *children*, *Christian* and *wilderness*.
13. Vennemann (1988: 33) is forced to interpret these facts about Italian as an exception to his Law of Finals, which expresses the insight that 'word-medial syllable codas are the more preferred, the less they differ from possible word-final syllable codas of the language system'. GP makes the much stronger claim that there is no difference between

word-medial codas and word-final codas (in Vennemann's sense of the term) *and* it can accommodate the Italian facts.

14. In some languages (e.g. in Moroccan Arabic, see Kaye 1987 and discussion in Section 3.3 above), the manifestation of an unlicensed empty nucleus is the cold vowel itself. In others, e.g. in French and German, an 'ambient' element A<sup>+</sup> is attached, yielding schwa. The apparent existence of ambient elements, for which no local source can be identified, is problematic for GP, since it is in conflict with the metatheoretical principle of non-arbitrariness (see KLV 1990: 194). See Brockhaus (1992: 122ff.) for discussion.