Syllable Theory without syllables

by
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For my parents
Abstract

The goal of this thesis is to develop a restrictive theory of syllabic structure that dispenses with constituents.

It starts with a review of previous approaches, discussing how syllabic structure has been characterised by constituent labels and/or dependency relations. Although the inventory of constituents may vary from one theory to another, the status of the syllable as the maximal constituent is taken for granted in most approaches.

This thesis presents two types of argument against the syllable as a constituent. First, the thesis gives a prosodic analysis of reduplication in Micronesian languages that reportedly copies an initial consonant, verifying the claim put forward in Prosodic Morphology that reduplicative templates are prosodically constrained. I show how neither the specification nor the satisfaction of the reduplicative template needs to make reference to the syllable. The second argument concerns stress in Aranda, which is reported to fall on syllables with onsets. I put forward an alternative analysis in which stress requires a foot to begin with an onset. This foot-based requirement plays a role in a wide range of languages, not just in stress assignment but also in segmental-distributional restrictions.

The absence of substantive evidence for the syllable as a constituent provides strong support for models of syllabic structure, such as Government Phonology, which dispense with a syllable node. However, similar arguments can be mounted against the subsyllabic constituents postulated in Government Phonology. Drawing heavily on Dependency Phonology, the present thesis shows how two types of dependency relation alone suffice to account for all of the significant regularities attributed to these constituents. The ultimate conclusion is that all syllabic constituency is redundant.

Finally, from a theoretical base comprising the two rather different frameworks of Optimality Theory and Government Phonology, the thesis makes the following proposals. First, the principles and parameters approach and the constraint ranking approach should be integrated to capture categorical and relative well-formedness. Second, syllable structure is present in lexical representation and, in line with Structure Preservation, remains unchanged in phonological output.
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1 Introduction

There is a general tendency, in the early development of a discipline, to extend its gains as rapidly as possible with the help of any concepts which may prove useful, whether their bases are clearly understood and formulated or not. There must come a time, however, if the discipline is to progress, when the theoretical validity of such conceptions must be more critically examined, and their bases firmly and rigorously established.

(O'Connor & Trim 1953: 103)

This thesis argues for a purely relational theory of syllabic structure. This is in stark contrast with current mainstream views of the syllable as being hierarchically organised into constituents. The initial motivation for the line of research pursued in this thesis is suitably expressed in the above quotation. Although the specific inventory of syllabic nodes continues to be a matter of debate, the existence of some form of syllable-internal constituency has generally been taken for granted. This thesis discusses a range of evidence that calls the theoretical validity of syllabic constituents into question.

The relational model of syllable structure proposed here is more restrictive than constituent-based alternatives in at least two respects: it reduces the inventory of representational resources, and it characterises them in such a way as to minimise theory-internal redundancy. The success of this overall approach has already been demonstrated in the realm of melodic structure.

Consider, for example, the monovalent theory of segmental primes. Bivalent features of the type proposed in The Sound Pattern of English (Chomsky & Halle 1968: SPE, henceforth) encode what Trubetskoy (1969: 75) calls equipollent oppositions. The bivalency of the feature [+round] implies that both [+round] and [-round] should be equally susceptible to phonological events such as harmony. However, unrounding harmony, which would refer to [-round], is not attested. On the other hand, monovalent primes of the type proposed by Anderson & Jones (1974) follow the privative view, whereby oppositions are characterised by the presence or absence of a melodic property. The opposition approximating to that between [+round] and [-round] is expressed by the presence or absence of the single prime [U]. It is not possible for this prime to describe any process equivalent to the spreading of [-round]. The impoverished inventory of
segmental resources available to a theory that works exclusively with monovalent primes contributes to restrictiveness by limiting its descriptive capacity. Furthermore, the monovalent system dispenses with extrinsic cooccurrence constraints such as *[+high, +low]. This particular constraint is required by the bivalent system to rule out a logically possible feature combination that is not pronounceable for physiological reasons. In the monovalent model, the above combination is intrinsically indescribable and therefore literally impossible. This advantage stems not simply from the size of the inventory of segmental resources available to the monovalent model but also from the way in which the individual resources are characterised. The same drive to minimise representational resources lies behind the theory of syllable structure proposed below.

The thesis is organised as follows. Chapter 2 reviews non-linear models of syllabic structure. It focuses on arguments for and against syllabic constituents as presented in the form of templates. It demonstrates the importance of recognising asymmetric relations in syllabic structure. In addition, it provides a detailed introduction to the model of Government Phonology (Kaye et al. 1990), on which the proposed relational theory is based.

In Chapter 3, I argue against the syllable as the maximal syllabic constituent by proposing alternative analyses of various phonological phenomena that supposedly support it. Prosodic Morphology (McCarthy & Prince 1986, 2001) claims that the set of reduplicative templates includes one defined in terms of the syllable. I show how cases of reduplication treated in these terms can be reanalysed without reference to the syllable. Then I turn to stress and distributional regularities that allegedly exhibit sensitivity to whether syllables begin with an onset. I show how these cases are more adequately analysed in terms of a constraint that requires feet to begin with an onset. The main conclusion of this chapter is that there is no empirical support for the formal status of the syllable as a constituent.

Chapter 4 discusses a licensing-based model of syllable structure that dispenses with a syllable node but retains three subsyllabic constituents: the onset, the nucleus and the rhyme. I claim that analyses referring to these constituents can be reformulated by exploiting head-dependent relations. The cumulative result is that no syllabic constituents are required in the representation of syllabic structure. I then propose a syllable theory that is defined solely in terms of dependency relations. It incorporates some constraints that are based on implicit assumptions of the licensing model and others that are adapted from Dependency Phonology (Anderson 1986, Anderson & Ewen 1987). While retaining the descriptive capacity of the licensing model, the proposed relational theory is formally
simpler in dispensing not only with constituents but also with several constraints that are poorly motivated in the licensing model.

The discussion leading up to the proposed theory exploits insights from both Government Phonology and Optimality Theory. In an attempt to further integrate the two frameworks, Chapter 5 explores the following proposals. First, the principles and parameters approach and the constraint ranking approach should be envisaged as being not mutually exclusive but complementary. This standpoint allows us to capture both categorical and relative well-formedness, as prescribed by inviolable and violable constraints respectively. Second, input representations are structured and specified to the same extent as output representations are. Therefore, lexical representations are fully syllabified. Third, Structure Preservation holds as a universal principle across derivation.

Finally, in Chapter 6, I summarise the main arguments of the thesis and suggest avenues for extending the proposals in future investigation.
2 Approaches to syllabic structure

In order to provide a background for later discussions, this chapter undertakes a critical review of representational theories of syllabic structure. The emphasis is on the arguments for the formal status of each syllabic constituent and for dependency relations within syllabic structure. The review also makes it clear that, although the inventory of constituents may vary, the status of the syllable as the maximal constituent is taken for granted in most theories.

2.1 Introduction

The syllable was the first prosodic property granted the formal status of a constituent in generative phonology. Constituency has since figured prominently in the literature, prosodic structure flourishing in phonological representation. This development is motivated by the assumption that constituency, formally incorporated into the representation, should offer deeper insights into the nature of phonological events. This assumption seems to have been borne out by analyses of various phenomena, to the extent that constituent nodes in phonological representation exercise a degree of explanatory power.

The notion of constituency has made a significant contribution to the overall simplification of phonological analyses. The identification of constituents has enabled phonologists to isolate portions of a string that provide the structural descriptions for accounts of phonological phenomena. As a result, this practice dispenses with complicated rules resulting from a linear mode of representation as well as the rule formalism advocated by SPE. For example, the environment 'before a consonant or word boundary' (\texttt{C} or \texttt{#}) translates into 'in syllable final position'; the structural description for penultimate stress, \texttt{VC}_0\texttt{VC}_0 (to be read as 'before a vowel preceded and followed by optional consonants), can be expressed as \texttt{σ}. The degree of formal simplicity that results is often equated with a greater plausibility; since disjoined and/or unnecessarily detailed environments are redefined as a single, concise structural description.
The advent of constituency has another, arguably far more significant consequence. The enrichment of phonological representation with constituent nodes raises a keen awareness of the importance of representational constraints. The ingredients of a representation are not simply descriptive tools with which rules are written to show phonological regularities. Avery & Rice (1989: 179) claim that 'the burden of explanation in phonology should be in the representational component rather than rule component'. This claim subsumes two metatheoretical assumptions. First, a phonological event should be directly motivated by its structural environment (cf. Goldsmith 1976: 50, Kaye et al. 1990: 194). In this respect, a rule-based account, in which a change can be expressed independently of its structural environment, is too arbitrary to be compatible with a restrictive theory, and thus must be excluded. Second, phonological representation should contain the bare minimum of components. This assumption is implicit in some of the syllable theories shown below as well as in theories of monovalent primes mentioned in the previous chapter. The appearance of a unit in phonological representation should entail the existence of some phonological event that is triggered by and/or operates on such a unit. Therefore, as the role of the representational component becomes more significant, it becomes increasingly important to ensure that the representation does not contain mere informal labels that generate unattested phenomena.

It is the second issue, call it MINIMAL COMPONENTIALITY, that concerns us throughout the present thesis. I will argue, in due course, that constraints on representational well-formedness should follow from a relational property without recourse to constituency. Consequently, I will propose to eliminate constituent nodes from the representation of prosodic structure. This line of argument has already been explored elsewhere, but such attempts were based on a formalism utilising extrinsically ordered rules, as described below. My intention is to pursue a representational theory that reflects recent advances in phonology. Such a theory thus ought to have different implications in the putatively more restrictive, output-oriented paradigm currently prevailing in the literature.

§2.2 reviews theories that propose a form of template embracing constituents as representational primitives, maintaining the focus on how such constituents have come to appear in (or disappear from) the representation. §2.3 illustrates a different approach that attempts to characterise syllabic structure by relations (e.g., head-dependent, strong-weak); constituency is a derivative notion in this approach, only certain relations being designated to invoke a constitutinal identity. §2.4 compares the two approaches
and presents arguments in favour of the relation-based approach. §2.5 then introduces a 'hybrid' approach which is fully relation-based but retains the primitive notion of constituency, thus incorporating advantages from both the above approaches.

2.2 The template-based approach

In the development of non-linear representations, the syllable first separates from a string of feature bundles and becomes a formal constituent in syllabic structure. It had been recognised as a prosodic (or suprasegmental) entity long before the introduction of generative phonology; the work of early structuralists refers to the syllable in terms of perception or its acoustic correlates (cf. Bloomfield 1933, Hockett 1955). However, the incorporation of the syllable into non-linear representations, and the subsequent development of its hierarchical organisation, purports to be motivated by phonological phenomena observed in languages. This section presents theories that make generalisations in the form of template, the shape of which reflects the decision of what phenomena should be attributed to syllabic constituents.

2.2.1 The two-tiered flat model

Kahn (1976) proposes a simple, non-linear mode of representation, in which syllable nodes are indicated as suprasegmental objects residing on a tier separated from the melody tier. Melodies are directly attached to syllable nodes by a set of syllabification rules. This two-tiered flat model is illustrated in (1) below (σ, C and V represent a syllable node, a consonant and a vowel, respectively).

\[ \sigma \]
\[ \text{C}_i \quad \text{V} \quad \text{C}_j \]

The syllable node (σ) allows reference to environments such as 'syllable-initial' and 'syllable-final'. Kahn demonstrated that this model of syllabic structure captures a number of generalisations related to string-adjacent melodies (e.g. alterations, deletion). This clearly indicates the merits of this representational formalism and, to this extent, offers evidence for the phonological reality of the syllable.

There are two points to be noted with his work. First, the two-tiered flat model can neither accommodate phonotactic restrictions nor provide more than a sketchy discussion
of stress assignment (1976: 134ff). This is because the model lacks a means of extracting the relevant sub-syllabic portions of melodies. This state of affairs motivates further elaborations on the internal structure of the syllable and/or the introduction of an alternative or additional mechanism, as shown below.

The second point, which will have repercussions for the representational theory to be developed later, is Kahn's view of representational constraints. He compares his model with the 'bracketing' notation used in Anderson & Jones (1974). Let us consider an example word *pony* /pəuni/, which is represented as follows.

(2)  

\[
\begin{align*}
\text{(a)} & \quad \text{[pəu [n] i]} \\
\text{(b)} & \quad \varepsilon_1 \quad \varepsilon_2
\end{align*}
\]

(2a) indicates two types of relations: PRECEDENCE (/?p/? ?/?əu/? ?/?n/? ?/?i/?; where '??' reads 'precede immediately and strictly') and DEPENDENCY (/?p/? /=/?əu/=/?n/, =/?n/=/?i/; where '='/ and '=' read 'be the dependent of' and 'be the head of', respectively). These two types of relations together invoke constituency, as shown by the brackets. The two modes of representations may seem to possess the same descriptive capability. However, Kahn criticises the bracketing notation for allowing a 'nonsensical' configuration such as (3a) below, in which non-consecutive melodies form a single syllable; he claims that his model CANNOT represent such a syllable structure.

(3)  

\[
\begin{align*}
\text{(a)} & \quad [p] \quad [əun] \quad [i] \\
\text{(b)} & \quad \varepsilon_1 \quad \varepsilon_2
\end{align*}
\]

Note that (3b) is different to (3a), Kahn claims, 'since even if [p] were associated with the final syllable, it would be interpreted as the INITIAL element of that syllable, due to the more constrained nature of the graphical representation' (Kahn 1976: 36-37). That is, (3b) is not ill-formed but simply equivalent to the following configuration.

(4)  

\[
\begin{align*}
\varepsilon_1 & \quad \varepsilon_2 \\
\text{əu} & \quad \text{n} \quad \text{p} \quad \text{i}
\end{align*}
\]
2 Approaches to syllabic structure

(3b) and (4) are both interpreted as [au n pi] — whether one may ever wish to represent /au n pi/ as (3b) is a different matter.

In order to examine the 'constrained nature of the graphical representation', let us consider an argument to reject the structure represented by (3a) in the context of Anderson & Jones (1974). In addition to the bracketing notation, they introduce 'a graph-theoretic interpretation of dependency structure' (1974: 9ff), in which vertical and horizontal axes indicate dependency and precedence, respectively (see §2.3 for details); e.g. (5a) amounts to (2a). Given this mode of representation, (3a) translates into (5b), which shows the same precedence relations as (2a) (/p/ ≼ /au/ ≼ /n/ ≼ /i/) but different dependency relations (/au/ ⊳ /n/, /p/ ⊳ /i/).

(5) (a)  
\[
\begin{array}{ccc}
  \text{p} & \text{au} & \text{i} \\
  \text{n} & & \\
\end{array}
\]
(b)  
\[
\begin{array}{ccc}
  \text{p} & \text{au} & \text{i} \\
  \text{n} & & \\
\end{array}
\]

Anderson & Jones assume, following Marcus (1967: 200ff), that representations must conform to projectivity, one of the well-formedness conditions that allows lines to 'intersect only at nodes' (1974: 12). Although this condition renders (5b) ill-formed as one would wish, the need for such a stipulation points to the fact that the theory suffers too strong descriptive power that must be suppressed by an extrinsic condition. The different treatment of the essentially same 'line-crossing' patterns clearly indicates that the 'constrained nature' is not inherent to the graphical mode of representation, but it stems from the metatheoretical assumption that phonological representation should ideally be able to express well-formed structures only.

Important to this assumption is not only the choice of the model of representation but also the precise inventory of representational components. Once stipulated, representational resources necessarily entail possible uses that include unintended ones. This is precisely why minimal componentiality is required — it may not be possible to select 'perfect' representational components, so it is important to reduce the risk of side effects by keeping the number of components to a bare minimum.

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1 Goldsmith (1976) proposes essentially the same graph-theoretic constraint that bans association lines from crossing.
2.2.2 The three-tiered flat model

Kahn's model, together with influential work by Goldsmith (1976) and Liberman & Prince (1977), establishes the foundation of the non-linear mode of representation in generative phonology. This prompts three innovations, which may be discussed in the same context but are rather independent of each other. First, revisions are made to the distinctive feature formalism, which treats all phonological properties as intrinsic to individual segments. Leben (1980) shows that more appropriate analyses can be obtained, without losing descriptive adequacy, by reformulating \([\pm\text{long}]\) and \([\pm\text{syllabic}]\) in the non-linear representation; and Selkirk (1980) insists that \([\pm\text{stress}]\) should be dispensed with in favour of a fully non-linear analysis of stress. Second, McCarthy (1979) and Halle & Vergnaud (1980) introduce another formal component that serves as the pivot in non-linear representations: the skeletal tier. This tier comprises slots that function as the terminals of prosodic structure, on the one hand, and as the anchors of (supra)segments, or autosegments, on the other. Finally, prosodic structure is enriched both beyond and inside the syllable. Selkirk (1980) proposes prosodic structure consisting of syllable (σ), stress foot (Σ) and prosodic word (ω). The internal structure of the syllable is approached in different studies, and the rest of this section illustrates one such attempt.

Clements & Keyser (1983) point out that Kahn's model needs to be improved in order to attribute the syllabic/non-syllabic distinction to a prosodic property internal to the syllable. In SPE, such a distinction is made by the value of the feature \([\text{syllabic}]\), a property intrinsic to melodies. Based on this assumption, Kahn (1976: 39ff) proposes that syllabification should be essentially carried out as follows: melodic units with \([+\text{syllabic}]\) are first associated to syllable nodes; and then possible initial/final clusters, independently stipulated for individual languages, are attached to the syllable nodes. The procedure crucially relies on the presence of \([+\text{syllabic}]\) melodies, but Clements & Keyser (1983: 5) state

... as a number of phoneticians have pointed out, syllabicity is not an intrinsic characteristic of segments but involves the relationship between a segment and its neighbors on either side.

Melodic units are not randomly concatenated; rather, their distribution conforms to a universal sequential pattern in a syllable, as well as to restrictions imposed by individual grammars. Syllabicity is a property that emerges from this pattern within a syllable; this entails that the syllabic/non-syllabic status of a melodic unit cannot be determined before
syllabification has been completed (cf. Lowenstamm 1981). In this respect, Kahn's syllabification encounters problems.

Sonority, a sound property often correlated with relative perceptual prominence, is frequently employed in the literature to account for this pattern (Steriade 1982, Selkirk 1984a, Zec 1988, Clements 1990). Within frameworks based on SPE-type features, it is claimed that the features are hierarchically ordered according to the contribution they make to melodic units in terms of their sonority value or index. A version of the universal sonority hierarchy is shown below (reproduced from Levin 1985: 63).²

(6)

\[\begin{array}{c}
\text{[-high]} & \text{[+high]} \\
\text{[-con]} & \text{[+con]} \\
\text{[+son]} & \text{[-son]} \\
\text{[+cont]} & \text{[-cont]} \\
\text{[-voice]} & \text{[+voice]} \\
\end{array}\]

In (6), the left branch is more sonorous than the right at each level, and the hierarchical structure indicates the order in which sonority values are calculated. So melodies with [-high] are the most sonorous; if [+high], melodies with [-cons] are more sonorous than [+cons] ones, and so forth. When a syllable contains more than two melodic units, their sequential patterns are constrained in terms of sonority. For example, if a syllable consists of three melodic units \((\ell_0 \, m_1 \, m_2 \, m_3)\), where \(m_i\) indicates a melodic unit, their sonority relations are exhausted as follows (the operators ' >' and '<' read 'more sonorous than' and 'less sonorous than', respectively).

(7)

(a) \(\ell_0 \, m_1 < m_2 > m_3\)
(b) \(\ell_0 \, m_1 < m_2 < m_3\)
(c) \(\ell_0 \, m_1 > m_2 > m_3\)
(d) \(\ell_0 \, m_1 > m_2 < m_3\)

² The formal definition of the sonority hierarchy is a matter of controversy. My reference to Levin's description is only intended to show the existence of a certain sequential pattern within a syllable, and I will not go into detail here in connection with the precise stipulation of this hierarchy; see Zec (1988: 79ff) for a detailed discussion of this issue. As an alternative to this feature-based stipulation, it has been proposed that sonority may be derived from the structural properties of melodic units; see Harris (1990), Rice (1992) and §3.4.5 for this view.
(7a-c) show legitimate sequences, whereas (7d) is unattested in any language. A syllable has only one melodic unit that forms the sonority peak, and the other melodies in the same syllable are distributed in such a way that they show a decrease in sonority towards the margins of the syllable. Accordingly, the sequence (7d), which shows two peaks (m₁ and m₃), is ill-formed.

Given that syllabicity is determined not by an inherent property of a single melodic unit but by a positional property defined with reference to the syllable, Clements & Keyser propose that the peak/margin distinction should be explicitly encoded on a tier, the CV tier, which mediates between the syllable tier and melody tier.

The CV tier comprises V positions, which constitute the sonority peak of each syllable, and C positions, which may appear to the side(s) of a V position within a syllable. The number of C positions at each syllable margin may range from zero to a certain number determined by the grammar of individual languages. The V position is the only obligatory category within a syllable, and it is again parameterised whether a syllable in a language can contain more than one V position.

The CV tier dispenses with the feature [±syllabic] in melodic structure, but it is not a mere notational variant. Clements & Keyser (1983: 136) claim

CV elements are not defined in terms of such distinctive feature categories as syllabic or consonantal, but are primitives of the theoretical vocabulary. These elements ... are interpreted as distinguishing the functional category syllable peak from syllable margin and thus determine the locus for the association of prosodic properties such as pitch and stress.

Yet this distinction of CV positions raises a question concerning those languages that allow syllables consisting of two V positions, such as long monophthongs and diphthongs. If we follow the above claim strictly, we may well assume that a syllable

---

3 A well-known apparent violation of this sonority constraint is the syllable-initial sequence of /s+C/. However, a body of evidence shows that the /s/ does not belong to any initial tautosyllabic cluster; see Kaye et al. (1990) and Kaye (1992a). For citing of other sequences with sonority reversals, see Clements (1990: 288).
containing two V positions has two syllable peaks, each of which functions as the locus for the association of pitch and stress. As far as the association of pitch is concerned, a syllable may carry more than one tonal specification (i.e. contours), but the association of tones often requires more than a peak/margin distinction (cf. Odden 1995: 448ff, Yip 1995: 488ff). As for stress, it seems difficult to find empirical evidence to support the presence of a syllable containing two peaks and 'double' stress. These problems, however, can be circumvented by refining the possible landing sites for prosodic properties. In this way, the issues do not undermine the claim that CV positions are representational primitives, an assumption which is also supported by the following discussion.

Integrating earlier proposals mentioned at the beginning of this chapter, the model depicted in (8) consolidates two important concepts in phonology. One of these is the concept of **phonological timing**. In addition to the peak/margin distinction mentioned above, units on the CV tier encode quantitative information, independently of the qualitative properties of melodies. Many stress systems invoke the notion of phonological weight: such a language requires the distinction between light and heavy syllables in stress assignment. The class of heavy syllables comprises the following three types: (a) syllables with a long monophthong, (b) syllables with a diphthong, and (c) syllables with a sequence of a short vowel and a following consonant. While no common factor is found among these types in terms of their qualitative properties, the CV model can show that they share the same quantitative specification, as shown below.

\[
\begin{align*}
\text{(9a-c) represent the three types of heavy syllables, respectively. The phonological quantity shown by the same number of CV positions allows us to capture a natural class of heavy syllables.}
\end{align*}
\]
referring to the metrical level, which is equivalent to the CV tier. Clements & Keyser (1983: 62ff) provide ample justification for the presence of the CV tier, including their analysis of compensatory lengthening. Note that, through such analyses, the notion of phonological timing also accommodates the concept of EMPTY positions (i.e. a position with no melodic content), which is only conceivable in this mode of representation (cf. Kaye & Lowenstamm 1981).

The other important concept reinforced by Clements & Keyser's model is the three-dimensional nature of phonological representations, introduced by McCarthy (1979) and then formalised by Halle & Vergnaud (1980). CV positions form the core string of phonological representation; attached to this CV tier are planes, each of which is linked to other planes via the CV tier.

McCarthy (1979) convincingly demonstrates that the three-dimensional conception has considerable merits in the analysis of Semitic morphology. Clements & Keyser exploit this conception in a unique way, as described below.

Although the introduction of the CV tier alone enables Clements & Keyser to account for many phenomena, they claim that yet another constituent, NUCLEUS (v), needs to be recognised in phonological representation. When it comes to the question of phonological weight mentioned earlier, a good deal of evidence shows one determining factor to be a string smaller than the syllable. The formal definition of the heavy syllable, therefore, requires more than the structural descriptions in (9), which are shown without any syllable-initial consonants for illustrative purposes. It is a well-known fact that, in terms of syllable typology, there is no language in which syllables categorically begin with a vowel (Jakobson 1962: 526). That is, (11a) can be found in any language, including those which permit the structures in (9), reproduced in (11bc) (the melody tier is irrelevant here and is therefore omitted).
Another crucial fact is that syllable-initial consonants never count with respect to phonological weight in stress systems.\(^4\) It then follows that (11bc) form heavy syllables whereas (11a) does not, despite the fact that the same number of positions are contained in the configurations. Clements & Keyser (1983: 12) propose that such a distinction should be made by referring only to the nucleus, which is a maximally binary-branching constituent consisting of 'any and all tautosyllabic sequences of the form V(X), where X ranges over single occurrences of C and V.\(^5\) Given this definition, the nucleus structures in (11) are represented as follows ('\(v'\) represents a nucleus node).

\[
\begin{align*}
(12) & \quad (a) \quad \vcenter{\vphantom{v}\xymatrix{& v \\ C \ar@{-}[u] \& V}} & (b) \quad \vcenter{\vphantom{v}\xymatrix{& v \\ V \ar@{-}[u] & V \ar@{-}[u]}} & (c) \quad \vcenter{\vphantom{v}\xymatrix{& v \\ V \ar@{-}[u] & C}}
\end{align*}
\]

Now phonological weight can be adequately determined by referring to the structure of the nucleus: the non-branching one in (12a) is light while the branching ones in (12bc) are heavy.

Clements & Keyser (1983: 17) make it clear that the nucleus is not a subconstituent of the syllable in such a strict hierarchical sense; the nucleus tier occupies its own plane independent of the syllable tier. The configurations (13) illustrate the difference.

\[
\begin{align*}
(13) & \quad (a) \quad \vcenter{\vphantom{\sigma}\xymatrix{\sigma \\ C \ar@{-}[u] & V \ar@{-}[u] & C}} & (b) \quad \vcenter{\vphantom{\sigma}\xymatrix{\sigma \\ C_i \ar@{-}[u] & V \ar@{-}[u] & C_j \ar@{-}[u]}}
\end{align*}
\]

Let us call the proposed model depicted in (13b) the three-tiered 'flat' model because it posits no intermediate constituents.\(^6\) The representation of each plane is formally termed DISPLAY; so the representations in (11) and (12) are syllable displays and nucleus displays, respectively. Although not explicitly stated, the lack of a hierarchical relation between the syllable and nucleus may well be explained by the same reason that excludes 'onset',

\[^4\text{An apparent counterexample to this premise is Aranda, which will be discussed in §3.4.}\]
\[^5\text{The variable C is not necessarily associated with a consonant. VC may dominate a long monophthong or a diphthong according to individual grammars (Halle & Vergnaud 1980: 12).}\]
\[^6\text{The model is in fact 'multi-tiered' because Clements & Keyser assume that the representation also contains other suprasegmental structural tiers such as foot (Selkirk 1980) and morpheme (McCarthy 1979), together with autosegmental tiers such as tonal (Goldsmith 1976) and laryngeal.}\]
'coda', 'rhyme' and 'mora' from the representation: the absence of empirical evidence that compels such a stipulation. Put differently, for any phonological phenomenon, (13a) does not provide a convincingly better analysis than (13b). Clements & Keyser (1983: 24) state

The theory ... represents an attempt to achieve maximal theoretical simplicity in the face of data of considerable intricacy and variety. Wherever possible, we have tried to avoid unnecessary additions to the theoretical apparatus of phonological theory by making maximal use of the notational distinctions provided by three-tiered syllable structure.

The three-dimensional concept, which is motivated independently, prevents the theory from assigning any redundant structural relation between the syllable and nucleus, thereby achieving minimal componentiality.

2.2.3 The multi-storey 'onset-rhyme' model

Clements & Keyser (1983) reject constituents other than the syllable and the nucleus due to the lack of compelling evidence for the formal status of any other constituents. Distributional regularities are prescribed in terms of 'positive and negative syllable structure conditions' (Clements & Keyser 1983: 19). These conditions refer both to C/V units and to syllable edges, and never invoke constituency. The presence of phonotactic restrictions, nevertheless, is often considered to be a sufficient condition for a constituent, as described in this section.

Harris (1983) adopts a mode of representation proposed in Halle & Vergnaud (1980) as shown below ('O' and 'R' represent the onset and the rhyme, respectively).^7

(14) 

[^7] Harris does not indicate the CV tier in (14). Its omission follows not from any principled reason but from the simple fact that the three-dimensional nature of representation is not within the scope of his work. Halle & Vergnaud (1980: 96) propose another constituent, the appendix, which is 'extrametrical' and 'limited to word final syllables'. This exceptional behaviour of the appendix seems to strongly suggest that it is not a general property of the syllable. Indeed, the 'termination' in Fudge (1969), equivalent to the appendix, disappears in Fudge (1987). The appendix, therefore, is not considered here.
The rhyme in this model more or less amounts to the nucleus of the three-tiered flat model, and the state of the rhyme node determines phonological weight. The two models agree on the redundancy of the 'coda'. Harris, however, differs from Clements & Keyser on the following two counts: (a) the onset is a formal constituent, and (b) the onset and the rhyme are the subconstituents of the syllable.

Harris argues for including both the onset and the rhyme because of 'their distinct principles of internal organisation' (1983: 8), and gives a detailed account of such principles in Spanish (1983: 20ff). However, the two constituents differ in their compositional characteristics: he shows that the rhyme plays a role in stress assignment, but presents no parallel case of the onset functioning as an active unit in prosodic phenomena. The onset is invoked solely as a phonotactic domain; in prosodic terms, the identification of the onset is only passively motivated by the presence of the rhyme.

As for the hierarchical organisation of the constituents, Harris (1983: 8) only states that 'the syllable has two immediate constituents'. Prior to such a statement, however, the theory needs to validate the status of the syllable as a constituent, and then motivate the structural relation between the syllable and its subconstituents. Consider the following facts resulting from the structure in (14): (a) the onset and the rhyme together allow us to dispense with descriptive categories such as 'syllable-initial' and 'syllable-final' because the two subconstituents provide exhaustive positional references; (b) given the presence of the rhyme, the syllable seems to play no essential role in prosodic phenomena. Besides, it is a matter of controversy whether the state of the syllable — branching or non-branching — should count in phonological analysis at all. The stipulation of the subconstituents gives rise to the question of how the syllable constituent per se can be formalised in syllabic structure (cf. §3.1). Therefore, neither the presence of the syllable nor the hierarchical structuring can be taken for granted. Chapter 3 will further discuss the constitutinal status of the syllable in detail.

The structure in (14) is often augmented in the literature — sometimes for descriptive purposes rather than for theoretical gain — with two rhymal subconstituents that hark back to work of the structuralists (cf. Hockett 1955: 52). One constituent is the nucleus (N), which comprises V positions alone; note that this constituent is different from the 'nucleus' (v) of Clements & Keyser (1983), which may dominate a C position. The other constituent is the coda (Co), which exhausts syllable-final C positions. (15) shows the representation of syllabic structure with these additional constituents.
The nucleus and the coda each may dominate more than one position subject to language-specific conditions.

The nucleus-coda division seems to be motivated primarily by distributional regularities. It has also been claimed that the nucleus is associated with phonological weight in some languages; I will return to this claim in §4.3. Like the onset, however, the coda fails to show any active participation in prosodic events. In the same way that the syllable splits into the onset and the rhyme, the rhyme is in turn divided into the nucleus and the coda. Although the coda displays its own internal organisation (cf. Fudge 1969), its status as a constituent seems less strongly defended than that of the onset, perhaps due to the fact that many languages systematically lack syllable-final consonants.

The full-blown syllabic structure in (15) offers precise descriptive labels and is employed particularly in the introductory literature (e.g. Katamba 1989, Durand 1990, Goldsmith 1990, Giegerich 1992). However, criticisms must be directed towards representational components that perform no more than a 'labelling' function. As mentioned above, there is a crucial lack of evidence in support of the compositional properties of the onset and the coda; no phonological phenomena seem sensitive to their branching/non-branching state, and no prosodic operation requires a unit such as the onset or the coda. The previous section showed that Clements & Keyser (1983) are aware of the importance of avoiding such informal labels. The following two sections introduce further attempts to attain a restrictive syllable theory.

2.2.4 'C/V' to 'x'

While there arises little doubt as to the validity of the three-dimensional view of non-linear representations, the nature of its core string remains somewhat controversial. The CV tier described in §2.2.2 encodes two kinds of information: phonological timing, and the functional category of individual timing units. However, subsequent works criticise the latter categorial information as redundant. Hyman (1985: 13) claims that melodic properties such as [±con] and [±son] are sufficient for drawing the categorial
distinction. For Lowenstamm & Kaye (1986: 110), the C/V distinction is predictable from a hierarchical syllabic structure, which is deemed indispensable. Further, Levin (1985: 29ff) argues that, in order to accounts for certain phenomena, timing units ought to remain featurally indistinguishable.

The first two arguments seem rather theory-internal and are well anticipated by Clements & Keyser. As for Hyman's claim, Clements & Keyser explicitly state that the CV units are not notational variants of distinctive features (see the quotation in §2.2.2, on page 18). Besides, Hyman's theory relies heavily on the distinctive feature [±con] and, in this regard, it does not seem particularly superior to the C/V distinction. Concerning Lowenstamm & Kaye's claim, Clements & Keyser (1983: 10) admit that the categorial information 'could be independently determined from the hierarchical syllable structure', although they still opt for the flat structure. Indeed, analyses developed using the multi-storey representation seem to be translatable into the flat model without much stipulation. For example, Kaye & Lowenstamm (1986: 114) claim that empty elements (i.e. terminals without melodic contents) cannot appear in a branching constituent. This has the effect of excluding (16a), in which one of the daughters in a branching nucleus contains an empty element (0), but allowing (16b) in which an empty element is dominated by a non-branching coda.

(16) (a) * \( \sigma \) \( \text{N} \) \( \emptyset \) (b) \( \sigma \) \( \text{R} \) \( \text{Co} \) \( \emptyset \)

The same constraint can be formulated in the flat mode of representation by prohibiting an empty element in consecutive identical positions.

(17) (a) * \( \sigma \) \( \text{V} \) \( \text{V} \) \( \emptyset \) (b) \( \sigma \) \( \text{V} \) \( \text{C} \) \( \emptyset \)

Comparing the two representations, we see that the advantage of discarding the CV distinction at the expense of additional hierarchical structure is not obvious; the mode of representation in (17) does not seem to suffer loss (or excess) of adequacy compared to that in (16).
Levin's argument also fails to justify abandoning the C/V distinction. Consider the following data from Mokilese, a Micronesian language spoken in Mokil Atol, Ponape District, Eastern Caroline Islands (Harrison 1976, sited in Levin 1985: 35).\(^8\)

(18) Mokilese

<table>
<thead>
<tr>
<th>Stem</th>
<th>Progressive</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) kasɔ</td>
<td>kas-kasɔ</td>
<td>'to be throwing'</td>
</tr>
<tr>
<td>mʷiŋe</td>
<td>mʷiŋ-mʷiŋe</td>
<td>'to be eating'</td>
</tr>
<tr>
<td>pɔtok</td>
<td>pɔt-pɔtok</td>
<td>'to be planting'</td>
</tr>
<tr>
<td>(b) wia</td>
<td>wii-wia</td>
<td>'to be doing'</td>
</tr>
<tr>
<td>caak</td>
<td>caa-caak</td>
<td>'to be bending'</td>
</tr>
<tr>
<td>pa</td>
<td>paa-pa</td>
<td>'to be weaving'</td>
</tr>
<tr>
<td>(c) ir</td>
<td>irr-ir</td>
<td>'to be stringing'</td>
</tr>
<tr>
<td>onop</td>
<td>onn-onop</td>
<td>'to be preparing'</td>
</tr>
<tr>
<td>antip</td>
<td>ant-antip</td>
<td>'to be spitting'</td>
</tr>
</tbody>
</table>

Observing that the prefix template varies according to the shape of stems (i.e., CVC, CV/VC, VCC) but keeps the same quantitative information (i.e., three timing units), Levin proposes that the progressive prefix has the template \([a \times \times \times]\), in which \('x'\) stands for a bare timing unit. However, McCarthy & Prince (1986: 20ff) put forward an alternative, arguably more convincing analysis that posits a heavy syllable \((\sigma_p)\) as the prefix template, asserting that 'The descriptive success of xxx is an artifact of the restricted syllable structure of this language' (1986: 4). Although their analysis is couched in the moraic model to be discussed in the next section, the proposed strategy is compatible with the CV tier model if we assume that the prefix must satisfy a branching structure defined by the nuclear display in (12a), which is reproduced below.

\(^8\) Harrison & Albert (1976) use a spelling convention to represent Mokilese five stops as \(p, d, j, k\) and \(pw\). However, Harrison (1976: 20-21) states that these stops 'are normally voiceless, but often have nondistinctive variants (allophones) that are voiced'; and he phonetically transcribes them as \(p, t, c, k\) and \(p^w\). Notwithstanding, the alveolar stop is often transcribed as \(d\) in the literature. I will use the following transcriptions for Mokilese consonants.
Recall that the second member of the nucleus above may dominate a vowel. In keeping with recent developments in the study of reduplication (cf. McCarthy & Prince 1995), let us further assume that copying from the stem to the prefix must be maximally faithful; i.e. as much of the stem as possible must appear in the prefix (cf. Blevins 1996). The following table reproduces (18), with derived words fully syllabified according to the Onset First Principle (Clements & Keyser 1983: 37) and reduplicative prefixes underlined.  

(20) (a) kas  kas.kas  
      m*ine m*ine.m*i.ne  
      poto tok poto.pot ook  
(b) wia wii.wi.a *wi.a.wi.a  
      caak caa.caak *caak.caak  
      pa paa.pa *pa.pa  
(c) ir ir.ir *i.ir, i:.ir  
      onop on.no.nop *o.no.nop, oo.o.nop  
      antip an.tantip *a.nan.tip, aa.an.tip

(20a) should be straightforward in light of the above assumptions. pa in (20b) is smaller in size than the required template, so it triggers the spreading of a to the final C position in the prefix template (19). wia in (20b) fails to appear in the prefix as it is, because this sequence is treated as bisyllabic in Mokilese (pronounced as wija), exceeding the size of the prefix. Therefore only the initial syllable is copied and the spreading of i follows to satisfy the template. (See §3.3.2 for a structural illustration of essentially the same spreading in Ilokano.) The ill-formedness of *caak.caak should indicate that Mokilese lacks trimoraic (or superheavy) syllables. As for the stem onop in (20c), if the initial sequence on is simply copied on to the prefix, the Onset First Principle syllabifies n into the onset of the stem-initial syllable, yielding *o.no.nop. The requirement of template satisfaction prompts the lengthening of n. This operation is not necessary in an.tan.tip because the sequence nt forms a well-formed coda-onset sequence on its own (cf.  

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9 Clements & Keyser adapted the Onset First Principle from Kahn (1976).
Harrison 1976: 41ff). Given this alternative account of Mokilese reduplication, Levin's argument in favour of anonymous timing units does not seem to hold.

Needless to say, the arguments made by Hyman, Lowenstamm & Kaye and Levin are important in their own rights, but the point being made here is that the proposed representations seem to have less bearing on the achievements of the models than the authors claim. However, arguments in defence of the C/V distinction are rarely put forward, and it becomes accepted practice to represent phonological timing with non-categorial place holders such as points or 'x's. Accordingly, the 'CV' tier may no longer be an appropriate term to use, so I will employ the 'skeletal' tier for the same purpose throughout the remainder of this work.

2.2.5 The moraic model

In connection with the skeleton model, questions are also raised as to the very concept of phonological timing. Hyman (1985: 9) criticises the exhaustive specification of timing in the skeletal tier on the grounds that certain positions (i.e. 'onset' consonants) are systematically ignored in suprasegmental phenomena. He claims that the theory should capture this state of affairs without recourse to the nucleus display (Clements & Keyser 1983) or the rhyme projection (Halle & Vergnaud 1980). McCarthy & Prince (1986: 3) also reject any level of representation that specifies the number of segments in phonemic terms. They argue that the skeletal tier is superfluous on the grounds that no phonological phenomena need count bare timing units (i.e. segments). These criticisms lead to a proposal that the representation contains only phonologically significant quantitative units: the mora (Trubetsky 1969: 173ff, Prince 1980: 525ff). The proposed representation takes the mora as a representational primitive (μ), although Clements & Keyser (1983: 79ff) treat it as a derived notion.

Hyman (1985) proposes the following mode of representation.\(^{10}\)

\[(21) \quad \begin{array}{ll}
\text{(a)} & \quad \begin{array}{c}
\sigma \\
\text{C}_i \quad \mu \\
\quad \mu \\
\quad V \\
\quad \text{C}_j
\end{array} \\
\text{(b)} & \quad \begin{array}{c}
\sigma \\
\text{C}_i \\
\quad \mu \\
\quad V \\
\quad \text{C}_j
\end{array}
\end{array}\]

\(^{10}\) Hyman (1985) introduces the 'weight unit' which, residing on its own x-tier, dominates every melodic unit in the underlying representation in much the same way as the timing unit on the CV tier does. However, this unit becomes equivalent to the mora through structure changing rules.
The number of the morae distinguishes the weight of the syllable. Since languages may differ in their evaluation of phonological weight, an apparently identical sequence of melodies (e.g. CjVCj) may receive different structural interpretations in different systems; $\sigma_{\mu}$ in (21a) and $\sigma_{\mu}$ in (21b). McCarthy & Prince (1986: 70) present an alternative mode of representation, in which each mora dominates only a single melodic unit. Their model is shown in (22ab), which correspond to (21ab), respectively.

Hayes (1989) makes a modification to McCarthy and Prince's model, proposing that non-moraic 'coda' consonants should be dominated not by the syllable but by the preceding mora. Therefore, he retains (22a) but replaces (22b) with (22c). This modification, he claims, offers a descriptive means to recapture the onset-rhyme division (Hayes 1989: 298). It is not clear, however, whether such a modification is really necessary in the moraic model. McCarthy & Prince (1986: 72) point out that 'Rhyme-domain phonological rules are typically trivially reformulated without reference to rhymes'. Still, Hayes' model seems to have been widely accepted in the literature.

One notable difference between (21) and (22) is the treatment of 'onset' consonants, and in this regard McCarthy and Prince's model seems to have the advantage over Hyman's. In a heavy syllable with an onset consonant (CVjVCj), Hyman's model assigns a compositional unit consisting of the initial two sounds. Therefore, (21a), but not (22a), may well raise the expectation that CjV and Cj should exhibit independent behaviour. This prediction is hard to verify. Broselow (1995: 190) cites Katada (1990) as a possible source of support for it; she claims that the Japanese language game called shiritori should provide the necessary evidence. In this game, participants take turns finding a word that begins with (C)V that matches the final (C)V of the previous word; if a player cannot find such a word or finds a word ending with a moraic nasal, the player loses the game. (23) shows an example sequence.

(23) neko 'cat' → koori 'ice' → risu 'squirrel' → sukii 'ski' → iruka 'dolphine'...
The word *kona* 'powder' is permitted to follow *neko*, but *kiiro* 'yellow' cannot be used after *sukii*. This fact allegedly supports the independence of the two units (CV₁ and V₂) in a single syllable (CV₂V₂). However, there exists another interpretation of the above fact: Japanese lacks true diphthongs or long monophthongs (cf. Yoshida 1991: 38ff). Given that the example words *koori* and *sukii* are syllabified as *ko.o.ri* and *su.ki.i*, respectively, the *shiritori* game simply requires syllable matching. According to Broselow (1995: 190), there appears to be no compelling evidence other than this game; the division of a heavy syllable indicated by Hyman's model thus seems untenable.

There is another less explicit difference between (21) and (22). Hyman claims that syllabification is not universal (Hyman 1983, 1985: 19ff) — or at least not exhaustive (Hyman 1990) — so it is the mora tier that exhausts melodies and serves as a core string in the three-dimensional representation. McCarthy & Prince regard syllabification as universal and assume that the syllable 'provides a locus for melodic units that do not contribute to weight' (1986: 70). The advantage of Hyman's model in (21), as pointed out by Zec (1988: 8), is its conformity to the Strict Layer Hypothesis (Selkirk 1984b: 26, Nespor & Vogel 1986: 7ff), which is violated in (22) by the presence of melodies directly appended to syllable nodes. On the other hand, McCarthy & Prince's model seems more flexible in the sense that the mora can be taken as a diacritic to indicate phonological weight only if necessary. Brentari & Bosch (1990: 13) argue that 'only quantity-sensitive languages make use of the mora in a non-redundant way'. Given this argument, one is tempted to posit a syllabic structure akin to Kahn's model (§2.2.1) for languages that do not refer to weight, assuming that the mora tier is absent in such languages, although this results in the loss of many of the cumulative insights from post-Kahnian work mentioned at the beginning of §2.2.2.

In addition to the argument for eliminating the redundancy of the skeletal tier mentioned earlier, Hayes (1989, see also Bickmore 1995) claims that an advantage of the moraic mode of representation is the descriptive adequacy it achieves in its account of compensatory lengthening. However, this argument does not necessarily criticise the skeletal tier per se; rather, the criticism seems to be directed towards a rich constituent structure (cf. §2.2.3). Hayes and Bickmore both argue that the skeleton theory, when coupled with such a structure, requires categorial changes to account for some compensatory lengthening phenomena. Consider an example from Illocano, cited in Hayes (1989: 269ff): /bagi–en/ → *baggjen* (or *bagjen*) 'to have as one's own'. As shown below, the onset-nucleus sequence in the second syllable /gi/ becomes a
coda-onset sequence as the result of the serial application of rules: glide formation (24b), compensatory lengthening (24c) and resyllabification (24d).

(24) (a) \[ \sigma \sigma \]  
\[ N N N N \]  
\[ X X X X X \]  
\[ b a g i e n \]  
(b) \[ \sigma \sigma \]  
\[ N N N N \]  
\[ X X X X X \]  
\[ b a g i e n \]  
(c) \[ \sigma \sigma \]  
\[ N N N N \]  
\[ X X X X X \]  
\[ b a g i e n \]  
(d) \[ \sigma \sigma \]  
\[ N N N N \]  
\[ X X X X X \]  
\[ b a g i e n \]  

In contrast, Hayes (1989: 274) claims that no such categorial alteration takes place in a moraic account of the process; glide formation (25b), parasitic delinking and resyllabification (25c) and compensatory lengthening (25d).

(25) (a) \[ \sigma \sigma \sigma \]  
\[ \mu \mu \mu \]  
\[ b a g i e n \]  
(b) \[ \sigma \sigma \sigma \]  
\[ \mu \mu \mu \]  
\[ b a g i e n \]  
(c) \[ \sigma \sigma \sigma \]  
\[ \mu \mu \mu \]  
\[ b a g i e n \]  
(d) \[ \sigma \sigma \sigma \]  
\[ \mu \mu \mu \]  
\[ b a g i e n \]  

The supposed problem of the skeleton theory stems from the presence of superfluous syllabic categories, again pointing to the importance of minimal componentiality. Lowenstamm (1996), for example, shows that the skeleton model in a more restrictive context can provide a more descriptively adequate account of compensatory lengthening.

The moraic model, regardless of the difference between (21) and (22), requires revisions in connection with the representation of length. As shown in §2.2.2, the skeletal tier offers a unified account of quantitative information: the short/long contrast of melodies is indicated by the number of timing units.

(26) (a) simplex  
(i) short  
(ii) long  
(b) complex  
(i) short  
(ii) long
However, an account such as this seems to give rise to some overgeneralisations. As for the representation of long simplex melodies in (26aii), for example, tautosyllabic \textit{V}V\textsubscript{i} sequences (i.e. long vowels) are found in many languages, while tautosyllabic \textit{C}_\textsubscript{i}C\textsubscript{i} sequences (i.e. geminates) are very rare; the latter seem to be restricted to heterosyllabic contexts. This state of affairs is predicted by the moraic model. The representations in (26aii) show that a single melodic unit is attached to two x-slots. A long vowel can be represented by two morae as anchors, as shown in (27a); in the case of a geminate, on the other hand, the melodic unit must be (directly or indirectly) attached to two different syllables, as shown in (27bc), since no subsyllabic unit other than the mora is available.\footnote{See Hayes (1989: 257) for details, and Tranel (1991) for a critical discussion of the issue.}

\begin{equation}
\begin{array}{ll}
\text{a) } & \text{b) } \\
\begin{array}{c}
\downarrow \\
\mu \\
\downarrow \\
\mu \\
\end{array} & \begin{array}{c}
\downarrow \\
\mu \\
\downarrow \\
C \\
\end{array}
\end{array}
\end{equation}

When it comes to the complex melody in (26b), however, the moraic model does not seem to enjoy as much advantage as is sometimes claimed. The moraic mode of representation fails to capture the contrast between contours (affricates and prenasalised stops) and clusters for the same reason that predicts the contrast in (27). The moraic model has to seek a level of representation that encodes the relevant quantitative information. Hyman (1985: 14) suggests that length distinctions should be made at the level of underlying representation. At this level, he claims, every melodic unit is attached to a timing (weight) unit, and the underlying structure is then transformed into proper moraic representations via the Onset Creation Rule and the Margin Creation Rule. That is, only at the cost of additional rule components can we arrive at the mode of representation devoid of timing units irrelevant to phonological weight. This account obviously refers to the level of representation equivalent to the skeletal tier and thus considerably weakens Hyman's theory. McCarthy & Prince (1986: 87ff) propose a different account, based on the model of melodic structure introduced by Clements (1985) and Sagey (1986). They posit that melodic structure includes a root tier with [cons] and [son] and a manner tier with [cont] and [nasal]. Contours are represented by the presence of the antagonistic values of a feature on the manner tier under a single root node, while clusters of the same phonetic content contain two root nodes. For example,
an affricate and a cluster are represented as in (28a) and (28b), respectively (McCarthy & Prince 1986: 89).

\[(28) \quad \begin{array}{ll}
(a) & \\
\quad \sigma & \\
\quad [+\text{cons}] & \\
\quad [-\text{cont}] & [+\text{cont}]
\end{array} \\ 
(b) & \\
\quad \sigma & \\
\quad [+\text{cons}] & [+\text{cons}] & \\
\quad [-\text{cont}] & [+\text{cont}]
\end{array} \]

This particular stipulation is claimed to offer insights into possible contours and their behaviour in spreading. McCarthy & Prince (1986: 89) argue that

The root tier differs from the CV skeleton in one important respect: it does not indicate quantitative distinctions, and thus in no sense corresponds to segments. Rather, a single unit on the root tier corresponds to the notion of "single melodic element".

However, the necessity of counting \ [+\text{cons} \] on the root tier — one for contours, two for clusters — seems to weaken the authors' original argument in favour of the mora tier as a replacement for the skeletal tier, because the proposed distinction is effectively made quantitatively in much the same way as shown in (26).

2.3 The relation-based approach

The proposals illustrated in §2.2 are subsumed under the template-based approach. A template expresses the inventory of suprasegmental units (i.e. constituents) and their structural unity, which serve to select a relevant group of melodies or a domain within which phonological processes may operate. It is important in this approach to avoid overgeneralisation and redundancy by positing the simplest of templates with the smallest of inventories. However, the limits of minimal componentiality can only be reached if no template is stipulated at all. This section describes the implementation of such a view — let us call it the relation-based approach — that syllabification is the process not of matching a fixed template with a string of melodies but of constructing a tree structure by a set of rules that syllabify melodic units (or skeletal positions) in accordance with relational properties.
2 Approaches to syllabic structure

2.3.1 Overview

Theories in the relation-based approach typically share the view that syllabic structure should parallel the structural characteristics found in other domains of phonology, and even in other fields of linguistics. In §2.2.1, I briefly mentioned a mode of representation based on a relational property termed dependency (Anderson & Jones 1974). In this theory, dependency between melodic units (i.e. a head and its dependent), determined with reference to their relative sonority ranking, plays a crucial role in building syllabic structure. (A detailed illustration of this theory will appear in §2.3.2.) This characterisation of relation and structure is assumed to recur not only in different domains of phonology but also in syntax (cf. Anderson 1992).

Kiparsky (1981) and McCarthy (1979) propose another way of defining the relational property by adapting the strong-weak relation that originates in metrical theory (cf. Liberman & Prince 1977). Kiparsky (1981: 250) assumes that "sonority" is simply the intrasyllabic counterpart of stress; given this interpretation, melodic units enter into binary relations, strong (S) and weak (W), in terms of their relative sonority ranking, as shown in (29a).

(29) (a)  
\[ \begin{array}{c}
  \sigma \\
  W \quad S \\
  W \\
  W \\
  W \\
  \ldots \\
  W \\
  S \\
  S \\
  S \\
  S \\
  S \\
  W \\
  \ldots 
\end{array} \]

Levin (1985: 52ff) puts forward yet another mode of representation depicted in (29b), which invokes the phonological interpretation of X-bar theory (cf. Jackendoff 1977). In this model, the nucleus (N) does not indicate inherent constituency but identifies the head of a syllable, which is determined lexically or via N-placement rules. The core syllabic structure shown in (29b) is built by the language-specific N'-projection rule (i.e. rhyme formation) and the universal N"-projection rule (i.e. onset formation). Further positions may be attached to the structure by incorporation and adjunction. The difference between these two processes is that only incorporation is constrained by the Sonority Sequencing Generalisation (Selkirk 1984a: 116).

---

12 Along with the X-bar model described here, Levin replaces the CV tier with the x tier, as discussed in §2.2.4, which represents categorially neutral timing slots.
In addition to the use of a relational property recurring at different levels, the above three models share other characteristics in the representations of syllabic structure they postulate. They assume that syllabic structure is built according to structure formation rules, which typically derive a proliferous structure containing a large number of binary branching nodes or a small number of n-ary branching nodes. A structure such as this also distinguishes units equivalent to the nucleus, the rhyme and the syllable: the projections of the head in a dependency/X-bar tree, or S nodes in a metrical tree. Beyond these common features, the three models can also be distinguished in terms of their vocabulary and descriptive characteristics. However, details such as these are not directly relevant to the present discussion. Instead, let us now consider how a syllabic structure is assigned in the relation-based approach with the dependency model, which shows the characteristics of both the sonority-based metrical model and the head-driven X-bar model.\textsuperscript{13}

2.3.2 The dependency model

Let me first introduce some conventions relating to the diagrams (or graphs) used in dependency representations. In §2.2.1, I employed representations such as (30b), in which melodies are moulded into the dependency tree (cf. Anderson & Jones 1974). In this section, I opt for the mode of representation shown in (30a), following more recent work in the framework (Anderson 1986: 60ff, Anderson & Ewen 1987: 85ff).

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{example.png}
\caption{(30) (a) (degree) (b)}
\end{figure}

This mode of representation comprises three components: vertices (or nodes), arcs (solid lines), and association lines (discontinuous lines). (30b) is surely more restrictive in the light of minimal componentiality; nevertheless, (30a) abstracts the relational structure from individual melodic properties, in keeping with the

\textsuperscript{13} The three relation-based models, of course, differ in their theoretical details. See, for example, Ewen (1986: 211ff) for a discussion of the difference between the metrical model and the dependency model.
three-dimensional notion of phonological representation (cf. §2.2.2), and thus can enjoy certain advantages stemming from autosegmental analysis.

The configuration in (30a) above includes four vertices involving three degrees of dependency. The vertices are construed as the projection(s) of the melodic units — recall the equivalence between (30a) and (30b). The association lines indicate correspondence between vertices and melodies. For illustrative purposes, let us refer to the vertex of degree 0 (i.e. at the top of the tree) as $V_0$, that of degree 1 as $V_1$, and the leftmost and rightmost vertices of degree 2 as $C_i$ and $C_j$, respectively. Every pair of vertices connected by an arc enter into two types of relation: PREDOMINANCE (along the horizontal axis) and INHERENT DEPENDENCY (along the vertical axis). Note that arcs are formally distinguished from association lines with respect to the type of dependency they represent (Ewen 1995: 580-581). (Henceforth, 'dependency' refers to inherent dependency, unless otherwise indicated.) The subjunctive structure (between $V_0$ and $V_1$), which was not mentioned in §2.2.1, is also defined in terms of the same two types of relation; the two vertices are identical in precedence, but $V_0$ governs $V_1$ (or $V_1$ is dependent on $V_0$). Accordingly, (30a) contains the precedence relations $C_i \ll V_0$, $V_0 = V_1$ and $V_1 \ll C_j$ ("\ll" shows equivalent precedence), and the dependency relations $C_i \Rightarrow V_0$, $V_0 \Rightarrow V_1$ and $V_1 \Rightarrow C_j$.

The representational well-formedness of syllabic structure is prescribed with respect to the following diagrammatic constraints (Anderson & Ewen 1987: 91).\(^{14}\)

\begin{equation}
(31) \quad \text{A representation is a proper tree if and only if}
\end{equation}

(a) there is a root (i.e. a unique vertex that terminates no arc);
(b) all other vertices subordinate to the root;
(c) all other vertices terminate one and only one arc; and
(d) it displays projectivity (i.e. arcs or arcs and association lines intersect only at a vertex).

Consider the following configurations in the light of the above conditions.

---

\(^{14}\) The constraints originate in Marcus (1967: Chapter 6); see Marcus (1967: 205) for (31a-c) and Marcus (1967: 239) for (31d).
(32a) fails to satisfy (31a) and (31c): it contains two roots (\( a_i \) and \( a_k \)), and the vertex \( a_j \) terminates two arcs. (32b) also contains two roots (i.e. two vertices that terminate no arc) and is thus ill-formed; if we assume that \( a_k \) is not a root due to its lower degree of (self-)dependency, (32b) then violates both (31bc). The projectivity constraint (31d) excludes (32c); the string of melodies is not projective because the arc from \( a_i \) to \( a_k \) intersects with the association line of \( a_j \). Although (32d) should also be ill-formed according to (31c), Anderson & Ewen (1987: 97) suggest that the constraint (31c) should be weakened to account for ambisyllabicity. The authors thus reformulate (31c) as 'no vertex terminates more than two arcs'. It is a matter of debate whether ambisyllabicity should be equated with bidependency because, as discussed in Anderson & Ewen (1987: 61ff), phonological phenomena related to ambisyllabicity can be accounted for by making reference to foot or morphological structure.¹⁵

Syllabification comprises structure formation rules which assign dependency relations in such a way that a melodic unit of greater sonority acts as a head governing a less sonorous unit.¹⁶ The formation of syllabic structure is a three-stage process, as illustrated below with an English example word \textit{strange}.¹⁷

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¹⁵ Anderson (1986) explores an alternative mode of representation that excludes bidependency structure (cf. §4.4.4).

¹⁶ In the dependency framework, sonority ranking is calculated with reference to the relative preponderance of \(|V|\) (monovalent 'vocalic' prime) in the melody-internal structure. See Anderson & Ewen (1987: Chapter 4) for details.

¹⁷ Anderson (1986: 74ff) proposes a number of modifications to the rules in (33). The nucleus formation rule is refined in order to account for the behaviour of /jʌt/ in English. The cluster formation rule is introduced to treat word-initial consonant clusters separately from rhyme formation. It is also claimed that dependency relations in consonant clusters hold in such a way that a less sonorous consonant governs a more sonorous one. I leave aside these modifications as well as the issues that motivate them, since they go beyond the scope of the present discussion.
(33) Syllabic structure formation rules

(a) Nucleus formation (Anderson 1986: 79)
Given vowels $a, b$, where $a \ll b, a \Rightarrow b$ iff $b$ is weak (i.e. is not more sonorous than $a$).

(b) Rhyme formation (Anderson & Ewen 1987: 108)
Given segments $a, b$, where $a \ll b, a \Rightarrow b$ iff $b$ is weak.

(c) Syllable formation (Anderson & Ewen 1987: 109)
Given segments $a, b$, where $a \leq b$ ('$\leq$' includes non-adjacent as well as equivalent precedence), and $a \neq b, b \Rightarrow a$.

Note that the head is projected onto the next level in each formation, creating a new layer of subjunctive structure. In addition to the well-formedness constraints in (31), the representation is assumed to comply with the binarity constraint on dependency relations (Anderson 1986: 125, Anderson & Ewen 1987: 109), although the latter constraint must be somewhat relaxed to allow bidependency structure.

The above formation rules could permit a number of pre- and post-vocalic melodic units within a syllable, as long as the sonority relation is not violated. Representations such as these are constrained by the following language-specific condition.⁸

---

⁸ The condition (34) is a reformulation of the Length parameter in Kiparsky (1981: 248), although the latter only refers to word-final consonant clusters.
(34) Syllable Depth Condition (Anderson 1986: 72)

No segment in English is more than two degrees of (adjunctive) dependency from the head of an obligatory construction.

Accordingly, the onset in (33c) is maximised, while the rhyme may contain another melodic unit as shown below.\(^\text{19}\)

\[(35)\]  

The derived tree representation is capable of generalising both prosodic and melodic phenomena, in much the same way as a syllabic template is: vertices serve to identify relevant units or domains.

Without categorial labels, the relation-based approach can offer a descriptive model equivalent to a template; yet there are drawbacks to this approach. One problem is related to the process of structure formation. A relational representation can be derived through the serial application of extrinsically ordered rules. Each rule may ensure a degree of local well-formedness of representation, but can exert little influence on the well-formedness of a resulting structure as a whole. Such rules can be created and ordered in a rather unconstrained way, possibly generating arbitrary structures and thus weakening the advantage of componential minimality. For example, Levin (1985: 146) states that the iterative application of (parameterised) incorporation and adjunction rules, which assemble yet unsyllabified positions in the head (i.e. nucleus) of a syllable, may create 'n-ary branching nodes'. The problem, which is shared by the template-based approach to the extent that syllabification is rule-oriented, seems well acknowledged, and we can find attempts to circumvent the problem by imposing constraints on the derived

\[\text{\textsuperscript{19} The Syllable Depth Condition needs an additional constraint that limits the appearance of bidependency structure within a syllable, because otherwise the following structure is generated.}\]
representation. The Syllable Depth Condition in (34) is one such example (see Anderson 1986 for more constraints of this kind). Drawing on Levin's example, incorporation is constrained by sonority distances, though adjunction is allowed to violate this constraint. However, the very fact that such constraints need to be invoked independently of the formation rules points to the arbitrary nature of the structure building process.

Another problem stems from the presence of a number of anonymous vertices in the relational representation. A derived tree may contain vertices corresponding to 'onset', 'coda', and even a smaller unit; e.g. in (33c), /st/, /str/ and /ndʒ/ each form a subtree rooted by the projection of /s/, /r/ and /n/, respectively. The compositional function of vertices must be selective, but the lack of categorial labels fails to show such selectivity. One might be tempted to posit that only the ultimate head of a domain should display compositional behaviour at levels of projection introduced by subjunction. Nevertheless, this solution raises another problem with respect to the adequacy of subjunctive structure. Subjunction creates referential vertices equivalent to 'syllable', 'rhyme' and 'nucleus' — as well as higher prosodic categories and the metrical grid (Ewen 1986: 215ff) — without invoking such categorial labels (Anderson 1986: 60-61). However, it is not explicitly argued whether each level of projection is really indispensable; as discussed in previous sections, the simultaneous presence of the three constituents seems redundant. The nature of the dependency relation between two subjoined projections is also rather arbitrary. A head-dependent relation between vertices in strict precedence is assigned by sonority-driven syllabification rules, which gives rise to the 'inherent' (as opposed to 'structural') nature of such dependency. Subjunctive structure seems rather exceptional in this regard.

Still, the relation-based approach enjoys advantages over the template-based approach. In the relational representation, syllabic structure has a direct relevance to string-adjacent regularities (Kiparsky 1981: 250ff, Anderson & Ewen 1987: 180ff). Phonotactic restrictions, for example, are mostly imposed in relation to neighbouring melodies rather than on any particular position within a syllable. Besides, a representation such as (33c) indicates an inherent connection between the shape of the dependency tree and the sonority profile of the string, which contrasts with the stipulatory nature of the peak/margin distinction in Clements & Keyser (1983).

An argument somewhat related to the above point is that the relation-based approach offers a means of encoding headship directly in syllabic structure. Consider, for example, the representation of a bimoraic syllable in the moraic model. In languages with bimoraic syllables, the two morae exhibit asymmetry in their sonority profile,
distributional freedom, and susceptibility to phonological processes. These indications most readily give rise to the special status of the first mora as the head. For example, Zec (1988: 105) posits a strong-weak relation for morae in proposing sonority sequencing constraints. Since there is no cogent reason why the first, rather than the second mora, should be assigned head status, this headship must be simply stipulated in the template-based approach.

Another argument in favour of the relation-based approach is that a postulated relational property, as mentioned in §2.3.1, displays recurrent applicability at different levels of linguistic structure. Although theories differ in the exact levels at which the relational property recurs, the full extent of applicability is maintained as follows.

(36) The structural analogy assumption (Anderson 1992: 2)
Minimise (more strongly, eliminate) differences between levels that do not follow from a difference in alphabet or from the nature of the relationship between the levels concerned.

This strong assumption gives rise to a considerable degree of theoretical restrictiveness, since it constrains stipulations unique to a certain level. In this sense, the formulation of a template in the template-based approach necessarily involves arbitrariness, since the way is opened for any template one may wish to create, due to the lack of a principled schema such as structural analogy.

2.4 Relation and constituency in syllabic structure

So far I have reviewed two contrasting approaches to syllabic structure, and have claimed in the preceding section that the relation-based approach has advantages over the template-based approach. This section compares the two approaches to provide further arguments in favour of the relation-based approach.

2.4.1 Exhaustivity
Syllable theories, regardless of differences in approach or in the formal characterisation of syllabic structure, generally make the following assumption.
(37) The exhaustivity assumption

All melodic units must be syllabified in a well-formed representation.

Here I interpret 'syllabification' in the broadest sense: melodic units must belong to syllabic structure, not necessarily to a syllable node.\(^\text{20}\) The end product of syllabification is very often a structure in which all melodies are (directly or indirectly) associated to the syllable node; however, a broad interpretation also accommodates the claim that the existence of the syllable constituent is not universal (cf. Hyman 1983, 1985).

The notion of extraprosodicity (Itô 1986: 53) does not contravene exhaustivity. Although an extraprosodic position initially does not belong to (or is not licensed by) any constituent, it becomes associated with a syllable at a later stage of derivation; otherwise it is erased and exhaustive syllabification is ultimately achieved. Itô (1986: 69) claims, for example, that a domain-final consonant in Diola Fogny is extraprosodic at the lexical level but is associated with a syllable at the post-lexical level at which extraprosodicity is universally absent. Anderson (1986: 73) presents a similar view under the Stray Segment Convention.

In the template-based approach, exhaustivity can only be implemented by resorting to the notion of constituency as follows.

(38) The exhaustivity assumption (in the template-based approach)

All melodic units must belong to a constituent in a well-formed representation.

(38) may figure in different guises such as the principle of Prosodic Licensing (Itô 1986: 2, Goldsmith 1990: 108) and Stray Erasure (Steriade 1982: 89). Under whatever guise, nonetheless, melodies are required to be daughters of some constituent node in order to become phonetically manifest. In the relation-based approach, on the other hand, the same well-formedness is entertained without recourse to constituency.

(39) The exhaustivity assumption (in the relation-based approach)

All melodic units must enter into dependency relations in a well-formed representation.

\(^{20}\) Some degree of ambiguity surrounds the status of the mora as a syllabic constituent. See Brentari & Bosch (1990) for a discussion of this issue.
Exhaustivity is a corollary of the proper tree condition in (31); (39) thus need not be stipulated. In the template-based approach, by contrast, (38) must be stipulated independently of the stipulation of syllabic constituents and their structural organisation.

### 2.4.2 Constituentiality

Although constituency plays a role in both approaches, it is interpreted differently in each case. In the template-based approach, constituentiality is embodied in syllabic constituents as representational primitives. In the relation-based approach, on the other hand, constituency is a derived notion, and constituentiality is invoked only for certain dependency relations. Accordingly, the two approaches may differ in their respective accounts of regularities holding over a sequence of melodies. In the template-based approach, such regularities must be attributed to the constituential identity of the melodies concerned, whereas this is not always the case in the relation-based approach. Dependency may hold without invoking constituentiality, as illustrated in §2.3.2. Relations and constituency both serve, perhaps independently, to offer generalisations in the relational representation.

The difference between the two approaches is far from trivial. A case in point is the constraint on a coda-onset sequence. This sequence can only consist of geminates and/or homorganic clusters in many languages. Distributional regularities are the consequence of string-adjacent dependency in the relation-based approach, and the coda-onset restriction is not an exception in this regard; the coda is thus dependent on the following onset. In the template-based approach, however, phonotactic restrictions must be stated in terms of the shape of a particular constituent; e.g., filters on the syllable-initial/final clusters (cf. §2.2.2), the principles of intraconstituent organisation (cf. §2.2.3). If we followed such a practice, we would be compelled to stipulate a constituent comprising the coda-onset cluster, but no serious argument for such a constituent has yet been put forward.

Itô (1986: 26ff) proposes the Coda Condition to deal with the problem of the template-based approach. She claims that, in Japanese, a [-nasal] consonant in the coda must be the first member of a geminate (e.g., kappa, *kapta), and proposes the following condition.
Japanese Coda Condition

\[
\begin{array}{c}
\ast \\
C_2 \\
[-\text{nasal}]
\end{array}
\]

This condition purports to exclude [-nasal] from a coda only when the feature is singly associated to the position, with the aid of the Linking Constraint: 'Association lines in structural descriptions are interpreted as exhaustive' (Hayes 1986: 331). Therefore, (40) permits [-nasal] doubly linked to a coda and the following onset simultaneously. Itô (1986: 28) argues that

The crucial point is that the condition ... is stated in a strictly local way and refers solely to information internal to the syllable. The principle of Locality is therefore not violated.

The principle of Locality prescribes that 'well-formedness of a prosodic structure is determined locally' (Itô 1986: 2). Yet the applicability of the condition in (40) depends on non-local information; i.e., the presence/absence of an association line from [-nasal] to the following (thus external) syllable. In this respect, Itô (1986: 28) further argues that

... external information ... still plays a role in the assessment of the syllabic well-formedness ... but crucially this information need only be available to the universal Linking Constraint and not to the language-specific syllable condition.\(^{21}\)

This way, the Coda Condition can account for the coda-onset restriction without giving rise to the above-mentioned problem of the template-based approach.

However, the fact that a condition such as (40) is required for the coda, but not for the onset, indicates the systematic asymmetry between them. That is, the coda is more distributionally constrained than the onset, in much the same way that the second mora shows less distributional freedom than the first mora in a bimoraic syllable. In relational terms, the state of affairs is intrinsic to the dependency relation holding between the two positions in question (cf. §2.5.2). The relation-based approach can accommodate a unified account by treating distributional regularities independently of constituentiality.

\(^{21}\) It is still not clear to me how the Linking Constraint alone effectively determines the well-formedness of, for example, kappa, while it cannot determine the ill-formedness of kapta and the decision has to be passed to the Coda Condition.
2 Approaches to syllabic structure

2.5 The licensing model: relation-based 'template'

The previous section highlighted the advantages of distinguishing relations from constituency. However, the latter notion is somewhat arbitrary in the relational representation because it is not clear which relations should invoke constituentiality. This ambiguity in the relation-based approach is obviously connected with the problems of the rule-based structure formation and the excessive number of vertices in the representation (cf. §2.3.2). Kaye et al. (1990) propose a relation-based model of syllabic structure which is free from these problems. This mode of representation — let us call it the licensing model — has the following two characteristics.

First, it is couched in the principles and parameters formalism, and syllabic structure is not constructed through the serial application of formation rules but prescribed by a set of well-formedness constraints. Second, the licensing model is endowed with tenets of the relation-based approach, but it also contains a priori constituents. This section provides an introduction to this model, showing the advantages stemming from these characteristics.

2.5.1 Prosodic licensing

The general well-formedness of phonological representations is prescribed by the following principle.

(41) Licensing Principle (Kaye 1990: 306)

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

The dependency model, it will be recalled, expresses the same well-formedness in (31ab) (i.e., there is a root, and all other vertices subordinate to the root). The syllable theory in the licensing model is framed under a relational property termed PROSODIC LICENSING (p-licensing, henceforth), one of the mechanisms that fulfil the licensing requirement in prosodic structure (cf. Harris 1994: 154ff). P-licensing is construed as an asymmetric relation, holding between a head and its dependent, in much the same way as a

---

22 Although the framework is originally referred to as Government Phonology, the theory has developed in such a way that licensing bears a more explanatory burden than government; e.g. 'Government is one form of licensing' (Kaye 1990: 306), 'We may refer to this restrictive sub-case of licensing as government' (Harris 1994: 168). Given this state of affairs, I will refer to the syllable theory as the licensing model rather than the government model, taking a restricted interpretation of government following Harris (1994: 148ff).
dependency relation described in §2.3.2. Although the Licensing Principle (41) only refers to 'positions' (i.e. phonological timing units), we may well assume that the notion of licensing, originating in syntax (cf. Chomsky 1986b: 93ff), extends through phonological representations by structural analogy (cf. Harris 1994: 154ff).

The following universal constraints define a well-formed p-licensing domain (Kaye et al. 1990: 198).

(42) (a) Localilty
The head must be adjacent to its dependent.
(b) Directionality
The head and its dependent assume a unidirectional precedence.

LOCALITY ensures that a p-licensing relation cannot bypass a position, and DIRECTIONALITY requires that the head resides at an edge of a p-licensing domain. These constraints effectively designate the domain as comprising at most two positions. Compare the following configurations, in which 'x' represents a phonological timing unit (cf. §2.2.4).

(43) (a) x
(a) x x
(a) x x
\[ a \quad a_j \quad a_i \quad a_j \quad a_i \]

(44) (a) *
(b) *
(c) *
\[ a_i \quad a_j \quad a_k \quad a_i \quad a_j \quad a_k \]

The representations in (43) conform to both the constraints in (42). Note that (43a), which contains no binary relation, still holds as a p-licensing domain in which Locality and Directionality are tacitly satisfied. The sole position acts as the head, the only obligatory component in the domain. A structure with two positions offers a two-way choice for the head: head-initial (43b) or head-final (43c); either way, the resulting configuration complies with the constraints. On the other hand, a structure with three positions necessarily violates either Locality or Directionality (Kaye et al. 1990: 199). The p-licensing domains in (44a) and (44c) are strictly directional (i.e. head-initial and head-final, respectively) but include a non-local p-licensing relation between \( a_i \) and \( a_k \). If
the medial position acts as the head, as shown in (44b). Locality is satisfied but p-licensing paths have to be directed towards antagonistic edges.

### 2.5.2 Syllabic constituents

Kaye et al. (1990: 198ff) propose that constituentiality in syllabic structure is universally invoked by head-initial p-licensing at the \(P_0\) projection (i.e. between string-adjacent positions). Therefore, the p-licensing domains in (43ab) define the possible structure of a syllabic constituent; put differently, constituents are maximally binary branching. Given this notion of constituentiality, the theory stipulates three syllabic constituents as theoretical primitives: ONSET (O), NUCLEUS (N) and RHYME (R). Note that not only the coda, which is also excluded in other models, but also the syllable fails to find a place in the inventory. The representations below give an exhaustive set of possible constituent structures.

\[(45) \quad (a) \quad \text{non-branching} \quad (b) \quad \text{branching} \]

\[
\begin{align*}
&\text{(i)} \quad \text{O} \\
&\quad \text{N} \\
&\quad \text{x} \\
&\text{(ii)} \quad \text{R} \\
\end{align*}
\]

\[
\begin{align*}
&\text{(i)} \quad \text{O} \\
&\quad \text{N} \\
&\quad \text{x} \\
&\text{(ii)} \quad \text{R} \\
&\quad \text{N} \\
&\quad \text{x} \\
&\text{(iii)} \quad \text{R} \\
\end{align*}
\]

The non-branching structures are found in all languages, while the appearance of the branching ones is subject to the setting of the relevant parameters. The rhyme is postulated to be 'the maximal projection of the nucleus' (Kaye et al. 1990: 199), so the head of the nucleus also acts as the head of the rhyme. Given this postulation, the theory claims that a branching rhyme cannot dominate a branching nucleus.

\[(46) \quad * \quad \text{R} \]

\[
\begin{align*}
&\text{N} \\
&\quad \text{x} \\
\end{align*}
\]

In the above configuration, the head fails to p-license the rhyme dependents due to the locality constraint (cf. Kaye 1990: 303, Kaye et al. 1990: 200).^{23}

---

^{23} Harris (1994: 163-164) suggests that (46) may be parametrically permitted.
Head-final p-licensing regulates the concatenation of syllabic constituents as follows.

(47) (a) Onset Licensing (Harris 1994: 160)
An onset head must be licensed by the following nucleus head.

(b) Coda Licensing (Kaye 1990: 311)
A rhyme dependent must be licensed by the following onset head.

Both the constraints are universal, though it is a language-specific matter as to whether the rhyme dependent may appear in the representation at all. With respect to head-final p-licensing, locality is assumed to hold at some level of projection, whether or not it also holds at the string-adjacent level. Consider the following configurations that illustrate the two types of p-licensing in question.

As shown in (48a), onset licensing cannot be strictly local at the string-adjacent level if the onset branches; however, the onset head and the following nucleus head are always adjacent at the head projection.

By analogy with the two head-final p-licensing domains, other 'interconstituent' p-licensing relations are conceivable as follows.

The configurations in (49cd) are ruled out by the phonological interpretation of a well-formedness constraint originally proposed in syntax (cf. Chomsky 1986a: 42).
(50) Minimality Condition (Charette 1989: 182)\textsuperscript{24}

\((\text{Given } \gamma, \delta \beta \ ] \ a,) \ a \text{ does not p-license } \beta \text{ if } \gamma \text{ is the immediate projection of } \delta,\)

excluding \(a.\)

However, it is left ambiguous whether (49ab) should be well-formed. These structures are not explicitly ruled out in the theory, though there seems to exist no reported case that motivates such p-licensing relations.

The lack of a serial process of structure formation gives rise to the constrained set of constituent structures, preventing proliferous relational representations. Here emerges the notion of 'template' which, unlike the templates described in §2.2, is founded on the principled schema of representational well-formedness. The three constituents are simply stipulated; together with the binarity restriction, however, this stipulation avoids the problems of latent constitutentiality and n-ary branching found in the relation-based approach. The licensing model, in this sense, benefits from both the template-based and relation-based approaches.

2.5.3 Government

With the two types of directed p-licensing, syllabic structure consists of licensing paths sourced by the ultimate head of a domain. Unlike other models in the relation-based approach, these licensing relations are not constructed or derived from a melodic property such as sonority. Rather, distributional regularities may arise as necessary conditions for a class of licensing termed GOVERNMENT, which is characterised as follows (Harris 1994: 167ff).

(51) Government convention

(a) Heads are ungoverned.

(b) Only immediate heads govern.

Among the legitimate p-licensing structure described so far, only the paths in (52a) form governing domains according to the convention, to the exclusion of those in (52b).

\textsuperscript{24} Charette (1989) proposes to adapt the Minimality Condition as a constraint on a broader interpretation of phonological government. In a more restricted interpretation as noted in footnote 22, the condition ought to apply to p-licensing in general, including government.
Given the notion of government, distributional regularities stem from the following constraint.

(53) Complexity Condition (Harris 1990: 274)

Let \( a \) and \( \beta \) be melodic expressions occupying the positions A and B respectively. Then, if A governs B, \( \beta \) is no more complex than \( a \).

Melodic oppositions are expressed in terms of the presence/absence of monovalent phonological primes termed elements (cf. Anderson & Jones 1974, Schane 1984, Kaye et al. 1985). The presence of elements is ensured if they are associated to a position via a relational property termed autosegmental licensing (a-licensing, henceforth). The complexity of expressions is representationally encoded by the number of elements a-licensed by a position (cf. §3.4.5). Note that, although the definition of government may refer to constituents as observed in (51b), the notion of government per se is independent of constituency, and this distinction between relations and constituency brings about a unified account of phonotactic restrictions as discussed in §2.4.2.

### 2.5.4 Structure preservation

From the discussion of how distributional regularities are derived, it follows that p-licensing structure should be directly specified in lexical representation. On the basis of the Licensing Principle, then, it must be assumed that lexical representation is fully syllabified. In this respect, the licensing model takes the strong view that p-licensing structure in lexical representation is hard-wired and thus inalterable. This state of affairs is declared as a restrictive interpretation of Structure Preservation, as follows.
Coupled with the exclusion of serial structure formation through extrinsically ordered rules, structure preservation eliminates the possibility of arbitrary structure-changing moves such as resyllabification, thereby achieving a significant degree of theoretical restrictiveness.

2.6 Summary

This chapter has reviewed approaches to syllable theory, discussing issues that arise from the articulation of individual models. With respect to the template-based approach, in which some important ideas such as the three-dimensional concept of phonological representation have been developed, I have presented arguments for the enrichment and impoverishment of syllabic structure. The notion of constituency alone bears the explanatory burden in this approach, so the issue is which phonological phenomena should invoke constituentiality. Since constituency manifests itself in the representation as constituent labels, different decisions are reflected in the shape of templates. In the relation-based approach illustrated in §2.3, syllabic structure is regulated by an asymmetric relational property, constituency being a derived notion. I have argued that, although the relational representation may become rather unconstrained and may leave indeterminacies as far as constituentiality is concerned, the relation-based approach still enjoys advantages over the template-based one, especially by virtue of separating relations and constituency. Retaining such advantages, the licensing model circumvents the problems of the relation-based approach by employing a restrictive theoretical formalism, on the one hand, and by identifying syllabic constituents as formal representational components, on the other. This strategy seems successful to the extent

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25 Kaye et al. (1990: 221) articulate Structure Preservation under the Projection Principle. The original version of Structure Preservation harks back to Selkirk (1982: 368), who proposes that 'the derived syllable structure produced by rules of resyllabification must conform to the syllable template of the language'. As for the stronger version presented here, see also Brockhaus (1995: 211ff) for a discussion.
that it achieves a degree of restrictiveness. Below I will develop a syllable theory which takes the licensing model as its point of departure.

Before introducing any details of the theory, however, I will discuss an issue concerning the formal status of the syllable constituent. Given the inventory of constituent structures in (44), syllabic structure in the licensing model comprises a sequence of a rhyme, the head of the structure and thus the obligatory component, with an optional preceding onset. That is, as noted in §2.5.2, this model posits no single level of representation that corresponds to the 'syllable' constituent. As regards this categorical exclusion of the syllable, the licensing model stands in a sharp contrast with the other models described in this chapter. In the next chapter, I will present further arguments against the syllable. These comments will be made in the spirit of minimal componentiality.
This chapter presents two arguments, couched in Optimality Theoretic terms, which reject the syllable as a constituent node. First, I provide a prosodic analysis of reduplication in Micronesian languages that reportedly copies an initial consonant, verifying the claim put forward in Prosodic Morphology that reduplicative templates are prosodically constrained. I then argue that reduplication crucially makes no reference to syllables in the description and satisfaction of templates. Second, stress in Aranda allegedly falls on syllables with onsets. I put forward an alternative analysis in which it is feet that demand onsets. The plausibility of the proposal is confirmed with respect to typological generalisations. The analysis is also shown to be most adequately formulated in terms of a licensing model that dispenses with the syllable as a constituent.

3.1 Introduction

Non-linear representations of syllabic structure show a strong tendency to assume that the maximal constituent should be the syllable. While the inventory of constituents may vary from one model to another in the template-based approach, all melodies are (directly or indirectly) dominated by syllable nodes (cf. §2.2). Even relational representations with no constituent labels contain an equivalent node (cf. §2.3). This state of affairs often seems to be taken for granted. Here is a good example; 'Consider the word *buey "ox"* [in Spanish]. This much is clear and uncontroversial: *buey* consists of a single syllable' (Harris 1983: 6). Assumptions of this kind, whether explicit or implicit, are frequently found in the literature, but arguments are rarely given for the status of the syllable as the maximal constituent. It sometimes appears that the criterion of a 'clear and uncontroversial' syllable refers to the intuition of native speakers. Although an intuition such as this should not be totally disregarded, it needs to be made clear what phonological entity it is referring to. For example, in the above Spanish case, it is one thing to note that *buey* contains a single metrical unit, which we may or may not associate with the label
'syllable', but it is quite another to then go on to claim that all melodic units in the word belong to this unit.

Hyman (1990) raises an objection about the current state of affairs. Quoting Greenberg (1962: 74) as stating that 'All consonants and vowels belong to some syllable', he suggests that such a 'traditional view' should contain two independent hypotheses: (a) 'all languages have phonological (i.e. structural) syllables'; and (b) 'all (surfacing) segments must belong to such a syllable'. He points out that 'nearly everyone assumes both that syllables are universal and that syllabification is exhaustive'. (Here 'syllabification' literally means parsing melodies into syllables.) While admitting the universality of syllables, he argues that melodies may remain unsyllabified (i.e. without a dominating syllable node) in some languages. Note that Hyman does not reject the notion of exhaustivity altogether; this notion is arguably indispensable for prescribing representational well-formedness. In his model of syllabic structure (cf. §2.2.5), instead, it is morae (or weight units) that exhaust melodic units. His discussion deserves attention in explicitly raising a question as to the privileged status of the syllable, demonstrating that exhaustivity can be entertained without invoking the constituent. For that matter, as discussed in §2.4.1, exhaustivity can be totally independent of constituency because it is an inherent property of relational structure in the relation-based approach — note that this option is not simply a notational variant, as discussed in §2.4.2. Exhaustivity thus does not have to be particularly allied with the syllable constituent.

Yet Hyman too takes the syllable per se for granted. The two hypotheses above crucially rest on an a priori assumption that the syllable exists. This assumption, however, is not as self-evident as it may seem. Although maintaining universality, Hyman (1990) weakens his earlier argument that some languages may make no reference to the syllable (cf. Hyman 1985: Chapter 3). Nevertheless, putative syllables in his analyses mostly appear in foot-initial position, and this predictability gives rise to redundancy. Halle & Vergnaud (1980: 93) notice this kind of redundancy surrounding the syllable. While positing that '... skeleta in all languages are subdivided into subsequences to which the term SYLLABLE has traditionally been attached', they state that 'it appears to us that the superordinate unit, the syllable, plays a much more marginal role in phonology'. This state of affairs may well cast doubt on the alleged universality of syllables. In spite of these arguments, however, the formal status of the syllable has not been challenged as frequently as that of the onset or coda.

It may seem that the syllable is occupying its rightful place, considering the fact that it is the first syllabic constituent that appeared in non-linear representations. As I briefly
mentioned in §2.2.3, however, the identification of subconstituents gives rise to redundancy as regards the roles that the syllable is initially supposed to play. Arguments for constituentiality, including that of the syllable, fall into two types. On the one hand, a constituent offers adequate accounts of string-adjacent phenomena (e.g. distributional regularity, alterations) by allowing positional references to relevant melodies in constituential terms. On the other hand, a constituent captures the compositional behaviour of melodies within suprasegmental units (e.g. those bearing stress/tone). In the two-tiered flat model (cf. §2.2.1), the syllable is the only constituent and necessarily carries all the explanatory burden in such arguments. The previous chapter showed, however, that syllable theories after Kahn (1976) agree on the necessity of singling out at least one recurrent sequence smaller than the syllable in size, which is perhaps most readily associated with phonological weight. Suppose $p$ represents the label for such a sequence. It seems that the syllable can be superseded by $p$, which provides the locus not only of weight information but also of tonal phenomena (cf. Hyman 1985: 9). Therefore, a configuration such as (55a) indicates that suprasegmental properties can be observed only with respect to $a_i$ and $a_k$, while $a_j$ and $a_l$ neither contribute to weight (we will discuss an alleged counterexample later, however) nor carry an independent tonal specification.

\[(55) \begin{align*}
\text{(a)} & \quad \begin{tikzpicture}
    \node (s) at (0,0) {$\sigma$};
    \node (a) at (1,-1) {$a_i$};
    \node (b) at (2,-1) {$a_j$};
    \node (c) at (3,-1) {$a_k$};
    \node (d) at (4,-1) {$a_l$};
    \draw (s) -- (a); \draw (s) -- (b); \draw (s) -- (c); \draw (s) -- (d);
    \node (x) at (2.5,-2) {$\rho$};
    \draw (x) -- (a); \draw (x) -- (b);
\end{tikzpicture} \\
\text{(b)} & \quad \begin{tikzpicture}
    \node (o) at (0,0) {$\sigma$};
    \node (a) at (1,-1) {$a_i$};
    \node (b) at (2,-1) {$a_j$};
    \node (c) at (3,-1) {$a_k$};
    \node (d) at (4,-1) {$a_l$};
    \draw (o) -- (a); \draw (o) -- (b); \draw (o) -- (c); \draw (o) -- (d);
\end{tikzpicture} \end{align*} \]

If the syllable only offers positional references in accounts of string-adjacent phenomena, (55b) is just as effective as (55a) — suppose $o$ expresses the label for residual melodies from the assignment of $p$. The two configurations have different structural implications, so the choice becomes an empirical matter. They both need a stipulation to ensure only $p$ displays compositional behaviour. However, contrary to the general preference for (55a)

\[\begin{tikzpicture}
    \node (s) at (0,0) {$\sigma$};
    \node (a) at (1,-1) {$a_i$};
    \node (b) at (2,-1) {$a_j$};
    \node (c) at (3,-1) {$a_k$};
    \node (d) at (4,-1) {$a_l$};
    \draw (s) -- (a); \draw (s) -- (b); \draw (s) -- (c); \draw (s) -- (d);
    \node (x) at (2.5,-2) {$\rho$};
    \draw (x) -- (a); \draw (x) -- (b);
\end{tikzpicture}\]

---

26 See Selkirk (1982) and Vincent (1986) for a somewhat finer classification of constituentiality. In the present discussion, 'melodic phenomena' subsume both static (phonotactics) and dynamic (alternation) operations.

27 In the present discussion, the following is only trivially different from (55a).
among syllable theories, (55b) may well be descriptively more adequate in explicitly separating \( a_j \) from \( a_k \), since no substantive evidence points to their sisterhood (cf. Fudge 1987). It is thus entirely reasonable for Aoun (1979: 146) to claim that 'the various phonological analyses referring to the syllable ... don't crucially refer to the syllable'. Lowenstamm (1981: 575) asserts that

... the arguments for the syllable are strictly phonological in that they all purport to show that the grammar would be optimized if the syllable were part of phonological theory.

From this viewpoint, it is surprisingly unclear on what phonological grounds the syllable should retain its sturdy place in non-linear representations.

The lack of compelling arguments in support of the syllable constituent leads Aoun (1979: 146) to further argue that

... the syllable doesn't have any status with respect to competence; it may at best have a status with respect to performance. ... no rule will refer to the syllable since there is no node (constituent) labelled "syllable".\(^{28}\)

He proposes a representation such as (56) below, which is similar to (55b) but embodies a relational concept implemented by the formalism of indices, claiming that the syllable can be defined 'as the set of elements bearing the same index'.

(56) \[ O_j \bigg/ R_i \bigg/ O_i \bigg/ R_j \bigg/ C_i \bigg/ V_i \bigg/ C_i \bigg/ C_j \bigg/ V_j \bigg/ C_j \]

Aoun claims that the rhyme confers the index on the other elements within a domain, and insists that the relations marked by the indices 'are not relations ... of constituency'. He gives a rather sketchy description of this model, without fully characterising the relations. Still, his proposal is important because it introduces the view that syllabic structure is EXOCENTRIC.

This view paves the way for the licensing model (cf. §2.5), in which a string of melodies is parsed into sequences of an onset and a rhyme. Kaye et al. (1990: 200) develop the following three arguments for the licensing mode of representation. First,

\(^{28}\) Aoun (1979: 146) notes that the argument is originally made by E. Williams and developed by J. R. Vergnaud and M. Halle.
provided that constitutiality is characterised by a head-initial p-licensing relation (cf. §2.5.2), if the syllable constituent dominated the onset and the rhyme, it is the onset that would act as the head of the constituent. No evidence supports such headship; rather, it is the rhyme that tends to behave more like the head. For example, there are languages that only allow a sequence of CV and V (e.g. Desano, Luo, Maori), but no language seems to consist of C and CV to the exclusion of V. This obligatory presence of V (i.e. the rhyme) can be construed as a property of the head. Second, due to the binarity restriction resulting from Locality and Directionality (cf. §2.5.1), neither the onset nor the rhyme could branch if the syllable dominated them.

\[(57) (a) \]
\[
\begin{array}{c}
\sigma \quad R \\
\text{O} \\
\text{N} \\
\text{x} \quad \text{x} \\
\text{a}_i \quad \text{a}_j
\end{array}
\]

\[(b) * \]
\[
\begin{array}{c}
\sigma \quad R \\
\text{O} \\
\text{N} \\
\text{x} \quad \text{x} \quad \text{x} \\
\text{a}_i \quad \text{a}_j \quad \text{a}_k
\end{array}
\]

This is surely too restrictive because it then follows that even the light/heavy distinction could not be made; a heavy syllable such as (57b) would necessarily violate Locality. Finally, as mentioned above, the onset and the rhyme are independent of each other in terms of distributional regularity, but Kaye et al. claim that this should not be the case if they belonged to a single constituent. The last reasoning, however, does not seem very convincing. In §2.4.2, I discussed the advantage of keeping distributional regularities and constitutiality separate. This point holds in the licensing model too, because the presence of a phonotactic domain is neither a sufficient nor a necessary condition for constitutiality. A coda must be governed (and thus distributionally constrained) by the following onset in accordance with to Coda Licensing (cf. §2.5.2), but this governing relation involves no constitutiality. Within a branching rhyme constituent, on the other hand, the nucleus head cannot govern its rhyme dependent due to the government convention (cf. §2.5.3). Therefore, let us leave aside the third argument in the present discussion.

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29 The government convention proposed in Harris (1994: 167ff) is not assumed by Kaye et al. (1990), but this does not affect the point being made here.
Although the first two arguments are sound, they are crucially theory-internal. This chapter provides further arguments for the exocentric mode of representation, in a somewhat theory-neutral context as regards constituentiality, by showing that all reference to the syllable constituent is redundant. The discussion proceeds as follows. §3.2 gives an illustration of two theories: Optimality Theory, in which the analyses to follow are couched, and the theory of empty categories proposed in Government Phonology, which plays a central role in the analysis of reduplication. The subsequent sections then discuss two phenomena, reduplication and onset sensitive stress, both of which reportedly refer to the syllable as a constituent. §3.3 first verifies the Prosodic Morphology hypothesis (McCarthy & Prince 1990: 209), asserting that constraints on reduplication is fully prosodic by presenting an prosodic analysis of a case of reduplication that apparently copies an initial consonant. Then I will indicate that no instances of reduplication seem to crucially depend on the constituential status of syllable, and argue that the analyses of reduplicated strings not only can be but rather should be recaptured in the exocentric model of syllabic structure. §3.4 discusses Aranda stress that allegedly invokes the weight distinction of the syllable constituent. I will propose an alternative analysis that introduces the concept that a well-formed foot should have an onset, and demonstrate that this line of analysis allows us to draw typological generalisations. Then, critically discussing two competing analyses, I will argue that the proposed concept can only be adequately implemented in syllable theory without syllables.

3.2 Formalising the interaction of constraints

Metatheoretical considerations of explanatory adequacy over more than a decade have yielded a view that grammar comprises not extrinsically ordered rewrite rules but constraints on representational well-formedness. This view is embedded in the principles and parameters formalism of Government Phonology (cf. Kaye et al. 1985, Harris 1990, Kaye 1990, Kaye et al. 1990, Charette 1991), which provides the theoretical basis of the licensing model discussed in §2.5. Universal principles and parameters both give rise to a categorical conception of well-formedness; representations must always conform to the principles and active parametric settings. In contrast, Optimality Theory (cf. McCarthy & Prince 1993, 1994a, 1995, 2001, Prince & Smolensky 2002) upholds a relative notion of
well-formedness. This section first describes how this notion is formalised in terms of constraint interaction.

### 3.2.1 Optimality Theory

Optimality Theory is founded on the following three theoretical components (cf. McCarthy & Prince 1994a: 336, Prince & Smolensky 2002: 4ff):

\[(58)\]

\[(a)\] **Con**

A set of universal constraints. The constraints are ranked according to their relative priority, which varies from one language to another, and it is these rankings that characterise individual grammars \(\Gamma_a, \Gamma_b, \ldots\).

\[(b)\] **Gen**

A function that, for an input \(in_i\), returns a set of (arguably infinite) output candidates \(\{cand_1, cand_2, \ldots\}\) by making all possible structural analyses of the input.

\[(c)\] **H-Eval**

A function that determines the relative well-formedness, or harmony, of the output candidates in terms of a particular grammar \(\Gamma_a\) and which selects the best candidate \(\{cand_{opt}\}\) as optimal.

A grammar is conceived of as a whole system that pairs inputs and their respective outputs, as shown below.

\[(59)\]

The schema of a grammar in Optimality Theory (Prince & Smolensky 2002: 4)

\[(a)\] Gen \((in_i) \rightarrow \{cand_1, cand_2, \ldots\}\)

\[(b)\] Eval \((\Gamma_a, \{cand_1, cand_2, \ldots\}) \rightarrow cand_{opt}\)

An input is a lexical representation, which is assumed to be a string of melodic units with mora specification (cf. McCarthy & Prince 2001: 23). Gen is endowed with information concerning 'representational primitives and their universally irrevocable relations' (Prince & Smolensky 2002: 5), and enjoys Freedom of Analysis (McCarthy & Prince 2001: 21, Prince & Smolensky 2002: 6). Given an input \(in_i\), Gen exploits its representational resources to generate output candidates of various forms. It does this by assigning prosodic structure to the input as well as altering the melodic configuration. Of the output candidates, Eval returns the optimal candidate \(cand_{opt}\) that achieves the maximal
well-formedness within a particular system $Γ_a$. It is not Gen but Eval that bears the explanatory burden in Optimality Theory.

The Eval function imposes an order of relative well-formedness on the output candidates, and this task rests on the following two assumptions. First, unlike the principles and parameters of Government Phonology mentioned above, the constraints are violable in nature but violation must be minimal (cf. McCarthy & Prince 2001: 6, Prince & Smolensky 2002: 2). Second, as stated in (58a), constraints are subject to certain strict dominance relations in a grammar, and these relations are formalised as a ranking of constraints (cf. McCarthy & Prince 2001: 6, Prince & Smolensky 2002: 12). Given these two assumptions, the optimal candidate to be returned by Eval is the one that conforms more closely to a higher ranked constraint than do all the other candidates; if two or more candidates tie with respect to this condition, then the candidate that incurs the least violation is deemed optimal. In the selection of an optimal candidate, Optimality Theory follows the simple algorithm in (60).

(60) Cancellation/Domination Lemma (Prince & Smolensky 2002: 142)

In order to show that one parse B is more harmonic [i.e. well-formed] than a competitor A which does not incur an identical set of marks, it suffices to show that every mark incurred by B is either (i) cancelled by an identical mark incurred by A, or (ii) dominated by a higher-ranking mark incurred by A. That is, for every constraint violated by the more harmonic form B, the losing competitor A either (i) matches the violation exactly, or (ii) violates a constraint ranked higher.

Suppose that two constraints $C_a$ and $C_b$ enter into a dominance relation $C_a \gg C_b$ in a language $L$; and that under consideration for an input $in_i$ are two output candidates: $cand_a$ that incurs violation of $C_a$ once, and $cand_b$ that contains two instances of $C_b$ violation. Their well-formedness is compared in a constraint tableau such as (61).

(61) INPUT: $in_i$

<table>
<thead>
<tr>
<th></th>
<th>$C_a$</th>
<th>$C_b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>$cand_a$</td>
<td>*!</td>
</tr>
<tr>
<td>(b)</td>
<td>$cand_b$</td>
<td>**</td>
</tr>
</tbody>
</table>
In the tableau, the top row lists the constraints in hierarchical order, and the leftmost column lists the candidates under comparison. The instances of violation are marked by *. Although (61b) incurs more violation marks regarding C_n, those marks are dominated by the mark incurred by (61a) with respect to the higher ranked constraint C_A. (61a) thus fatally violates C_A, and ! indicates this crucial violation. The dominance relation is strict in the sense that, if a higher ranked constraint is fatally violated, it is irrelevant to consider the relative well-formedness with respect to lower ranked constraints. The fact that (61a) outperforms (61b) with respect to C_n has no bearing on the outcome, as the shaded column indicates. Consequently, (61b) is assumed to achieve a higher degree of well-formedness, and ^ points to this optimal candidate. Now consider a case in which two candidates tie with respect to the rank of the highest constraint they violate but one candidate incurs more violation marks for that constraint than the other.

(62) INPUT: \textit{inj}

<table>
<thead>
<tr>
<th></th>
<th>C_A</th>
<th>C_B</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>\textit{\textbf{\textit{\textsc{\textbf{\textit{cand}}}}}}</td>
<td>##</td>
</tr>
<tr>
<td>(b)</td>
<td>\textit{cand_b}</td>
<td>##*!</td>
</tr>
</tbody>
</table>

In this case, the cancellation technique singles out an optimal candidate. As the result of cancelling out the marks, as shown by \#\#*, there still remains one violation mark with (62b); this violation is fatal, rendering (62a) optimal.

Constraints of Con fall into two categories: markedness and faithfulness. The former type is formulated either as an affirmative declaration of unmarked structure or a negative statement of marked structure. Below are some of the markedness constraints that I will use in this chapter.
(63) Markedness constraints

(a) Affirmative constraints

ONSET: syllables must have onsets. (Prince & Smolensky 2002: 17)

FtBIN: (Foot Binarity) feet must be binary under syllabic or moraic analysis. (Prince & Smolensky 2002: 50)

(b) Negative constraints

*CODA: a syllable must not have codas. (Prince & Smolensky 2002: 34)

*COMPLEX: no more than one C or V may associate to any syllable position node. (Prince & Smolensky 2002: 96)

Each of the above constraints is a restatement of a well-attested phonological tendency in languages. On the other hand, faithfulness constraints are based on a genuinely theoretical assumption concerning derivation: lexical representation should be mapped onto the output representation as faithfully as possible. Constraints of this type thus militate against changes to a given input, as shown in (64).

(64) Faithfulness constraints (McCarthy & Prince 1995: 260ff)

MAX-IO: every element in an input must appear in its output.

DEF-IO: every element in an output must be present in its input.

The leading idea of Optimality Theory lies not so much in the individual constraints themselves but in the determination of how they interact. The following subsection shows that the latter notion is also assumed, albeit in an informal way, in Government Phonology (Charette 1991: 104ff).

3.2.2 Constraints in conflict

Central to the framework of Optimality Theory is the keen awareness that constraints come into conflict in many circumstances. Furthermore, the assumption that a given input cannot conform to all constraints means that well-formedness is bound to be a relative notion. This view apparently does not go along with the categorical notion of well-formedness in the principles and parameters formalism. However, an implicit acknowledgement that conflicts can arise amongst principles and parameters can be found, rather unexpectedly, in a particular analysis couched in Government Phonology terms.
Charette (1991: 106ff) discusses syncope in Tangale, a Western Chadic language. In descriptive terms, the short vowel in a stem-final CV is deleted when followed by a suffix, as shown below (tones are omitted).

(65) Tangale syncope (Kenstowicz & Kidda 1987: 230, Nikiema 1990: 41-42)

<table>
<thead>
<tr>
<th>Stem</th>
<th>Syllable</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>tana</td>
<td>+ do</td>
<td>tando 'her cow'</td>
</tr>
<tr>
<td>dobe</td>
<td>+ no</td>
<td>dobno 'call me'</td>
</tr>
<tr>
<td>yidi</td>
<td>+ lawo</td>
<td>yidlawo 'a child's calabash'</td>
</tr>
<tr>
<td>lanjoro</td>
<td>+ lawo</td>
<td>lanjorlawo 'a child's donkey'</td>
</tr>
</tbody>
</table>

Following Nikiema (1990: 46ff), Charette claims that, in Tangale, a domain-final nucleus does not a-license any melodic content when it is followed by a suffix. For example, in /dobe + no/ shown below, the melodic expression /e/ is delinked from the stem-final position N₂.

(66)

```
   O R O R O R
  / \ / \ / \ / \N₁ N₂ N₃
 [ [ x x x x ] x x ]
 d o b e n o
```

Note that suffixation does not delete the stem-final position altogether; the delinking of a melodic expression leaves an empty nucleus.

The theory of empty categories (positions without melodic content) features prominently in Government Phonology (cf. Kaye 1990, Kaye et al. 1990, Charette 1991, Kaye 1992a). An empty nucleus such as N₂ in (66) is subject to the following principle.


(a) A licensed empty nucleus receives no phonetic interpretation.

(b) An empty nucleus is licensed if

(i) it is properly governed,

(ii) it is domain final in languages that license domain-final empty nuclei, or

(iii) it is within an inter-onset licensing domain.
An unlicensed empty nucleus must be interpreted, and its phonetic properties are
determined on a language-specific basis. In Tangale, empty nuclei manifest themselves
as \( \text{u} \). Among the conditions prescribed above, (67bi) is the one that gives rise to the
phenomenon in question. Proper government is a special case of government and it
holds not only at the string-adjacent level but also at levels of prosodic projection. The
conditions for proper government are defined as follows.

\[
\text{(68) Proper government (Kaye 1995: 295)}^{30}
\]

\( \alpha \) properly governs \( \beta \) iff

\[
\begin{align*}
&\text{(a) } \alpha \text{ is adjacent to } \beta \text{ on the relevant projection,} \\
&\text{(i) } \text{[Diagram]} \\
&\text{(ii) } \text{[Diagram]} \\
&\text{(iii) } \text{[Diagram]}
\end{align*}
\]

\[
\begin{align*}
&\text{(b) } \alpha \text{ is not itself licensed, and} \\
&\text{(i) } \text{[Diagram]} \\
&\text{(ii) } \text{[Diagram]}
\end{align*}
\]

\[
\begin{align*}
&\text{(c) no governing domain separates } \alpha \text{ from } \beta. \\
&\text{(i) } \text{[Diagram]} \\
&\text{(ii) } \text{[Diagram]} \\
&\text{(iii) } \text{[Diagram]}
\end{align*}
\]

In the case of /dobe + no/, the empty nucleus \( N_2 \) in (66) is properly licensed by \( N_3 \),
satisfying the conditions (68a-c), and thus leaves no audible trace in the phonetic
interpretation: \( \text{dobe} \theta \text{no} \) (\( \theta \) represents an uninterpreted empty position). This analysis can
account for a case involving two suffixes without any other stipulation (Charette 1991:
107).

---

\(^{30}\) Following Nikiema (1990: 49), I assume that an empty onset head position is also subject to proper
government.
(69) \( \text{dobe} + \text{no} + \text{go} \rightarrow \text{dobungo} \) 'called me'

\[
\begin{array}{cccccccc}
\text{O} & \text{R} & \text{O} & \text{R} & \text{O} & \text{R} & \text{O} & \text{R} \\
\text{N}_1 & \text{N}_2 & \text{N}_3 & \text{N}_4 \\
[ [ [ \times \times \times ] \times \times ] \times \times ] \\
\text{d} & \text{o} & \text{b} & \text{e} & \text{n} & \text{o} & \text{g} & \text{o}
\end{array}
\]

\( N_2 \) and \( N_3 \) above become empty because they are both domain final and followed by a suffix. \( N_4 \) properly licenses \( N_3 \), but the latter cannot properly license \( N_2 \) due to condition (68b). Accordingly, \( N_3 \) receives no phonetic interpretation but \( N_2 \) receives the phonetic interpretation of an empty nucleus, i.e. \( \text{u: dobungo} \) (the sound enclosed in a rectangle indicates the phonetic interpretation of an empty nucleus).

Following the above analysis, Charette goes on to discuss two Tangale dialects, Billiri and Kaltungo, which demonstrate different syncope patterns when the penultimate rhyme branches.

(70) Dialectal variations in Tangale

(a) Billiri

\[
\begin{align*}
\text{landa} + \text{zi} & \rightarrow \text{lanzi} \quad \text{'your (fem.) dress'} \\
\text{kambo} + \text{go} & \rightarrow \text{kamgo} \quad \text{'your (masc.) growth'} \\
\text{monde} + \text{go} & \rightarrow \text{mongo} \quad \text{'forgot'} \\
\text{simbe} + \text{go} & \rightarrow \text{simgo} \quad \text{'met'}
\end{align*}
\]

(b) Kaltungo

\[
\begin{align*}
\text{landa} + \text{zi} & \rightarrow \text{landuzi} \\
\text{kambo} + \text{go} & \rightarrow \text{kambugo} \\
\text{monde} + \text{go} & \rightarrow \text{mondugo} \\
\text{simbe} + \text{go} & \rightarrow \text{simbugo}
\end{align*}
\]

By analogy, \( /\text{landa} + \text{zi}/ \), for example, is expected to be realised as \( \text{land0zi} \); suffixation triggers the delinking of the stem-final \( /a/ \), and the resulting empty nucleus is not interpreted because it is properly governed by the following nucleus \( /i/ \). However, neither of the dialects follows this pattern. In Billiri, not only the empty nucleus but also the preceding onset receives no phonetic interpretation: \( \text{lan00zi} \). On the other hand, Kaltungo fails to license the empty nucleus: \( \text{landuzi} \). Charette (1991: 101-102)
proposes the following constraints and claims that the unexpected behaviour stems from
the presence of the coda-onset governing relation before the stem-final empty nucleus.

(71) Government licensing
For a governing relation to hold between a non-nuclear head $\alpha$ and its complement
$\beta$, $\alpha$ must be government-licensed by its nucleus.

(72) Government licensor
The government licensor of an onset is a nucleus which is not properly governed.

(71) and (72) together prevent the cases depicted below, in which $N_i$ is in the position both
to government-license the preceding onset and to be properly governed by $N_j$.

(73) (a) *
\[ \begin{array}{cccc}
  O & R & O & R \\
  \uparrow & \downarrow & \uparrow & \uparrow \\
  N & N_i & N_j & \circ \\
  x & x & x & x \\
\end{array} \]

(b) *
\[ \begin{array}{cccc}
  O & R & O & R \\
  \uparrow & \downarrow & \uparrow & \uparrow \\
  N & N_i & N_j & \circ \\
  x & x & x & x \\
\end{array} \]

Yet it is precisely (73a) that represents the situation of the example word /\text{landa} + zi/. In
order to account for the observed dialectal variations, and Charette (1991: 112) argues
that 'While Kaltungo ... opt[s] for government-licensing, Billiri opts for proper
government of empty nuclei', as illustrated below.

(74) (a) Billiri
\[ \begin{array}{cccc}
  O & R & O & R \\
  \uparrow & \downarrow & \uparrow & \uparrow \\
  N & N_i & N_j & \circ \\
  [ [ x x x x x ] x x ] \\
  \text{landa} & \text{azi} \\
\end{array} \]

(b) Kaltungo
\[ \begin{array}{cccc}
  O & R & O & R \\
  \uparrow & \downarrow & \uparrow & \uparrow \\
  N & N_i & N_j & \circ \\
  [ [ x x x x x ] x x ] \\
  \text{landa} & \text{azi} \\
\end{array} \]

Consequently, in Billiri, the properly governed $N_i$ fails to government-license the
preceding onset; and this onset accordingly 'is not interpreted as a governor' (1991:}
109). In Kaltungo, on the other hand, N remains ungoverned and thus receives the phonetic interpretation u.

Although Charette describes the difference between the two dialects in a way that presages Optimality Theory, Government Phonology lacks a means of formalising the assumption that the typological variations emerge out of the interaction between two conflicting constraints. Consider the above analysis in light of the following hypothesis.

(75) Minimalist hypothesis (Kaye 1992b: 141)

Processes apply whenever the conditions that trigger them are satisfied.

Strictly following this hypothesis, it is not justifiable to suspend the application of proper government in Kaltungo. The only possible way to avoid this problem within the principles and parameters formalism would be to stipulate relevant parameters such as 'an empty nucleus is properly governed UNLESS it acts as a government-licensor'. Nevertheless, introducing conditional parameters such as this severely weakens the theoretical restrictiveness of the model, since it opens the way for one to create arbitrary parameters by combining any pair of constraints regardless of whether the constraints are in conflict or not. Furthermore, parameterisation obscures the fact that the categorical notion of well-formedness no longer holds with the case of Tangale dialectal variations; proper government and government licensing cannot be satisfied simultaneously. What is necessary is a formal theory that explains how grammars resolve the tension between conflicting constraints in pursuit of relative well-formedness.

I began this section by briefly introducing the basic tenets of Optimality Theory, and then claimed that the formal theory of constraint interaction is necessary to accommodate the notion of relative well-formedness even in a framework couched in the principles and parameters formalism that incorporates the notion of categorical well-formedness. I also introduced the theory of empty categories. Practical applications

---

31 In the Billiri case, it is not clear why the coda n is still p-licensed by the onset that fails to be government-licensed. One might be tempted to claim that the onset may fail to govern the coda but still be able to p-license it, in much the same way that a rhyme p-licenses its preceding onset without governing it (cf. §2.5.3). This solution does not work, however. If we allow ungoverned codas, no distributional regularities are required between such a coda and the following onset, and this leads to severe loss of generalisation (cf. §2.4.2). Besides, it seems highly unlikely that we would find a parallel case with respect to (73b); i.e. a configuration in which an onset-dependent position is p-licensed by the preceding onset that is not phonetically interpreted (e.g. /lipra+no/ → /li0r0no). Charette (1991: 248) resorts to resyllabification of n into an onset, but this move crucially infringes Structure Preservation (cf. §2.5.4). I will further discuss this problem in §4.4.2.
of these theoretical assumptions will appear in the rest of this chapter, in which I will develop arguments against the syllable as a constituent.

### 3.3 Reduplication without syllables

This section attempts to verify Aoun's claim that 'no rule will refer to the syllable' in analyses of reduplication. This phenomenon has been studied most extensively in Prosodic Morphology, which puts forward the following assumption (McCarthy & Prince 1990: 209).

\[(76) \text{Prosodic Morphology hypothesis} \]

Templates are defined in terms of the authentic units of prosody: mora (\(\mu\)), syllable (\(\sigma\)), foot (Ft), prosodic word (PrWd), and so on.

This hypothesis is revised in the context of Optimality Theory (cf. McCarthy & Prince 2001: 109ff), and templates are now construed as being derived from constraints on the prosodic well-formedness of morphological domains (cf. McCarthy & Prince 1994b). Still, 'the authentic units of prosody' remain intact, their presence figuring prominently in these constraints (cf. Footnote 34). In the first half of this section, I will illustrate the framework and give support for the view that the well-formedness of a reduplicative string is prosodically constrained. Subsequently, however, I will argue that the relevant constraints should be elaborated without reference to the syllable as a unit, on the grounds that examples of unconditionally syllable-sized reduplication are extremely rare.

#### 3.3.1 Constraints on identity

Reduplication is a type of affixation in which an affix assumes (totally or partially) the same phonetic shape as that of its stem (cf. Marantz 1982, McCarthy & Prince 1986, 1995). A stem acts as a base (B) that has proper phonological contents; and an affix is interpreted as a replicant (R), a string that mirrors melodies of the base. (77) shows cases of total reduplication from Warlpiri, a member of the Pama-Nyungan group of Australian languages spoken in the Northern Territory of Australia (Nash 1980: 130, Marantz 1982: 483), and from Indonesian, a member of the Malayo-Polynesian group of Austronesian languages (Cohn 1989: 185, Cohn & McCarthy 1994: 52).
What matters in this type of reduplication is the perfect identity between a base (B) and its reduplicant (R). Since a reduplicative affix is not specified with melodic content, I will use /RED/ to show its lexical representation, following the practice of Prosodic Morphology (McCarthy & Prince 2001: 66). Suppose that Warlpiri reduplication involves a reduplicative prefix; then kurdukurdu is derived from /RED + kurdu/, effectively repeating the stem.

Adopting the output-oriented conception of grammar (cf. §3.2), I will assume that the identity between the base and the reduplicant, or B-R identity, is ensured not by exact copying processes but by constraints on the output representation. McCarthy & Prince (1995) propose a theory of generalised faithfulness between representations, which is schematically presented as follows.\(^{32}\)

\[\begin{align*}
\text{(78) Correspondence Theory (McCarthy & Prince 1995: 252)}
\end{align*}\]

\[
\begin{array}{c}
\text{Input:} & /Af^\text{RED} + \text{Stem}/ \\
\downarrow & I-O \text{ Faithfulness} \\
\text{Output:} & R \leftrightarrow B \\
& B-R \text{ Identity}
\end{array}
\]

This theory proposes that paradigmatic input-output faithfulness and syntagmatic B-R identity are subsumed under correspondence relations. Accordingly, the faithfulness constraints in (64) are generalised as the following 'constraint families' (McCarthy & Prince 1995: 370-372).

\[^{32}\text{I will employ the 'basic model' of Correspondence Theory that suffices for discussions in this thesis.}\]
Faithfulness constraints on two structures $S_1$ (e.g. input, base) and $S_2$ (e.g. output, reduplicant)

- **MAX**: every element of $S_1$ has a correspondent in $S_2$.
- **DEP**: every element of $S_2$ has a correspondent in $S_1$.

$MAX$-IO and $DEP$-IO are instantiations of the above constraints in the input-output dimension. Likewise, $MAX$-BR and $DEP$-BR are designated to constrain base-reduplicant relations. To account for the full range of reduplicative phenomena, McCarthy & Prince also propose the following faithfulness constraint families: **IDENT(F)**, **CONTOUITY**, **ANCHORING**, **LINEARITY**, **UNIFORMITY**, and **INTEGRITY**. I will leave out these constraints in this thesis, unless otherwise necessary, because neither their nature nor violability has direct relevance to the issue to be discussed below.

Total reduplication requires full compliance with both of the constraints in (79), as is evident in the Warlpiri example word kurdukurdu. However, as discussed in §3.2, constraints are assumed to be violable, and the faithfulness constraints in (79) are no exception. McCarthy & Prince (1995: 260) suggest that $DEP$-BR is violated when there exist 'fixed default segments in the reduplication'; this case will not be pursued below.

What concerns us in the rest of this section is partial reduplication, which necessarily involves the violation of $MAX$-BR.

### 3.3.2 Prosodic shaping of reduplicants

Moravcsik (1978: 307) reports a number of cases of partial reduplication from various sources, describing reduplicative strings as being characterised in terms of 'consonant-vowel sequences and absolute linear position' (1978: 307). Following this observation, Marantz (1982) claims, extending the framework proposed by McCarthy (1979, 1981), that reduplicative strings are affixes defined by templates comprising CV skeleta. McCarthy & Prince (1986, 2001) further improve on this claim in the theory of Prosodic Morphology. Rejecting the skeletal tier (cf. §2.2.5), they propose that reduplicative templates should be defined by referring to prosodic categories such as prosodic word (PrWd), foot (Ft) syllable ($\sigma$) and mora ($\mu$). This section illustrates this
<p>3 Against the syllable</p>

proposal, drawing heavily on the insightful analyses of Ilokano by Hayes & Abad (1989) and McCarthy & Prince (1994b).

Ilokano is an Austronesian language spoken in the Philippines (Bernabe et al. 1971: 180). This section looks at the two types of reduplication shown below.

(80) Ilokano

<table>
<thead>
<tr>
<th>Adjective</th>
<th>Plural</th>
<th>Comparative</th>
</tr>
</thead>
<tbody>
<tr>
<td>na-pin.tas</td>
<td>na-pi-pin.tás</td>
<td>na-pín-pin.tás</td>
</tr>
<tr>
<td>na-ru-git</td>
<td>na-ru-ru.gíť</td>
<td>na-rúg-ru.gíť</td>
</tr>
<tr>
<td>na-la.ín</td>
<td>na-la-la.ín</td>
<td>na-láa-la.ín</td>
</tr>
<tr>
<td>a.si.deg</td>
<td>a-así.deg</td>
<td>as-así.deg</td>
</tr>
<tr>
<td>a.ki.kid</td>
<td>a-a.ki.kid</td>
<td>ák-a.ki.kid</td>
</tr>
<tr>
<td>dak.kel</td>
<td>da-dak.kél</td>
<td>dák-dak.kél</td>
</tr>
</tbody>
</table>

The above data includes two kinds of adjectives: affixed adjectives (starting with na-) and base adjectives (cf. Bernabe et al. 1971: 69) A reduplicative prefix always copies melodies from its base, ignoring the adjectival affix. Descriptively, the template of the plural is (C)V, while that of the comparative is either (C)VC or (C)VjVj, depending on the presence/absence of onset consonants in the second syllable of the base.

In the context of Prosodic Morphology, the reduplicants of the plural and of the comparative are defined by the constraints Rpi=a^ (light syllable) and Rcmp=Gpp (heavy syllable), respectively (cf. Hayes & Abad 1989: 356ff). (R=τ' refers to a family of constraints on the shape of reduplicants, henceforth.) The faithfulness constraint Max-BR prompts exact mapping of base melodies onto reduplicants, as shown in the previous section. This constraint is obviously in conflict with R=τ; Max-BR requires perfect B-R identity, while R=τ prevents copying beyond the designated size. As described in §3.3.1, this conflict is resolved by the ranking of the constraints in question. Unlike the case of total reduplication, Max-BR must be violated in partial reduplication,

---

34 As mentioned in §3.3, 'templates' are now assumed to be derived from the interaction of constraints. For example, McCarthy & Prince (1994b) claim that foot-sized reduplication takes place when Max-BR is dominated by a constraint ALIGN(FT, L, PrWd, L), which requires all feet to align with the left edge of some prosodic word (cf. Footnote 56 for the definition of the constraint ALIGN). The syllable-sized prefixes in Ilocano are derived by ALIGN(σ, L, PrWd, L) by analogy, the weight distinction (σi/σj) being drawn on the basis of the difference between internal and external affixes. However, this notion of generalised template is not crucial to the present discussion, so I will use templates such as 'R=σj' without showing details of constraint interaction behind their formulation.
and it is $R=\pi$ that compels its violation (McCarthy & Prince 2001: 149-150). This is shown by the following constraint ranking.

\[(81) \quad R_{pi}=\sigma_{\mu}, \quad R_{cmp}=\sigma_{\mu} \gg \text{MAX-BR}\]

Since $R_{pi}=\sigma_{\mu}$ and $R_{cmp}=\sigma_{\mu}$ never interact with each other in a way that affects the selection of an optimal candidate, no dominance relation is assumed to hold between them. Accordingly, both the $R=\pi$ constraints are undominated, and \text{MAX-BR} is ranked lower.

The following tableau compares the output candidates for the plural of \text{dakkel} in light of the above constraint hierarchy (stress is omitted; reduplicants are underlined).\(^{35}\)

\[(82) \quad \text{INPUT: RED}_{pi} + \text{dakkel}\]

<table>
<thead>
<tr>
<th></th>
<th>$R_{pi}=\sigma_{\mu}$</th>
<th>MAX-BR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>dak.kel.dak.kel</td>
<td>*!</td>
</tr>
<tr>
<td>(b)</td>
<td>dak.dak.kel</td>
<td>*!</td>
</tr>
<tr>
<td>(c)</td>
<td>$\not\equiv$ da.dak.kel</td>
<td></td>
</tr>
<tr>
<td>(d)</td>
<td>$\not\equiv$ a.dak.kel</td>
<td></td>
</tr>
</tbody>
</table>

I assume that $R=\pi$ is a binary constraint, so $R_{pi}=\sigma_{\mu}$ is violated if the reduplicant consists of one heavy syllable (e.g. dak) or of two or more syllables (dak.kel). The number of violations of \text{MAX-BR} corresponds to the number of unmapped melodic units irrespective of their internal properties (at least in the present discussion). In the above tableau, (82ab) fatally violate the higher ranked constraint $R_{pi}=\sigma_{\mu}$. Both the remaining candidates incur the violation of \text{MAX-BR}, but (82c) shows a closer conformity to the constraint as indicated by one less violation mark. Therefore, Eval selects it as the optimal output for the given input.

Note that, although all constraints including $R_{cmp}=\sigma_{\mu}$ are universal and therefore present in the constraint hierarchy, it is common practice for a tableau to include only relevant constraints. It is implicit in (82) that the reduplicative strings are tokens of $R_{pi}$ corresponding to /RED$_{pi}$/ in the input. In this case, the constraint $R_{cmp}=\sigma_{\mu}$ is \textit{vacuously} violated.

\(^{35}\)The tableau ignores candidates such as $d_1e_2-d_1a_1k_1k_4e_1l_6, \ k_5e_2-d_1a_1k_1k_4e_1l_6, \ l_6a_2-d_1a_1k_1k_4e_1l_6$, etc. (82d) violates \text{ANCHORING} and \text{ONSET} but is still considered here only to illustrate cancelling of violation marks.
satisfied by virtue of the absence of $R_{\text{cmp}}$, so it exerts no influence on the selection of the optimal candidate for the input /RED$_{\text{cmp}}$ + dakkel/.

The output of the comparative /RED$_{\text{cmp}}$ + dakkel/ is derived by the same logic as above; only the use of a different $R=\pi$ constraint gives rise to a different result. This time, (83b) outperforms the other candidates as shown below.

(83) INPUT: RED$_{\text{cmp}}$-dakkel

<table>
<thead>
<tr>
<th></th>
<th>$R_{\text{cmp}}=\sigma_{\mu\mu}$</th>
<th>MAX-BR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>dak.kel.dak.kel</td>
<td>*!</td>
</tr>
<tr>
<td>(b)</td>
<td>^ dak.dak.kel</td>
<td>***</td>
</tr>
<tr>
<td>(c)</td>
<td>da.dak.kel</td>
<td>*!</td>
</tr>
</tbody>
</table>

However, the comparative adjective nalaalain calls for a somewhat different account, because simple copying of the base melodies, *nailain or *nalalain, cannot satisfy $R_{\text{cmp}}=\sigma_{\mu\mu}$. Consider the following tableau.\(^{36}\)

(84) INPUT: na-RED$_{\text{cmp}}$-laij

<table>
<thead>
<tr>
<th></th>
<th>$R_{\text{cmp}}=\sigma_{\mu\mu}$</th>
<th>MAX-BR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td></td>
<td>*!</td>
</tr>
<tr>
<td>(b)</td>
<td></td>
<td>*!</td>
</tr>
<tr>
<td>(c)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Let us assume that RED$_{\text{cmp}}$ is required to adjoin to the stem lai. (84a) exceeds the designated monosyllabic template; the sequence ai is heterosyllabic in Ilokano. The reduplicant in (84b) consists of a single syllable la. Although this is the optimal output.

\(^{36}\) Following the practice in Prosodic Morphology, the above tableau employs the moraic model of syllabic structure (cf. §2.2.5). However, the proposed analysis is not reliant on this particular mode of representation, and can be expressed using any syllable theory that distinguishes phonological weight.
for the plural, it contains only one mora and thus fails to achieve the required heavy quantity for the comparative. The best satisfaction of the constraint hierarchy is obtained by the configuration (84c). The reduplicant copies the same melodies \( \text{la} \) as does the reduplicant in (84b), but \( R_{\text{cmp}}=\sigma_{uu} \) is satisfied in (84c) by the spreading of \( a \) into the following mora.\(^{37}\)

Let us note three points concerning the above analysis before ending this section. First, the spreading solution does not affect the tableau analysis in (83); \( \text{daa.dak.kel} \) cannot be optimal because this candidate registers four violation marks against MAX-BR, and is therefore unable to compete with \( \text{dak.dak.kel} \). Second, recall that the progressive of Mokilese described in §2.2.4 exhibits the same type of compensatory lengthening, e.g. \( /\text{RED} + \text{wia}/ \to \text{wiiwia} \). The above analysis is also applicable to this case. Finally, spreading is not an option available free of charge. In I-O faithfulness relations, spreading of the kind \( /a/ \to \text{aa} \) incurs the violation of DEP-IO (cf. McCarthy & Prince 1995: 275, Myers 1997: 860ff), because mora specification is part of lexical representation (cf. §3.2.1) and spreading thus amounts to creating an association that does not have a correspondent in the input. By the same token, I assume that (84c) violates DEP-BR.\(^{38}\) However, neither the violation of this constraint nor the necessary dominance

\(^{37}\) Hayes & Abad (1989: 358-359) discuss the following cases that trigger compensatory lengthening unexpectedly.

\begin{align*}
\text{róòót} & \quad '\text{leaves, litter}' \quad \to \quad \text{röó-róòót} & \quad '\text{leaves, litter (pl.)}' \\
\text{trák} & \quad '\text{truck}' \quad \to \quad \text{traa-trák} & \quad '\text{trucks}' \\
\text{nárs} & \quad '\text{nurse}' \quad \to \quad \text{naa-nárs} & \quad '\text{nurses}'
\end{align*}

Hayes & Abad claim that \( \text{?} \) cannot occupy a coda position (e.g. \( \ast\text{röò-róòót} \)), and that compensatory lengthening is triggered to satisfy the reduplicative template. On the other hand, as for the failure to copy the final consonants in the stems of a single syllable, they claim that total reduplication is somehow prohibited (e.g. \( \ast\text{nárs-nárs} \)), though they admit that this analysis faces difficulties as regards legitimate cases such as \( \text{ʔagín-ʔya-ʔyá} '\text{to pretend to be an aunt}' \) and \( \text{sí-swa-swa} '\text{filled with pomelos}' \). In terms of Government Phonology, the three cases can be considered to share the same characteristic: they all involve an empty category, provided that (a) \( ? \) is the interpretation of an empty onset, and (b) a domain-final empty nucleus is permitted. Hence the above words are represented as \( \text{ró.òò.òò, trá.kò and ná.r.sò} \). \( \text{röó-róòót} \) is obtained by stipulating that \( ? \) appears only before a non-empty nucleus; this essentially amounts to Hayes & Abad's proposal. The remaining cases can be accounted for by a single stipulation: a melodic unit cannot establish a correspondence relation if it is on a licensing path from an empty category. Notice that, in \( \text{naa-nárs} \), not only the final consonant \( s \) but also the preceding consonant \( r \) is ignored; \( r \) is coda-licensed by \( s \), which is in turn government-licensed by the domain-final empty nucleus, so \( r \) and \( s \) are both on a licensing path from an empty nucleus. Although the above account is only sketchy, it seems interesting to see how empty categories figure in prosodic-morphology phenomena.

\(^{38}\) DEP-BR is proposed as BASE-DEPENDENT in McCarthy & Prince (1994b). Blevins (1996) uses MSEG (cf. McCarthy & Prince 1994a: 366) to account for a similar case in Mokilese. Spreading is also subject to IDENT that requires 'complete featural identity between correspondent segments' (McCarthy & Prince 1995: 265). I will leave discussions of these constraints untouched here.
relation $R_{cmp} = \sigma_{pp} \gg \text{DEP-BR}$ raises a relevant issue here, so I refrain from discussing the interaction between \text{DEP-BR} and other constraints in detail.

### 3.3.3 Initial gemination in prosodic morphology

A great deal of cross-linguistic investigation couched in Prosodic Morphology has given significant insights into the understanding of reduplication, offering integrated analyses of diverse phenomena (cf. McCarthy & Prince 2001, and references therein). The assumption that the well-formedness of reduplicants is prosodically constrained seems to have been well borne out by a body of empirical evidence. Nevertheless, an apparent challenge to this assumption is raised by Marshallese (cf. Moravcsik 1978: 308), in which reduplication reportedly involves a non-prosodic reduplicative prefix comprising a single consonant. In this section, I will argue that the reduplicative prefix does assume a prosodically constrained structure.

According to Harrison (1973: 443ff), this type of reduplication, which he calls 'initial gemination', exists 'to some extent in all nuclear Micronesian languages'.

(85) (a) Marshallese

jibiriy 'to hug (vt.)' jjibiri 'to hug (vi.)'
qiñey 'to extinguish (vt.)' qqiñi 'to extinguish (vi.)'
kiney 'to invent (vt.)' kkeni 'to invent (vi.)'
liw 'to scold' lliw 'angry'

(b) Trukese

fini 'to select (vt.)' ffin 'to select (vi.)'
posuu 'to stab (vt.)' ppos 'to stab (vi.)'
tap"eey 'to chase (vt.)' ttap"i 'to chase (vi.)'
turuñi 'to seize (vt.)' ttur 'to seize (vi.)'
cônun 'liquid of' ccôn 'wet'

(c) Woleaian

mata 'eye' mmata to wake up'
b"uuaa 'to boil it (vt.)' bb"uua 'to boil (vi.)'

This fact indicates that the phenomenon should not be exceptional, but rather, should constitute one type of reduplication. The right-hand column in (85) lists the forms with initial geminate consonants. One might well be tempted to throw in a constraint $R=C$ — or a constraint that directly refers to a single consonant under whatever guise — to
Against the syllable

capture the generalisation. However, this move undermines the Prosodic Morphology hypothesis in (76), leading to a severe loss of restrictiveness by possibly allowing one to create arbitrary reduplicative forms.

Before contemplating on Marshallese data any further, it may be instructive to consider the following data from another Micronesian language, Mokilese (Harrison 1976: 24).

(86) Historical initial gemination in Mokilese

(a) immas 'ripe' (earlier *mmas)
    um"m"uc 'to vomit' (earlier *m"m"uc)
    um"m"cis 'to play' (earlier *m"m"cis)
(b) impal 'coconut cloth' (earlier *ppal)
    insa 'blood' (earlier *ssa)
    īnkōŋ 'sharp' (earlier *kkōŋ)

Ponapeic languages including Mokilese no longer retain words with initial geminates in the lexicon. The example words in (86) demonstrate that two types of chronological changes have taken place in words originally beginning with geminate consonants, as shown in parentheses to the right (asterisks indicate that the forms are no longer permitted in the language). As mentioned in §2.2.5, tautosyllabic geminates are highly marked (or even impossible), and, in this regard, the presence of all the initial geminates in (86) has been facilitated through prothesis. The prosthetic vowel is u before a sequence of a rounded geminate (p"p" or m"m") and a rounded vowel (u, o or c); otherwise, i appears in initial position. The other type of alteration is what Harrison calls 'nasal dissimilation': the first part of a non-nasal geminate changes into a homorganic nasal, as shown in (86b). It does not occur synchronically; any non-nasal consonant can form a geminate in Mokilese: e.g. ċpi 'pull it', ċppop/oppop 'pulling'. Nasal dissimilation does not concern us below, so let us focus instead on the cases of total gemination in (86a).

The structure of immas, for example, should be represented as follows.

(87) $\sigma$ $\sigma$

\[
\begin{array}{c}
\mu \\
\mu \\
\mu \\
\mu \\
i \\
\text{m} \\
\text{a} \\
\text{s}
\end{array}
\]
3 Against the syllable

If its earlier form, \textit{mmas}, had been derived from a reduplicative prefix characterised by the constraint \( \text{R} = \text{C} \), it must initially have assumed either of the following structures.

\begin{align*}
(88) & \quad (a) & (b) \\
\begin{array}{c}
\sigma \\
\mu & \mu & \mu & \mu \\
\mu & \mu & \mu & \mu \\
\mu & \mu & \mu & \mu \\
\mu & \mu & \mu & \mu \\
\end{array} & \quad \begin{array}{c}
\sigma \\
\mu & \mu \\
\mu & \mu \\
\mu & \mu \\
\end{array}
\end{align*}

These configurations give rise to indeterminacy as to their relative well-formedness. In terms of markedness, the tautosyllabic geminate \textit{mm} in (88a) is highly marked if not impossible, whereas the occurrence of initial syllabic consonants such as (88b) is amply attested (cf. Bell 1978). In light of faithfulness, on the contrary, (88a) outperforms (88b); the latter violates \text{DEP-BR} because \textit{m} in the reduplicant is parsed into a mora that lacks a correspondent in the base. It seems difficult to find a decisive ranking argument. Besides, whichever of the two structures is posited, an account of the \( \text{i/u} \) prothesis would have to involve a dynamic chronological metamorphosis of the single consonant prefix into a heavy syllable. The problems appear to stem from the postulation of the \( \text{R} = \text{C} \) constraint.

An alternative would be to posit that the reduplicative prefix is a heavy syllable in the first place, and that the constraint \( \text{R} = \sigma_{\mu} \) dominates \text{MAX-BR} in the same way as it does in the comparative reduplication in Ilokano (cf. §3.3.2). The difference in the resulting optimal outputs arises from the way individual grammars achieve the satisfaction of designated templates: \( \text{R} = \sigma_{\mu} \) is \text{MAXIMALLY} satisfied in the Ilokano case, while it is \text{MINIMALLY} maintained in Mokilese initial gemination. In the former, a reduplicant copies as large a portion of its base as possible within the limit designated by the template. On the other hand, in the Mokilese case, a reduplicant copies only enough melodic information to satisfy the required template as shown below.

\begin{align*}
(89) & \quad \begin{array}{c}
\sigma \\
\mu & \mu & \mu & \mu \\
\mu & \mu & \mu & \mu \\
\mu & \mu & \mu & \mu \\
\end{array}
\end{align*}

I put forward two assumptions below from which this representation should follow.
First, Max-BR is dominated not only by \( R=\sigma_{\text{mu}} \) but also by \(^{\text{*STRUC}}(R)\), a member of the constraint family \(^{\text{*STRUC}} \) which ensures that 'structure is constructed minimally' (Prince & Smolensky 2002: 25). Were \(^{\text{*STRUC}}(R)\) undominated, the null parse (i.e. /RED-mas/ \( \rightarrow \) mas) would be the optimal candidate, so this constraint itself must be dominated by M-Parse which 'requires the structural realization of morphological properties' (Prince & Smolensky 2002: 52).\(^{39}\) The violation of M-Parse will not matter in the present thesis, so I will not include this constraint in any subsequent tableaux, assuming that it is undominated.

Second, I assume that Mokilese allows an empty nucleus (i.e. an empty head mora) to appear in representations (cf. §3.2.2). This assumption is well motivated elsewhere. Consider the following syncope (Harrison 1976: 324).\(^{40}\)

(90) Mokilese syncope

<table>
<thead>
<tr>
<th>kanaa</th>
<th>'his food'</th>
<th>kanora</th>
<th>'their (two) food'</th>
</tr>
</thead>
<tbody>
<tr>
<td>molukluk</td>
<td>'forgetful'</td>
<td>molokoka</td>
<td>'to forget'</td>
</tr>
<tr>
<td>alic</td>
<td>'beard'</td>
<td>oloco</td>
<td>'his beard'</td>
</tr>
<tr>
<td>ren</td>
<td>'to hear'</td>
<td>korone</td>
<td>'to listen'</td>
</tr>
</tbody>
</table>

Mokilese exhibits a canonical case of empty-category licensing via proper government in the environment (91a), which is equivalent to (91b).

(91) (a) 

\[
\begin{array}{c}
\text{R} \quad \text{O} \quad \text{R} \quad \text{O} \\
N_j \quad N_j \quad N_k \\
\times \quad \times \quad \times \\
\end{array}
\]

(b) 

\[
\begin{array}{c}
\sigma \quad \sigma \\
H_1 \quad H_1 \quad H_k \\
C \quad V \quad C \quad 0 \quad C \quad V \\
\end{array}
\]

According to Harrison (1976: 38ff), a short vowel in \( N_j \) disappears when the following three conditions are met: (a) it is followed by another syllable (i.e. a proper governor \( N_k \)); (b) it is in an open syllable (i.e. no coda-onset governing domain separates \( N_j \) and \( N_k \)); and (c) it is preceded by an open syllable (i.e. \( N_j \) does not government-license its onset). Mokilese does not allow onsets to branch (cf. Harrison 1976: 28), so no branching onset

\(^{39}\) As shown in §2.2.4, duplication of the progressive maximally satisfies \( R=\sigma_{\text{mu}} \) (e.g. k\( \text{as} \)-k\( \text{as} \)), so Max-BR must dominate \(^{\text{*STRUC}}(R_{\text{prog}})\) in modern Mokilese.

\(^{40}\) The alternations in vowel quality involve an independent process.
either precedes $N_j$ or intervenes between $N_j$ and $N_k$. In this environment, $N_j$ receives no phonetic interpretation or, if the resulting consonant cluster is not a legitimate one in Mokilese, $N_j$ may be interpreted as an ex cresc ent vowel, the quality of which is indeterminate: 'it is certainly central and seems most often to be higher mid, phonetically [i]' (Harrison 1976: 39). This phenomenon should sufficiently verify the claim that Mokilese phonology sanctions empty nuclei.

Given the above assumptions as to the constraint ranking and empty nuclei, the following tableau illustrates the alternative analysis.\footnote{Assuming the conformity to anchoring, the tableau (92) does not include candidates such as $\underline{a}_2 \underline{s}_2 - m_1 \underline{a}_2 \underline{s}_1$, $\underline{s}_2 - m_1 \underline{a}_2 \underline{s}_1$, etc.}

\begin{table}
\centering
\begin{tabular}{|c|c|c|c|c|}
\hline
& & & & \\
\hline
\textbf{(a)} & $\sigma$ & $\sigma$ & $R=\sigma_{\mu\mu}$ & $\ast\text{STRUC}(R)$ & \text{MAX-BR} \\
& mas & mas & & & \\
\hline
\textbf{(b)} & $\sigma$ & $\sigma$ & & $\ast\ast\ast$ & \\
& mas & mas & & & \\
\hline
\textbf{(c)} & $\sigma$ & $\sigma$ & & $\ast$ & ** \\
& mas & mas & & & \\
\hline
\textbf{(d)} & $\sigma$ & $\sigma$ & & $\ast$ & ** \\
& mas & mas & & & \\
\hline
\end{tabular}
\caption{INPUT: RED-mas}
\end{table}

I assume that the violation of $\ast\text{STRUC}(R)$ is registered for every melodic association to a prosodic unit. (92a) exhibits full compliance with \text{MAX-BR}, maximally satisfying the heavy syllable template ($\sigma_{\mu\mu}$), but loses the competition due to the excessive violation of $\ast\text{STRUC}(R)$. Spreading does not improve the state of affairs this time, as shown in (92b). The least structured reduplicant can be found in (92c) and (92d). The former fatally violates $R=\sigma_{\mu\mu}$, while the latter manages to barely satisfy this constraint by copying the
single consonant \( m \) into the coda position of the reduplicant. Consequently, Eval returns (92d) as the optimal output.

In the above tableau, I tentatively assume \( R=\sigma_{\mu\mu} \gg *\text{STRUC}(R) \), although nothing rests on this particular ranking. The permutation of \( R=\sigma_{\mu\mu} \) and \( *\text{STRUC}(R) \) is irrelevant as far as the present case of initial gemination is concerned, but it does make different predictions when the base begins with a vowel. Compare the following candidates for a hypothetical input \( \text{am} \).

\[
\text{(93) INPUT: RED-am}
\]

<table>
<thead>
<tr>
<th></th>
<th>( R=\sigma_{\mu\mu} )</th>
<th>( *\text{STRUC}(R) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>( \sigma )</td>
<td>#<em>!</em></td>
</tr>
<tr>
<td></td>
<td>( \mu )</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( \mu )</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( \mu )</td>
<td></td>
</tr>
<tr>
<td>a m</td>
<td>a m</td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td>( \sigma )</td>
<td>*!</td>
</tr>
<tr>
<td></td>
<td>( \mu )</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( \mu )</td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>a</td>
<td>m</td>
</tr>
</tbody>
</table>

\( R=\sigma_{\mu\mu} \gg *\text{STRUC}(R) \) prefers \( \text{ammam} \), whereas the reverse ranking opts for \( \text{aam} \). The former pattern figures in synchronic reduplication, too (e.g. \( \text{en} \) 'air, breeze, wind' \( \rightarrow \) \( \text{enjen} \) 'to dry'); and the number of words beginning with a long vowel is severely restricted. The suggested ranking \( R=\sigma_{\mu\mu} \gg *\text{STRUC}(R) \) at least reflects these observations, but an argument for its adequacy requires further etymological studies, which go beyond the scope of this thesis.\(^{42}\)

Regarding the presence of empty morae, let us consider the following candidate.

---

\(^{42}\) Another possible candidate is \( \text{amam} \). This sequence is most likely to be syllabified as \( \text{a.mam} \), which cannot really compete with the candidates in (93); however, if syllabified as \( \text{am.am} \), this candidate outperforms the other candidates with respect to the constraints considered in the tableau. Syllable theories consistently uphold a constraint that syllabifies a sequence \( VCV \) as \( V.CV \) (cf. Kahn 1976: 42, Itô 1986: 165). In Optimality Theory, the presence of \( \text{ONSET} \) and \( *\text{CODA} \) (cf. §3.2.1) always renders \( V.CV \) preferable to \( V.C.V \), all else being equal. It then follows that \( \text{am.am} \) cannot be an optimal candidate.
This configuration may seem to improve on (92c) by including another empty mora. However, the theory of empty categories and phonological government assumed here (cf. §3.2.2) prohibits a licensed empty nucleus from licensing another empty position, as prescribed in (68bii). Couched in the moraic mode of representation, this prohibition bars representations that include the following structures (θ explicitly indicates the absence of melodic contents).

I argue that structures such as these should be CATEGORICALLY ill-formed, as originally proposed in Government Phonology, because they are bound to seriously undermine theoretical restrictiveness, irrespective of the particular theory employed. For the sake of the present discussion, let us just assume that Con has a constraint (or constraints) that militates against the above structures, and that this constraint is sufficiently highly ranked to prevent the structural analysis (94) from becoming an optimal representation of the initial geminate in question.

Not only does the proposed analysis avoid referring to a non-prosodic unit such as a single consonant, in accordance with the Prosodic Morphology hypothesis, but it also accommodates an account of the i/u prothesis by positing (92d) as the optimal candidate. As mentioned earlier, illegitimate consonant clusters may be circumvented in Mokilese by inserting an excrescent vowel in phonetic interpretation. Considering the fact that initial geminates are excluded from non-analytic domains in general, mmas may well be liable to vowel epenthesis. Here the question is WHERE this epenthetic vowel should be expected. Given that an excrescent vowel is the interpretation of an empty nucleus, the

---

43 A more theory-internal explanation for the excrescent vowel is available. In the licensing model, the coda-onset sequence forms a governing domain, so the initial empty nucleus in θm.mas cannot be properly governed by the following nucleus, as depicted in (68ciii). According to the Empty Category Principle, the initial empty nucleus must therefore be phonetically interpreted.
representation (92d) ensures that the vowel appears in the initial position (*m0 mas), not within the geminate (θmmas). Furthermore, as empty nuclei lack melodic specification, it is natural that the quality of excrescent vowels should show a certain indeterminacy, arguably susceptible to the influence of their phonetic environment. I suggest that, in the course of the lexicalisation of excrescent vowels, this factor may have given rise to the i⇒u variation of prosthetic vowels.

Bearing in mind the above analysis of the historical initial gemination in Mokilese, let us return to the initial gemination in Marshallese. According to Harrison (1973: 443-444),

'... initial gemination is found in most distributive forms (usually together with -CVC# reduplication) e.g. paniq 'to pile up' ppaniqniq 'to pile carelessly' and in some intransitive counterparts of transitive verbs'.

Examples of the latter type are shown in (85a), which is repeated below.

(96) Marshallese

<table>
<thead>
<tr>
<th>Marshallese</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>jibiri</td>
<td>'to hug (vt.)'</td>
</tr>
<tr>
<td>jjibiř</td>
<td>'to hug (vi.)'</td>
</tr>
<tr>
<td>qihe</td>
<td>'to extinguish (vt.)'</td>
</tr>
<tr>
<td>qqiń</td>
<td>'to extinguish (vi.)'</td>
</tr>
<tr>
<td>kinė</td>
<td>'to invent (vt.)'</td>
</tr>
<tr>
<td>kkęń</td>
<td>'to invent (vi.)'</td>
</tr>
<tr>
<td>liw</td>
<td>'to scold'</td>
</tr>
<tr>
<td>lliw</td>
<td>'angry'</td>
</tr>
</tbody>
</table>

The descriptively simple constraint R=C should be seen as a last resort because of the unfavourable consequences it would bring about. By analogy with the analysis of the earlier Mokilese forms in (86), I argue that reduplicants in (96) should be subject to a prosodic well-formedness constraint (σ=π). The following assumptions also hold in Marshallese initial gemination: (a) σ=π is undominated, (b) *STRUC dominates MAX-BR, and (c) reduplicants contain empty nuclei. As discussed above, this analysis allows us to avoid the problematic constraint R=C and maintain the Prosodic Morphology hypothesis.

Besides this theoretical advantage, there is another cogent reason to put forward the above argument. Consider the following observation by Harrison (1973: 444).

Phonetically, the ... geminate clusters are 'softened' by a prosthetic vowel in the Ralik dialect and by an epenthetic vowel in the Ratak dialect. For example; bbaq 'swollen' — Ralik [ɛbbək], Ratak [babək].
In descriptive terms, the two dialects of Marshallese avoid the highly marked initial geminates by breaking up the sequence into two syllables through the insertion of an excrescent vowel: i.e. $eb\,b\,ok$ and $ba\,b\,ok$. I shall claim that the appearance of vowels such as these should strongly indicate that the reduplicative prefix is something more than a single consonant. Let us assume that prosthetic/epenthetic vowels are the manifestation of empty nuclei, as in the analysis of Mokilese. The input $/RED\,+\,baq/$ is interpreted as $\emptyset b\,b\,ok$ in Ralik and as $b\emptyset b\,ok$ in Ratak. The difference in the precise interpretation of $\emptyset (\varepsilon\sim\Lambda)$ stems from the typical indeterminacy of empty categories with respect to qualitative properties. The Ralik case fully parallels the derivation $/RED\,+\,mmas/$ $\rightarrow$ $\emptyset m\,mas$ in Mokilese, as shown below, so the reduplicant must be subject to the undominated constraint $R=\sigma_\mu$.

The only difference between the two systems is that the prosthetic vowel is lexicalised in Mokilese while it remains excrescent in the Ralik dialect of Marshallese.

On the other hand, Ratak differs from Ralik in where the epenthetic vowel goes. In $b\emptyset b\,ok$, the empty nucleus resides between the components of the initial geminate, and this entails the syllabification of the initial consonant into an onset: $b\emptyset .b\,ok$. Notice that this syllabic configuration can be found in the defeated candidate (97b), which fails to satisfy the quantitative requirement enforced by $R=\sigma_\mu$. I propose that the reduplicants in the Ratak dialect should be characterised by the undominated constraint $R=\sigma_\mu$. 
R=σᵢ and R=σᵢᵢ exhibit complementarity in the evaluation of monosyllabic candidates. Hence, if R=σᵢ dominates R=σᵢᵢ, the latter is effectively unable to distinguish the relative well-formedness of candidates so it can occupy any position in the constraint hierarchy; and vice versa. If the two constraints are both undominated, they cancel out each other and exert no influence on the selection of an optimal output.

In this section, I have put forward a prosodic analysis of the reduplicative prefix that apparently consists of a single consonant. The proposed analysis not only enjoys empirical advantages with respect to the account of prothesis/epenthesis but also derives the typology of monosyllabic reduplication. The dialectal variations in Marshallese stem from the same pair of prosodic constraints on the well-formedness of reduplicants (R=σᵢ and R=σᵢᵢ) that draw the lexical distinction between the plural adjective and the comparative adjective in Ilokano. However, the relative ranking of MAX-BR and *STRUC(R) gives rise to the polarity between minimal (Marshallese) and maximal (Ilokano) template satisfaction. The following table summarises the typological consequences.

<table>
<thead>
<tr>
<th></th>
<th>R=σᵢ</th>
<th>R=σᵢᵢ</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAX-BR ⊃ *STRUC(R)</td>
<td>Ilokano plural</td>
<td>Ilokano comparative</td>
</tr>
<tr>
<td>*STRUC(R) ⊃ MAX-BR</td>
<td>Ralik</td>
<td>Ratak</td>
</tr>
</tbody>
</table>

The above analysis crucially relies on the theory of empty categories. This theory is originally put forward in the principles and parameters formalism, which does not admit
the Optimality Theoretic notion of violability. I will return to this issue of different theoretical assumptions in Chapter 5.

3.3.4 **Nowhere 'syllable'**
The preceding two sections essentially supported the Prosodic Morphology hypothesis, reasserting that the well-formedness of reduplicants is prosodically constrained even in the case of initial gemination. I presented the prosodic constraints in the way the hypothesis is put into practice in Prosodic Morphology: the well-formedness of reduplicants is defined in terms of prosodic constituents such as syllables and morae. Considering the two contrastive templates of reduplicants (R=σ_u and R=σ_m), the formulation of constraints clearly needs a unit such as the mora to encode the weight distinction. On the other hand, it is not as evident whether reduplication must refer to the syllable, a superordinate unit comprising the weight units and onsets. It has already been noticed elsewhere, as shown below, that syllables are ignored in the mapping of melodies from a base to its reduplicant. This section claims that the same goes for reduplicative templates and puts forward an alternative implementation of the Prosodic Morphology hypothesis without referring to syllables.

In sharp contrast to the notably prosodic templates illustrated in the previous sections, correspondence relations between a base and its reduplicants distinctly demonstrate a segmental bias. Moravcsik (1978: 311-312) points out that

> ... evidence is not available to me to indicate the necessity of such a definition [i.e. a syllabic definition of a reduplicated sequences] in any language ... the only phonetic properties that partial reduplication rules may refer to are consonantality and vowelhood ...

What concerns us here is not the shape of reduplicants but the melodies to be reduplicated from bases. Examples such as na.pi.pin.tás and na.rúg.ru.gít from Ilokano (cf. §3.3.2) illustrate typical cases in which reduplicated melodies fail to coincide with the original syllabification in their base.

However, reduplication does not seem to ignore prosodic information altogether. It retains the opposition between i/u and j/w (cf. Steriade 1988: 89-90), which is generally deemed prosodic in non-linear phonology, as illustrated with the moraic model below.
A case in point can be found in the Mokilese progressive (cf. §2.2.4). This is the type of reduplication that maximally satisfies the \( \sigma_{pp} \) template, so let us assume that it is subject to the same constraint hierarchy as that of Ilokano comparative adjective. The following tableau provides an illustrative example \( /\text{RED} \ + \ \text{kas} / \rightarrow \text{kaskas} \) to be throwing.\(^{44}\)

\[
\begin{array}{|c|c|c|c|}
\hline
& \text{R-} \sigma_{pp} & \text{MAX-BR} & \text{*STRUC(R)} \\
\hline
(a) \text{ka.s}\text{s}\text{a}.\text{s}\text{a} & *! & **** \\
(b) \text{\textasciitilde kas} \text{ka.s}\text{s}\text{a} & * & *** \\
(c) \text{ka.ka.s}\text{a} & *! & ** \\
\hline
\end{array}
\]

Now let us consider the following forms in which bases begin with a vowel (Harrison 1976: 61, 221).

(102) Mokilese

\[
\begin{align*}
\text{idip} & \quad \text{iddidip} & \text{‘to be drawing’} \\
\text{alu} & \quad \text{allalu} & \text{‘to be walking’}
\end{align*}
\]

\(^{44}\) As mentioned in §2.2.4, this analysis is essentially the same as that by Blevins (1996). However, it fails to account for a case such as \( /\text{RED} \ + \ \text{caak} / \rightarrow \text{caak-caak} \) to be bending. This is because the following configuration is not ruled out in the moraic model and Eval thus selects the candidate \( *\text{caak-caak} \) as optimal in light of the proposed constraint ranking.

As pointed out in McCarthy & Prince (1986: 21), superheavy syllables (CVVC) only appear in word-final position, so the reduplicant in \( *\text{caak-caak} \), although best satisfying MAX-BR, cannot be a well-formed syllable word-internally. However, the ranked constraints alone cannot exclude the superheavy candidate. I tentatively assume that \( *\text{COMPLEX}(\mu) \) (i.e. morae cannot branch) crucially dominates MAX-BR, although it never exerts influence on the first mora. (\( *\text{COMPLEX}(\mu) \) must be dominated by MAX-IO to avoid \( *\text{caaa-caaa} \).) I will present an alternative analysis in the licensing model in §4.1.

As mentioned in §2.2.4, this analysis is essentially the same as that by Blevins (1996). However, it fails to account for a case such as \( /\text{RED} \ + \ \text{caak} / \rightarrow \text{caak-caak} \) to be bending. This is because the following configuration is not ruled out in the moraic model and Eval thus selects the candidate \( *\text{caak-caak} \) as optimal in light of the proposed constraint ranking.
If reduplication ignores prosodic information or, put differently, if correspondence is purely segmental, the optimal candidates for idip and alu would be *idjidip and *alwalu, respectively.

(103) INPUT: RED-alu

<table>
<thead>
<tr>
<th></th>
<th>R=σμμ</th>
<th>MAX-BR</th>
<th>*STRUC(R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>!</td>
<td>!</td>
<td>***</td>
</tr>
<tr>
<td>(b)</td>
<td></td>
<td></td>
<td>***</td>
</tr>
</tbody>
</table>

Since a front glide j can only be found after a high front vowel i in Mokilese (cf. Harrison 1976: 29ff), *idjidip can be excluded for an independent reason such as the Obligatory Contour Principle (cf. McCarthy & Prince 1995: 275). However, *alwalu cannot be immediately rejected because of the existence of a word such as welwel 'curved (of a wave), to sway'. This state of affairs strongly indicates that MAX-BR should refer to morae, so that this constraint is also violated in (103b) and thus passes the buck to another constraint such as CODACOND (cf. Itô 1986: 26ff, Prince & Smolensky 2002: 109), which prefers a homorganic coda-onset cluster. (I will present an alternative analysis in §4.1, however.) An argument for preserving the moraic structure of the base is also put forward by McCarthy & Prince (1986: 102).

In addition to morae, feet — or more precisely, minimal prosodic words — are claimed to show correspondence. As quoted above, Moravesik (1978) finds no syllable-based reduplication, but Marantz (1982: 440) cites Yidiŋ as 'only one exception to Moravesik's claim'. The relevant data is given below (Dixon 1977: 156-157, 233-236).

---

45 In a case such as kəs,ka,sə, the moraic correspondence is not perfect because of the difference in the syllabification of s. This is not unexpected, considering the violable nature of constraints, but I will present an alternative analysis in §4.1.
Nash (1980: 144) suggests that the above reduplication should be accounted for 'in terms of syllables, since it copies only the first two syllables of a three-syllable root, and takes the coda of the second syllable'. However, notice that the reduplicative prefix comprises not one single syllable but two; this is not necessarily direct evidence of the putative syllable-based reduplication. Indeed, McCarthy & Prince (1990: 232-234, 2001: 115-116) claim that Yidji reduplicates a minimal prosodic word defined as a disyllabic foot, effectively invoking the correspondence of feet. That is, the foot defines the segmental portion of the base that is copied to its reduplicant. Consequently, correspondence constraints on reduplication may refer to prosodic information such as morae and feet but never syllables.47

The absence of the syllable as a constituent also emerges in the constraints on reduplicative affixes. As maintained in the previous sections, constraints on the shape of reduplicative affixes are prosodically prescribed and, like other prosodic phenomena, they ignore onset consonants — descriptions such as 'monosyllabic' and 'disyllabic' are

---

46 According to Dixon (1977: 31ff), Yidji has the canonical three vowels (a i u) and the consonantal inventory below (the palatal stop is represented with the equivalent IPA symbol).

<table>
<thead>
<tr>
<th>stop</th>
<th>labial</th>
<th>apical</th>
<th>retroflex</th>
<th>laminal</th>
<th>dorsal</th>
<th>labio-dorsal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b</td>
<td>d</td>
<td>j</td>
<td>k</td>
<td></td>
<td></td>
</tr>
<tr>
<td>nasal</td>
<td>m</td>
<td>n</td>
<td>j</td>
<td>n</td>
<td></td>
<td></td>
</tr>
<tr>
<td>lateral</td>
<td></td>
<td>l</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>trill</td>
<td>r</td>
<td></td>
<td></td>
<td>[</td>
<td></td>
<td></td>
</tr>
<tr>
<td>glide</td>
<td></td>
<td></td>
<td>j</td>
<td>w</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Although the stops are sometimes represented with voiceless counterparts in the literature, Dixon (1977: 32) describes that 'Stops are almost always voiced. Partly voiced allophones are sometimes encountered word-initially ... words cannot end in a stop'. Homorganic nasal-stop clusters are assumed to be tautosyllabic (cf. Nash 1980: 144).

47 An apparent counterexample can be found in Kaingang (Wiesemann 1972, cited in McCarthy & Prince 1986: 41, Steriade 1988: 76), in which a root-final syllable is reduplicated; e.g. vâ → vâ.vâ 'to throw away', vâ.sân → vâ.sân.sân 'to exert, fatigue'. However, Steriade (1988: 79) puts forward an alternative analysis based on a heavy monosyllabic template, claiming that the failure of vâ → *vâ.vâ stems from the lack of long vowels in the language.
obliviou to the presence/absence of onsets. The template $\sigma_{\mu\mu}$ for the Ilokano comparative adjective, for example, only requires reduplicants to contain two tautosyllabic morae, and whether they should have onsets is a matter for other constraints; reduplicants may have a prosthetic consonant to satisfy ONSET, or constraints demanding melodic faithfulness position by position may force the copying of onset consonants from the base. The neglect of onsets is obvious in the Ralik dialect of Marshallese discussed in §3.3.3; the reduplicant is again $\sigma_{\mu\mu}$ but it never copies consonants into the onset due to the ranking of constraints. This state of affairs renders the template $\sigma_{\mu\mu}$ superfluous since the sisterhood of onset and moraic melodies is redundant in reduplicative templates.

Still, one may argue that the syllable constituent should be necessary to count morae for the light/heavy distinction of 'monosyllabic' reduplicants, on the one hand, and to assemble morae into units for 'disyllabic' reduplicants, on the other. Without syllables, $R=\sigma_{\mu\mu}$ would have to be reformulated as $R=\mu\mu$. The latter is clearly problematic because it cannot distinguish a reduplicant of one single heavy syllable from another comprising two consecutive light syllables. For example, the input /na-REDcmp-lain/ in Ilokano is given the wrong output *nalailain. Compare the following tableau with (84).

(105) INPUT: na-REDcmp-lain

<table>
<thead>
<tr>
<th></th>
<th>R_{cmp}=$\mu\mu$</th>
<th>MAX-BR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>![Diagram]</td>
<td>#</td>
</tr>
<tr>
<td>(b)</td>
<td>![Diagram]</td>
<td>#*!</td>
</tr>
</tbody>
</table>

The weight distinction is certainly indispensable not only for reduplication but also for prosodic phenomena in general, as repeatedly mentioned in Chapter 2. However, the problem described above is specific to the moraic model, and it does not arise if we employ a different mode of representation in which the weight is determined not by counting morae within syllables but by referring to the presence/absence of a dependent within a domain such as the rhyme. Supposing $R_{hvy}$ amounts to $\sigma_{\mu\mu}$, diagrammatically

\[\text{An apparent exception to this state of affairs is onset simplification (cf. McCarthy & Prince 1986: 16ff, Steriade 1988, Brockhaus 1995: 215ff). However, since onsets are never required to be complex or 'heavy', this phenomenon cannot be analysed in parallel to the light/heavy distinction. Following Steriade, I assume that simplification stems from constraint interaction involving a general notion of structural markedness, but leave the details open here.}\]
defined as 'a branching rhyme'. The following tableau succeeds in selecting the optimal
candidate without referring to syllables.

(106) INPUT: na-RED<sub>cmp</sub>-lain

<table>
<thead>
<tr>
<th></th>
<th>R&lt;sub&gt;cmp&lt;/sub&gt;=R&lt;sub&gt;hvy&lt;/sub&gt;</th>
<th>MAX-BR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>OR ORR ORR</td>
<td>*!</td>
</tr>
<tr>
<td></td>
<td>XXXXXX XXXXX</td>
<td></td>
</tr>
<tr>
<td></td>
<td>na la la la la la</td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td>OR ORR ORR</td>
<td>**</td>
</tr>
<tr>
<td></td>
<td>XXXXXX XXXXX</td>
<td></td>
</tr>
<tr>
<td></td>
<td>na la la la la la</td>
<td></td>
</tr>
</tbody>
</table>

In an earlier version of Prosodic Morphology which predates the advent of
Correspondence Theory, the bare rhyme template is not expected to copy onset
consonants (cf. McCarthy & Prince 1986: 72ff), so the above account crucially depends
on MAX-BR (and other faithfulness constraints) that ensures correspondence at the
string-adjacent level. An objection may be raised against the presence of the onset
constituents — in fact, onset consonants can be represented with bare x-slots in the above
tableau — and the presence of x-slots also may attract criticism from a different
viewpoint (cf. §2.2.5). I will discuss these issues in Chapter 4. The alternative
representation above can be applied to cases with 'disyllabic' templates; it should suffice
to compare the following representations of Yidin reduplication.

(107) (a) Ft Ft

(108) (a) Ft Ft
The representations in (108) suffer no loss of structural information, and remain amenable to the Prosodic Morphology analysis by McCarthy & Prince mentioned above: Yidi requires the correspondence of a minimal prosodic word consisting of a 'disyllabic' foot.

In this section, I have put forward an alternative representation of reduplication, making use of a mode of representation akin to the licensing model. The above illustration confirms Aoun's (1979:146) claim that 'phonological analyses referring to the syllable ... may be reformulated in terms of rime or onset'. However, McCarthy & Prince (1986:70ff) also argue that 'Rhyme-domain phonological rules are typically trivially reformulated without reference to rhymes', rejecting the rhyme as a subconstituent of the syllable. We can infer from these remarks that either the syllable and mora or the rhyme alone suffices in phonological analyses, but that the choice is not so much an empirical matter as a theoretical one. Indeed, both models seem descriptively adequate, but the above discussion indicates that the exocentric representation (i.e. syllabic structure without the syllable constituent) has the advantage on the following two counts. First, it allows us to capture the requirements for reduplicative templates more precisely than the moraic model. Second, it provides an explanation for the distinct absence of syllables in reduplication, in line with Aoun's claim that there is no node labelled 'syllable'. Although I will further elaborate the model of representation in the next chapter, I argue, at this point, that the Prosodic Morphology hypothesis should be implemented without referring to the syllable constituent.

Before concluding this section, let me note yet another advantage of the exocentric mode of representation. The notion that syllables ought to have onsets has been well established in syllable theories (cf. Footnote 42), and it is implemented as the constraint Onset in Optimality Theory, too. Let us compare the well-formedness of the following configurations in terms of this constraint (» reads 'is better-formed than').

\[
\begin{align*}
(109) \quad & \text{(a) the moraic model} & \text{(b) the exocentric model} \\
\sigma & \sigma & O & R & R \\
\mu & \mu & x & x & x \\
a_i & a_j & a & a_i a_j & a
\end{align*}
\]

The constraint per se is a pure stipulation based on an observational fact relating to syllable markedness, without reflecting any intrinsic property of syllabic structure, and
the two models can equally distinguish the relative well-formedness of the structures as far as this constraint is concerned. However, notice that they have different implications for structural complexity; in the moraic model, a complex (branching) syllable is better than a simplex one. This result is far from ideal because, apart from a case with a specific purpose such as stress assignment in which 'heavy' may be preferred, it is common practice to draw generalisations in such a way that complex structures are more marked than simplex ones. This is always the case in the licensing model; branching structures are always more marked than their non-branching counterparts (§2.5.2). The concept that markedness is built into structural complexity has also been extended to melodic structure; within a theory of monovalent phonological primes, Anderson & Ewen (1987: 30) claims that 'the relative markedness of a segment is an intrinsic property of its representation [i.e. the complexity of intramelodic structure]'. Couched in the moraic model, Optimality Theory also resorts to the notion of structural markedness as follows (cf. Prince & Smolensky 2002: 108).

Both Onsets and Codas are limited to a single segment, and nuclei consist of either a single short or long vowel [in Lardil]. ... *COMPLEX ... says that syllable positions are limited to single segments.

Given that *COMPLEX is a generalised statement of syllable markedness, the unmarked status of the branching syllable in the moraic model — or any model with the syllable as the maximal constituent, for that matter — shows a marked contrast with other structural generalisations. Moreover, the putatively well-formed structure in (109a) entails that ONSET comes into conflict with *COMPLEX. Considering that no language is assumed to opt for syllables without onsets (cf. Prince & Smolensky 2002: 93ff), the ranking of the constraints in question seems to be fixed as ONSET $\gg$ *COMPLEX. This state of affairs obviously stems from the anomalous property of the syllable constituent, and a question may well arise as to the validity of postulating the very existence of this constituent. In this regard, I argue that the exocentric model devoid of the syllable constituent is to be preferred in terms of explanatorily adequacy, offering cohesive generalisations based on structural markedness.
3.4 Onsets of feet

This section focuses on a case of stress assignment in which syllables are reportedly involved. Stress languages are generally assumed to fall into two groups according to whether or not they refer to phonological weight, a concept which invokes the binary distinction between light and heavy (cf. §2.2.2). This distinction is made by referring either to the number of tautosyllabic morae or the branching/non-branching state of a rhyme/nucleus, depending on the model of syllabic structure employed. Either way, onsets are left aside in this regard. If this is really the case, then stress is another source of evidence against the syllable.

However, Aranda (cf. Strehlow 1942, 1943-1944), a Pama-Nyungan language, is reported to have a peculiar stress system that challenges the above assumption. In this language, stress assignment needs to refer to the presence/absence of onsets. This fact leads Davis (1988) to argue that onsets may have a contribution to make to phonological weight: branching syllables are heavy while non-branching ones are light; this amounts to counting non-moraic segments in the moraic model. I agree with Davis that Aranda stress exhibits onset sensitivity, but will argue below that the presence of an onset is crucial with respect to not phonological weight but rather the general well-formedness of foot structure. Following this line of argument, this section proposes an alternative analysis of Aranda stress without invoking the weight of syllable nodes, and also highlights that some typological consequences of the proposed analysis.

3.4.1 Aranda stress and rule-oriented analyses

This section reviews rule-based analyses of Aranda stress.\textsuperscript{49} Below is the data to be considered, taken from Strehlow (1942) (\textquoteleft and \textquoteright indicate primary and secondary stress, respectively).\textsuperscript{50}

\textsuperscript{49} The data presented in this thesis is based on the Western Aranda dialect.

\textsuperscript{50} Allophonic details in Strehlow (1942) are omitted from the data. In particular, b and d in the original transcription are replaced with p and t, respectively, since stops lack a voicing contrast.
Words minimally contain two syllables in Aranda. In disyllabic words such as those in (110b), the initial syllable regularly bears primary stress. In (110a) that lists words of three or four syllables, primary stress is assigned to the initial syllable only if the word begins with a consonant; if not, primary stress falls on the second syllable. Secondary stress appears one syllable away from the primary one. The final syllable never receives stress.

It follows from the above observation that, leaving aside disyllabic words, stress assignment is undoubtedly sensitive to the presence/absence of syllable onsets. Aranda is
not wholly exceptional. Alyawarra (cf. Turtle 1977, Yallop 1977), a Pama-Nyungan
language belonging to the same Arandic group, also disregards initial vowels in stress
assignment; e.g. 'ŋularna 'tomorrow', i'lipa 'axe'. Hale (1976: 44) also reports that
Uradhi, and in fact all of the Northern Paman languages, demonstrate the same pattern of
stress assignment; e.g. 'minhitji 'bird', u'taga 'dog'. Alyawarra and Uradhi differ from
Aranda in that disyllabic words are also subject to onset sensitivity; e.g. i:l'pa 'ear'
(Alyawarra), i'pi 'water' (Uradhi). Hale puts forward the following rule to account for
stress assignment.

\[(111) V \rightarrow \tilde{V} / #(V)C_1\]

According to this rule, stress assignment in the Australian languages proceeds by
scanning a string from the left edge to identify the first syllable with an onset as a landing
site. The question is how to formalise this state of affairs within a non-linear prosodic
theory, capturing the variations with respect to disyllabic words: Alyawarra and Uradhi
follow the rule (111) while Aranda assigns stress to initial syllables.

Halle & Vergnaud (1987: 48-50) account for Aranda stress by fully exploiting the
notion of extrametricality, drawing on Archangeli (1986). They posit that both the
domain-initial and the domain-final segments of a word, irrespective of their melodic
content, are marked as extrametrical. Extrametricality is claimed to percolate upwards,
and constituent nodes immediately dominating the extrametrical melodies also become
extrametrical. This is illustrated below (extrametrical units are enclosed in angled
brackets).

\[(112) (a) \begin{array}{l}
\langle O \rangle R \ O \ R \ O \langle R \rangle \\
\langle \tilde{t} \rangle a \ r \ a \ m \langle a \rangle 
\end{array} (b) \begin{array}{l}
\langle R \rangle O \ R \ O \langle R \rangle \\
\langle \tilde{\eta} \rangle u \ \langle a \rangle 
\end{array}\]

Given this way of marking extrametricality, the domain-initial and the domain-final
melodic units and their respective parent nodes remain invisible to stress assignment.
Aranda stress is then claimed to fall on the leftmost rhyme (i.e. stress bearing unit) in the
domain. In 'tarama, the first rhyme from the left receives stress; on the other hand, the

54 In Alyawarra, a glide in initial position is not counted as an onset consonants in stress assignment.
According to Yallop (1977: 25ff), ji/jə and wu/wə are free variants of i and u, respectively; ju and
wa are regarded as complex vowels.
initial rhyme is marked extrametrical in i'ŋula, so stress finds its place in the following rhyme. This analysis makes the correct predictions as far as words of three or more syllables are concerned. However, disyllabic words need an additional condition because, if they begin with a vowel, the application of extrametricality to the melodic units at both edges leaves no rhyme visible to stress, as shown below.

(113) (a) \[O \mathit{R} \ O<\mathit{R}>\] (b) * \[\mathit{R} \ O<\mathit{R}>\]

\[\mathit{k} \mathit{a} \mathit{m} \mathit{a} \mathit{p} \mathit{a}\]

For cases such as 'ilpa, Halle & Vergnaud (1987: 50) suggest the following condition.

An element marked extrametrical is invisible to the rules constructing metrical constituents only if at the point in the derivation at which these rules apply (a) the element begins or ends the phonological string and (b) does not constitute the entire string.

This expresses the fact that the occurrence of extrametricality is restricted to the edges of a domain, and that the application of extrametricality must be blocked if it leaves no landing-site for stress.

Halle & Vergnaud manage to avoid referring to onsets in the above account of Aranda stress by exploiting extrametricality. However, a drawback of the above analysis is that extrametricality must have recourse to percolation. The postulation of initial extrametricality may be justified to the extent that it can be extended to other phenomena where initial elements are disregarded. Charette (1991: 202ff) discusses the inapplicability of proper government (cf. §3.2.2) in domain-initial position in languages such as Parisian French, Tangale, Mongolian, Tonkawa, Yawelmani, and Turkish. Yoshida (1992) also argues that initial nuclei (or morae) are inaccessible to tone spreading in Tokyo Japanese. On the other hand, percolation, on which Aranda stress crucially relies, does not seem to be invoked in any other phenomenon.

Davis (1988: 4) criticises the analysis by Halle & Vergnaud on the grounds that the application of extrametricality to both edges of a domain 'is apparently otherwise unprecedented in stress systems'; stress in languages usually exhibits extrametricality domain-finally but not domain-initially. He argues that Aranda stress should be accounted for by directly referring to the syllable projection: stress falls on the first
branching syllable. Given this argument, Davis revises the procedure for stress assignment suggested by Halle & Vergnaud and proposes the following alternative.

(114) Aranda primary stress (Davis 1988: 14)

(a) Mark a domain-final vowel extrametrical.
(b) Assign a line 1 grid mark to syllables containing onsets.
(c) Line 1 constituents are left-headed.
(d) Construct on line 1 an unbounded constituent.
(e) Conflate. [i.e. remove grid marks (above line 0) from all syllables other than the syllable having the most grid marks.]

The above rules allow us to derive the correct stress patterns of the words in (110) without recourse to initial extrametricality, as illustrated below with the example words ‘tarama, ar’tjanama, and ‘ilba.

(115) Rule (a) * * — * * * — * —
    ta rama ar tja nama i l ba

Rule (b) * * — * * * — * —
    ta rama ar tja nama i l ba

Rule (c) * * — * * * — * —
    ta rama ar tja nama i l ba

Rule (d) * * ( ) ( * * ) ( * )
    ta rama ar tja nama i l ba

Rule (e) * * — * * — * —
    ta rama ar tja nama i l ba

The rules in (114) do not mention secondary stress, e.g. ‘kutu,ŋula, but its placement is accounted for by adding a binary-foot formation rule that creates bounded constituents (cf. Halle & Vergnaud 1987: 49). Davis claims that direct reference to the syllable projection also accommodates an account of Pirahã stress (cf. Everett & Everett 1984), which is sensitive to onsets with a voiceless consonant (cf. §3.4.5).

The above analysis revives the rule (111) in the non-linear context by characterising the structural description in terms of syllabic structure, as is evident in the formulation of the rule (114b). It seems reasonable to assume that stress may be sensitive to onsets, rather than to appealing to initial extrametricality and percolation, but a question arises as
to whether onset sensitivity should invoke phonological weight at the level of syllable projection. In canonical cases of weight-dependent stress assignment, a rhyme node is heavy not only when the rhyme node itself branches but also when the nucleus node, its subconstituent, branches. However, the same is not true for Aranda stress: a syllable is heavy only when the syllable node itself branches. (In the moraic model, a heavy syllable must contain a pair of non-moraic and moraic segments.) Besides, there does not seem to exist a system in which a rhyme is heavy only when the rhyme itself, but not the nucleus, branches. Because of these anomalies, I argue that the analysis of onset sensitivity based on syllable weight should be rejected. Still, onset sensitivity ought to be subsumed under some generalised notion, rather than being simply stipulated as (114b), in order to avoid creating an arbitrary rule such as 'assign grid marks to syllables containing codas'. This is the main issue to be discussed in the following section.

It should also be noted that both Halle & Vergnaud and Davis resort to extrametricality. In this regard, let us recall the following facts about Aranda.

\[(116)\]
\[
\begin{align*}
(a) & \text{ Stress never falls on a word-final syllable.} \\
(b) & \text{ Words are minimally disyllabic.} \\
(c) & \text{ Secondary stress falls one-syllable away from primary stress.}
\end{align*}
\]

These facts seem to be related to each other; given that a word is required to contain at least one stressed syllable, the minimal-word size should be derived from (116a); the distance between primary stress and secondary stress also coincides with this disyllabic size. Stipulating extrametricality has direct relevance to (116a), and allows us to deduce (116b) with the presupposition of obligatory stress, but seems to have nothing to say about (116c), resulting in a generalisation being overlooked. In support of the view that extrametricality should be epiphenomenal and follow from the interaction of constraints on the well-formedness of phonological structure (cf. Prince & Smolensky 2002: 33ff), the next section puts forward an alternative way of capturing the generalisation inherent in (116).

### 3.4.2 An alternative analysis of Aranda stress

Drawing on Takahashi (1994), this section argues that Aranda stress crucially refers to the well-formedness of feet. I will first focus on words with an initial consonant (C-initial words, henceforth) and illustrate Aranda foot structure utilising constraints reasonably well established in Optimality Theory. I will then go on to discuss the onset sensitivity
observed in words beginning with a vowel (V-initial words, henceforth), proposing that
the constraint ONSET should hold not only for syllables but also for feet.

C-initial words such as 'kama, 'tarama, and 'kutu,ulula indicate that words are
parsed into syllabic trochees, schematically shown as [(\(\sigma\sigma\))], [(\(\sigma\sigma\)::\(\sigma\sigma\))] (square and round brackets indicate prosodic-word and foot boundaries, respectively).
The lack of words containing a degenerate foot such as [(\(\sigma\))] and [(\(\sigma\sigma\)::\(\sigma\))] shows that
feet must comprise two consecutive syllables. From these conditions, I assume that two
constraints, \(\text{FtBin}\) in (63a) and FOOT-FORM(TROCHAIC) prescribed below, must be
undominated in the Aranda constraint hierarchy.

(117) FOOT-FORM(TROCHAIC)
\[\text{Ft} \rightarrow \sigma_5\sigma_w \ (\text{McCarthy \& Prince 1993: 11})\]

Since the two constraints never figure independently, I will amalgamate them into a
shorthand constraint \(\text{Ft}^=\sigma\) for the sake of simplicity in the following discussion.\(^{55}\) The
following constraint rules out unstressed monosyllabic words in Aranda (cf. Prince &
Smolensky 2002: 45).

(118) \(LX \approx PR\)

A member of the morphological category corresponds to a prosodic word.

A prosodic word contains at least one foot and, as prescribed above, \(\text{Ft}^=\sigma\) ensures this
foot is disyllabic (i.e. [(\(\sigma\sigma\))] but never *[(\(\sigma\))]).

In C-initial words, the primary stress foot is always located at the left edge.
Adopting the generalised alignment schema proposed by McCarthy \& Prince (1993: 18),

\(^{55}\) Considering the fact that the quantitative specification of feet always involves two units, \(\text{Ft}^=\sigma\)
may be regarded not as an informal notation but rather as a formal constraint that replaces \(\text{FtBin}\) and
FOOT-FORM(TROCHAIC). We may assume that feet are phonetic correlations of dependency (i.e.
binary head-dependent) relations, rendering the recurrent binarity an intrinsic nature of feet. Then
types of feet are defined by referring to the level at which dependency relations should hold.
I assume that the foot orientation is determined by the constraint ALIGN-HEAD (abbreviated to ALIGN-H in tableaux) as prescribed below.\(^56\)

(119) ALIGN-HEAD

\[
\text{Align(PrWd, L, Head(PrWd), L)}
\]

This prescribes that the left edge of every prosodic word must coincide with the left edge of a primary stress foot. The assignment of secondary stress requires the foot-parsing of residual syllables from ALIGN-HEAD. This is ensured by the following constraint.

(120) PARSE(\sigma)

All syllables must be parsed into feet.

The following tableau shows stress assignment in 'kutu,\text{j}ula.

\begin{tabular}{|c|l|}
\hline
(121) INPUT: & \text{kutu,\text{j}ula} \\
\hline
\text{ALIGN-H} & \text{PARSE}(\sigma) \\
\hline
(a) & [('kutu)\text{j}ula] \\
(b) & \Leftarrow [('kutu)(,\text{j}ula)] \\
(c) & [('kutu)(\text{j}ula)] \quad (\text{\text{j}ula})! \\
\hline
\end{tabular}

PARSE(\sigma) comes into conflict with FT='\sigma\sigma' in words of three syllables, and this invokes the ranking FT='\sigma\sigma' \succ PARSE(\sigma) as illustrated in the following tableau.\(^57\)

---

\(^56\) McCarthy & Prince (1993: 2) define generalised alignment as follows.

\[
\text{Align(Cat1, Edge1, Cat2, Edge2)} =_{\text{def}} \forall \text{ Cat1 } \equiv \text{ Cat2 such that Edge1 of Cat1 and Edge2 of Cat2 coincide.}
\]

\text{Where}

Cat1, Cat2 \in \text{PCat} \cup \text{GCat}

Edge1, Edge2 \in \{\text{Right, Left}\}

McCarthy & Prince (1995: 371) suggest that anchoring should subsume alignment, but I will not explore the consequences of this reformulation in this thesis.

\(^57\) Strehlow (1942: 301) describes that, in C-initial words of five syllables, secondary stress 'is usually placed on the third syllable or on the fourth'; i.e. [(\'\sigma\sigma)(,\sigma\sigma)\sigma] or [(\'\sigma\sigma)\sigma(,\sigma\sigma)]. However, these words seem to be mostly morphologically complex; this is confirmed by Yallop (1977: 44) with respect to a closely related language, Alyawarra. In reduplication, reduplicants echo their stem; in compounds, each component retains stress (e.g. 'to:tura,tura 'marsupial mole', 'ilpa,gata 'ear' ('ilpa) + 'with' ('gata). Due to a lack of forms that are clearly morphologically simplex, I refrain from discussing the alignment of secondary stress feet.
The constraints $LX \approx PR$ and ALIGN-HEAD do not crucially interact with other constraints, so let us tentatively assume that they are undominated along with $Ft='\sigma\sigma$. The four constraints introduced thus far give the following ranking.

(123) $\{Ft='\sigma\sigma, LX \approx PR, ALIGN-HEAD\} \gg \text{PARSE}(\sigma)^{58}$

The foot structure of C-initial words in Aranda is determined by this constraint hierarchy.

The three facts mentioned at the end of §1.4.1 are derived from $Ft='\sigma\sigma$ and its interaction with the other constraints. I mentioned above that the disyllabic size of minimal words is derived from the coordination of $Ft='\sigma\sigma$ and $LX \approx PR$. Likewise, the coordination of $Ft='\sigma\sigma$ and $\text{PARSE}(\sigma)$ gives rise to alternating strong-weak syllables. The effect of extrametricality can be derived as follows. In words containing an even number of syllables, $Ft='\sigma\sigma$ renders the final syllable the dependent member of a foot; in words containing an odd number of syllables, the dominance relation $Ft='\sigma\sigma \gg \text{PARSE}(\sigma)$ leaves the final syllable unparsed. Hence, a final syllable can never be an optimal foot head, effectively being extrametrical.

Now let us turn to the onset sensitivity manifest in V-initial words such as $i'\etaula$ and $i'lu lama$. I assume that these words are parsed into syllabic trochees, analogous to the foot-parsing of C-initial words but violating ALIGN-HEAD: $[i'(\etaula)], [i'(lu \text{lama}]. *[(i'\etau)\text{la}]$ and $*[(i'lu)\text{lama}]$, which conform to ALIGN-HEAD at the expense of the violation of $Ft='\sigma\sigma$, are rejected because $[(i'lu)\text{lama}]$ cannot outperform $[(i'lu)\text{(lama}]]$ according to $\text{PARSE}(\sigma)$. Therefore, cases of onset sensitivity must be considered to

---

58 The postulation of (123), in which constraints are undominated unless they are forced to be violated, reflects the assumption that constraints should be demoted rather than promoted in acquisition (cf. Tesar & Smolensky 1998). However, the following ranking based on constraint promotion seems as descriptively appropriate as (123).

\{Ft='\sigma\sigma\} \gg \{\text{PARSE}(\sigma), LX \approx PR, ALIGN-HEAD\}

If the hierarchy is to be drawn strictly from phonological evidence, the lack of implications for the ranking of $LX \approx PR/ALIGN-HEAD$ should lead to three parallel scales as follows.

\{Ft='\sigma\sigma\} \gg \{\text{PARSE}(\sigma)\}, \{\{LX \approx PR\}\}, \{\{ALIGN-HEAD\}\}

I leave it open whether any of the above variations gains empirical/theoretical advantages.
involve the violation of **ALIGN-HEAD**. However, the problem is that the constraint hierarchy (123) cannot motivate this violation and thus renders the attested output ill-formed. Instead, it incorrectly selects "*iŋula" as the optimal candidate, as shown in the following tableau.

(124) INPUT: **iŋula**

<table>
<thead>
<tr>
<th></th>
<th>FT='σσ : Lx≈Pr</th>
<th>ALIGN-H</th>
<th>Parse(σ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) [i('ŋula)]</td>
<td></td>
<td></td>
<td>σ</td>
</tr>
<tr>
<td>(b) [i('ŋula)]</td>
<td></td>
<td></td>
<td>i! σ</td>
</tr>
</tbody>
</table>

The four-syllable word "i'ulama" gives a poor performance with respect to **PARSE(σ)** as well as **ALIGN-HEAD**, compared with "*i'ulama".

(125) INPUT: **ilulama**

<table>
<thead>
<tr>
<th></th>
<th>FT='σσ : Lx≈Pr</th>
<th>ALIGN-H</th>
<th>Parse(σ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) [i('ilu)(lama)]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) [i('ilula)ma]</td>
<td></td>
<td></td>
<td>i! σσ</td>
</tr>
</tbody>
</table>

For Eval to select appropriate outputs for V-initial words such as these, it is necessary to identify a constraint that forces the violation of both **ALIGN-HEAD** and **PARSE(σ)**.

I argue, following Takahashi (1994), that this constraint should be related to the assumption that the presence of an onset contributes to the well-formedness of a prosodic domain. Although this assumption has been entertained only with respect to syllables (cf. Footnote 42), it is generalised in the following constraint.

(126) **ONSET(δ)**

A prosodic domain δ must have an onset.

This constraint prescribes that, in much the same way that a syllable is compelled to have an initial consonant, a foot, a prosodic word, etc. may be required to begin with a consonant. I argue that Aranda stress requires **ONSET(Ft)** (abbreviated to **ON-Ft** in tableaux). For the input "ilulama", infixing the foot as in the attested form i('lula)ma is certainly one way of satisfying this constraint; however it can also be satisfied by inserting an initial consonant: [i('□ilu)][(lama)] (□ stands for any prothetic consonant).
In fact, (ʼilu)(lama) is better-formed than i(ʼlula)ma because the former also conforms to ALIGN-HEAD and PARSE(σ). In order to arrive at the correct output, DEP-IO (cf. §3.2.1) needs to dominate ALIGN-HEAD and PARSE(σ). The constraint hierarchy (123) is thus revised as follows.

\[(127) \{\text{ONSET}(Ft), \text{DEP-IO}, Ft='σσ, Lx≈Pr\} \gg \{\text{ALIGN-HEAD, PARSE(σ)}\}\]

The following tableau illustrates the derivation of i'ulama in light of this ranking (DEP-IO is abbreviated to DEP in subsequent tableaux).

\[(128) \text{INPUT: ilulama} \]

<table>
<thead>
<tr>
<th></th>
<th>ON-Ft:</th>
<th>DEP</th>
<th>Ft='σσ</th>
<th>Lx≈Pr</th>
<th>ALIGN-HEADPARSE(σ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>[ʼilu),(lama)]</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td>[ʼilulu),(lama)]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c)</td>
<td>i(ʼlula)ma</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(d)</td>
<td>ilu(ʼlama)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Although ALIGN-HEAD is dominated, it still plays a role in keeping primary stress as close to the left edge as possible.

Onset sensitivity ceases to have an effect for disyllabic V-initial words such as 'ilpa. In order for [(ʼilpa)] to be the optimal output, ONSET(Ft) has to be violated. Therefore, it is necessary this time to seek a constraint that forces its violation. Let us compare the expected output with competing candidates [il(ʼpa)] and [(ʼilpa)] in terms of the constraint hierarchy (127).

\[(129) \text{INPUT: ilpa} \]

<table>
<thead>
<tr>
<th></th>
<th>ON-Ft:</th>
<th>DEP : Ft='σσ</th>
<th>Lx≈Pr</th>
<th>ALIGN-HEADPARSE(σ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>[(ʼilpa)]</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td>il(ʼpa)]</td>
<td></td>
<td>*!</td>
<td>il    σ</td>
</tr>
<tr>
<td>(c)</td>
<td>[ʼilpa)]</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As can be seen in the above tableau, there is no need to resort to a new constraint; it suffices to demote ONSET(Ft) below DEP-IO and Ft='σσ. Note that ONSET(Ft) still needs to dominate ALIGN-HEAD and PARSE(σ), as discussed above. Incorporating the
demotion of ONSET(Ft), (130) presents the complete version of the constraint ranking in Aranda.

(130) \{\text{DEP-IO, Ft} \sim \text{σ}, \text{LX} \approx \text{PR}\} \Rightarrow \{\text{ONSET(Ft)}\} \Rightarrow \{\text{ALIGN-HEAD, PARSE(σ)}\}

The following tableaux confirm that the above constraint hierarchy accounts for the stress assignment of 'ilpa as well as the other example words considered so far.

(131) INPUT: ilpa

<table>
<thead>
<tr>
<th></th>
<th>DEP</th>
<th>Ft=σ</th>
<th>LX≈PR</th>
<th>ON-Ft</th>
<th>ALIGN-HPARSE(σ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>(b)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>il σ</td>
</tr>
<tr>
<td>(c)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

INPUT: injula

<table>
<thead>
<tr>
<th></th>
<th>DEP</th>
<th>Ft=σ</th>
<th>LX≈PR</th>
<th>ON-Ft</th>
<th>ALIGN-HPARSE(σ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*! σ</td>
</tr>
<tr>
<td>(b)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>σ</td>
</tr>
<tr>
<td>(c)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>i σ</td>
</tr>
</tbody>
</table>

INPUT: ilulama

<table>
<thead>
<tr>
<th></th>
<th>DEP</th>
<th>Ft=σ</th>
<th>LX≈PR</th>
<th>ON-Ft</th>
<th>ALIGN-HPARSE(σ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*!</td>
</tr>
<tr>
<td>(b)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>j σσ</td>
</tr>
<tr>
<td>(d)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>j!u σσ</td>
</tr>
</tbody>
</table>

INPUT: tarama

<table>
<thead>
<tr>
<th></th>
<th>DEP</th>
<th>Ft=σ</th>
<th>LX≈PR</th>
<th>ON-Ft</th>
<th>ALIGN-HPARSE(σ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>σ</td>
</tr>
</tbody>
</table>

INPUT: kутuŋula

<table>
<thead>
<tr>
<th></th>
<th>DEP</th>
<th>Ft=σ</th>
<th>LX≈PR</th>
<th>ON-Ft</th>
<th>ALIGN-HPARSE(σ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>σ!σ</td>
</tr>
</tbody>
</table>
According to the proposed analysis, the absence of onset sensitivity in disyllabic V-initial words is also construed as an attempt to improve the relative well-formedness of feet.

In this section, I have shown that the interaction of constraints gives rise to the properties of Aranda stress, putting forward a notion that the presence of an onset contributes to the well-formedness of feet. This notion is implemented as \textsc{Onset(Ft)}, and I have shown that this constraint accounts for onset sensitivity without recourse to the problematic application of phonological weight to the syllable constituent. In the Aranda constraint hierarchy, \textsc{Onset(Ft)} dominates \textsc{Align-Head} and \textsc{Parse(σ)}, on the one hand, and it is dominated by \textsc{Dep-IO} and \text{\textit{Ft}='σσ}, on the other. If \textsc{Onset(Ft)} is ranked lowest than \textsc{Align-Head} and \textsc{Parse(σ)}, the resulting system simply lacks onset sensitivity. On the other hand, if \textsc{Onset(Ft)} is ranked higher than \textsc{Dep-IO} and \text{\textit{Ft}='σσ}, different types of onset sensitivity may well be expected. In this respect, I will explore some typological consequences as regards onset sensitivity to add support for the postulation of \textsc{Onset(Ft)} in the next section.

### 3.4.3 Variations in onset sensitivity

As mentioned in §3.4.1, Alyawarra and Uradhi demonstrate almost the same stress pattern as Aranda except in disyllabic words. The analysis in the previous section shows that, in Aranda, it is more important for a foot to keep the shape of a syllabic trochee than to have an onset (e.g. 'ilpa 'ear'), as expressed by the ranking \textit{Ft='σσ \gg Onset(Ft)}. The opposite preference is observed in Alyawarra (e.g. \textit{i:l'pa 'ear'}) and Uradhi (e.g. \textit{i'pi 'water}). We may well assume that, all else being equal, this state of affairs should stem from the reversed dominance relation \textsc{Onset(Ft)} \gg \textit{Ft='σσ}, as illustrated in the tableau (132) below.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|}
\hline
 & \textsc{Dep-IO, On-Ft; Lx\approx Pr} & \textit{Ft='σσ} & \textsc{Align-H, Parse(σ)} \\
\hline (a) & [('i:lpa)] & *! & \\
(b) & [i:l('pa)] & * & il \textlt; σ \\
\hline
\end{tabular}
\end{table}

Recall that \textit{Ft='σσ} and \text{\textit{Lx\approx Pr}} together constrain the minimal size of a prosodic word in Aranda; the demotion of \textit{Ft='σσ} has the effect of relaxing the restriction. In this regard, Yallop (1977: 28) makes an interesting observation.
Word-initial vowels are invariably unstressed in Alyawarra and initial a- is often dropped before a single consonant or before a sequence of consonants in which the first can become syllabic. ... The borderline between the presence and absence of an initial vowel is by no means clearcut, but it seems that some words never have an initial vowel when spoken in isolation.

Turtle (1977: 48) and Yallop (1977: 142) provide two instances of monosyllabic words: ra 'he/she' and ṇa 'you (sg. nom)'. I assume that, although the low frequency of words such as these still reflects the high ranking of FT=σσ and LX≈PR, the tolerance Alyawarra shows for monosyllabic words, in comparison with Aranda, should stem from the demoted status of FT=σσ. Accordingly, variations across the closely related languages boil down to the difference in the ranking of ONSET(Ft) and FT=σσ.

ONSET(Ft) and DEP-IO interact in Aranda in such a way that the undominated constraint DEP-IO rejects output candidates with prothesis (e.g. /iŋula/ → *'iŋula), compelling the violation of dominated ALIGN-HEAD that results in stress shift (e.g. iŋula). This state of affairs is thus derived from the following dominance relation of the three constraints: {DEP-IO, ONSET(Ft)} ≫ {ALIGN-HEAD} (the ranking of DEP-IO and ONSET(Ft) does not matter as far as the present effect is concerned). Factorial typology should predict instances in which a consonant is inserted to achieve the relative well-formedness of feet. This is indeed the case in Standard German. According to Alber (2000), it differs from Southern Germen in that the former inserts a glottal stop not only before vowels in morpheme-initial position (except in suffixes) (133a), but also before morpheme-internal stressed vowels without an onset consonant (133b). In both dialects, morpheme-internal unstressed vowels without an onset consonant do not trigger the insertion (133c).60

59 Taking the view that Alyawarra, like Aranda, must adhere the disyllabic size of minimal words requirement, an alternative account is to decompose FT=σσ into FTBIN and FOOT-FORM(TROCHAIC), and demote only the latter, leaving the former undominated; Eval then selects [(Ill'pa)] as the optimal candidate. Another alternative is to promote ONSET(Ft) above {Dep, FT=σσ, LX≈PR}.

60 Alber (2000: Footnote 5) notes that secondary stress also triggers glottal stop insertion for many speakers (e.g. Mi.chae.l 'Michael', fO.ze.rn 'ocean'). However, because of the tendency to avoid stress clash, glottal stops are less common in disyllabic words such as Chà.tos 'chaos' and Né.ton 'neon'.
In order for the input /cha.ó.tisch/ to yield the optimal output cha.ó.tisch, \textsc{Dep-Io} must be dominated by \textsc{Onset(Ft)} as well as by an alignment constraint, which prevents stress shift, in Standard German: \{\textsc{Onset(Ft)}, \textsc{Align}\} $\gg$ \{\textsc{Dep-Io}\}.\footnote{Alber proposes that the insertion of a morpheme-initial glottal stop arises from the interaction between \textsc{Contiguity} $\gg$ \textsc{Onset(\textalpha)} $\gg$ \textsc{Dep}. A possible alternative is postulating a constraint such as \textsc{Onset(STEM)}, but this requires the extension of \textsc{Onset(\textdelta)} in (126) beyond prosodic structure. I leave this issue open.}

Alber proposes a constraint \textsc{Onset(stress)}, which prescribes that stressed syllables must have onsets, to account for the above dialectal variations. As far as the cases considered thus far are concerned, \textsc{Onset(Ft)} and \textsc{Onset(stress)} are more or less equivalent. However, I argue that \textsc{Onset(stress)} should be replaced by \textsc{Onset(Ft)} on the grounds that the instantiation of onset sensitivity is not restricted to stress assignment. Below I will claim that Gokana (cf. Hyman 1985: 19ff, Hyman 1990: 176ff), an Ogoni language spoken in Eastern Nigeria, features the ranking \{\textsc{Onset(Ft)}, \textsc{Align}\} $\gg$ \{\textsc{Dep-Io}\} in distributional regularities.

Noun/verb stems in Gokana conform to the template \textsc{C1V(V)(C2)(V)}(V), although \textsc{C1VVC2} and \textsc{C1VVVV} are excluded.\footnote{Although Hyman (1985: 27) employs a slightly different template \textsc{C1V(V)(C2)(V)}, Hyman (1990: 177) mentions that \textsc{CVVCV} and \textsc{CVVV} are possible. As for the ill-formedness of \textsc{CVV}, Hyman (1990: 191) notes he has found \textipa{piobb} 'tsetse fly' and \textipa{biddim} 'fingernail', but no \textsc{CVV} word.} \textsc{C1} and \textsc{C2} exhibit clear difference in terms of the range of contrasts each can support as (134) shows.\footnote{Gokana exhibits the following melodic oppositions (Hyman 1985: 22).}

\begin{center}
\begin{tabular}{lll}
\textsc{Oral consonants} & \textsc{Vowels} & \textsc{Nasal consonants} & \textsc{Vowels} \\
p/b & t/d & k/g/l & \textipa{??} \\
f/v & s/z & kp/gb & (?) \\
i/i & u/u & o/oo & e/e \\
e/e & j/j & i/i & \textipa{s/s} \\
l & \textipa{a/a} & & \textipa{a/a} \\
\hline
\end{tabular}
\end{center}

The melodic property of nasal consonants depends on the presence/absence of a nasal autosegment. See Hyman (1985: Chapter 8) for details.
3 Against the syllable

(134) (a) $C_1$ displays a wide range of melodic oppositions while $C_2$ allows only three consonants.

(i) $C_2 \rightarrow \text{b, l, g} / _#$  
/zoB/ → zob 'chance'  
/kIÎ/ → kil 'go'  
/piG/ → pig 'mix'

(ii) $C_2 \rightarrow \text{v, r, g} / _V$
/tôB-i/ → tôvî 'throw'  
/dâ–Da/ → darâ 'pick up'  
/v'liG-a/ → viigà 'swing'

(b) $C_1$ is obligatory, and a glottal stop is inserted if necessary to ensure its presence.

/ù/ → ʔù 'to die'  
/eG/ → ʔeg 'to go up'  
/ÎG-a/ → ʔigà 'to twist'

Hyman argues that a typical syllable-based analysis cannot account for the environment in which melodic oppositions are neutralised. It would have to assume that $C_2$ is syllabified into a coda position, compelling resyllabification in words such as tôvî, darâ and viigà; however, *viig.à is impossible since Gokana does not permit *C₁VC₂, as mentioned above. He also claims that (134b) cannot be a case of obligatory syllable onsets because the insertion of a glottal stop is not observed internally; e.g. kuùà 'to open (intr.)' → kuuaï '(2 pl.)' *kuua?i.

To account for the asymmetric properties of $C_1$ and $C_2$, Hyman (1990: 179-180) suggests that noun/verb stems should be parsed into the structure shown in (135) (he employs a version of the moraic model in which melodies are exhaustively parsed into morae, or weight units, as described in §2.2.5).

(135)

From the viewpoint that syllable-parsing is not exhaustive (cf. §3.1), he claims that only the initial $C_1V$ constitute a syllable, and that the observed disparity between $C_1$ and $C_2$ stems from the affiliation of the former to this syllable node: only the syllable-licensed consonant may support an extensive inventory of melodic oppositions; and every syllable must have an onset. Although syllables do not have an explicit onset in the moraic model
he employs, it may be inferred from his earlier work (cf. Hyman 1985: 37) that prothesis
is formulated as the rule (136a), which states that a glottal stop is inserted if a mora
dominated by a syllable does not branch; for example, (136b) illustrates the derivation of
/eG/ → ʔeg.

(136) (a)  
(b)  

He also mentions that the syllable may form a foot with the following non-syllabified
morae, without discussing its theoretical motivation.

The specification of both the syllable and the foot in (135) is obviously redundant
because both the syllable and the foot provide the same contextual reference. We can
express the same generalisations as above by referring to feet as follows: only onsets of
feet may support an extensive inventory of melodic oppositions; and every foot must have
an onset. In fact, Hyman (1990: 177-178) refers to the foot-based account of
neutralisation ('foot-C2 can only be /B D G/') as a possibility. Compare the following
representations.

(137) (a)  
(b)  

Hyman's insight into the Gokana phenomena is arguably appropriate, but what concerns
us here is the formalisation of his analysis. Although Hyman argues for non-exhaustive
syllabification (137a) in the above account of Gokana, a foot-based analysis such as the
one mentioned above is not only possible but in fact preferable for the following two
reasons.

First, not only is the assignment of the syllable in (137a) essentially arbitrary, but
also the non-exhaustive syllabification misses an important generalisation. Notice that
the noun/verb stem template CV(V)(C)(V)(V) clearly shows the recurrent disyllabic
pattern that cannot be optimised by the bare sequencing of morae. Hyman upholds the
syllabic non-exhaustivity of Gokana on the grounds that no phenomena in this language
invoke the postulation of exhaustive syllables rather than morae; however, this claim
depends heavily on the particular theory of syllabification in which a domain-final consonant is syllabified as a coda. Let us consider how a theory such as this syllabifies the CV sequences yielded by the template C\_1V\_2(V\_3)(C\_4)(V\_5)(V\_6).

\[(138) \quad C\_1V\_2\]
\[\quad C\_1V\_2V\_3 \quad C\_1V\_2C\_4 \quad C\_1V\_2 \cdot V\_5/6\]
\[\quad *C\_1V\_2V\_3C\_4 \quad C\_1V\_2V\_3 \cdot V\_5/6 \quad C\_1V\_2 \cdot C\_4V\_5/6 \quad *C\_1V\_2 \cdot V\_5V\_6\]
\[\quad C\_1V\_2V\_3 \cdot C\_4V\_5/6 \quad *C\_1V\_2V\_3 \cdot V\_5V\_6 \quad C\_1V\_2 \cdot C\_4V\_5V\_6\]
\[\quad C\_1V\_2V\_3 \cdot C\_4V\_5V\_6\]

Given that the absence of CV.VV and CVV.VV is due to the general process of vowel geminate shortening that applies in postvocalic position (VV \rightarrow V / V__) (cf. Hyman 1990: 178), it seems that the legitimate sequences contain only well-formed syllables CV, CVV and CVC, the lack of *CVVC being accounted for by stating that superheavy syllables are prohibited. Still, the template cannot be simplified as \(o(o)\) because of the restricted distribution of a coda; it is permitted in the monosyllabic stem CVC but prohibited in disyllabic stems such as *CV.CVC.

However, the licensing model, empowered by the theory of empty categories (cf. §3.2.2), can draw a generalisation rather straightforwardly (cf. Kaye 1990: 323). Suppose the following parameter settings characterise Gokana syllabic structure: (a) only nuclei branch; and (b) a domain-final empty nucleus is licensed. The first condition entails that representations comprise only (139ab), excluding (139cd).

\[(139) \quad (a) \quad O \quad (b) \quad R \quad (c) \quad *O \quad (d) \quad *R\]
\[\quad x \quad x(x) \quad x \quad x \quad x \quad x\]

Given that the first CV is obligatory and stems are maximally disyllabic, the combination of (139ab) generates the following structures (representations are simplified; the sequences CV.VV and CVV.VV are omitted).
The nine legitimate sequences are included in this inventory, so all we have to do is to account for the absence of CVV.C0; this is not a superheavy syllable in the model. According to Kaye (1995: 299-300), S. Yoshida (1992) proposes that government licensing (cf. 3.2.2) should be generalised to apply to branching nuclei. Kaye illustrates this proposal with the vowel length alternation in Yawelmani: ?a:milhin 'helped' ~ ?amlit 'was helped'.

In the above representations, [i] indicates the phonetic interpretation of an empty nucleus that results from the failure of proper government. The first nucleus is branching in both configurations, but the dependent position can be governed only when the head position is government-licensed by virtue of being properly governed by the following nucleus. By the same token, I assume that the first syllable in CVV.C0 cannot branch in Gokana.
because it is not government licensed, effectively giving rise to an event called closed syllable shortening, as shown below.

\[(142)\]

Consequently, the shapes of noun/verb stems in Gokana can be defined simply as the maximally disyllabic template \(\sigma(\sigma)\) without further stipulation specific to Gokana. This prosodic template is arguably preferred to the segmental template \(CV(V)(C)(V)(V)\), and, given this advantage, I argue that Gokana is analysed on the basis of exhaustive syllabification of the sort already seen in the above licensing model. It thus becomes untenable to account for the asymmetrical behaviour of \(C_1\) and \(C_2\) in terms of the partial syllable parsing in (137a).

The second argument for adopting the foot-based analysis in (137b) is that it can capture the contrastive properties of \(C_1\) and \(C_2\) more adequately in relational terms. The non-exhaustive assignment of syllables in (137a) implies that syllabicity is a property that individual morae may or may not have. In this view, the presence of syllabic morae is expected to be independent of the presence of non-syllabic morae, yet this does not seem to be the case. Hyman discusses other languages that are allegedly subject to non-exhaustive syllable parsing, but it appears that no two contiguous morae ever bear syllables. This state of affairs indicates the necessity of the notion of foot, giving rise to redundancy as observed in (135). Note that the reverse is not true. The foot-based representation (137b) would not necessarily require any specific reference to the initial syllable. The obligatory onset does not have to be regarded as the property of foot-initial syllables now that we have postulated ONSET(Ft). As regards neutralisation, it is particularly instructive that Harris (1994: 205ff, 1997) shows that the notion of foot-internal position as the neutralising context can be generalised under the following constraint on licensing relations.

\[(143)\] Licensing Inheritance

A licensed position inherits its a-licensing potential from its licensor.
Recall that a-licensing is a structural dependency relation in which a position sanctions the presence of phonological primes (cf. §2.5.3); a-licensing potential, according to Harris (1997: 340), is 'the position's ability either (i) to directly a-license a melodic unit or (ii) to confer a-licensing potential on another position'. Therefore, a position with a greater a-licensing potential is capable of supporting a richer inventory of melodic oppositions. In a disyllabic foot such as (144a), which is represented in the licensing model and applies to all examples of neutralisation in (134a), positions enter into the licensing relations illustrated in (144b).

(Licensing Inheritance prescribes that $x_2$ provides all the a-licensing potential discharged in this domain. Harris argues that the potential granted to other positions is diminished as a function of the distance of licensing paths from the source, assuming that some stock of a-licensing potential is discharged at every instance of its retrieval. Since an inventory of melodic oppositions is in a direct correlation with the amount of a-licensing potential, $x_3$ displays a more limited distribution than $x_1$ in (144b). By extension, neutralisation, or a restricted capacity for supporting melodic oppositions, is construed as a characteristic of prosodic dependency. In the Gokana stem template, the initial $C_1V$ invokes the status of head, as is borne out by its obligatory presence, while $C_2V$ can be taken as a dependent of this head. A domain designated by a dependency relation such as this is adequately encapsulated by the notion of foot, as argued by Harris (1997, 1999) with a demonstrative analysis of neutralisation in Ibibio, a Lower Cross language of the same Benue-Congo family.

Given the above arguments, I claim that neutralisation and prothesis in Gokana both stem from the requirement that feet must be well-formed. In neutralisation, prosodic dependency relations are optimised in accordance with Licensing Inheritance. The prothesis of a glottal stop achieves the well-formedness prescribed by $\text{ONSET}(Ft)$, which crucially dominates $\text{DEP-IO}$ in Gokana to prevent a candidate such as *ìgà from becoming optimal. Note that, in a disyllabic word such as this, $\text{ONSET}(Ft)$ can be satisfied by infixing the foot: *[ì(ɡà)]. As mentioned with respect to the case of Standard
German, an alignment constraint, which I tentatively assume is \( \text{ALIGN} \text{(PrWD, L, FT, L)} \), also needs to dominate \( \text{DEP-IO} \). The following tableau illustrates prothesis in Gokana.

(145) INPUT: \( iGa \)

<table>
<thead>
<tr>
<th></th>
<th>ON-FT</th>
<th>ALIGN</th>
<th>DEP</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>((i\text{gà}))</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td>((?i\text{gà}))</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>(c)</td>
<td>(i(\text{gà}))</td>
<td>!</td>
<td></td>
</tr>
</tbody>
</table>

Gokana mirrors Standard German with respect to the insertion of a glottal stop in foot-initial position, the only difference being the primary phonetic correlation of feet: stress (Standard German) or distributional regularities (Gokana). This raises the question of whether there is a language that mirrors Aranda in much the same way; that is, feet correspond to a domain of neutralisation like Gokana but are ensured to have an onset by infixation like Aranda by the ranking \( \{\text{DEP-IO, ONSET(FT)}\} \gg \{\text{ALIGN}\} \). Efik (cf. Cook 1969, Cook 1985, cited in Hyman 1990: 180ff), a Lower-Cross language of Eastern Nigeria, fits this profile.

Efik shows regularities in consonant distribution similar to Gokana in the following sequences, which are designated as feet by Hyman.

(146) \( C_1(G)V_1 \quad C_1(G)V_1C_2 \quad C_1(G)V_1C_2V_2 \)

While \( C_1 \) enjoys a large inventory of melodic oppositions, \( C_2 \) is restricted to \( /B \ D \ G \ m \ n \eta/ \). \( /B \ D \ G/ \) are phonetically interpreted as voiceless consonants (p t k) in final position and as 'taps' (b r y) in intervocalic position as shown below (subsequent data is taken from Hyman 1990).

(147) (a) \( b\dot{\text{o}} \) 'receive' \quad \( \text{dè} \) 'sleep' \quad \( \text{tô} \) 'hit; plant'

(b) \( s\acute{\text{p}} \) 'be quick' \quad \( \text{yèt} \) 'wash' \quad \( t\grave{\text{k}} \) 'urinate'

(c) \( s\dot{\text{b}}\dot{\text{b}} \) 'be sold quickly' \quad \( \text{yèrè} \) 'wash oneself' \quad \( t\grave{\text{y}}\grave{\text{y}} \) 'pour out'

In addition to the neutralisation described above, a foot is characterised by the phonetic interpretation of high vowels in \( V_1 \) position: \( /i/ \) and \( /u/ \) are centralised to \( \text{i} \) and \( \text{u} \), respectively, when followed by \( C_2 \).
Given that feet are indicated by both the foot-internal phenomena pertaining to \( V_1 \) and \( C_2 \), it is interesting to note that, in vowel-initial words, the first intervocalic consonants are not subject to neutralisation (149a), and furthermore, the initial vowels do not undergo high vowel centralisation (149b).

\[
\begin{align*}
(149) \quad (a) & \quad \text{ébót} & \text{'goat'} & \quad \text{étó} & \text{'tree'} & \quad \text{éró} \\
& \quad \text{édèt} & \text{'tooth'} & \quad \text{íkót} & \text{'bush'} & \quad \text{íyót} \\
(b) & \quad \text{idèt} & \text{'hair'} & \quad \text{íkpó} & \text{'funeral'} & \quad \text{íkpó} \\
& \quad \text{úfɔk} & \text{'house'} & \quad \text{úkóm} & \text{'stop'} & \quad \text{úkóm}
\end{align*}
\]

Instead, the distributional restriction applies to the second consonant if any. This is more evident in (150), in which \( t \) and \( k \) are observed to alternate with \( r \) and \( y \), respectively. Furthermore, it is the second vowel that is centralised if it is a high vowel. The first example below is a case in point.

\[
\begin{align*}
(150) \quad \text{éfít} & \text{'fifteen'} & \quad \text{éfír è nàŋ} & \text{'nineteen (fifteen plus four)'} \\
& \quad \text{úfɔk} & \text{'house'} & \quad \text{úfɔɣ ibà} & \text{'two houses'}
\end{align*}
\]

This state of affairs indicates that the initial vowel and the following consonant do not occupy \( V_1 \) and \( C_2 \) positions. Hyman analyses this state of affairs by positing a syllable node dominating the first \( CV \) in an analogous way to Gokana. In Efik, he also suggests that a consonant following the first \( CV \) should be syllabified into this syllable, attributing neutralisation to the property of syllabic coda. The syllabification is implemented as follows.

---

\(^{64}\) Hyman (1990: 183) states that an initial vowel is 'frequently not identifiable as a prefix'. I thus assume that the words in (149) are not morphologically analytic.
(151) Efik syllabification (Hyman 1990: 183)

(a) Mark a domain-initial V as extraprosodic.
(b) Form a single maximal syllable on the left edge of the domain (maximal syllable: CGVC).

Below is an illustration of this proposal with sibɛ and ɛfɨt (tones are omitted).

\[
\begin{array}{c}
\text{Rule (a)} \\
\text{N/A} \\
\text{Rule (b)} \\
\end{array}
\]

As I have already discussed the problem of non-exhaustive syllabification, here I only point to the fact that the proposed analysis fails to give a unified account of essentially the same distributional regularities in Gokana and Efik. The presence of C₁ is forced by syllable well-formedness in Gokana but by extrametricality in Efik: the disparity in distributional inventories arises between syllable-licensed consonants and unsyllabified ones in Gokana, but between syllable onsets and syllable codas in Efik.

In (151a), initial extrametricality is invoked in a way which is reminiscent of Davis (1988) (cf. §3.4.1). Indeed, Efik demonstrates the same type of onset sensitivity as Aranda does: feet must have an onset, and this is ensured not by prothesis but by shifting feet inward if necessary. In terms of constraint ranking, ALIGN is crucially dominated by ONSET(FT) and DEP-IO.

(153) (a) INPUT: ɛfɨD

<table>
<thead>
<tr>
<th></th>
<th>DEP</th>
<th>ON-FT</th>
<th>ALIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>[(ɛfɨt)]</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td>[ɛfɨt]</td>
<td></td>
<td>é!</td>
</tr>
<tr>
<td>(c)</td>
<td>[(□ɛfɨt)]</td>
<td>□!</td>
<td></td>
</tr>
</tbody>
</table>
I assume that neutralisation is derived from the same mechanism described with respect to Gokana: Licensing Inheritance has the effect of restricting the inventory of melodic oppositions in foot-internal position.

This section has presented some typological variations relating to the postulation of \textsc{Onset(Ft)}. On the one hand, I have discussed the factorial typology involving four constraints: \textsc{Onset(Ft)}, \textsc{Ft}=$\sigma\sigma$, \textsc{Dep-IO} and \textsc{Align}. On the other hand, based on the view that feet correspond to a domain of distributional regularities, which is formalised by Harris under Licensing Inheritance \citenum{Harris1993}, I have also shown how the same type of onset sensitivity may manifest itself in apparently different guises such as stress and neutralisation. A summary is provided below.

\begin{equation}
\begin{aligned}
(154) (a) & \{\textsc{Ft}=$\sigma\sigma}\} \gg \{\textsc{Onset(Ft)}\} : \text{Aranda} \\
& \{\textsc{Onset(Ft)}\} \gg \{\textsc{Ft}=$\sigma\sigma}\} : \text{Alyawarra, Uradhi}
\end{aligned}
\end{equation}

\begin{table}[h]
\begin{center}
\begin{tabular}{|c|c|c|}
\hline
 & Stress & Neutralisation \\
\hline
\{\textsc{Onset(Ft)}, \textsc{Dep-IO}\} $\gg$ \{\textsc{Align}\} & Aranda & Efik \\
\{\textsc{Onset(Ft)}, \textsc{Align}\} $\gg$ \{\textsc{Dep-IO}\} & Standard German & Gokana \\
\hline
\end{tabular}
\end{center}
\end{table}

The above discussion is far from complete, however. For example, I have left open the issue of which variations are expected from the interaction between \textsc{Onset(Ft)} and another faithfulness constraint, \textsc{Max-IO}. It also remains to be clarified how \textsc{Onset(\delta)} is instantiated with respect to other prosodic domains (prosodic words or higher domains pertaining to intonation). These are questions that need to be investigated in future research.

### 3.4.4 \textsc{Onset(Ft)} explicated: Goedemans (1996) and Downing (1998)

On the basis of \citenum{Takahashi1994}, I have been arguing that a constraint on the well-formedness of feet plays a crucial role in the analysis of Aranda stress. Similar Optimality Theoretic analyses are independently put forward by Goedemans (1996) and Downing (1998). The three proposals all share the concept that onset sensitivity should be construed as pertaining to the well-formedness of feet; nevertheless, they differ considerably in their implementation of the concept in question. This section discusses their theoretical implications, arguing for the \textsc{Onset(Ft)} analysis.
3 Against the syllable

3.4.4.1 Goedemans (1996)

Goedemans (1996: 43) formulates the relevant constraint based on the generalised alignment schema. McCarthy & Prince (1993: 20) suggest that ONSET and *CODA can be reformulated as ALIGN(σ, L, C, L) and ALIGN(σ, R, V, R), respectively. Goedemans develops this view and proposes ALIGN(Ft, L, C), which asserts that every foot must begin with a consonant. Although this constraint can replace ONSET(Ft) of the analysis put forward in the previous section without causing any loss of descriptive adequacy, the suggested adaptation of alignment is untenable on the following two counts.

First, in connection with the reformulation of ONSET and *CODA, McCarthy & Prince (1993: 21) note that 'Unlike the prosodic constraints ... [ALIGN(σ, L, C, L) and ALIGN(σ, R, V, R)] show a distinct lack of free combination of argument-settings'. The severely restricted choice of the arguments seems to render ALIGN(σ, L, C, L) no more than a notational variant of ONSET. Considering common practice in Optimality Theory to employ the moraic model of syllabic structure that accords no formal status to 'onset', it may be deemed beneficial to formalise the apparently illegitimate constraint in terms of the generalised alignment schema. Yet, the suggested reformulation obviously leads to overgeneralisations. If the argument-settings have to be fixed without any intrinsic reasoning, I assume this to be a strong indication that the reformulation is not appropriate here. That is, neither ONSET nor *CODA should be subsumed under the notion of alignment. Note that the state of affairs does not improve even if we reformulate ONSET and *CODA into anti-alignment constraints such as *ALIGN(σ, L, μ, L) (cf. Downing 1998: 12), which reads 'the left edge of syllables must not coincide with the left edge of any mora'. On the contrary, if the alignment schema is indeed generalised, then allowing the formulation of anti-alignment constraints immediately expands the number of possible permutations — and the number of cases with fixed argument-settings — resulting in the loss of insights offered by the original proposal of the schema. The same goes for ALIGN(Ft, L, C). Goedemans omits the last argument that specifies the edge of a bare consonant since it is always the same as the first edge-argument. This appears sensible but, in fact, the first edge-argument is also predictable because ALIGN(Ft, R, C) is rendered impossible by the fixed argument-settings; Goedemans (1996: 43) assumes that, like the alignment version of *CODA, only vowels may align to the right edge of feet: ALIGN(Ft, R, V). Leaving out both the predictable arguments, the resulting constraint is ALIGN(Ft, C), on which the generalised alignment schema has little bearing.

Second, McCarthy & Prince (1993) repeatedly refer to ONSET and *CODA as 'purely prosodic' constraints. This must be true as regards ALIGN(Ft, L, C), too. It then seems
inappropriate to define these constraints by referring to a bare segment C. Furthermore, the definition of the generalised alignment (cf. Footnote 56) restricts the categories of arguments to PCat (i.e. prosodic) and MCat (i.e. morphological/syntactic), so a consonant cannot be a legitimate argument. For that matter, given no independent categorial entity such as 'consonant' in the formal sense, it is not clear what phonological object is being referred to by C. If it is meant to stand for a root node or a set of particular features, this immediately opens the way for postulating a number of different Cs to be used in the constraint schema by permuting featural specification. This problem stemming from the argument C must be another indication that one should seek a schema other than alignment to formalise the concept in question.

3.4.4.2 Downing (1998)

While Goedemans' proposal crucially depends on the reformulation of Onset in the generalised alignment schema, Downing (1998: 24ff) proposes a constraint on the relevant well-formedness by adopting the notion of constraint conjunction (cf. Steriade 1995, Hewitt & Crowhurst 1996). According to this notion, two constraints sharing (at least) one argument C1(α) and C2(α, β) are conjoined to define an independently rankable constraint C1(α)∧C2(α, β); this constraint prescribes that the conjoined constraints need to be simultaneously satisfied with respect to the shared 'focus' argument α. In order to account for onset sensitivity in Aranda and Alyawarra, Downing claims that two alignment constraints are respectively conjoined with Onset(σ) to form new constraints in which σ is the focus argument, as shown below.65

(155) (a)  Onset∧Alignσ

Onset(σ)∧Align(Prwd, L, σ, L): the left edge of all prosodic words must coincide with the left edge of some syllable with an onset (Downing 1998: 32).

(b)  Onset∧AlignFT-σ

Onset(σ)∧Align(FT, L, σ, L): the left edge of all feet must coincide with the left edge of some syllable (Downing 1998: 38).

---

65 Downing (1998) claims that Onset is formally an anti-alignment constraint *Align(σ, L, µ, L). Although this reformulation is problematic as mentioned earlier, this does not affect the issue at hand, so I use Onset(σ) in the present discussion.
3 Against the syllable

With the additional constraints listed in (156), the difference between Alyawarra and Aranda is accounted for as illustrated in (157) and (158).

(156) (a) **MIN**
    **Prosodic Word Minimality**: words can be no smaller than 2 units
    (Downing 1998: 34).
(b) **MAX M-P**
    Every element of the M-Stem (i.e. the stem of the morphological constituent)
    has a correspondent in the P-Stem (i.e. the stem of the morpho-prosodic
(c) **BIN**
    Foot Binality (cf. §3.2.1)
(d) **ALIGNFT**
    Align(Ft, L, PrWd, L): The left edge of each foot must coincide with the left
    edge of some prosodic word.

(157) Aranda

(a) **INPUT: iŋula**

<table>
<thead>
<tr>
<th></th>
<th>MIN</th>
<th>ONSET ∧ ALIGN</th>
<th>MAX M-P; BIN</th>
<th>ONSET ∧ ALIGNFT-σ</th>
<th>PARSEμ</th>
<th>ALIGNFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>*</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ii)</td>
<td></td>
<td>ONSET!</td>
<td>ONSET</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(iii)</td>
<td></td>
<td>ONSET!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(b) **INPUT: ilpa**

<table>
<thead>
<tr>
<th></th>
<th>MIN</th>
<th>ONSET ∧ ALIGN</th>
<th>MAX M-P; BIN</th>
<th>ONSET ∧ ALIGNFT-σ</th>
<th>PARSEμ</th>
<th>ALIGNFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ii)</td>
<td></td>
<td>ONSET</td>
<td>ONSET</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(iii)</td>
<td></td>
<td>ONSET</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

vocabulary such as 'stem' and 'root' is inappropriate to define domains to which phonological
processes apply. However, it is not clear how the P-Stem is defined in Aranda/Alyawarra stress, in
which the notion of stem as a phonological domain does not seem to be invoked in the first place.
(158) Alyawarra

(a) INPUT: i:lpi\(\text{la}\)

<table>
<thead>
<tr>
<th></th>
<th>MIN</th>
<th>ONSET &amp; ALIGN(\sigma)</th>
<th>ONSET &amp; ALIGN(\text{FT-}\sigma)</th>
<th>MAX M-P: Bin</th>
<th>PARSE(\mu)</th>
<th>ALIGN(\text{FT})</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>i:l(l('pila))</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(ii)</td>
<td>l('i:lpi)la</td>
<td>ONSET!</td>
<td>ONSET</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(iii)</td>
<td>i:l('pila)</td>
<td>ONSET!</td>
<td>ONSET</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

(b) INPUT: i:lpa

<table>
<thead>
<tr>
<th></th>
<th>MIN</th>
<th>ONSET &amp; ALIGN(\sigma)</th>
<th>ONSET &amp; ALIGN(\text{FT-}\sigma)</th>
<th>MAX M-P: Bin</th>
<th>PARSE(\mu)</th>
<th>ALIGN(\text{FT})</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>i:l(l('pa))</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(ii)</td>
<td>l('i:lpa)</td>
<td>ONSET!</td>
<td>ONSET</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(iii)</td>
<td>i:l('pa)</td>
<td>ONSET</td>
<td>ONSET</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

The above analysis contains redundancy. In (158ab), for example, the different states of alignment between the M-Stem and the P-Stem are crucial to distinguish i:l(l('pila)) from *i:l(l('pila)) as well as [i:l('pa) from *i:l(l('pa)), but it is neither reported nor claimed to have any bearing on phonetic interpretation. That is, [i:l(\text{ and i:l(\ are phonetically identical, so the selection of the optimal outputs depends heavily on the theory-internal notion of well-formedness. However, an alternative analysis is possible without recourse to the alleged crucial constraint ONSET \& ALIGN\(\sigma\), as shown below.

(159) Aranda

(a) INPUT: i\(\text{ju}\)la

<table>
<thead>
<tr>
<th></th>
<th>MIN</th>
<th>ONSET &amp; ALIGN(\sigma)</th>
<th>MAX M-P: Bin</th>
<th>ONSET &amp; ALIGN(\text{FT-}\sigma)</th>
<th>PARSE(\mu)</th>
<th>ALIGN(\text{FT})</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>i(l('\text{ju}la))</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(ii)</td>
<td>l('i\text{ju}la)</td>
<td>ONSET</td>
<td>ONSET!</td>
<td>#</td>
<td>#</td>
<td>#</td>
</tr>
<tr>
<td>(iii)</td>
<td>i(l('\text{ju}la))</td>
<td>ONSET</td>
<td>ONSET</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

(b) INPUT: ilpa

<table>
<thead>
<tr>
<th></th>
<th>MIN</th>
<th>ONSET &amp; ALIGN(\sigma)</th>
<th>MAX M-P: Bin</th>
<th>ONSET &amp; ALIGN(\text{FT-}\sigma)</th>
<th>PARSE(\mu)</th>
<th>ALIGN(\text{FT})</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>il(l('pa))</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(ii)</td>
<td>l('ilpa)</td>
<td>ONSET</td>
<td>ONSET</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(iii)</td>
<td>il('pa)</td>
<td>ONSET</td>
<td>ONSET!</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>
(160) Alyawarra

(a) INPUT: i:lpa

<table>
<thead>
<tr>
<th></th>
<th>MIN</th>
<th>ONSET ∩ ALIGNσ</th>
<th>ONSET ∩ ALIGNFt-σ</th>
<th>MAX M-P: Bin</th>
<th>PARSEμ</th>
<th>ALIGNFt</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) i:l[('pa)]</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ii) [i:l][('pa)]</td>
<td>ONSET</td>
<td>ONSET!</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(iii) ⇨ i:l[('pa)]</td>
<td>ONSET</td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

(b) INPUT: i:lpa

<table>
<thead>
<tr>
<th></th>
<th>MIN</th>
<th>ONSET ∩ ALIGNσ</th>
<th>ONSET ∩ ALIGNFt-σ</th>
<th>MAX M-P: Bin</th>
<th>PARSEμ</th>
<th>ALIGNFt</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) i:l[('pa)]</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ii) [i:l][('pa)]</td>
<td>ONSET</td>
<td>ONSET!</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(iii) ⇨ i:l[('pa)]</td>
<td>ONSET</td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

In light of the assumption that M-Stem≈P-Stem (morphological constituents must correspond to morpho-phonological ones) is 'default' (Downing 1998: 12), the alternative analysis is in fact more plausible because the optimal candidates all conform to Max M-P. Considering that the constraint hierarchy without ONSET ∩ ALIGNσ is also applicable to C-initial words, I will exclude this constraint from consideration, focusing only on ONSET ∩ ALIGNFt-σ in the present discussion.

Although ONSET ∩ ALIGNFt-σ prescribes the same structural well-formedness as ONSET(Ft) does, Downing (1998: 40ff) rejects the latter for the following two reasons. First, she claims that the constraint in question is compositional in nature, as is adequately expressed by ONSET ∩ ALIGNFt-σ; it is thus redundant to postulate a single constraint ONSET(Ft) along with ONSET and ALIGNFt-σ. Second, output candidates conforming to ONSET(Ft) always satisfy ALIGNFt-σ but this relation must be only epiphenomenal because the two constraints are formally independent; on the other hand, the constraint conjunction analysis can explicitly show that the conformity to ALIGNFt-σ is a necessary condition for the satisfaction of ONSET ∩ ALIGNFt-σ. I will claim that neither of these arguments is tenable.

Let me first discuss the compositionality argument. Downing assumes that the constraint in question requires feet to begin with a syllable with an onset, and that this should be construed as cumulatively enhancing structural well-formedness by satisfying the following two constraints simultaneously: (a) a foot optimally begins with a syllable (ALIGNFt-σ); and (b) a syllable optimally begins with an onset (ONSET). She claims that
not only is the postulation of ONSET(Ft) redundant because the relevant constraint can be derived by exploiting the existing constraints by conjunction, but also ONSET(Ft) fails to reflect the state of affairs that feet are required to begin with an optimal syllable rather than with a bare consonant.

This argument cannot hold for the following two reasons. First, if it were truly the case that the constraint in question is compositional in the way suggested, we may well expect to find parallel cases that call for conjunct constraints such as *CODA ∧ ALIGNFt-σ (a foot is required to begin with an open syllable) and *COMPLEX ∧ ALIGNFt-σ (a foot must begin with a core CV syllable). Although constraints such as these would improve the well-formedness of foot-initial syllables in much the same way as ONSET ∧ ALIGNFt-σ does, they do not seem to be attested in any language. Therefore, recourse to constraint conjunction leads to problems of overgeneralisation.

The second reason for the rejection of the argument is related to the notion of constraint conjunction per se, which supposedly parallels logical conjunction as shown below (Downing 1998: 26).

(161) (a) Logical conjunction
(b) Constraint conjunction

<table>
<thead>
<tr>
<th>Assertion A</th>
<th>Assertion B</th>
<th>Constraint A</th>
<th>Constraint B</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>T</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>T</td>
<td>F</td>
<td>√</td>
<td>*</td>
</tr>
<tr>
<td>F</td>
<td>F</td>
<td>*</td>
<td>√</td>
</tr>
<tr>
<td>F</td>
<td>T</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

ONSET ∧ ALIGNFt-σ, however, does not work in a way analogous to logical conjunction. For example, let us consider the evaluation of ('i:i'pa) and i:l('pa) in the tableau (160b). Even though both candidates contain a syllable without an onset in initial position, only the former incurs the violation of ONSET in ONSET ∧ ALIGNFt-σ.

(162)

<table>
<thead>
<tr>
<th>ONSET</th>
<th>ALIGNFt-σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>('i:i'pa)</td>
<td>*</td>
</tr>
<tr>
<td>i:l('pa)</td>
<td>√</td>
</tr>
</tbody>
</table>

That is, ONSET is evaluated with respect to not every syllable but only the syllable that is involved in the satisfaction of ALIGNFt-σ (i.e. a foot-initial syllable). It then follows that, if ALIGNFt-σ is violated (i.e. if a foot does not begin with a syllable), ONSET is vacuously satisfied because there is no foot-initial syllable. Hence ONSET is active only when
Against the syllable

ALIGNFT-σ is satisfied. Note that the reverse is not true: the result of evaluating ALIGNFT-σ in the conjunct constraint always agrees with that of the independently rankable ALIGNFT-σ. This state of affairs indicates that ONSET ∨ ALIGNFT-σ does not really conjoin the two existing constraints, but rather modifies ONSET so that the scope of its argument is narrowed by ALIGNFT-σ in much the same way as ONSET(Ft) does. Even if this arbitrary interpretation, which certainly cannot be derived via the notion of logical conjunction, can be somehow justified, the acclaimed advantage of constraint 'conjunction' is no longer possible to maintain.

Now let us turn to Downing's second argument: only the conjunct constraint can explicitly demonstrate that the satisfaction of (independently rankable) ALIGNFT-σ is a logical consequence of the compliance with ONSET ∨ ALIGNFT-σ. This argument is unsound on the following two counts. First, in the constraint conjunction analysis, reasoning analogous to logical conjunction does not necessarily hold. For example, as shown in (162), even if ONSET ∨ ALIGNFT-σ is not violated, ONSET may still be violated; note that this is predicted by ONSET(Ft) given that Ft is superordinate to and thus more specific than σ. In this regard, ONSET ∨ ALIGNFT-σ does not particularly enjoy any advantage over ONSET(Ft). Second, and more crucially, the validity of the constraint ALIGNFT-σ, more precisely ALIGN(Ft, L, σ, L), is highly questionable. It should be reasonable to postulate this constraint in light of the generalised alignment schema but, as I argue below, this constraint can never be violated.

In order to make this situation clear, let us first consider how a prosodic word and a foot can be misaligned. Gen is endowed with structural relations of prosodic units that are deemed irrevocable (cf. §3.2.1); the prosodic word is superordinate to the foot, so the edge of PrWd cannot be placed inside a Ft domain. On this premise, the misalignment between a prosodic word and a foot is restricted to the four patterns below.

---

67 This asymmetry seems to arise from an inappropriate choice of the focus argument. Crowhurst & Hewitt (1997: 9ff) argue that 'A constraint's focus is identified by the universally quantified argument', and show that, in terms of *CODA ∨ PARSE(σ) for example, every syllable in candidates is checked for whether it has a coda or not and also for whether it is parsed into a foot or not. In Onset ∨ ALIGNFT-σ, the argument of Onset has universal scope (EVERY syllable must have an onset) but the scope of σ in ALIGNFT-σ is existential; it is Ft that has universal scope (EVERY foot must begin with SOME syllable). It seems that constraints to be conjoined need to share at least one argument with universal scope; therefore, the validity of Onset ∨ ALIGNFT-σ per se is put into question.
(163) Misalignment between PrWd and Ft

(a) the left edges of PrWd and Ft: \([\sigma_1(\sigma) \ast(\sigma[\sigma]]\]

(b) the right edges of PrWd and Ft: \(\sigma_1[\ast(\sigma[\sigma])\]

(c) the left edge of PrWd and the right edge of Ft: \(\sigma_1[\ast(\sigma[\sigma])\]

(d) the right edge of PrWd and the left edge of Ft: \([\sigma_1(\sigma) \ast(\sigma[\sigma])\]

As shown schematically above, the misalignment involves the presence of one or more foot-unparsed syllables between the designated edges.

Following a similar line of thinking, let us now consider the misalignment between a foot and a syllable. Knowing that the former is superordinate to the latter, Gen never generates a structural analysis in which a foot boundary falls inside a syllable. Accordingly, the misalignment is again restricted to four patterns almost identical to (163), the difference being the identity of the phonological objects involved; the boundaries of PrWd and Ft are replaced with those of Ft and \(\sigma\), respectively, and the units separating the designated edges are syllable-unparsed morae and/or bare melodic units. The four patterns are depicted below.

(164) Misalignment between Ft and \(\sigma\)

None of these four structures seems feasible. The problem stemming from these representations concerns the exhaustivity assumption (cf. §2.4.1 and §3.1). Exhaustivity ensures that melodic units are either syllabified (i.e. prosodically licensed by virtue of being incorporated into syllabic structure) and realised phonetically, or unsyllabified and destined to be removed by stray erasure. This assumption is necessary to impose distributional regularities on a string of melodies, but the syllable-unparsed morae and/or segments in (164) are exempt from such a restriction. Considering that stray erasure results in the violation of Max, one might be tempted to posit that exhaustivity is a violable constraint so that (164) can be an optimal structure if this constraint is dominated by Max. This argument holds technically, but hardly gains empirical support. It is
3 Against the syllable

extremely doubtful if any analysis would benefit from the postulation of stranded melodies such as these.

Notice that the structure (164b) is reminiscent of the representation (135) put forward by Hyman to argue for non-exhaustive syllabification in Gokana (cf. §3.4.3). His representation purports to dispense with redundant syllable nodes, but is rejected on the grounds that it misses generalisations. The focus of the present discussion is different, but the representations in (164) are untenable for similar reasons. Legitimising the structures in (164) must entail that some structural well-formedness is achieved by the misalignment of the designated edges; however, a constraint that would induce this state of affairs seems most improbable. The postulation of misalignment is thus unlikely to serve as a generalisation, its effect being only to diminish theoretical restrictiveness. It is not accidental that Downing (1998) includes no analysis in which the violation of ALIGNFt-σ matters at all; this constraint makes no contribution to the explanatory adequacy of her analysis. I claim that ALIGNFt-σ — or any constraint of the shape ALIGN(PCAT, L/R, σ, L/R), for that matter — is utterly superfluous and should be excluded from the inventory of constraints. Consequently, the analysis based on the conjunct constraint ONSET ∧ ALIGNFt-σ is untenable.

3.4.4.3 Takahashi (1994)

In the preceding two sections, I have critically analysed two proposals for implementing the concept that feet optimally begin with an onset. Given the existing constraint ONSET, which requires well-formed syllables to have an onset, it is natural to explore the possibility of exploiting it to attain the relevant constraint. In making an attempt such as this, Goedemans (1996) and Downing (1998) propose analyses couched in the moraic model of syllabic structure, following established practice in Optimality Theory. As shown above, neither of the proposals is tenable, and I assume that their problem stems non-trivially from the choice of syllable theory. In the moraic model, the formal status of ONSET is ambiguous due to the non-existence of the prosodic identity of 'onset', so the extended application of ONSET involves the task of formally characterising this constraint. In this connection, reference to the syllable is indispensable because it is the only prosodic unit that bears a direct structural relation to onset consonants. Goedemans and Downing try to reformulate ONSET in terms of the generalised alignment schema, either by aligning syllables with a non-prosodic unit such as consonant or by disaligning them from a mora, with argument-settings fixed in both cases. This attempt is unsuccessful as discussed above. At this point, a question may well arise as to why a
well-established constraint such as ONSET is so difficult to formally spell out. Downing's analysis does not crucially depend on this problematic reformulation of ONSET. The formal definition of this constraint may remain obscure as long as it prescribes the well-formedness of a syllable with an onset, but ONSET must be conjoined with ALIGNFT-σ to ensure that a foot begins with a well-formed syllable with an onset. Leaving aside the notion of constraint conjunction, the postulation of ALIGNFT-σ causes a major problem for the analysis; here again, a question may well arise as to why an apparently uncontroversial constraint such as ALIGNFT-σ cannot be legitimate.

My answer to these questions is that the difficulties stem from the strategy of drawing generalisations based crucially on the syllable constituent. The analyses presented in §3.4.2 and §3.4.3 do refer to 'syllables' in a general sense, but this particular constituent plays no vital role in the analyses based on ONSET(Ft). For example, I presented an alternative analysis of Gokana in the licensing model which makes no reference to syllables. It should be envisaged that other constraints such as Ft='σσ can be instantiated without referring to syllables, in much the same way that a disyllabic reduplicative template R=σσ can be recaptured in the exocentric mode of representation in §3.3.4. In this regard, it should also be noted that this reinterpretation of constraints does not result in merely seeking notational variants; it allows us to circumvent the problems related to the syllable constituent. This section discusses ONSET(Ft) in the context of a representational theory without syllables, as originally put forward in Takahashi (1994).

Employing a version of the licensing model of syllabic structure, Takahashi (1994: 487) claims that Onset Licensing (cf. §2.5.2) should be revised as a violable constraint equivalent to ONSET in Optimality Theory.

(165) ONSET (in the licensing model)

Every nucleus must p-license an onset.\(^68\)

In the licensing model, the onset is a formal object defined as a prosodic position that acts as a non-nuclear head, so (165) needs no further elaboration. However, note that the definition of ONSET significantly differs from that of Onset Licensing. In fact, the above reformulation gives rise to a problem with respect to exhaustivity implemented in relational terms in the licensing model. Onset Licensing is originally conceived of as an

\(^68\) Takahashi refers to onset as 'prehead', but this difference should not concern us here.
Inviolable universal principle which prevents an unlicensed onset. For example, the configuration (166a) is ill-formed since an onset is not allowed to appear in domain-final position (# indicates a domain boundary); Onset Licensing ensures the presence of an empty nucleus in this context, as shown in (166b).

(166) (a) * 

\[\begin{array}{c}
onset
\end{array}\]

(b) 

The well-formedness prescribed in (165) alone makes no impact on the representation (166a), so I assume in the present discussion that ONSET does not take the place of but is independent of Onset Licensing, retaining the latter in its original formulation.

Generalising ONSET in (165), Takahashi proposes \textsc{Onset}(\delta) in (126), stating that the violation of this constraint may be incurred by nuclei cumulatively at different projections if they do not have an onset. Consider the following configuration.

(167) 

\[\begin{array}{c}
\text{Onset}(\delta)
\end{array}\]

In his adaptation of the licensing model, the disposition of syllabic units indicates their dependency and precedence relations along the vertical and horizontal axes, respectively, in much the same way as vertices in a dependency tree (cf. §2.3.2). \textsc{Onset}(\delta) requires every nucleus at the projection level \delta to p-license an onset that immediately precedes it. Accordingly, in (167), \textsc{Onset}(\delta) forces \textit{N}i and \textit{N}j to p-license an immediately preceding onset; likewise, \textsc{Onset}(\text{Ft}) demands that \textit{N}i p-licenses an onset that immediately precedes \textit{N}i'. The following tableau illustrates the analysis of Aranda stress in this model.\textsuperscript{69}

\textsuperscript{69} Takahashi (1994) proposes a different constraint hierarchy, assuming that secondary stress is also designated at the left edge of prosodic words (cf. Footnote 57).
(168) INPUT: ḯuļula

<table>
<thead>
<tr>
<th>(a)</th>
<th>N₁'</th>
<th>(N₁, N₂)</th>
<th>N₃</th>
<th>DEP: Fₜ = 'σο</th>
<th>Lₓ≈Pr</th>
<th>ON-Ft</th>
<th>ALIGN-HPARSE(σ)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N₁'</td>
<td>N₂'</td>
<td>N₃</td>
<td></td>
<td></td>
<td>N₁'</td>
<td>N₃</td>
</tr>
<tr>
<td></td>
<td>i</td>
<td>u</td>
<td>a</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The initial nucleus N₁ violates ONSET(σ) in both configurations. ONSET(Fₜ), or more precisely ONSET(N₁') in this model, is evaluated with respect to nuclei entering into N' projection; N₁ in (168a) fatally violates this constraint.

As the above example shows, ONSET(Fₜ) prescribes that the head of a foot must p-license an onset. Note that this is somewhat similar, though not equivalent, to Downing's compositionality argument that a foot optimally begins with a syllable which optimally begins with an onset. In the licensing model, the identity of positions is intact regardless of levels of projection according to Structure Preservation (cf. §2.5.4). Therefore, N₁' is construed as the same phonological object as N₁, and it is unnecessary to interpret ONSET(Fₜ) as imposing two different levels of well-formedness (e.g., N₁' must be the projection of N₁, and N₁ must p-license an onset). If N₁ p-licenses an onset, so does N₁'.

From a theory-internal viewpoint, this implementation of ONSET(Fₜ) leaves some indeterminacy. Let us recall the difference between a branching rhyme and a branching nucleus in the licensing model. Given that the rhyme is the maximal projection of the nucleus (cf. §2.5.2), p-licensing a dependent at different levels of projection may entail different structural analyses, as shown in (169ab).

(169) (a) 

By analogy, the structures (170ab) below may well be deemed structurally contrastive.
Note that this does not legitimise a structure such as (171a), which apparently combines (170ab) and corresponds to a case of Ft-σ misalignment (171b) similar to (164a) discussed above, for the same reason that rejects (171c); that is, p-licensing of an onset must comply with Locality in the same way as that of a nucleus/rhyme dependent.

Accordingly, arbitrary adjunction in (171a) can be excluded, but the question remains as to whether the distinctiveness of (170ab) would ever need to be invoked. Given that N and N' are identified as the same phonological object, both configurations are assumed to satisfy Onset(σ) as well as Onset(Ft), in much the same way that (169ab) are both regarded as heavy in terms of phonological weight. However, the structural difference between (170ab), if posited, does not seem to mirror that between (169ab). The rhyme dependent in (169b) is independent of the preceding head in terms of distributional regularities, while the nucleus dependent (169a) tends to display a much more limited range of oppositions than the nucleus head. This kind of asymmetry is unlikely to be found between the structures (170ab). I will return to this problem in §4.4.4.

Despite this indeterminacy, the above analysis enjoys advantages over the other two analyses couched in the moraic model. In the licensing model, Onset can be defined as a 'purely prosodic' constraint, without giving rise to the problem of overgeneralisation that confronts the alignment reformulation. Besides, the relevant constraint to account for onset sensitivity can be stipulated only by allowing this constraint to take an argument that specifies the prosodic domain over which it presides, without recourse to a new theoretical device such as constraint conjunction. Consequently, I claim that the Onset(Ft) analysis couched in the licensing model should be regarded as achieving the highest degree of adequacy among the proposals being compared.
In this section, I have argued that the constraint on the well-formedness of a foot with an onset, which plays a crucial role in the analysis of onset-sensitive phenomena discussed in the previous sections, can be adequately couched in a syllable theory without the syllable constituent. In effect, the proposed constraint $\text{ONSET(FT)}$ 'merely requires the foot to begin with a consonant', as Downing (1998: 41) critically observes, in much the same way that $\text{ONSET(\sigma)}$ requires a 'syllable' to begin with a consonant. In a formal sense, as claimed above, $\text{ONSET(\delta)}$ does not refer to an onset 'consonant' as a phonological object because the exocentric model of syllabic structure recognises the prosodic identity of onset. (Note that this does not necessarily entail that the theory posits an onset constituent; this issue will be discussed in the next chapter.) Apart from this theoretical argument, a somewhat more plausible way of characterising the restriction imposed by $\text{ONSET(\delta)}$ can be entertained, if we take into consideration the phonetic fact that consonant-vowel transitions give rise to the acoustic/auditory salience that provides an efficient cue for listeners to identify the beginning of syllables (cf. Ohala & Kawasaki 1984: 115ff). Because there seems to be no reason that this effect has to be confined to syllable domains, I suggest that $\text{ONSET(\delta)}$ should be conceived of as generally requiring the head of a domain $\delta$ to have a delimiter, which correlates with the salience stemming from CV transitions, to enhance the perceptual intelligibility of the domain. As regards the syllabic domain, then, the delimiter should supplement/enhance the effect of sonority distance (cf. §2.2.2). Likewise, the perceptibility of the foot domain can be amplified by the obligatory presence of CV transitions as well as by other manifestations of phonetic prominence such as stress. Following this line of argument, which is admittedly speculative, I assume that $\text{ONSET(FT)}$ requires not merely a consonant but rather a CV interface that explicitly signals the head of a foot.

### 3.4.5 Excursus: optimising onsets

This section presents some theoretical implications of the hypothesis that the presence of an onset contributes to the marking of the delimiter of a domain. Although I have only discussed cases that refer to the binary distinction between the presence and absence of onsets, the acoustic/auditory salience that derives the delimiter effect is scalar and relative in nature. Let us assume that this fact has relevance in phonology in such a way that certain onsets are capable of phonetically inducing a more salient CV transition that acts as a more robust delimiter. This viewpoint raises the possibility that the well-formedness of an onset per se may matter under certain circumstances. I will sketch below the hypothesis that feet may be required to p-license not simply an onset but possibly an
optimal onset, in which the optimum is construed as the potential to give rise to maximal salience in CV transitions.

The well-formedness of onsets should concern feet rather than syllables, given that a relation of specific to general holds between the onset of a foot and the onset of a syllable. Consider a sequence of two syllabic trochees as schematically shown below.

![Diagram of syllabic trochees](image)

The presence of some delimiter should suffice to indicate the beginning of syllables, but feet may well demand a more salient delimiter to be efficiently distinguished.

In order to meet this demand, the onsets of feet, in cases where optimisation is required, should be able to make a more robust delimiter than those of foot-internal syllables. Given the relative nature of salience, however, there is an alternative way of attaining the same optimisation: the onsets of foot-internal syllables should be less capable of creating a strong delimiter, in order to effectively enhance the efficiency of onsets of feet. I claim that this may provide a suitable approach to an explanation of foot-internal neutralisation. We have already encountered relevant examples from Gokana and Efik (cf. §3.4.3), in which foot-internal onsets show limited melodic oppositions and are thus 'monotonous' compared with foot-initial onsets that demonstrate a wider variety of melodic contrasts. In this case, neutralisation hampers the potential of foot-internal onsets to support a foot delimiter by cutting down the inventory of melodic oppositions. Neutralisation may also deprive foot-internal onsets of their distinctiveness in a more dynamic way. The allophonic alternation of /t/ in American English (cf. Kahn 1976: 68ff) is a case in point. In foot-initial position, /t/ is realised as a voiceless aspirated alveolar stop (e.g. `crea[tʰ]ivity'); elsewhere, /t/ is interpreted as a voiced tap in intervocalic position (e.g. `crea[r]ing') and as a voiceless unaspirated (glottalised) alveolar stop often without audible release in word-final position (e.g. `crea[t]').

These non-foot-initial positions are captured by the same structural description as foot-internal

---

70 I leave aside the controversial matter of s+C clusters.
onsets in the licensing model (cf. Harris 1997: 353); the apparently foot-final consonant is followed by an empty nucleus (i.e. *crea[tʰ0]*). Considering that vowels are normally voiced, */t/ → *r* should create a less distinctive CV transition by diminishing the disparity in voicing between the consonant and a following vowel; *r* also induces a much less abrupt change in acoustic energy in intervocalic position compared with *t*. The reduction or suppression of audible release in */t/ → *t* can be regarded as cancelling one of the acoustic cues for the perception of CV transitions: noise burst.

As discussed in §3.4.3, neutralisation is regarded as a direct consequence of Licensing Inheritance (143), which accords foot-internal onsets depleted a-licensing potential. Harris (1997: 341ff) argues that the amount of a-licensing potential is reflected in the complexity of melodic expressions (cf. §2.5.3); melodic complexity is equated to the number of phonological elements a-licensed by a position. As stated in §2.5.3, elements are monovalent primes which give rise to privative oppositions (cf. Trubetskoy 1969: 75); in the present discussion, I assume a version of Element Theory elaborated on by Lindsey & Harris (1990) and Harris & Lindsey (1995). For example, the neutralisation of */t/ is represented in elemental terms as follows (cf. Lindsey & Harris 1990, angle brackets indicate unparsed elements).

\[(173)(a) \quad \text{t}^h \quad | \quad R \quad ? \quad h \quad |
\]
\[
\text{t}^t \quad | \quad R \quad ? \quad <h>\quad |
\]
\[
\text{r} \quad | \quad R \quad <?> \quad <h>\quad |
\]

The three elements |R|, |?| and |h| correspond phonetically to coronality, occlusion and turbulent noise, respectively. With limited a-licensing potential inherited, foot-internal onsets are driven to suppress elements to reduce melodic complexity. On the other hand, foot-initial onsets tend to enjoy a greater a-licensing capacity, capable of fully supporting complex expressions. Note that foot-initial onsets may a-license a less complex expression than foot-internal ones (e.g. *yacht* in which the initial consonant *j* is the

---

71 Each element is assumed to have the same bearing on melodic complexity. Licensing Inheritance is not selective regarding the choice of elements to be suppressed. However, it does not seem to be accidental that *t* does not appear in foot-internal intervocalic position; intuitively, it is more plausible to suppress audible release before a pause in both articulatory and auditory terms. I leave this issue open.

72 Harris & Lindsey (1995: 49-50) argue convincingly that the phonetic interpretation of elements should be captured primarily in acoustic terms. Strictly adhering to this position, [R] correlates with formant transitions typically associated with coronal gesture, [?] with an abrupt and sustained decrease in acoustic energy, and [h] with aperiodic noise (see figures in Lindsey & Harris 1990).
interpretation a simplex expression \(|l|\), or they can even be empty (e.g. utter). These instances, nevertheless, do not detract from the validity of the above analysis of neutralisation. Licensing Inheritance is a constraint on the distribution of a-licensing potential in a well-formed representation, but does not determine how the potential is discharged in individual instances. Therefore, the constraint would be invalidated only if there existed a language in which the complexity of foot-internal onsets were to categorically exceed that of foot-initial onsets. Following this line of thinking, the optimisation of onsets in terms of Licensing Inheritance confirms that foot-internal onsets a-license a less complex melodic expression that does not phonetically induce an overly robust delimiter, yet it does not necessarily require foot-initial onsets to a-license a melodic expression of some designated degree of complexity.

The onsets of feet, as mentioned above, can be optimised by directly improving their well-formedness. Let us consider this possibility as we maintain the assumption that melodic complexity is at least one measure of the well-formedness of onsets. The optimisation of onsets should then require foot-initial onsets not only to possess a sufficient stock of a-licensing potential but also to exercise the potential to acquire a degree of melodic complexity that has a robust delimiting effect. I will now claim that this provides an appropriate analysis of stress assignment in Pirahá, an Amazonian language, which is sensitive not only to the presence of an onset but also its phonetic content.

According to Everett & Everett (1984: 706), stress in Pirahá falls on one of the last three syllables in accordance with the following 'weight' scale that defines the priority order of syllables in stress assignment (C and G stand for a voiceless and a voiced consonant, respectively).

\[
(174) \text{CVV} > \text{GVV} > \text{VV} > \text{CV} > \text{GV}
\]

The above scale indicates two characteristics of Pirahá stress. On the one hand, stress is quantity sensitive, demonstrating the preference for heavy syllables. On the other hand, stress is also onset sensitive, referring not only to the presence/absence of an onset but also to its qualitative properties: a stress-bearing syllable should have an onset, and
preferably an onset which is voiceless. These characteristics can be observed in the data below, taken from Everett & Everett (1984).

(175) Pirahã stress

(a) ko'po  'cup'  CV.CV
paóhoa'hai  'anaconda'  CVCVV.CV
(b) ?isi'taí  'feather'  CV.CV.CV
?apa'baasi  'square'  CV.CW.GV.CV
   baábi  'bad'  CW.CV
   'giisógi  'turtle'  CV.CV.CV
(c) ?ogi'ai  'big'  CV.CV.CV
?a'aíbi  'thin'  CW.CV.CV
(d) giai'baí  'dog'  GV.CV.GV
   'gaoii  'proper name'  CV.CV.CV
   poo'gái'hiaí  'banana'  CV.CV.CV.CV.CV
(e) kagi'hí  'wasp'  CV.CV.CV
   ti'pogi  'species of bird'  CV.CV.CV
   '?abagi  'toucan'  CV.CV.CV
(f) kosoiig'ai'tai  'eyebrow'  CV.CV.CV.CV.CV
   pa'haibii  'proper name'  CV.CV.CV.CV

In (175a), which lists words comprising syllables of the same shape, stress is assigned to the syllable at the right edge of a word without referring to the scale (174). This default edge orientation should follow from Align(Head(PrWd), R, PrWd, R), which forces all feet to coincide with some prosodic word (ALIGN-H, henceforth). Accordingly, for example, Eval selects paó.hoa.'hai over *'paó.hoa.'hai or *'paó.'hoa.hai.

Stress shifts leftwards if a more suitable landing site in light of the scale (174) is available within the last three syllables. The preference for heavy syllables indicated in (175bc) should invoke the following constraint (176a); as illustrated in the tableau (176b), this constraint must dominate ALIGN-H.

---

73 Everett & Everett (1984: 706-707) report that Pirahã has seven consonant phonemes /p t ?, b g s h/, three vowel phonemes /i a o/ and two (register) tones, high ' and low. Stress, which is independent of tones, primarily correlates with intensity. Everett (1986: 315) describes k as a free variation of the cluster /hi/. It follows that the lexical representation of ko'po, for example, is /hiopo/ (CV.CV), so stress must be assigned in accordance with output representations; this is confirmed by alternations such as bi'l'ai (GVV.CV) ~ 'bil'isi (GVV.CV) 'red'.
(176) (a) 

WSP

Weight-to-Stress Principle: heavy syllables are prominent in foot structure and on the grid. (Prince & Smolensky 2002: 56)

(b) 

INPUT: baábi

<table>
<thead>
<tr>
<th></th>
<th>WSP</th>
<th>ALIGN-H</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>'baá.bi</td>
<td>σ</td>
</tr>
<tr>
<td>(ii)</td>
<td>baá.'bi</td>
<td>*!</td>
</tr>
</tbody>
</table>

Stress assignment in (175d) is onset sensitive. Assuming that Pirahã stress constitutes a head-initial unbounded foot for the reason to be stated shortly, I argue that onset sensitivity should follow from the dominance relation ONSET(Ft) ⇒ ALIGN-H.

WSP and ONSET(Ft) come into conflict in (175c), in which WSP compels the violation of ONSET(Ft); hence, WSP ⇒ ONSET(Ft). The tableau (177) illustrates the interaction of the three constraints.

(177) INPUT: poo'gáihiaí

<table>
<thead>
<tr>
<th></th>
<th>WSP</th>
<th>ON-Ft</th>
<th>ALIGN-H</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>poo.gáí.hi.(ai)</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>(ii)</td>
<td>poo.gáí.(hi.ai)</td>
<td>*!</td>
<td>σσ</td>
</tr>
<tr>
<td>(iii)</td>
<td>≠ poo.(gáí.hi.ai)</td>
<td>σσ</td>
<td></td>
</tr>
</tbody>
</table>

I tentatively assume that 'poo.gáí.hi.ai, a candidate with pre-antepenultimate stress, is ruled out by * lapse (Elenbaas & Kager 1999: 282), which is adapted from the Principle of Rhythmic Alternation (Selkirk 1984b: 52) and effectively bars a sequence of three unstressed syllables.\(^{74}\) However, this constraint is not crucial to the present discussion, so

---

\(^{74}\) Everett (1988) puts forward two competing analyses. One of these is a 'ternarity' analysis, which assigns a ternary foot domain-finally and seeks the first heavy syllable in terms of the weight scale (174) from right to left according to the obligatory (syllable-)branching parameter (cf. Halle & Vergnaud 1978, Hammond 1986). This analysis also needs to stipulate the notion of invisibility (cf. Poser 1986) to deal with the anomalous extrametrical suffix -šáí, which does not concern us here. The other is a 'mixed grid-tree' analysis that assigns a disyllabic foot skipping a domain-final extrametrical syllable (e.g. poo(gáíhí)<ai>), removes extrametricality to derive a ternary domain (e.g. poo(gáíhiaí)), and then applies the End Rule (cf. Prince 1983). Although *LAPSE accommodates a simpler and less problematic account, a problem arises with ko.so.ii.gaí.'tal in (175f), which violates the constraint. We either need to find a way to limit the domain to which *LAPSE is applicable (i.e. syllables after primary stress) or we should seek an alternative constraint. I leave this issue open.
I will take it for granted that primary stress falls within the last three syllables, without incorporating *LAPSE into the constraint hierarchy.

The ranking of constraints in the above tableau is reminiscent of the Aranda constraint hierarchy in that a constraint on the well-formedness of stress bearing units (FT = 1σσ in Aranda, WSP in Pirahā) dominates ONSET(FT), which in turn dominates an alignment constraint. However, Pirahā differs from Aranda in that stress is sensitive to the voicing properties of onset consonants (CV > GV and CVV > GV), as demonstrated in (175ef); descriptively, a voiceless consonant makes an optimal onset. Let me accommodate this notion by allowing the onset constraint to have an optional second argument that causes the onset of a foot to be optimised: ONSET(Ft, OPTIMISE) (OPTON-Ft, henceforth). Here the question arises as to the definition of OPTIMISE and how conformity to this constraint should be evaluated. If the presence of this second argument is regarded as demanding the presence of a specific element (e.g. the voiceless element H), which is the strategy put forward by Davis (1988: 15), permutation generates as many parallel interpretations of this constraint as the number of primes (e.g. an onset is optimised with the nasal element N). Besides, it also obscures the point made above that certain onsets are deemed optimal not by virtue of their own intrinsic properties, but rather, because they can give rise to a salient CV transition into a following vowel. I assume that what makes an onset optimal in Pirahā is not voicelessness but a sufficiently low level of sonority. Although Halle & Vergnaud (1987: 224) also resort to the notion of sonority, regarding the scale (174) rather idiosyncratically as a hierarchy of 'syllable sonority', the assumption being made here is based on the more widely-held view of melodic sonority. Given that vowels are inherently highly sonorous, decreasing the sonority of onsets maximises the sonority distance between them and renders CV transitions more readily perceptible. This assumption gains support from the documented fact that onsets tend to opt for less sonorous consonants. For example, Sanskrit (cf. Steriade 1982: 312ff) derives perfect forms via core-syllable reduplication and, if the base has an initial cluster, it is the less sonorous member that appears in its reduplicant; e.g. tsar → ta-tsar 'to throw', stu → tu-stu 'to praise'. Smith (1973: 165ff) reports that a child learning English tends to simplify initial clusters in a similar way; e.g. stop → dop, play → ber, milk → mik. Adopting the concept that 'sonority increases in inverse

---


76 The similarity in the described patterns of simplification is also pointed out in Brockhaus (1995: 215)
 proportion to segmental complexity' (Harris 1990: 276) in the context of Element Theory, I stipulate for OPTON-Ft that (a) an optimal onset of a foot is required to achieve the level of complexity equated to voicelessness; and that (b) an onset failing to reach this level receives one violation mark; and finally that (c) the entire absence of an onset incurs two violation marks. The analysis in (177) is thus revised as in (178a); the tableau (178b) illustrates a case in which OPTON-Ft is crucial for Eval to select an optimal output.

(178) (a) INPUT: poo'gáíhíaí

<table>
<thead>
<tr>
<th></th>
<th>WSP</th>
<th>OPTON-Ft</th>
<th>ALIGN-H</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>poo.gáí.hi.(‘ai)</td>
<td>#*!</td>
<td></td>
</tr>
<tr>
<td>(ii)</td>
<td>poo.gáí.(‘hi.ai)</td>
<td>*!</td>
<td>σ</td>
</tr>
<tr>
<td>(iii)</td>
<td>*poo.(‘gáí.hi.ai)</td>
<td>#</td>
<td>σσ</td>
</tr>
</tbody>
</table>

(b) INPUT: pa’haibíí

<table>
<thead>
<tr>
<th></th>
<th>WSP</th>
<th>OPTON-Ft</th>
<th>ALIGN-H</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>pa.hai.(‘bií)</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>(ii)</td>
<td>*pøa.(‘hai.bií)</td>
<td></td>
<td>σ</td>
</tr>
<tr>
<td>(iii)</td>
<td>(’pa.hai.bií)</td>
<td>*!</td>
<td>σσ</td>
</tr>
</tbody>
</table>

The evaluation of OPTON-Ft presupposes that voiced stops are more sonorous than voiceless fricatives. It is generally assumed that voiced stops are less sonorous than voiceless fricatives (cf. §2.2.2); however, Everett (1986: 316) reports that the two voiced stops b and g are phonetically interpreted as homorganic nasals initially. I infer from this fact that these voiced stops achieve a considerable degree of sonority that exceeds voiceless fricatives in Pirahã.

Notice that the assigned feet in (178) conform to Licensing Inheritance in light of the obtained constraint hierarchy; no foot-internal rhymes are prosodically more complex (i.e. heavier) than the foot-initial one, and, weight being equal, no foot-internal onsets are more complex than the foot-initial one. Halle & Vergnaud (1987: 225) and Davis (1988: 15) claim that feet are right-headed and unbounded, on the grounds that stress falls on the final syllable by default; e.g. (pa’hoah’ai). Although this difference in the directionality of foot-parsing does not raise any serious empirical problem, I argue that

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77 This stipulation oversimplifies the relation between melodic complexity and sonority, since ʔ and h are defined as simplex expressions despite being voiceless. Still, in the interests of restrictiveness, I will continue to pursue complexity-based analysis here, leaving the problem of the representation of glottal consonants for future research.
the analysis proposed here gains the advantage by generalising foot structure in terms of complexity.

The discussion presented in this section is admittedly speculative in several respects. The proposed analysis of Pirahã stress raises questions, including whether the optimization of onsets is ever invoked for syllables, and how factorial typology finds other types of onset optimization. But the central point should be clear: any evaluation of onsets in prosodic well-formedness must refer not just to presence or absence but also to segmental content.

### 3.5 Summary

In this chapter, I have presented detailed analyses of two phonological phenomena, reduplication and onset sensitive stress, along with discussions of related issues. Although syllables figure prominently in the literature on reduplication, I have shown that this constituent needs to be invoked neither in constraints on the well-formedness of reduplicants nor in descriptions of reduplicated strings in bases. For onset sensitive stress, I have proposed an analysis based on the constraint ONSET(FT), claiming that stress is assigned in such a way that feet, not stress-bearing syllables, become well-formed by virtue of having an initial onset. Crucially, this chapter has indicated that syllables are not only redundant but also rather problematic, and I have claimed that analyses of the above phenomena are most adequately accommodated in the exocentric model of syllabic structure. Let us recall the following configurations compared at the beginning of this chapter.

\[(179) \text{(a)} \quad \text{(b)}\]

I stated that the choice between the two representations is an empirical matter. Now we have reasons to reject (179a): the postulation of a single level of representation for the syllable \(\sigma\) crucially fails to be borne out by any empirical evidence. Consequently, I reject the formal status of the syllable as a constituent and argue for the exocentric mode of
representation, 'syllable' being no more than an informal label in much the same way as 'segment' is.

Note that the rejection of (179a) does not immediately lead to the acceptance of (179b) as it stands. As this chapter has shown, even a widely established object such as the syllable can be entirely discredited on close examination; the same may apply to subsyllabic objects. Indeed, I already mentioned in §2.2.5 that the formal status of the onset constituent, which corresponds to o in (179b), has itself been questioned. The next chapter will discuss constituents in the exocentric model of syllabic structure.

In the previous chapter, the exocentric mode of representation was cast in terms of the licensing model. Implementing this mode of syllable theory is not simply a matter of eliminating syllable nodes from representations: it necessarily involves a commitment to a fully-fledged theory of prosodic relations. Although most template-based models of syllabic structure invoke the notion of head, this notion only seems to connote local properties of a particular unit, such as obligatory presence, stress-bearing capability, sonority peak, and so forth; therefore, they cannot be converted into an exocentric model without stipulations akin to the principles and conditions described in §2.5. Although the dependency model is firmly wedded to a relational view of syllabic structure, it is not readily compatible with the exocentric notion of structure. Therefore, I will employ the licensing model as a basis for my discussion throughout the remainder of this thesis.
4 A farewell to constituency

This chapter explores the desirability and plausibility of eliminating constituents from the representation of syllabic structure. I first discuss the formal status of constituents in the licensing model and claim that no substantive phonological evidence exists to justify them. Then, I propose a syllable theory which defines syllabic structure only in terms of dependency relations between positions without recourse to constituency, by reformulating constraints in the licensing model and by incorporating ideas from the dependency model. This theory is shown to derive syllabic configurations similar to those of the licensing model, but I argue that the proposed model is more restrictive by virtue of its intrinsic capacity to exclude ill-formed representations.

4.1 Introduction

The previous chapter rejected the formal status of the syllable as a syllabic constituent, thereby motivating the use of the licensing model, which is restrictive enough to exclude this constituent. This section first presents an additional argument for this model by demonstrating that it can provide an efficient account of Mokilese progressive reduplication, which is problematic for the moraic model. Then I turn to an examination of the formal status of syllabic constituents in the licensing model and then propose a revised model of syllabic structure without constituents.

In Footnotes 19 and 20 in Chapter 3, I mentioned two problems in connection with the analysis of Mokilese progressive reduplication in the moraic model. One problem pertains to vowel-glide correspondence. In order for the input /RED-alu/ to map to the optimal output allalu, rather than *alwalu, I suggested that w and u should not stand in a correspondence relation because of their different moraic status. However, this entails that the two tokens of /s/ in kaskaso do not correspond to each other (only the first s is moraic), which might call for further stipulation. The other problem is related to the derivation /RED-caak/ → caacaak. The moraic model should require the constraint *COMPLEX(μ) to prevent *caakcaak from becoming optimal, but the application of this
constraint must be limited to the second mora in a bimoraic syllable because the first mora never seems to be allowed to branch in the moraic model.

The licensing model can provide an alternative analysis without these problems. Let us assume that (a) Mokilese is a strict CV language (i.e. no syllabic node branches), and that (b) the reduplicant is a disyllabic foot in which the final nucleus is fixed to be empty (CV.C0). Given these assumptions, allalu is represented as follows.

\[(180)\]

\[
\begin{array}{cccccccc}
\text{O} & \text{O} & \text{O} & \text{O} & \text{O} & \text{N} \\
X_1 & X_2 & X_3 & X_4 & X_5 & X_7 & X_8 \\
a & a & a & u & & & \\
\end{array}
\]

\[
\begin{array}{cccccccc}
\text{O} & \text{O} & \text{O} & \text{N} & \text{N} \\
X_1 & X_2 & X_3 & X_4 & X_5 & X_6 & X_7 & X_8 \\
\emptyset & a & u \\
\end{array}
\]

The dotted association lines indicate the association of reduplicated melodic units. Since \(X_4\) is lexically specified as empty, a correspondent of \(u\) does not appear in this position. The configuration (180) contains three empty positions \(x_1, x_4\) and \(x_5\), which are subject to the Empty Category Principle (cf. §3.2.2). Compare the three licensing patterns below.

\[(181)\]

\[(a) \quad \begin{array}{cccccccc}
\text{O} & \text{O} & \text{O} & \text{O} & \text{O} & \text{N} \\
X_1 & X_2 & X_3 & X_4 & X_5 & X_6 & X_7 & X_8 \\
a & a & \text{I} & a & u \\
\end{array}
\]

\[
\begin{array}{cccccccc}
\text{O} & \text{O} & \text{O} & \text{N} & \text{N} \\
X_1 & X_2 & X_3 & X_4 & X_5 & X_6 & X_7 & X_8 \\
0 & a & u \\
\end{array}
\]

The initial empty onset \(x_1\) can always be properly governed. The empty nucleus \(x_4\) is licensed in (181a) by virtue of being captured within an inter-onset licensing domain. As a result, \(x_4\) is not phonetically realised, and \(x_5\) receives interpretation mirroring \(x_3\), as shown by \(\text{I}\) in (181b). \(x_4\) is licensed by proper government. However, in this case, \(x_5\) cannot be properly licensed, as indicated by *, because no governing domain may appear within a domain of proper government. The unlicensed onset \(x_5\) must be interpreted with some phonetic content that is determined on a language-specific basis; this state of affairs is indicated by the icon \(\text{M}\). If the licensing of \(x_5\) is given priority, it is the nucleus \(x_4\) that

---

\(78\) I assume that the concept of interpretation via 'mirroring' interpretation is implemented by element activation (cf. Backley & Takahashi 1998) which is more restrictive than spreading. (See also Backley 1998, Nasukawa 2000 for discussions.)
receives phonetic interpretation, as shown in (181c). Based on this comparison, I propose that Mokilese prohibits the presence of unlicensed empty positions receiving phonetic interpretation: i.e. empty nuclei must be licensed in accordance with the Empty Category Principle. Given that the interpretation allalu results from the analysis (181a), consider the derivation /RED-kaso/ → kaskaso.

(182)

Unlike the case of /RED-alu/, in which inter-onset licensing offers a better licensing solution than proper government for the licensing of the reduplicant-final empty nucleus, proper government can readily handle the empty nucleus x₄ in (182). In fact, to enforce inter-onset licensing in the above representation would require somehow emptying x₅, compelling less faithful parsing.

The other problematic word for the moraic model, caacaak, is accounted for without any further stipulation.

(183) (a) (b)

(183b) shows that proper government again leaves an unlicensed onset. In (183a), on the other hand, the empty nucleus x₄ mirrors the phonetic interpretation of x₂ in much the same way as the inter-onset licensing in (181a); in this situation, x₄ can act as a proper governor of the onset x₃. Notice that a in x₄ does not correspond to a in x₈. The analysis caacaak is parallel to /RED-wia/ → wia and /RED-pa/ → paia, and I claim that these three patterns should be treated uniformly.

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79 This is the case with the vowel-zero alternation that occurs in front of h-aspiré in French (cf. Charette 1991: 92-94); e.g. de héros /d0.0e.ro/ → da.0e.ro, va dehors /va.d0.0c.ro/ → va.0c.0r0. I leave it open whether the analysis (181b) can be attested.
Before leaving Mokilese reduplication, let us also consider the following two configurations.

\[(184) \begin{align*}
\text{(a) } & \quad \text{ stripped version} \\
\text{(b) } & \quad \text{ extended version}
\end{align*}\]

Although the representation (184a), which shows $/\text{RED+onop/ onnonop/}$, assumes the same licensing pattern as that in (181a), the former contains an extra syllable in the base, and we might also expect $\text{p}$ in $x_9$ to be copied into $x_5$ because this position, unlike $x_4$, is not fixed as empty. I suggest that this failure of mapping should be accounted for by appealing to Contiguity: mapping must not skip melodic units (cf. McCarthy & Prince 1995: 371). As explicitly claimed in the dependency model (cf. §2.3.2), precedence is essential to define relational structure, and the same holds in the licensing model, as implied by Locality and Directionality (cf. §2.5.1); these constraints must presuppose fully specified precedence relations. Making use of the notation of the dependency model, the base string $/\text{onop/}$ involves the immediate precedence relations $/o/ << /n/ << /o/ << /p/$. If $\text{p}$ appeared in $x_5$, this would create the relation $/o/ << /n/ << /o/ << /p/$, in which the presence of $/\emptyset/ \text{ leaves } /p/ \text{ non-contiguous and, as a result, stranded. This problem does not arise in (184b), in which the position } x_5 \text{ does copy the base melody } t \text{ because the resulting string still maintains the same precedence } /a/ << /n/ << /\emptyset/ << /t/ \text{ as that in the base.}$

As demonstrated by the above analysis as well as by other cases discussed in the previous chapter, the shift in the mode of representation from the moraic model to the licensing model not only provides us with a means of implementing the exocentric concept of syllabic structure but also affords deeper insights into phonological phenomena. Nevertheless, the onus is still on the licensing model to respond to the criticism raised by the moraic model: the validity of x-slots, on the one hand, and the formal status of the onset constituent, on the other.

McCarthy & Prince (1986: 2-3) criticise the exhaustive specification of timing on the grounds that a syllable theory using x-slots 'must count segments, and must count many of them', claiming that 'rules count moras (µ), syllables (σ), or feet (F) but never segments'. I agree that segments are never counted; for that matter, I take the somewhat
stronger view that phonological events never resort to the counting of any representational units.\textsuperscript{80} The notion of counting inevitably gives rise to arbitrariness, which must be circumvented by a stipulation such that counting does not go beyond a certain limit. In this regard, the recurrent number is 'two', and McCarthy & Prince (1986: 1) speculate that this number stems from 'General considerations of locality'. However, locality has no intrinsic bearing on the act of counting per se and cannot prevent counting more than two; locality may reject tertiary feet as being ill formed but cannot stop the formulation of a constraint such as 'feet must be tertiary'. Besides, the notion of counting fails to capture the strong tendency that counted units typically exhibit asymmetric properties that single out one member as the head. I argue that any apparently quantitative limit should be more adequately generalised in terms of the notion of dependency. Accordingly, descriptions such as 'bimoraic' and 'disyllabic' denote the presence of a dependent at a relevant level of analysis. Locality can be more plausibly construed as a constraint on dependency relations. Besides, as discussed in §2.5.1, the maximal binarity of head-dependent relations (i.e. the recurrent number 'two') can be logically deduced from locality together with a constraint on directionality, the notion that also figures prominently in prosodic analyses. For these reasons, any argument which sets out to demonstrate the redundancy of counting cannot decisively reject the postulation of x-slots.

Now let us turn to the onset. Hyman (1985) criticises onset consonants for being redundant typically in prosodic phenomena such as stress and tone (cf. §2.2.5), and he grants formal status only to moraic (or weight) units. However, as shown in the previous chapter, 'non-moraic' positions need to be formally identified in prosodic terms. Recall that the moraic model faces great difficulty in defining the Onset constraint (cf. §3.4.4). This state of affairs must point to the formal status of these 'non-moraic' positions. From a more theory-internal viewpoint, Prosodic licensing in the licensing model does involve non-nuclear positions, and this premise is indispensable. I have illustrated above that it is crucial to the analysis of Mokilese reduplication how empty positions including non-nuclear ones are licensed. Government licensing featured in §3.2.2 is a prosodic constraint on non-nuclear head positions. Consequently, I argue that the exhaustive specification of positions is essential in syllable theory.

Note that the argument for non-nuclear positions is independent of that for the onset constituent; in fact, the formal status of the latter is rather obscure. I briefly mentioned in

\textsuperscript{80} See Brockhaus (1995: 189) for a similar discussion.
§3.3.4 the redundancy of onset specification in the analysis of reduplication. Compare, for example, the following with the representations in (184).

(185) (a) \[ \begin{array}{ccccc} & N & N & N & N & N \\ \hline \hline x & x & x & x & x & x & x \\ : & : & : & : & : & : & : \\ o & n & o & n & o & p \end{array} \] (b) \[ \begin{array}{ccccc} & N & N & N & N & N \\ \hline \hline x & x & x & x & x & x & x \\ : & : & : & : & : & : & : \\ a & n & t & a & n & t & i \ p \end{array} \]

These configurations indicate all necessary information just as efficiently. The presence of bare non-nuclear positions will therefore suffice, the specification of onset nodes being redundant. The previous chapter also discussed the extension of the 'Onset' constraint. In order to implement this constraint, non-nuclear positions must be accorded formal status as argued above, but they need not be assembled within onset constituents. In much the same way that Coda Licensing is not literally a constraint on the coda constituent, Onset Licensing can be regarded as a constraint that ensures a non-nuclear head position is licensed. This reformulation does not affect the analyses based on Onset(Ft). This constraint can be regarded as effectively requiring feet to begin with a non-nuclear head which is melodically filled. For example, consider the following two output candidates for the input /igula/ in Aranda (cf. §3.4.4).

(186) (a) \[ \begin{array}{cccc} & N \\ \hline \hline N & N & N \\ \hline \hline x & x & x & x & x \\ i & n & u & a \end{array} \] (b) \[ \begin{array}{cccc} & N \\ \hline \hline N & N & N \\ \hline \hline x & x & x & x & x \\ i & n & u & a \end{array} \]

Despite the absence of onset nodes, it should not be difficult to see that (186b) is well formed in accordance with the constraint in question.

The onset, together with the rhyme and the nucleus, is assumed as an a priori representational primitive in the licensing model. As described in §2.5.2, the postulation of these constituents restricts the unconstrained expansion of dependency structure, the latter posing a major problem for the relation-based approach. However, it does not yet seem to have been verified whether this structural restrictiveness should be imposed by constituency. The advantages of the licensing model demonstrated so far largely stem from tenets of the theory of phonological licensing and government, whereas the notion of constituency is rather peripheral. Indeed, as will be discussed below, the problem is
not only the formal status of the onset constituent; rather, the notion of constituency per se is at stake in the licensing model of Syllable Theory. In due course, I will argue that constituency is redundant and should be dispensed with in light of minimal componentiality.

The rest of this chapter is organised as follows. In §4.2, I discuss an analysis in which onset nodes supposedly bear the explanatory burden independently of positions. I will claim that those 'floating' onsets are superfluous. I present an alternative analysis based on morphological conditioning. §4.3 examines the nucleus and the rhyme, and demonstrates that relational structure not only suffices to account for those phenomena that allegedly motivate the distinction but also renders these constituents redundant. In §4.4, I develop a syllable theory that constructs sufficiently constrained representations using dependency relations alone.

4.2 Non-nuclear positions

In §2.4.2, I stated that constituentiality is invoked only for certain dependency relations in the relation-based approach, but I left it ambiguous as to what kind of relations should be relevant in this respect. Although the licensing model stipulates that syllabic constituents are head-initial p-licensing domains, this chapter questions the appropriateness of this definition. In §3.1, I quoted Lowenstamm as stating that 'the arguments for the syllable are strictly phonological'; this must hold for other constituents, too. Let me begin this section by reiterating the arguments for constituentiality in the licensing model. Then I will discuss the formal status of the onset as a syllabic constituent in this model.

4.2.1 Constituentiality in the licensing model

The discussion in Chapter 2 demonstrated that constituents have often been assumed to fulfil the following two functions: on the one hand, they offer positional references for the generalisation of string-adjacent phenomena; and, on the other, they behave as primitive units in suprasegmental analyses. However, as shown in §2.4.2, distributional regularities can be construed as a direct consequence of relational structure, which is formally distinguished from constituency, and I claimed that the relation-based approach reaps certain benefits from this assumption. In the licensing model, in which string-adjacent regularities stem from local p-licensing relations, constituency should
thus concern only the compositional function of melodies as a structural primitive in prosodic phenomena.

Given this conception of constitutiality, let us consider the implications of the syllabic structure put forward in the licensing model. In accordance with the Licensing Principle, positions are exhaustively syllabified either into an onset or into a nucleus in a well-formed representation. (Based on the assumption that the rhyme is the maximal projection of the nucleus, let us not distinguish the two constituents for the time being.) In this respect, positions display a binary opposition. The presence of the independent constituent categories amounts to asserting that the opposition is equipollent: each category independently invokes constitutiality. Accordingly, the onset constituent should exhibit as active participation in prosodic events as the nucleus.

However, it has often been pointed out that this is not the case. This issue harks back to Trubetskoy (1969: 170), who defines 'syllabic nucleus' as 'that portion of a syllable which ... carries the distinctive prosodic properties'. It then follows that the residual portion has no relevance with respect to prosodic distinctiveness, and this state of affairs indicates that the opposition is privative in nature. That is, positions should be distinguished not on the basis of which constituent they belong to but by whether they belong to a nucleus or not. This is indeed the standpoint of the moraic model (i.e. melodic units are either moraic or non-moraic).

The privative opposition may still be claimed to invoke two complementary constituents. Consider the following remark by Fudge (1989: 219).

In order to make a constituent cut, do we need clearly separate criteria for the status of each constituent? ... We need just one motivation for the cut, which then in turn motivates recognition of both constituents.

That is, according to Fudge, once a constituent is assigned to a sequence of positions within a domain, the postulation of another constituent is passively motivated for the remainder, if any, perhaps for descriptive purposes. However, as shown in Chapter 2, taxonomic practice of this kind has become subject to severe criticism. For instance, Levin (1985: 87) states that 'labels like onset and coda ... are merely an informal reference to segments preceding the head [i.e. the nucleus] and following the head respectively'. Fudge's claim is reminiscent of the equipollent distinctive feature system in which the
assignment of one value (a natural class) to a distinctive feature entails the existence of the opposite value. The complementarily assigned class in this system may turn out to be far from natural, if it cannot be shown to function as a referential unit in any phonological event. The concept of privativeness ensures that formal status is only accorded to those representational units that are active in phonological phenomena, and this metatheoretical condition is important to avoid the redundancy that leads to overgeneralisation. By the same token, I argue that constituentiality should only be invoked on strictly phonological grounds. In view of minimal componentiality, therefore, I reject the practice of merely labelling the absence of distinctive properties.

In the template-based approach, no compelling evidence has been presented to justify the presence of the onset in prosodic terms, the primary motivation for the onset constituent lying only in distributional regularities. For the licensing model to maintain the onset in its inventory of constituents, it needs to identify some phonological event that is dependent on the formal identity of this constituent as an independent prosodic unit. In representational terms, there must be a constraint that crucially refers to the node O in (187) below and cannot be reformulated in terms of non-nuclear positions $x_1$ and $x_2$ without additional stipulation.

\[
(187) \quad O \quad N \\
\quad x_1 \quad (x_2) \quad x_3
\]

With this goal in mind, the following section examines how O can consolidate its presence in the licensing model.

### 4.2.2 Floating onsets

Kaye et al. (1990: 201) claim that 'The three postulated syllabic constituents, O, N and R, are universally present in syllabic inventories'. Nevertheless, the onset constituent keeps a low profile: prosodic phenomena disregard this constituent, or otherwise any reference to onset nodes can be trivially replaced by reference to non-nuclear heads instead. In fact, the latter seems to be able to accommodate more adequate generalisations. Let us consider, for example, core syllable reduplication briefly mentioned in the previous chapter. In Tagalog, the recent perfective is formulated with a monosyllabic reduplicant that may have no more than one onset consonant; e.g. **ka-**-**ta**-**trabaho** 'just finished working', **ka-**-**bo**-**bloaut** 'just gave a special treat' (Bowen 1969, sited in McCarthy &
Prince 1986: 16). As far as this case is concerned, it is ambiguous whether (a) an onset constituent cannot branch or (b) a non-nuclear head cannot p-license a dependent. As shown in §3.4.5, however, the Sanskrit perfective shows an instance \textit{stu} \rightarrow \textit{tu-stu} 'to praise'. Since the initial \textit{st} is parsed as a coda-onset sequence (i.e. \textit{Øs.tu}) in the licensing model (cf. Kaye et al. 1990: 202ff), this must be analysed as case (b) above. Indeed, Kaye (1991) is reported to have proposed that 'only head projections of the stem melody can be reduplicated' (Brockhaus 1995: 217). Still, there is one (and probably only one) argument that prompts the postulation of the onset constituent. Among the three constituents, it is only onsets that are allowed to appear without dominating positions in representations. If the presence of such 'floating' onsets were legitimised, the status of O as a representational primitive might well be justified. However, this section demonstrates that this possibility has to be ruled out.

First, let us consider 'The lexical representation of the words \textit{patrie} and \textit{partie}' in French assumed in Charette (1991: 234).

\begin{equation}
\begin{aligned}
(188) (a) & \quad O N O N \quad \text{(b) O N O N} \\
& \quad \begin{array}{c}
X_1 \quad X_2 \quad X_3 \quad X_4 \quad X_5 \\
\text{p a t r i} \\
\end{array} \\
& \quad \begin{array}{c}
X_1 \quad X_2 \quad X_3 \quad X_4 \quad X_5 \\
\text{p a r t i} \\
\end{array}
\end{aligned}
\end{equation}

Notice that these representations contain not only floating onsets but also bare positions. These non-nuclear positions are in due course syllabified in a quasi-auto-segmental way (e.g. association lines do not cross), based on string-adjacent phonotactics (e.g. tr is a well-formed branching onset while rt is not, so the latter is syllabified as a coda-onset sequence). Although the moraic model also maintains that non-moraic positions are unsyllabified in lexical representation (§3.2.1), this assumption does not seem to provide much explanation in the licensing model. In (188), \textit{p} is always syllabified into the initial onset; indeed, Coda Licensing prevents it from being syllabified into the rhyme of a preceding word under any circumstances. Likewise, tr forms a branching onset in (188a), while rt is heterosyllabic in (188b). In fact, if syllabification of the bare positions is to be carried out this way during derivation, it is not simply redundant but amounts to a blatant violation of Structure Preservation (cf. §2.5.4). Kaye et al. (1990: 221), implementing the same constraint as the Projection Principle, state that
... for any two objects, either they stand in a government relationship defined at the level of lexical representation, or not. If they do not, no such relationship can be created in the course of a phonological derivation. If they do, the relationship is inalterable.

The Projection Principle is construed as excluding not only structure-altering but also structure-building processes with respect to constituent and interconstituent p-licensing (i.e. p-licensing relations established on the skeletal tier, cf. Kaye 1995: 293-294). Accordingly, in (188ab), if \( x_i \) is to act as an onset, it should be lexically p-licensed by the following nucleus \( x_2 \), and the same line of argument applies to \( x_3 \) and \( x_4 \). The consonants should be lexically syllabified in the representations (188ab), and no floating onset thus needs to be posited.

Now let us examine another representation that contains a floating onset but does not infringe Structure Preservation.

(189) (a) (b)

The representation (189a) indicates p-licensing 'between contiguous nuclei' (Kaye et al. 1990: 210). Charette (1991: 25) claims that this p-licensing relation gives the structural description for the constraint on vowel sequences; I will discuss one such example in French below. In (189a), the presence of a floating onset between heterosyllabic nuclei is deduced from two theoretical assumptions. On the one hand, Charette (1991: 25-26) argues that

an interconstituent [p-licensing] relation between a nucleus and a preceding onset is always present ... It is from this relation contracted between a nucleus and a preceding onset that the two constituents are grouped together in a domain which is generally called the syllable.

That is, the licensing model assumes that phonological representations comprise ON sequences, in much the same way that melodies are assumed to be parsed into a sequence

---

82 In the original text, Kaye et al. use the term 'government' in a broad sense, more or less equivalent to 'p-licensing' in the present thesis. The latter is used here, reserving government for a particular type of p-licensing as described in §2.5.3.
of syllables in other models. On the other hand, Kaye et al. assume that interconstituent p-licensing and constituent p-licensing are both strictly local, their only difference being the direction: head-final and head-initial, respectively. Hence, the absence of any onset position on the skeletal tier in (189a) is a necessary condition, ensuring that 'Locality in the strict sense is to be defined on the skeletal tier' in this interconstituent p-licensing domain (Kaye et al. 1990: 211). There arises a problem regarding this claim, however. If interconstituent p-licensing requires strict locality, then an onset and a following nucleus, which also hold an interconstituent p-licensing relation, must also be adjacent on the skeletal tier, as depicted in (189b). Obviously, this condition is not met in (189a), so the floating onset node cannot be p-licensed. As a result, this unlicensed onset fails to comply with the Onset Licensing constraint, rendering the representation (189a) ill-formed.

However, the strictness of locality causes a problem not only with the configuration (189a) but also with a branching onset. As noted by Charette (1990: Footnote 6), the head of a branching onset is p-licensed by a following nucleus head, but they are not strictly adjacent on the skeletal tier. Following the same line of argument as above, we would have to exclude a branching onset, too. We need to relax the Locality constraint by assuming that interconstituent p-licensing does not have to be strictly local but must be local at relevant projections, as described in §2.5.2.

(190)

As shown above, the head of a branching onset should be adjacent to its p-licensor at the head projection, regardless of the presence/absence of its dependent.

The revised condition of Locality can save the floating onset within the interconstituent p-licensing domain in (189a) if we assume that this onset is p-licensed by the following nucleus at the head projection. However, now that p-licensing between the two nuclei can hold at the nuclear projection without requiring strict adjacency on the skeletal tier, the intervening onset no longer needs to be floating in the first place. Compare the following structures.
Either of the above can be regarded as the representation of two phonetically contiguous nuclei. Then, if the onset node is allowed to exist independently of any position, the licensing model must recognise two types of empty onset: one with an empty position (191a) and the other without a position (191b). The question to be raised is whether this distinction between the two representations (191ab) can be matched by any empirical evidence.

In the analysis of h-aspiré, Charette (1991: 88ff) makes use of the contrast between (192a) and (192b), which are substructures of (191a) and (191b), respectively.

In French, nouns phonetically beginning with a vowel fall into two classes according to their influence on a preceding article. The vowel of an article is not interpreted when it precedes a noun that truly begins with a vowel. However, in front of a noun that begins with an h-aspiré, an article retains its vowel just as it does when it precedes a noun beginning with a consonant. Below are examples taken from Charette (1991: 91).

In order to account for the different behaviour of the phonetically vowel-initial nouns, Charette assumes, following Vergnaud (1982), that nouns beginning with an h-aspiré contain an initial empty onset position, while nouns beginning with a vowel only contain a floating onset. The three types of noun in (193) are thus represented as follows.
In (194a), the nucleus $x_2$ immediately precedes the nucleus $x_3$ on the skeletal tier. Charette (1991: 90) proposes that, in this case, the first of the two adjacent nuclei is deleted due to the Obligatory Contour Principle (OCP). In (194b), on the other hand, the onset $x_3$ intervenes between the two nuclei $x_2$ and $x_4$, preventing the application of OCP.

As Brockhaus (1995: 212) points out, the application of OCP to syllabic structure is rather idiosyncratic, and it may crucially contradict the Projection Principle (i.e. Structure Preservation). Still, as mentioned by Charette (1991: 25), vowel-vowel sequences trigger syncope in languages as follows.

(195) (a) Mongolian (Charette 1991: 25)

\[
\begin{align*}
\text{unE} + \text{EE} & \quad \rightarrow \quad \text{unEE} \quad \text{'one's own price'} \\
\text{taib} + \text{cc} & \quad \rightarrow \quad \text{taibcc} \quad \text{'one's own spot or stain'} \\
yatga + \text{aa} & \quad \rightarrow \quad \text{yatgaa} \quad \text{'one's own musical instrument'}
\end{align*}
\]

(b) Ogori (Chumbow 1982, cited in Clements & Halle 1983: 177)

\[
\begin{align*}
\text{igilà} \quad \text{'yam'} & \quad + \quad òkeke \quad \text{'small'} & \quad \rightarrow \quad \text{igilòkeke} \\
uòbò \quad \text{'house'} & \quad + \quad òbòrò \quad \text{'good'} & \quad \rightarrow \quad uòbòrò \\
èbi \quad \text{'water'} & \quad + \quad òbòrò \quad \text{'good'} & \quad \rightarrow \quad èbòbòrò
\end{align*}
\]

It is clear that some generalisation must be invoked here, the exact implementation of which will go beyond the purpose of this section. Although OCP may not be the most appropriate solution, let us accept the suggested adaptation of this constraint for the sake of the present discussion. (However, I will show that this constraint is not necessarily at work in French.)

A more crucial problem with the above analysis is the superfluous nature of the proposed distinction between the two kinds of empty onset. Given that the contrast is not exploited in all languages, one of the two structures, the onset with an empty position (192a) or the floating onset (192b), must stand as the default representation of an empty onset. Tranel (1995: 809) describes /h/-aspiré words (i.e. words beginning with an empty onset position) as a 'small class', and this might be taken to indicate their marked status,
rendering the floating onset as default. Nevertheless, the theory does not seem to be able to explain why this should be the case. Furthermore, they can be contrastive only in word-initial position. In French, we may assume that floating onsets are excluded from word-internal position due to the restriction imposed by OCP. However, the application of OCP must be parameterised since many languages lack the kind of syncope illustrated in (195); and, in such languages, if empty onsets are parametrically permitted, floating onsets may well be posited word-internally along with onsets with an empty position. There does not seem to be any grammar that crucially relies on their distinction in word-internal position.

The proposed distinction also gives rise to problems in the analysis of liaison in French. Charette (1991: 126) claims, following Vergnaud (1982), that liaison consonants are bare floating segments, and that positions to which these segments are attached are created on demand. The derivation is illustrated in (196) with the example bon ami 'good friend' (Prunet 1986, cited in Kaye 1995: 308).

\[
\begin{array}{cccccccc} 
ON & ON & ON & ON & ON & ON & ON & ON \\
|x_1 x_2 + x_3 x_4 x_5| & x_1 x_2 (x) & x_3 x_4 x_5 \\
bòn & ami & bòn & ami \\
\end{array}
\]

On the other hand, h-aspiré words (tend to) parallel consonant-initial words in their behaviour (Tranel 1995: 809). For example, liaison does not take place either in petit héros p(à)tierno 'little hero' or in petit rot p(à)tiro 'small burp'.

\[
\begin{array}{cccccccc} 
ON & ON & ON & ON & ON & ON & ON & ON \\
x_1 x_2 x_3 x_4 x_6 x_7 x_8 x_9 \\
|ptierno| \\
\end{array}
\quad
\begin{array}{cccccccc} 
ON & ON & ON & ON & ON & ON & ON & ON \\
x_1 x_2 x_3 x_4 x_6 x_7 \\
|ptitrot| \\
\end{array}
\]

The representations (197ab) show that héros and rot begin with an onset position that is absent in ami, successfully differentiating the structural description that triggers the phenomenon in question. However, a question arises as to what prevents t from being associated to x₅ in (197a). Note that, in (196), the floating segment n is accommodated into an onset despite the trouble of creating a lexically absent position. If (196) describes a legitimate event, it is rather peculiar that (197a) induces no phonological effect because it should be more economical for a floating segment to dock into a vacant position which
is readily available. This state of affairs undermines the metatheoretical condition of non-arbitrariness: 'There is a direct relation between a phonological process and the context in which it occurs' (Kaye et al. 1990: 194).

Regarding (196), another question arises about the inapplicability of OCP to the sequence of nuclei $x_2$ and $x_3$. Since the floating segment $n$ does not intervene between these two positions on the skeletal tier, the structural condition might well induce the OCP effect: *bami.

(198) $*$ ON ON ON

\[
\begin{array}{c|c|c|c|c}
| & | & | & | \\
\hline
x_1 & x_2 & x_3 & x_4 & x_5 \\
\hline
\end{array}
\]

b o n a m i

Referring to Schane (1974), Durand (1986b: 163) states that 'if we leave aside a few words like si, la and tu, elision does not involve the deletion of the class of vowels before a vowel but in fact only applies to schwa'. It then seems more plausible to assume that the putative vowel-zero alternation in the article la is conditioned morphologically rather than phonologically, in order to avoid a stipulation akin to an extrinsic ordering of rewrite rules (i.e. 'create a position BEFORE applying OCP'). I tentatively suggest that both l and la should be registered as the lexical representations of la, and that the selection should be made in such a way to derive a well-formed phonological representation.

In contrast, Tranel (1995: 809ff) argues for an entirely different approach which attributes the difference between truly vowel-initial and h-aspiré words to morphological diacritic information rather than phonological structuring. That is, the two classes of words do share the same structural configuration with respect to the initial empty onset, but the small class of h-aspiré words are morphologically specified to behave in parallel with consonant-initial words. He mentions three advantages of this alternative approach, of which the following is particularly crucial in terms of explanatory adequacy.

... It clearly encodes that h-aspiré words are exceptional vowel-initial words, thus explaining why they tend to regularize, as evidenced by so-called errors in child language, popular speech, and spontaneous speech. (Tranel 1995: 811)

The morphology-oriented analysis, despite its own problems (cf. Tranel 1995: 812-813), seems descriptively no less adequate than the structural analysis. If Tranel is correct,
French *h*-aspiré does not stand as substantive evidence for the distinction between the two types of empty onsets (192ab), which are reproduced below as (199ab).

\[
\begin{array}{cccc}
(199)\ (a) & O \ N & (b) & O \ N \\
& x & x & x \\
& \emptyset & x & x \\
\end{array}
\]

\[
\begin{array}{cccc}
(c) & N' \ O \ N' & (d) & N' \ O \ N' \\
& x & x & x \\
& \emptyset & x & x \\
\end{array}
\]

Since there does not seem to be any other argument for this distinction, it also follows that interconstituent p-licensing between phonetically contiguous nuclei need not invoke the two different representations (191ab), reproduced above as (199cd). Consequently, floating onsets are superfluous and should be excluded from representations.

In this section, I have discussed and rejected the postulation of floating onsets as the only possible evidence for the formal status of the onset. Therefore, the putative onset constituent should not be included in the inventory of syllabic constituents, and the configurations (199b) and (199d) are not only ill-formed but are inconceivable once the onset node O is excluded from the representational vocabulary. This conclusion entails that (200a) is the formal representation of the domain in which a non-nuclear head position acts as a p-licensor (I will continue to use 'onset' as a shorthand term for this domain in the remainder of the thesis).

\[
\begin{array}{cccc}
(200)\ (a) & x \ (x) & (b) & \ ? \\
& \emptyset & x & x \\
\end{array}
\]

As explicitly shown by the arrow, the head still needs to precede the dependent in this domain; the formal status of the onset as a constituent has been rejected in this section, but the head-initial p-licensing relation must remain intact to derive string-adjacent generalisations (e.g. the head position enjoying greater distributional freedom, being obligatorily present, etc.). Here arises the theory-internal problem of how the direction of p-licensing can be constrained. Since the two positions do not belong to any constituent, they are involved in neither constituent nor interconstituent p-licensing, so Locality and Directionality, as prescribed in §2.5.1, cannot rule out (200b) or even (200c). A head parameter would then need to be stipulated arbitrarily for non-constituent p-licensing in
addition to constituent and interconstituent p-licensing. The exclusion of the onset constituent causes another problem. Consider the representation equivalent to a syllable with a branching onset below.

\[(201)\]

The licensing paths indicated in (201) all conform to Locality and Directionality, but the p-licensing relation between \(x_j\) and \(x_k\) must be excluded to avoid overgeneralisation. The Minimality Condition (cf. §2.5.2) is no longer applicable since \(x_j\) is not protected by the immediate projection of \(x_i\). I will continue the discussion of these problems in the following sections.

4.3 Redundancy of the nucleus-rhyme distinction

The discussion in the previous section leaves us with two constituents, the nucleus and the rhyme. However, a formal distinction between these constituents fails to be made in all the other models of syllabic structure described in Chapter 2 except for the full-blown onset-rhyme model (cf. §2.2.3). This section demonstrates that the postulation of both constituents is also redundant in the licensing model, maintaining the following two arguments: (a) distributional regularities resting on the presence of the rhyme node should be captured in terms of head-dependent relations alone, as argued in §2.4.2; and (b) reference to the two constituents deemed necessary for the purposes of phonological weight can be trivially reformulated by appealing to types of relations without invoking constituency. Consequently, I will claim that the nucleus and the rhyme do not merit independent constituent status in the licensing model.

Let us recall that the rhyme is formally regarded as the maximal projection of the nucleus head. The difference between a nucleus dependent and a rhyme dependent thus stems from the levels of projection at which they are p-licensed, as shown below (I will use 'coda' as a shorthand term for a rhyme dependent).
Strong motivation for the constitutential distinction at issue comes from the need to account for different distributional regularities observed in the dependent positions of the two constituents. In (202a), melodic distribution within the dependent position relies significantly on the melodic properties of the preceding head. The nucleus head typically licenses only vocalic expressions, and the dependent may contain only a subset of those expressions. On the other hand, in (202b), the presence of the coda must be sanctioned not only by the preceding nucleus head but also by the following onset (the onset in turn must be licensed by a following nucleus, omitted here). This is then assumed to result in the onset taking control over the range of melodic oppositions in the coda position, which is thus occupied only by a consonantal expression. Further motivation for the postulation of both constituents stems from the necessity of distinguishing two types of heavy syllable (cf. Hayes 1995: 50ff). Concerning stress systems that are sensitive to phonological weight, some refer to syllables with an intra-rhyme branching node (a branching nucleus or a branching rhyme) as heavy, while others consider only those syllables with a branching nucleus as heavy.

In the licensing model, neither of the above arguments sufficiently justifies the postulation of the two distinct constituents. As for quantity-sensitive stress, the necessary distinction can instead be made by referring to licensing configurations. I propose that (a) phonological 'weight' should refer not to the branching/non-branching state of nucleus/rhyme nodes but to the presence/absence of a nucleus dependent, assuming that the rhyme is not distinguished from the nucleus; and that (b) quantity-sensitive stress systems should fall into two classes according to whether stress-bearing nucleus heads are required to p-license a dependent EXCLUSIVELY or not. Consider the following representations in which the two levels of projection in (202ab) are conflated.

(203) (a) 
\[
\begin{array}{c}
  x_1' \\
  x_1 \\
  x_j \\
\end{array}
\]

(b) 
\[
\begin{array}{c}
  x_1'' \\
  x_1' \\
  x_j \\
  x_k \\
\end{array}
\]
In (203a), the head \( x_i \) exclusively p-licenses the dependent \( x_j \); on the other hand, in (203b), \( x_i \) does not hold an exclusive licensing relation with \( x_j \) since the latter is simultaneously p-licensed (i.e. coda-licensed) by the following \( x_k \). In this way, it becomes possible to isolate the two types of stress systems just as efficiently, but by referring only to licensing relations rather than to constituents. Therefore, the nucleus-rhyme subjunctive structure can be dispensed with in the analysis of quantity-sensitive stress.

The alternative representations (203ab) may be no less stipulative than (202ab), but the former indicate more explicitly the specific-to-general relation between the 'branching nucleus' and the 'branching rhyme'. If weight is described in terms of the nucleus and the rhyme, we may well predict three types of quantity-sensitive languages: (a) one in which only branching rhymes are heavy, (b) another in which only branching nuclei are heavy, and (c) the other in which both branching nodes are heavy. On the other hand, the analysis suggested above allows only two systems equivalent to (b) and (c). If a nucleus dependent is simply required, stress seeks both (203ab) from a designated edge; however, if the dependent must be exclusively p-licensed, only (203a) act as a stress landing site. Accordingly, the analysis based on the representations in (203) should be more restrictive to such an extent that it avoids overgeneralisation. Given this state of affairs, I claim that the presence of the two different weight systems does not support the formal distinction between the nucleus constituent and the rhyme constituent.

Now let us turn to the other argument, based on melodic distribution. In §2.5.2, I claimed that the relation-based approach can provide a unified account of distributional regularities by analysing them independently of constituency. This holds in the licensing model, too, and a coda-onset sequence does not form a constituent but defines a governing domain. Nevertheless, the condition for this domain to be well formed relies crucially on the notion of constituency: unlike other positions, codas must be affiliated to a constituent that is not the immediate projection of its head, as illustrated in (204a).

---

83 Lahiri & Koreman (1988, sited in Ewen & Hulst 2001: 158-159) analyse Dutch as a stress system in which syllables with branching rhymes, but not with branching nuclei, are heavy. However, this analysis must be rejected in the licensing model for a theory-internal reason. The question is whether this language allows nuclei to branch at all. If it does, there arises a situation in which 'long vowels occur in open syllables only ... while short vowels can only occur in closed syllables' (Ewen & Hulst 2001: 158). However, there cannot be a language that lacks open syllables with a short vowel according to the assumption of structural markedness (cf. §2.5.2). Therefore, Dutch must be analysed as a language that allows only rhymes to branch, the duration of vowels being subject to phonetic investigation, the details of which goes beyond the scope of this thesis and are thus left open here.
By virtue of being directly dominated by a rhyme node, codas are externally licensed by a following onset. This external licensing is compelled by Coda Licensing, on the one hand, and is permitted by the Minimality Condition, on the other. As a result, codas display a different melodic opposition from that of nucleus dependents, which are protected from external p-licensing in accordance with the Minimality Condition, as indicated in (204b). Unlike nucleus heads, onset heads cannot p-license a dependent at two different levels of projection, and the absence of subjunctive constituent structure prevents onset dependents from being externally licensed by a following nucleus head, as shown in (204c). Although the rhyme constituent may seem to play an important role in regulating licensing relations, I will present an alternative way of capturing the different licensing conditions illustrated above without recourse to constituency, based on Takahashi (1993: 400f).

Regarding the nucleus-rhyme contrast, it is important to note that a nucleus may branch (if the relevant parameters are set accordingly) regardless of the presence/absence of a following onset. On the other hand, it must be ensured that a branching rhyme, which contains a consonantal expression unlike a branching nucleus, appears only in front of an onset. In this respect, the licensing model described in §2.5 makes two essentially separate assumptions: (a) the presence of a coda must be licensed by a following onset in accordance with Coda Licensing, and (b) the melodic distribution of a coda is governed by a following onset; i.e. a coda may a-license the stricture elements [?] and [h] (cf. Kaye et al. 1989, Harris & Lindsey 1995) but a nucleus dependent may not. The structural difference between a coda and a nucleus dependent may seem to be justified to maintain the above assumptions. Nevertheless, by exploiting Licensing Inheritance, I put forward below a simpler, yet equally plausible alternative assumption that a nucleus dependent position acts as a 'coda' only when it is licensed by an onset.

As noted by Harris (1997: 361ff), nuclei exhibit anomalies as regards Licensing Inheritance. The melodic complexity of an onset head tends to exceed that of its licensor, a following nucleus head; likewise, a coda may a-license a more complex expression than one of its licensors, a preceding head. In fact, the problem is not simply a matter of complexity. A nucleus head cannot a-license the stricture elements — leaving aside the
issue regarding the representation of syllabic consonants — whereas an onset head and a coda both can. Given that a nucleus head is the ultimate licensor of a syllabic domain, the question is how the licensed positions, an onset head and a coda, can obtain a-licensing potential that does not seem to be inherited. Takahashi (1993: 399) puts forward the following constraint in an attempt to formally acknowledge the exception to Licensing Inheritance described above (the elimination of the onset constituent in the previous chapter renders the distinction between 'constituent' and 'interconstituent' p-licensing inappropriate, but let me continue to use the terms in an informal sense for the time being).

(205) Stricture element a-licensing condition

A position may a-license the stricture elements |?| and |h| only when it inherits a-licensing potential through interconstituent p-licensing.

This proposal is based on the hypothesis that a nucleus head does possess a-licensing potential for the stricture elements but cannot utilise the potential at its disposal. Hence, relevant a-licensing potential is indeed provided by a nucleus head to other positions but becomes available for use only via interconstituent p-licensing.

Given this conception, I suggest that the Complexity Condition (cf. §2.5.3) should be revised so that the relative melodic complexity of two positions is compared only with respect to the a-licensing potential available for discharge. The complexity of an onset head and a coda may exceed that of a nucleus head in genuinely quantitative terms; nevertheless, a nucleus head typically a-licenses only resonant elements for vocalic expressions and, as far as this element type is concerned, an onset head and a coda may a-license no more than one such element in conformity with Licensing Inheritance.

With the above exception to Licensing Inheritance in mind, compare the following illustrations.

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84 An apparent exception to this assumption is consonants with double articulation (e.g. kp). The structure of such consonants concerns Element Theory in general, and I leave this issue aside in the present discussion.
In (206a), the nucleus dependent position $x_j$ is not the target of interconstituent p-licensing and thus receives a-licensing potential solely from the preceding nucleus head $x_i$ without satisfying the condition (205) (the SEA condition, henceforth). As a result, there is no possibility for this position to a-license a stricture element. On the other hand, in (206b), the onset $x_k$ inherits a-licensing potential from the nucleus $x_i$ through interconstituent p-licensing. Therefore, it is capable of exploiting a-licensing potential for the stricture elements according to the SEA condition and can confer the potential onto the preceding coda again through interconstituent p-licensing. This state of affairs is manifested by the possible presence of expressions with stricture elements in these positions. Following this line of thinking, there is no need to posit any constituent difference between a nucleus dependent and a coda; it suffices to assume that a nucleus dependent may a-license a stricture element (i.e. behave like a coda) only when it is licensed and accorded relevant a-licensing potential by a following onset.

The proposed assumption allows us not only to conflate the two levels of projection (i.e. nucleus and rhyme) but also to dispense with Coda Licensing. The ill-formedness of a 'coda' without a following onset is now explained by Licensing Inheritance; a position receives a-licensing potential from its licensor, and the source of a-licensing potential for the stricture elements can only be provided by an onset head. In light of the revised Complexity Condition, it also becomes redundant to distinguish between the governing and non-governing domains shown in (52) in §2.5.3, reproduced below.

---

85 According to this assumption, the Coda Condition (cf. Ito 1986) can be construed as describing a sub-case of Licensing Inheritance.
The above distinction purports to define phonotactic domains, but the SEA condition can account for distributional regularities without invoking these domains.

Besides, it is no longer necessary to stipulate that a coda must be strictly adjacent to its head (cf. §2.5.2) to rule out the tertiary structure which contains both a branching nucleus and a branching rhyme. Given that Locality is satisfied at the head projection in onset-nucleus p-licensing as discussed in the previous section, the representation (208a) may well be permitted.

\[
(208) \begin{align*}
\text{(a)} & \quad (x'') \xrightarrow{\text{x'}} x' \xrightarrow{\text{x}} x \xrightarrow{\text{x}} x \xrightarrow{\text{x}} x \\
\end{align*}
\]

This structure is no longer conceivable, now that the two levels of projection do not exist. The elimination of the nucleus-rhyme distinction also avoids arbitrariness stemming from the assumption that the intermediate projection and the maximal projection invoke different constituential identities. Consider the representations (202ab) reproduced below.

\[
(209) \begin{align*}
\text{(a)} & \quad (x'') \xrightarrow{\text{x'}} x' \xrightarrow{\text{x}} x \xrightarrow{\text{x}} x \\
\text{(b)} & \quad (x'') \xrightarrow{\text{x'}} x' \xrightarrow{\text{x}} x \xrightarrow{\text{x}} x \\
\end{align*}
\]

If p-licensing at different levels of projection results in different constituential properties as shown above, we may well postulate two different levels of head projection for onset licensing as follows.

\[
(210) \begin{align*}
\text{(a)} & \quad (x'') \xrightarrow{\text{x'}} x' \xrightarrow{\text{x}} x \xrightarrow{\text{x}} x \\
\text{(b)} & \quad (x'') \xrightarrow{\text{x'}} x' \xrightarrow{\text{x}} x \xrightarrow{\text{x}} x \\
\end{align*}
\]

This obviously redundant contrast between (210a) and (210b) does not concern us in the absence of multilevel projection within syllabic structure.
4 A farewell to constituency

However, the elimination of the nucleus-rhyme distinction gives rise to a problem with respect to onset dependents. If a nucleus dependent can be licensed by a following onset as argued above, the Minimality Condition can no longer be in effect and nothing should prevent an onset dependent from being licensing by a following nucleus head, resulting in the following superfluous contrast.

\[(211) \begin{align*}
(a) & \quad \text{(a)} \quad \text{(b)} \\
& \quad \begin{array}{c}
\text{\(x\)' \(x\)' / \(O\) \(N\) \(x\)'} \\
\text{\(x\) \(x\) \(x\)}
\end{array} \\
& \quad \begin{array}{c}
\text{\(x\)' \(x\)' / \(?\)} \\
\text{\(x\) \(x\) \(x\)}
\end{array}
\end{align*}\]

Still, it is possible to reject (211b) by referring to its peculiar licensing configuration, which is distinct from any other well-formed syllabic structure. Consider the representation (212), which shows a sequence of two syllables with maximally expanded p-licensing paths (constituent and interconstituent p-licensing paths are indicated by solid and dotted arrows, respectively).

\[(212) \begin{align*}
& \quad \begin{array}{c}
\text{\(x_1\)' \(x_2\)' \(x_3\)' \(x_4\) \(x_5\)' \(x_6\)' \(x_7\) \(x_8\)} \\
\text{\(x_1\) \(x_2\) \(x_3\) \(x_4\) \(x_5\) \(x_6\) \(x_7\) \(x_8\)}
\end{array} \\
& \quad \begin{array}{c}
\text{\(O\) \(R\) \(O\) \(R\)} \\
\text{\(x_1\) \(x_2\) \(x_3\) \(x_4\) \(x_5\) \(x_6\) \(x_7\) \(x_8\)}
\end{array}
\end{align*}\]

Notice that no position p-licenses more than one position in the same direction. Based on this state of affairs, Takahashi (1993: 395) proposes the following constraint.

\[(213) \quad \text{Within syllabic structure, a position universally may p-license another position only once in each direction.}\]

This constraint excludes (211b), in which the onset head p-licenses a position to its left twice at different levels of projection, without resorting to the Minimality Condition. However, the drawback of the above proposal is that it invokes the notion of counting, which was rejected in §4.1. I will put forward an alternative constraint that circumvents this problem in §4.4.4.

In this section, I have shown that the distinction between the nucleus and the rhyme is redundant, given the relational mechanism pervading syllabic structure as assumed in the licensing model. It then follows that, in light of minimal componentiality, there
should be only one constituent, the nucleus, in phonological representation. (We may equally call it rhyme — the difference does not matter here.) Accordingly, I wholly reject the multi-level construction in favour of a flat model of syllabic structure akin to the nucleus display of Clements & Keyser (1983) described in §2.2.2, as shown below.

The representations (214ab) illustrate an open and a closed syllable, respectively. With respect to the non-nuclear positions $x_1$ and $x_2$, let me arbitrarily assume for the time being that they are required to enter a head-initial dependency relation. A nuclear dependent $x_4$ contains an expression that includes stricture elements, indicated by $C$ in (214b), only when (i) it obtains the stock of relevant a-licensing potential at its disposal, and (ii) the supply of this stock is made available through interconstituent p-licensing in accordance with the SEA condition (205). Therefore, the autosegmental association of $x_4$ to $C$ is a direct reflection of interconstituent p-licensing between $x_4$ and a following position (omitted here), and I argue that the doubly licensed state of this nucleus dependent should not be redundantly represented by the presence of a rhyme node.

With respect to the flat mode of representation illustrated in (214), a question still arises as to the necessity of the last remaining constituent. I put forward the analysis of phonological weight based on the state of nucleus heads (i.e. whether they p-license a nucleus dependent or not), but this analysis does not invoke the identity of a structural unit comprising a nucleus head and a nucleus dependent. For that matter, reference to nucleus heads seems to suffice for any prosodic phenomenon. Consequently, I conclude that no p-licensing relation demonstrates constituency in syllabic structure and thus the notion of constituency should be done away with altogether in Syllable Theory. Recall that this conclusion has already been entertained by the dependency model (cf. §2.3.2). Indeed, now that no constituents need to be present, the representation (212), comprising $x$ slots and arrows that can be regarded as corresponding to vertices and arcs, respectively, should be regarded as a formal representation. However, there arises the question, which was also addressed at the end of the previous section, regarding the means by which the relational structure can be constrained; the total absence of
constituents renders this question even more pressing. In §4.4, I will propose a model of syllabic structure that is wholly reliant on dependency relations in a way that is highly reminiscent of the dependency model, but which retains the theoretical insights offered by the licensing model and thus achieves a significant degree of restrictiveness.

4.3.1 Stress systems referring only to vowel length

In the previous section, I mentioned two quantity-sensitive stress systems; one in which syllables with either a branching nucleus or a branching rhyme are heavy, and the other in which only those with a branching nucleus are heavy. Let me first touch on the latter type, the existence of which I call into question, before returning to the nucleus-rhyme distinction.

Huasteco (cf. Larsen & Pike 1949), a Mexican language, is regarded as one of the languages in which stress assignment refers only to the weight of nuclei (cf. Hyman 1985: 5-6, Katamba 1989: 178-179). Consider the following data taken from Katamba (1989: 179).^86

---

<table>
<thead>
<tr>
<th></th>
<th>labial</th>
<th>alveolar</th>
<th>postalveolar</th>
<th>dorsal</th>
<th>labio-dorsal</th>
<th>glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td>stop</td>
<td>p/b</td>
<td>t/t?</td>
<td>tʃ/ʃʃ?</td>
<td>k/k?</td>
<td>kʷ/kʷʔ</td>
<td>?</td>
</tr>
<tr>
<td>affricate</td>
<td>ts/tsʔ</td>
<td>tʃ/tʃʔ</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>fricative</td>
<td>θ</td>
<td>ʃ</td>
<td></td>
<td>h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>nasal</td>
<td>m</td>
<td>n</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lateral</td>
<td>l</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>glide</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>j</td>
<td>w</td>
</tr>
</tbody>
</table>

The authors note that d f g r s are also found in Spanish loan words.

---

^86 According to Larsen & Pike (1949), Huasteco has the canonical five vowels (i e a o u) and the following consonantal inventory (the IPA symbols are used in transcription except for ʃ, which stands for glottalisation).
According to Larsen & Pike (1949: 274), stress falls on the final long vowel if there is one; otherwise, the first syllable bears stress. However, notice that, although Huasteco does have words with a final vowel (e.g. 'pakθa 'tall'), all the words in (215) end with a consonant. It is generally accepted that such a consonant does not make its presence felt in stress assignment, i.e. it is extrametrical (cf. Hayes 1985). In terms of the licensing model, a domain-final consonant must be syllabified into an onset followed by an empty nucleus. Either way, if final consonants are disregarded in the above data, it is unnecessary to exclude branching rhymes from the inventory of heavy syllables in stress assignment. Only the first word in (215b) contains a coda-onset sequence, and the branching rhyme does receive stress, although it happens to be in the position for default stress.

In order to show that only syllables with a long vowel are heavy, we need to find a case such as 'CV:CV(C) or 'CV:CVCCV(C). However, no such instances can be found in Larsen & Pike (1949), and there is a good reason for their absence. Descriptively, free morphemes in Huasteco are minimally bimoraic and maximally disyllabic, and every syllable must have an onset.
(216) Free morphemes in Huasteco

<table>
<thead>
<tr>
<th>Syllable Structure</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVC</td>
<td>hom 'increase', ts(\dot{e})n 'mountain'</td>
</tr>
<tr>
<td>CVCV</td>
<td>?a'ta: 'house'</td>
</tr>
<tr>
<td>CVCVC</td>
<td>be'le:w 'nine'</td>
</tr>
<tr>
<td>CVCCVC</td>
<td>'t(\dot{u})l(\dot{k})uts 'scarecrow', (\dot{a})m(\dot{b})o:k 'wishbone'</td>
</tr>
</tbody>
</table>

In the above list, V can be either a short or a long vowel. From the viewpoint of the licensing model, the lack of word-final consonant clusters indicates that an onset before a domain-final empty nucleus is not government-licensed. That is, a closed syllable may appear only in initial position, and the final syllable never contains a coda. Given this state of affairs, Huasteco stress is not necessarily a language that ignores branching rhymes in stress assignment. The same goes for compound words comprising bound morphemes (stems, affixes, proclitics), which assume one of the following shapes: V, C, CV, VC, CVC, CVCV. Notice that, unlike free morphemes which include the form CVCCVC, no bound morpheme contains internal clusters. Examples of compound words are given below (hyphens separate proclitics, which are ignored in stress assignment).

(217) Compounds in Huasteco

<table>
<thead>
<tr>
<th>Compound</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>'k'i(\dot{b})el</td>
<td>'to lose oneself' (k(\dot{b}) 'to perish' + e 'intransitive' + l 'present active')</td>
</tr>
<tr>
<td>'kalel</td>
<td>'to go away' (kale 'to go out' + l 'present active')</td>
</tr>
<tr>
<td>?in-(\dot{i})bi:l</td>
<td>'it is a root' (?in 'his' + ?ib 'root' + il 'possessive indicator')</td>
</tr>
<tr>
<td>?alwa?'me:</td>
<td>'became good' (?alwa? 'good' + me: 'inchoative')</td>
</tr>
<tr>
<td>'(\dot{i})n(\dot{i})kt(\dot{f})ik</td>
<td>'men' (?inik 'man' + t(\dot{f})ik 'pluraliser')</td>
</tr>
<tr>
<td>'wajal</td>
<td>'sleeps' (waja 'to sleep' + l 'present active')</td>
</tr>
</tbody>
</table>

If Structure Preservation rules out resyllabification in compounds (e.g. the concatenation of ?i.ni.k\(\theta\) and t\(\dot{f}\)i.k\(\theta\) results in ?i.ni.k\(\theta\).t\(\dot{f}\)i.k\(\theta\), not ?i.ni.k\(\theta\).t\(\dot{f}\)i.k\(\theta\)), codas may appear only in disyllabic free morphemes but never in compounds. It does not help to observe

---

87 This list contains only those words that are morphologically non-analytic. Larsen & Pike (1949: 276) also include CVCC in the list. However, taj? 'lime' is the only cited example of this type. This cluster shows peculiar behaviour: putative three-consonant clusters always begin with j? or w?. This seems to indicate that they are the single glottalised consonants j? and w?, respectively. Because of this indeterminacy and the absence of other examples, I omit CVCC from the inventory here.

88 It is not reported how the vowel in il becomes long.
stress patterns in phrases/sentences because stress is assigned to each word; e.g. 'ʔutejits ko'jo:ts ta'naʔi? 'ʔa:l an-k'imaʔi: 'He drew near and rested there in the house'. Consequently, close examination reveals that Huasteco is not really an example of the quantity-sensitive stress system in which only branching nuclei, but not branching rhymes, are visible in stress assignment.

Selkup, a West Siberian language, is also mentioned as a language in which weight refers only to nuclei. Tranel (1991: 294) states that 'in its right-to-left scan seeking the first heavy syllable, stress skips CVC syllables'. Below are some relevant data taken from Halle & Vergnaud (1983: 189).

(218) Selkup

<table>
<thead>
<tr>
<th>English</th>
<th>Selkup</th>
</tr>
</thead>
<tbody>
<tr>
<td>'amirna</td>
<td>'eats'</td>
</tr>
<tr>
<td>kanaŋ'mi:</td>
<td>'our dog'</td>
</tr>
<tr>
<td>'unŋinti</td>
<td>'wolverine'</td>
</tr>
<tr>
<td>'qumit</td>
<td>'human beings'</td>
</tr>
<tr>
<td>qu'mo:qi</td>
<td>'two human beings'</td>
</tr>
<tr>
<td>qumo:qi'li</td>
<td>'your two friends'</td>
</tr>
<tr>
<td>qum'mi:</td>
<td>'our friend'</td>
</tr>
<tr>
<td>'qummi:</td>
<td>'my friend'</td>
</tr>
<tr>
<td>'qom'</td>
<td>'human beings'</td>
</tr>
<tr>
<td>'qu'co:qi</td>
<td>'I work'</td>
</tr>
<tr>
<td>u:ctkkak</td>
<td>'I am working'</td>
</tr>
<tr>
<td>u:ctkk</td>
<td>'be working'</td>
</tr>
<tr>
<td>ak/o:qi</td>
<td>'I/we'</td>
</tr>
</tbody>
</table>

Words such as 'amirna and 'unŋinti seem to confirm Tranel's account. Yet, notice that we may well infer from their glosses that 'amirna is a compound, and it is not clear if any morphology is involved in this word. Consider an apparent coda-onset sequence in qum'mi:. The presence of kanaŋ'mi: indicates that mi: is a possessive 'our'; it then follows that qum'mi: is likely to be syllabified not as qum.'mi: but as qu.m0.'mi:, which does not contain a true geminate. Also 'u:ctkkak and u:ctk'ko:qi seem to be decomposed into u:ctkk 'be working' and ak/o:qi 'I/we' (cf. 'u:ctak, qu'mo:qi). The morphological structure of u:ctkk is not obvious due to the lack of further comparable examples, but at least we can assume that the final kk does not form a coda-onset sequence because no word in the data ends with a consonant cluster, indicating that a domain-final empty nucleus cannot government-license a preceding onset. Given these observations, it is not entirely evident whether Selkup allows branching rhymes at all.

Given these indeterminate cases, it seems well worth investigating in light of the licensing model whether two different quantity-sensitive stress systems are really necessary at all. If it turns out that reference only to rhymes will suffice, the distinction
between exclusive/non-exclusive p-licensing suggested in the previous section can be
done away with. However, it goes beyond the scope of this thesis to go through the
details of all those languages which are described in Hayes (1995: 296-297) as being
sensitive to the weight of nuclei, so I leave this issue for future research.

4.4 Syllable Theory without constituents

Following the conclusion in §4.3, this section proposes a model of syllabic structure that
apparently deviates from the licensing model but essentially achieves the same degree of
structural restrictiveness solely through head-dependent relations. I will first introduce
two types of dependency crucial to the present theory, and then demonstrate how the
proposed model employs these relations as the basis for a syllabic structure which is
equally restrictive as that associated with the licensing model. The theoretical foundation
of the proposed model is naturally provided by the licensing model, but it also draws
heavily on the dependency model, in particular, Anderson (1986). The resulting theory
will thus be effectively consistent with the tenets of the licensing model, but can also be
appropriately described as a constraint-oriented dependency model.

4.4.1 Endocentric and exocentric dependency

The elimination of constituents leaves phonological positions as the only representational
units in syllabic structure. Positions are still assumed to be subject to the Licensing
Principle (cf. §2.5.1), but the question to be raised in this regard is what relations exhaust
them. The licensing model posits two types of dependency relation in syllabic structure:
constituent and interconstituent p-licensing. However, the rejection of constituency
forces us to consider whether this distinction should also be discarded or recast in some
other terms. This section argues for the latter and presents an alternative, non-constituential way of creating the relevant distinction.

The dependency model illustrated in Chapter 2 apparently maintains only one type
of dependency, but two distinct relations are in fact invoked through the syllabic structure
formation rules. Nucleus/rhyme formation assigns head-initial dependency relations
between strictly adjacent segments (a≺b ∧ a≻b), while syllable formation builds
head-final dependency relations between (not necessarily strictly) adjacent segments
(a≤b ∧ a≡b). If we modify the formation rules in §2.3.2, following Anderson (1986:
74ff), so that less sonorous segments act as heads in consonant clusters (cf. Footnote 17 in
Chapter 2), and so that a dependent is not available for subsequent dependency assignment, the dependency model and the licensing model assign an almost identical dependency structure to an English word such as *stray*, as shown below.

(219) (a) ![Diagram for endocentric dependency]

(b) ![Diagram for exocentric dependency]

Pertinent to the present discussion is the fact that each of the above models invokes both directions of dependency. For that matter, the same is true for other relation-based models too (cf. §2.3.1). The distinction is arguably indispensable in ensuring the well-formedness of syllabic structure.

Following the above argument, I claim that the two types of dependency should be formally distinguished as follows.

(220) (a) **Endocentric Dependency**: if $a = \beta$, then $a \ll \beta$

In endocentric dependency wherein $a$ and $\beta$ are the head and the dependent position, respectively, $a$ strictly and immediately precedes $\beta$ in phonetic interpretation.

(b) **Exocentric Dependency**: if $a \rightarrow \beta$ then $a > \beta$

In exocentric dependency wherein $a$ and $\beta$ are the head and the dependent position, respectively, $a$ strictly but not necessarily immediately follows $\beta$ in phonetic interpretation.

In the absence of constituents, the notions 'endocentric' and 'exocentric' are construed as attributes of dependency domains. An endocentric domain is one in which a head (potentially) has a *persistent non-head* position as its dependent (i.e. a position that never acts as a head of a dependency domain, cf. Harris 1994: 168). An exocentric domain comprises a head and a dependent that belong to different endocentric dependency domains.

Notice that the two types of dependency (220a) and (220b) effectively correspond to constituent and interconstituent p-licensing, on the one hand, and to the nucleus/rhyme
and syllable formation rules, on the other, respectively; the same headedness directions and (strict or not strict) locality requirements characterise the respective relations. Let me illustrate this state of affairs with the representation (212), reproduced below.

(221)

In (221) and subsequently, the solid and dotted arrows stand for endocentric dependency (en-dependency, henceforth) and exocentric dependency (ex-dependency, henceforth), respectively. This representation indicates that a sequence of two syllables with maximally expanded p-licensing paths contains four en-dependency relations ($x_1 \Rightarrow x_2$, $x_3 \Rightarrow x_4$, $x_5 \Rightarrow x_6$, $x_7 \Rightarrow x_8$) and three ex-dependency relations ($x_1 \Leftarrow x_3$, $x_4 \Leftarrow x_5$, $x_5 \Leftarrow x_7$).

The definitions of the two dependency types in (220) apparently amount to the restatement of the distinction between constituent and interconstituent p-licensing, or to the reformulation of the nucleus/rhyme and syllable formation rules as output-oriented constraints. Nevertheless, notice that neither of the definitions makes reference to any extrinsic structures such as constituents or equivalent structural notions. (220a) does not require that a domain extrinsically specified as being endocentric MUST BE head-initial and strictly local, but describes that en-dependency IS head-initial and strictly local; likewise, (220b) asserts that final headedness is the distinctive, intrinsic property of ex-dependency. In light of this understanding, I argue that there cannot be an ill-formed representation in which an endocentric dependency domain is head-final or an exocentric dependency domain is head-initial.

This state of affairs clearly departs from the way of ensuring the well-formedness of representations in both the licensing model and the dependency model. In these models, the headedness direction of dependency is determined by the particular context (i.e. constituents or rules) which invokes this relation. Consider the following supposedly ill-formed configurations, for example.
A head-final dependency relation is not allowed to appear either in the nucleus constituent of the licensing model (222a) or in the nucleus formation rule of the dependency model (222b), because this headedness direction defines interconstituent p-licensing in the former and syllable formation in the latter.

However, let us consider the significance of this mismatch in the first place, which becomes clear when we consider (222b). In the dependency model, only the linear ordering of melodic units is specified in lexical representation (i.e. unsyllabified), the dependency relations being assigned (i.e. syllabified) through the serial application of extrinsically ordered rules during derivation, as illustrated in §2.3.2. As regards (222b), hence, $a_i$ and $a_j$ only assume the precedence relation $a_i \ll a_j$ lexically, and there is a stage at which the choice of the head must be made between $a_i$ and $a_j$. The ill-formedness of (222b) seems to carry an explanatory burden only in this serial conception of derivation, which most theorists no longer see as an appropriate view of grammar.

It then follows that the ill-formedness of (222a) should carry no explanation in the licensing model. Given that lexical representations are fully syllabified and that this syllabification remains intact according to Structure Preservation, it is redundant to assume the precedence relation $x_i \ll x_j$ independently of the head-dependent relation holding between $x_i$ and $x_j$; in a literal sense, an 'interconstituent' relation should be inconceivable within a 'constituent'. Here, let us recall the discussion in §2.2.1 with respect to 'the more constrained nature of the graphical representation' entertained by Kahn (1976). If we follow his line of argument, $x_j$ is simply interpreted before $x_i$ in (222a) because constituent p-licensing must be head-initial, and whether we would ever wish to use this somewhat counter-intuitive representation is a different matter.

This point is being made explicit in the present theory by making it impossible for representations to separate precedence from dependency. According to (220ab), if two positions $x_i$ and $x_j$ hold an en-dependency relation $x_i \Rightarrow x_j$, $x_i$ is interpreted immediately before $x_j$; in much the same way, if the two positions enter into an ex-dependency relation $x_i \Leftarrow x_j$, $x_i$ is interpreted after $x_j$. I mentioned in earlier sections that the absence of constituents leads to the loss of the contexts in which Directionality can impose structural restrictions, making it difficult to rule out a representation such as (222a). In direct
contrast, however, the exclusion of constituents reintroduces the need to recognise the
two types of dependency, and the distinction put forward in (220) can offer a
redundancy-free mode of representation. Given the restrictive nature of the proposed
model, the Directionality constraint becomes no longer necessary. Consider the ternary
structure (223a), which is rejected in the licensing model because it fails to conform to
Directionality (X represents any constituent).

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{figure223.png}
\caption{(a) \quad (b) }
\end{figure}

The same structure cannot be represented in terms of en-/ex-dependency; a position with
two dependents in antagonistic directions, as shown in (223b), is regarded as the head of
two independent domains $x_i \rightarrow x_i$ and $x_j \Rightarrow x_k$. Consequently, Directionality is dispensed
with in the present theory.

I have introduced a formal distinction between two types of dependency relation,
this distinction being necessary for organising syllabic structure without recourse to
constituency. The two types essentially assume the same directions and locality
requirements as the corresponding relations in the licensing model, but, within a context
devoid of constituents, the proposed relations come closer to achieving a redundancy-free
mode of representation.

**4.4.2 Intrinsic locality**

The interaction of Locality and Directionality brings about a restriction of maximal
binarity on syllabic constituents in the licensing model. However, I have shown that the
proposed mode of representation is sufficiently constrained without Directionality.
Taking this argument further, the question naturally arises as to whether Locality is still
independently required. In this section, I will claim that the effect of Locality, just like
Directionality, is a derived effect, rather than a primitive of the theory.

To demonstrate the redundancy of Locality we must follow essentially the same
line of thinking as that adopted in the previous section. Immediate precedence is the
direct consequence of en-dependency that parallels constituent p-licensing. Given this
premise, a configuration such as (224) need not be ruled out as being ill-formed.
This representation contains an arbitrary number of positions $x_i$, $x_{i+1}$, ..., and $x_{i+n}$, of which $x_i$ and $x_{i+n}$ hold an en-dependency relation $x_i \Rightarrow x_{i+n}$. Using the same logic that was used to show the redundancy of Directionality, I argue that this representation tells us nothing more than the fact that $x_i$ immediately precedes $x_{i+n}$ in phonetic interpretation in accordance with (220a). In fact, even if positions 'inside' an en-dependency domain were posited in a representation — leaving aside the question of how this state of affairs could be motivated at all — Structure Preservation would never allow such stranded positions to be on a sound dependency path. I assume that the notion of soundness follows from the Licensing Principle: dependency paths are sound if they originate from the ultimate head of a domain. Therefore, those bypassed positions would never be licensed and would thus never be phonetically interpreted, their presence being highly questionable in the first place. This way, (224) may be superfluous in a more metatheoretical sense, but I claim that it does not amount to a case of Locality violation.

Ex-dependency need not be constrained by Locality either, although this relation is not a perfect mirror image of en-dependency. Consider the following configuration.

(225) 

Positions in ex-dependency assume a strict but not necessarily immediate precedence, as stated in (220b). Therefore, the above representation ensures that $x_{i-n}$ is interpreted before $x_i$, but does not exclude the possibility of other positions intervening between them; as shown below, those other positions can be phonetically interpreted, if they are on a sound dependency path, without causing the locality problem of the ex-dependency relation between $x_{i-n}$ and $x_i$. Accordingly, it is not necessary to extrinsically impose the locality restriction on either of the proposed dependency types in the present theory.

For that matter, there does not seem to be a case in which only locality matters, even in the licensing model. Consider the representation (226) below, which indicates the presence of a stranded position $x_j$ between $x_i$ and $x_k$ at a level of projection.

(226) 

...$x_i$ ...$x_j$ ...$x_k$...
The violation of Locality is invoked in this representation on the basis of the apparent precedence relation \( x_i \ll x_j \ll x_k \). As argued in the previous chapter, however, no explanation is gained by positing a precedence relation such as this independently of dependency relations in a non-transformational model such as the licensing model. In light of Kahn's understanding of the 'constrained nature of the graphical representation', (226) can be regarded not as an ill-formed representation that violates Locality but as a well-formed one that simply allocates the interpretation of \( x_i \) before \( x_k \).

I suggest that this way of understanding should make more sense when it comes to the representation of \( \text{là amie} \) (194a), reproduced below as (227a).

Let us assume, following Charette (1991), that OCP deprives the nucleus \( x_2 \) of its capacity to \( p \)-license an onset, leaving aside the problem of the floating onset and the alternative analysis suggested in the previous section. A question that was left untouched in the previous section is how the representation (227a) induces the phonetic interpretation \( \text{lari} \). If \( x_2 \) is effectively 'deleted', \( x_1 \) can no longer be licensed and should thus be uninterpreted. Charette (1991: 90) shows that (227a) becomes (227b), in which the orphaned \( x_1 \) is now \( p \)-licensed by the nucleus \( x_3 \). Although she does not explicitly mention the mechanism, in accordance with Structure Preservation (or the Projection Principle), \( x_2 \) and the floating onset should not have been literally removed from the representation to make \( x_1 \) and \( x_3 \) adjacent at the head projection (cf. Polgardi 1998). Rather, (227a) should be construed as (227c); I claim, in an Optimality Theoretic way, that, given the orphaned onset \( x_1 \), on the one hand, and the nucleus \( x_3 \) with an empty onset, on the other, a \( p \)-licensing path is assigned from \( x_3 \) to \( x_1 \) in order to keep as many components on sound \( p \)-licensing paths as possible. If we retain Locality in its original form as a universal principle, (227b) would be the result of a process that involves some transformation from (227a), as pointed out by Brockhaus (1995: 212); this not only contradicts Structure Preservation but also seriously undermines the restrictiveness of the framework.
The proposed understanding of locality also allows us to solve the problem raised in §3.2.2 (cf. Footnote 6 in Chapter 3). Recall that Billiri and Kaltungo, the two dialects of Tangale, differ in the priority each give to proper government and government licensing; this difference is reflected in the interpretation of /landa+zi/: lanzi in Billiri and landa\u2011zi in Kaltungo. The following representations, reproduced from (21) in Chapter 3, illustrate the respective licensing analyses.

\[(228)\hspace{1cm}(a)\]

\[
\begin{array}{c}
\text{O} \text{R} \text{O} \text{R} \text{O} \text{R} \\
\text{N} \text{N}_i \text{N}_j \\
\text{x} \text{x} \text{x} \text{x} \text{x} \text{x} \text{x} \\
\Rightarrow \\
\text{a n d a z i}
\end{array}
\]

\[(b)\]

\[
\begin{array}{c}
\text{O} \text{R} \text{O} \text{R} \text{O} \text{R} \\
\text{N} \text{N}_i \text{N}_j \\
\text{x} \text{x} \text{x} \text{x} \text{x} \text{x} \\
\Rightarrow \\
\text{a n d a z i}
\end{array}
\]

The problem arises with respect to the Billiri case (228a). According to Charette (1991: 112), Billiri opts for proper government, so the stem-final nucleus Nj, properly governed by the suffix nucleus Nj, cannot government-license the preceding onset; and this results in d being left out of the phonetic interpretation. However, it is not clear why the coda n can still be p-licensed by the following onset d, which is not allowed to govern a dependent. The representation (228a) poses another, even more serious problem. Implicit in the above account is the assumption that an uninterpreted onset head could p-license a coda. This would permit an intervocalic and word-final consonant to be syllabified in two ways; for example, the English words bet and better could be syllabified as be.t0 or bet.00 and as be.ta or bet.0a, respectively. A more plausible consequence of proper government would be the following interpretation.

\[(229)\]

\[
\begin{array}{c}
\text{O} \text{R} \text{O} \text{R} \text{O} \text{R} \\
\text{N} \text{N}_i \text{N}_j \\
\text{x} \text{x} \text{x} \text{x} \text{x} \text{x} \\
\Rightarrow \\
\text{a n d a z i}
\end{array}
\]

In (229), it is the coda n that should be left unparsed instead of d because the properly governed nucleus Nj may not government-license but should still be able to p-license the
preceding onset. However, the phonetic interpretation *la.\_d0.\_zi is not the attested Billiri variant.

An alternative analysis of the dialectal variation would be that Kaltungo gives priority to the parsing of as many melodic units as possible, like MAX-IO in Optimality Theory, while Billiri, parallel to Mokilese discussed in §4.1, requires empty nuclei to be licensed according to the Empty Category Principle (this excludes unlicensed empty nuclei receiving phonetic interpretation). (228b) still represents lan.\_du.\_zi in Kaltungo, but the retention of government-licensing at the expense of proper government is now motivated by a different reason: all melodic units in the representation reside on licensing paths and are thus phonetically interpreted in this licensing analysis, satisfying the above requirement. On the other hand, I argue that the Billiri variation lan.\_zi stems not from (229) but from the following licensing analysis.

(230)

\[
\begin{array}{cccc}
O & R & O & R \\
N & N_i & N_i \\
[ \_ \_ \_ \_ \_ ] \\
\_ \_ \_ \_ \_ \\
\_ \_ \_ \_ \_ \_ \\
\_ \_ \_ \_ \_ \\
\end{array}
\]

In (230), the coda \( n \) is p-licensed by the suffix onset \( z \), which is government-licensed by the following nucleus. In much the same way as (227c) above, the assignment of p-licensing as indicated by the arrow does not cause the problem of locality but ensures that \( n \) and \( z \) form a coda-onset sequence (i.e. the interpretation of \( z \) follows that of \( n \)), thereby causing the stem-final syllable to be left stranded. In this licensing analysis, the stem-final empty nucleus does not merely fail to be properly governed but falls outside the licensing structure. I claim that positions not located on sound licensing paths have no bearing on the well-/ill-formedness of representations and are effectively stray-erased (i.e. i.e. leave no trace in phonetic interpretation) — the presence of such positions still matter in terms of faithfulness. Accordingly, the requirement that empty nuclei must be licensed in Billiri is vacuously satisfied in (230) by virtue of the absence of empty nuclei on any licensing path. Here, note that the licensing analysis (229) also satisfies this

\[\text{In Optimality Theoretic terms, if we assume that phonetically interpreted empty nuclei incurs a violation of DEP-IO as a case of epenthesis, the difference between Kaltungo and Billiri boils down to the difference in ranking of MAX-IO and DEP-IO.}\]
requirement by licensing the stem-final empty nucleus through proper government; the two representations (229) and (230) thus make competing output candidates in an Optimality Theoretic sense. I assume that the relative well-formedness of lan.zi over *la.d0.zi is determined by the Contiguity constraint, which also plays a role in Mokilese as shown in §4.1. That is, a parsed string must be a substring of the lexical representation in order to achieve a higher degree of correspondence; the sequence lan can be found in the lexical representation of landa, but lad cannot, so lan.zi is the optimal interpretation of /landa+zi/.

As illustrated in the above analyses, the notion of locality as an intrinsic property of dependency enjoys certain advantages, and this may well motivate us to discard the extrinsic Locality constraint. The above analyses of the French article and Billiri suffixation may seem to infringe Structure Preservation since they allow the assignment of licensing paths that are absent in lexical representations. Nevertheless, notice that additional paths appear only in a derived environment, crossing over a morphological boundary. I will discuss this issue in the next chapter and argue that this should not be regarded as an instance of Structure Preservation.

### 4.4.3 Unique Path

The previous section showed that, like Directionality, Locality cannot be adequately motivated in a no-rule theory such as the licensing model. I thus argue that Locality and Directionality should both be excluded from the inventory of well-formedness constraints, in favour of the redundancy-free mode of representation. Unlike Directionality, however, Locality may seem to be necessary when it comes to maintaining the maximal binarity restriction of dependency relations. Consider the following configurations (X represents any constituent).

(231) (a) \[ X \quad X \quad X \]

(b) \[ X \quad X \quad X \]

(c) \[ X \quad X \quad X \]

The licensing model permits (231a) as the only legitimate structure of a branching constituent in light of Locality, but I have been claiming that (231b) should also be well formed, although the two representations differ in their phonetic interpretations. Given that both (231a) and (231b) are legitimate, it may seem to follow that a ternary branching constituent such as (231c) should also be well formed in representational terms, resulting
in a lifting of the binarity restriction. The well-formedness of (231c) would also entail that interconstituent p-licensing could be ternary, permitting a nucleus to p-license two onsets, for example. This state of affairs would certainly be far from restrictive.

Note that we cannot deduce the well-formedness of (231c) from the legitimacy of (231ab) in the en-/ex-dependency model. The argument against the ternary (or n-nary) constituent in accordance with Locality attributes the ill-formedness of (232c) to that of (231b); that is, the representation (232c) is ill-formed because it contains the non-local licensing path between $x_i$ and $x_k$. It is the precedence relation $x_i \ll x_j \ll x_k$ that gives rise to the alleged non-adjacency. However, precedence is not assumed to exist independently of dependency in the present theory, as discussed above. Let us consider the following configurations that seemingly correspond to those in (231), respectively.

$$(232) \begin{align} (a) & \quad x_i \quad \stackrel{\rightarrow}{x_j} \quad x_k \\ (b) & \quad x_i \quad \stackrel{\rightarrow}{x_j} \quad x_k \\ (c) & \quad x_i \quad \stackrel{\rightarrow}{x_j} \quad x_k \end{align}$$

Under the conception that precedence is intrinsic to dependency, the ill-formedness of (232c) has nothing to do with (232b); rather, the problem of the representation (232c) is that, adhering to the definition of en-dependency (220a), both $x_j$ and $x_k$ must immediately follow $x_i$ in phonetic interpretation. If the horizontal axis were assumed to correspond to time, (232c) should be represented as (233a).

$$(233) \begin{align} (a) & \quad x_i \quad \small\nearrow \quad x_j \quad \small\nearrow \quad x_k \\ & \quad \text{time} \\ (b) & \quad X \quad \small\nearrow \quad x_j \quad \small\nearrow \quad x_k \\ & \quad \text{time} \end{align}$$

The two en-dependency relations $x_i \Rightarrow x_j$ and $x_i \Rightarrow x_k$ enforce the simultaneous relation between $x_j$ and $x_k$. This would amount to positing a constituent structure such as (233b), although this has never been seriously argued for in any template-based model of syllabic structure. The simultaneous relation is implausible for a rather obvious reason: positions, which represent phonological timing, should be related to each other asynchronously, although this assumption is rarely stated explicitly. Representations such as (233ab) are not phonetically interpretable; or put more appropriately, they are 'nonsensical', borrowing the expression from Kahn (cf. §2.2.1). Therefore, I argue that the proposed model cannot represent ternary (or n-nary) en-dependency relations, and this argument
should be valid to the extent that the representation (232c)/(233a) is as inconceivable as (233b).

The ill-formedness of ternary ex-dependency relations involves somewhat different arguments, for the precedence derived by this dependency need not be immediate, as defined in (220b). Let us first consider the representation (234a) below, which shows two ex-dependency relations $x_j \rightarrow x_k$ and $x_j \leftarrow x_k$.

![Diagram](none)

I claim that the two relations in (234a) still enforce the simultaneous relation between $x_i$ and $x_j$, as shown in (234b), although neither of the positions is required to immediately precede $x_k$ in phonetic interpretation. The representation (234a) does not specify any dependency between $x_i$ and $x_j$, so the two positions should be regarded as equally (exocentrically) dependent on $x_k$, giving rise to their simultaneous occurrence. An attempt to resolve this simultaneous relation into an asynchronous one, deriving either $x_i < x_j < x_k$ or $x_j < x_i < x_k$, is bound to be arbitrary because it would have to create a precedence relation between $x_i$ and $x_j$ which is phonologically undesignated. This arbitrariness must be excluded from a metatheoretical point of view. Therefore, (234a) is inconceivable for the same reason that the ternary en-dependency relation in (233a) is must be.

The discussion so far should have demonstrated that maximal binarity emerges from the intrinsic properties of en-/ex-dependency. Nevertheless, the proposed model can assign apparently well-formed ternary ex-dependency relations with the aid of an additional en- or ex-dependency path, as shown below.

![Diagram](none)

The representation (235a) shows three ex-dependency relations $x_i \rightarrow x_j$, $x_i \leftarrow x_k$ and $x_j \leftarrow x_k$, which derive the precedence relation $x_i < x_j < x_k$, including a transitive relation $x_i < x_k$, without invoking any simultaneous or contradictory relation. Likewise, (235b)
comprising the en-dependency relation \( x_i \Rightarrow x_j \) and the ex-dependency relations \( x_i \leftarrow x_k \) and \( x_j \leftarrow x_k \) derives \( x_i \ll x_j \ll x_k \), including \( x_i \ll x_k \) transitively. The configuration (235a) would translate into either (236a) or (236b), and the equivalent to (235b) would be (236c), given that the en-/ex-dependency distinction effectively corresponds to that between constituent and interconstituent p-licensing in the licensing model.

Neither of these representations could be well formed. If the proposed model is to be no less restrictive than the licensing model, it must be able to put the ill-formedness of the dependency relations in (235) beyond doubt. Although I have been emphasizing the redundancy-free nature of the en-/ex-dependency model, it is not restrictive enough to intrinsically rule out superfluous representations, so the present theory must have recourse to an extrinsic well-formedness constraint.

Recall that (236c) was already discussed in §4.3 when the elimination of the nucleus-rhyme distinction rendered the Minimality Condition ineffective in preventing a nucleus head from p-licensing a preceding onset dependent. As a possible alternative to effectively replace the Minimality Condition, I suggested in (213) that a position should be able to p-license another position at most once in each direction. If we adapted this constraint for en-/ex-dependency, to which headedness directions are intrinsic, it would restrict any dependency relation to maximally binary; i.e. a head may have no more than one dependent in both en-/ex-dependency domains. This constraint certainly excludes the redundant representations in (235) as we would wish, but it is rejected here for the following two reasons. First, as pointed out in §4.3, it invokes the notion of counting (i.e. 'only one, not two or more'). Second, it fails to capture the fact that ternary ex-dependency is possible only when an additional path exists; without such a path, the notion of en-/ex-dependency suffices to intrinsically exclude a dependency domain with two (or more) dependents, as discussed above.

Instead, drawing on the notion of a proper tree in the dependency model (cf. §2.3.2), I propose the following constraint:
(237) Unique Path

Let α and β be positions. A dependency path from α to β must be unique within a domain.

As stated in the second reason above, ternary ex-dependency relations rely crucially on the presence of an additional path, which inevitably creates a circuit in the resulting dependency structure. As a result, there exist two routes from \( x_k \) to \( x_i \) in (235a): \( x_k \rightarrow x_i \) and \( x_k \rightarrow x_j \rightarrow x_i \). Likewise, (235b) shows two different paths from \( x_k \) to \( x_j \): \( x_k \rightarrow x_j \) and \( x_k \rightarrow x_i \rightarrow x_j \). The above constraint attributes the ill-formedness of these representations to the very presence of a circuit resulting from such parallel paths.

Unique Path is more than just an ad hoc solution to the problem of the redundant representations. Consider the following configuration, reproduced from (212), which shows a sequence of two syllables with maximally expanded licensing relations.

(238)

A well-formed representation such as (238) never contains a circuit of licensing paths, but the absence of a circuit is no more than epiphenomenal in the licensing model. However, recall that it is a corollary of necessary conditions for a proper tree in the dependency model (cf. §2.3.2). The notion of a proper tree comes originally from Marcus (1967: 205), who explicitly states that a proper tree 'has no circuit'. Anderson (1986: 74ff) explores ways of implementing the relevant restriction under the Single Path Condition, which deletes parallel paths, and the Modifier Convention, which protects a dependent from the assignment of any further dependency relation in subsequent rules. Unique Path is yet another such attempt in the context of the en-/ex-dependency model; reference to the uniqueness of paths harks back directly to the theory of trees in Graph Theory (cf. Berge 1962, Berge & Ghouila-Houri 1965), which provides the foundation of the argument by Marcus. Not only does the constraint inherit the notion of a proper tree, but also this constraint explicitly captures the generalisation that is missed in the licensing model.
**4.4.4 Syllabic structure**

I have argued thus far that well-formed representations comprise positions entering into en-/ex-dependency relations in compliance with Unique Path. This section endeavours to show that the above assumption, with two additional constraints proposed below, derives syllabic structure in a way that is at least as restrictive as that in the licensing model.

To begin with, let us remind ourselves of the en-/ex-dependency distinction and related notational conventions. En-dependency, indicated by the operator \( \Rightarrow \), is a primitive relation in which the dependent is a persistent non-head and immediately follows its head in phonetic interpretation. Ex-dependency, denoted by the operator \( \Rightarrow \), is a relation holding between two positions belonging to different en-dependency domains, and the dependent is phonetically interpreted (not necessarily immediately) before its head.\(^\text{90}\) For the purposes of further reference, this distinction is set out in the following four statements.

(239) Let \( \alpha \) and \( \beta \) be positions.

(a) If \( \alpha \Rightarrow \beta \), then \( \beta \) is a persistent non-head.
(b) If \( \alpha \Rightarrow \beta \), then \( \alpha \ll \beta \).
(c) If \( \alpha \ll \beta \), then \( \alpha \) and \( \beta \) belong to different en-dependency domains.
(d) If \( \alpha \ll \beta \), then \( \alpha \ll \beta \).

The symbols \( \ll \) and \( < \) are to be read as 'precede strictly and immediately' and 'precede strictly but not necessarily immediately', respectively. Let me also note the following statement.

(240) Let \( \alpha \) and \( \beta \) be positions. If \( \alpha \neq \beta \), then \( \alpha \neq \beta \).

The statement (240) purports to make it explicit that positions, if not identical, must be asynchronous in phonetic interpretation, the assumption that is widely but implicitly held in the literature, as mentioned in the previous section. I will use the symbols \( =/\neq \) to denote the state of being identical/non-identical phonologically, and \( \equiv/= \) to indicate phonetic synchronism/asynchronism.

\(^\text{90}\) It should also be noted that the SEA condition (205) applies to ex-dependency relations in the present model.
4 A farewell to constituency

Given the two types of dependency, (241) exhausts the identities that a position $x_i$ may assume in a representation.

(241) (a) $x_i(=x_{i+1})$ : $x_i$ is an en-dependency head (EN-HEAD)

(241) (b) $x_{i+1}=x_i$ : $x_i$ is an en-dependency dependent (EN-DEP)

(241) (c) $x_{i+1}=x_i$ : $x_i$ is an ex-dependency head (EX-HEAD)

(241) (d) $x_i=x_{i+1}$ : $x_i$ is an ex-dependency dependent (EX-DEP)

A position may assume two of these identities simultaneously, but not every combination is possible, as shown below (impossible combinations are indicated by asterisks).

(242) (a) $*(x_i=x_{i+1} \land x_i=x_{i+2})$ : en-head and en-head

By (239b), $x_i \ll x_{i+1}$ and $x_i \ll x_{i+2}$ because $x_i=x_{i+1}$ and $x_i=x_{i+2}$, respectively; thus $x_{i+1}=x_{i+2}$ (cf. §4.4.2). However, by (240), $x_{i+1} \neq x_{i+2}$ because $x_{i+1} \neq x_{i+2}$. Hence, this representation is ill formed.

(242) (b) $*(x_{i-1}=x_i \land x_i=x_{i+1})$ : en-head and en-dep

By (239a), $x_i$ is a persistent non-head because $x_{i-1}=x_i$. However, $x_i$ acts as a head in $x_i=x_{i+1}$. Hence, this representation is ill formed.

(242) (c) $(x_{i-1}=x_i \land x_i=x_{i+1})$ : ex-head and ex-head

This representation is well formed.
4 A farewell to constituency

(d) (i) \( *(x_i \Rightarrow x_{i+1} \land x_i \leftarrow x_{i+1}) : \text{en-head and ex-dep (1)} \)

\[ \xymatrix{ x_i \ar[r] & x_{i+1} \ar[l] } \]

By (239a), \( x_{i+1} \) is a persistent non-head because \( x_i \Rightarrow x_{i+1} \). However, \( x_{i+1} \) acts as a head in \( x_i \leftarrow x_{i+1} \). Hence, this representation is ill formed.

(ii) \( (x_i \Rightarrow x_{i+1} \land x_i \leftarrow x_{i+2}) : \text{en-head and ex-dep (2)} \)

\[ \xymatrix{ x_i \ar[r] & x_{i+1} \ar[l] & x_{i+2} } \]

This representation is well formed.

(e) \( *(x_{i-2} \Rightarrow x_i \land x_{i-1} \Rightarrow x_i) : \text{en-dep and en-dep} \)

\[ \xymatrix{ x_{i-2} \ar[r] & x_i \ar[l] & x_{i-1} } \]

By (239b), \( x_{i-2} \ll x_i \) and \( x_{i-1} \ll x_i \) because \( x_{i-2} \Rightarrow x_i \) and \( x_{i-1} \Rightarrow x_i \), respectively; thus \( x_{i-2} \equiv x_{i-1} \) (cf. §4.4.2). However, by (240), \( x_{i-2} \not\equiv x_{i-1} \) because \( x_{i-2} \not\equiv x_{i-1} \). Hence, this representation is ill formed. An en-dependency relation is maximally binary as a corollary of (242a) and (242e).

(f) (i) \( *(x_{i-1} \Rightarrow x_i \land x_{i-1} \leftarrow x_i) : \text{en-dep \& ex-head (1)} \)

\[ \xymatrix{ x_{i-1} \ar[r] & x_i \ar[l] } \]

By (239a), \( x_i \) is a persistent non-head because \( x_{i-1} \Rightarrow x_i \). However, \( x_i \) acts as a head in \( x_{i-1} \leftarrow x_i \). Hence, this representation is ill formed.

(ii) \( *(x_{i-1} \Rightarrow x_i \land x_{i-2} \leftarrow x_i) : \text{en-dep \& ex-head (2)} \)

\[ \xymatrix{ x_{i-2} \ar[r] & x_{i-1} \ar[l] & x_i } \]

By (239a), \( x_i \) is a persistent non-head because \( x_{i-1} \Rightarrow x_i \). However, \( x_i \) acts as a head in \( x_{i-2} \leftarrow x_i \). Hence, this representation is ill formed.

(g) \( (x_{i-1} \Rightarrow x_i \land x_i \leftarrow x_{i+1}) : \text{en-dep \& ex-dep} \)

\[ \xymatrix{ x_{i-1} \ar[r] & x_i \ar[l] & x_{i+1} } \]

This representation is well formed.
(h) *(x_{i-2} \leftarrow x_i \land x_{i-1} \leftarrow x_i) : ex\text{-}head \& ex\text{-}head

By (239d), x_{i-2} < x_i and x_{i-1} < x_i because x_{i-2} \leftarrow x_i and x_{i-1} \leftarrow x_i, respectively. We infer x_{i-2} \equiv x_{i-1} in the absence of any dependency between x_{i-2} and x_{i-1} (cf. §4.4.2). However, by (240), x_{i-2} \not< x_{i-1} because x_{i-2} \not\equiv x_{i-1}. Hence, this representation is ill formed. Even if x_{i-2} and x_{i-1} hold a dependency relation as shown below,

(i) *(x_{i-2} \leftarrow x_{i-1} \land x_{i-1} \leftarrow x_i)

(ii) *(x_{i-2} \leftarrow x_{i-1} \land x_{i-1} \leftarrow x_i)

this additional relation creates a circuit of dependency paths, thereby contravening Unique Path (237); x_i \rightarrow x_{i-2} \leftarrow x_{i-1} \leftarrow x_i in (242hi) and x_i \rightarrow x_{i-2} \Rightarrow x_{i-1} \leftarrow x_i in (242hii). Hence, these representations are both ill formed.

(i) (x_{i-1} \leftarrow x_i \land x_i \leftarrow x_{i+1}) : ex\text{-}head \& ex\text{-}dep

This representation is well formed.
(j) \((x_i \leftarrow x_{i+1} \land x_i \leftarrow x_{i+2})\) : ex-dep & ex-dep

\[ \begin{array}{c}
\bullet \\
x_i \rightarrow_1 x_{i+1} \\
x_i \rightarrow_2 x_{i+2}
\end{array} \]

By (239d), \(x_i < x_{i+1}\) and \(x_i < x_{i+2}\) because \(x_i \leftarrow x_{i+1}\) and \(x_i \leftarrow x_{i+2}\), respectively. We infer \(x_{i+1} \equiv x_{i+2}\) in the absence of any dependency between \(x_{i+1}\) and \(x_{i+2}\) (cf. §4.4.2). However, by (240), \(x_{i+1} \not\equiv x_{i+2}\) because \(x_{i+1} \not\equiv x_{i+2}\). Hence, this representation is ill formed. Even if \(x_{i+1}\) and \(x_{i+2}\) hold a dependency relation as shown below,

(i) \[ \begin{array}{c}
\bullet \\
x_i \rightarrow_1 x_{i+1} \\
x_i \rightarrow_2 x_{i+2}
\end{array} \]

(ii) \[ \begin{array}{c}
\bullet \\
x_i \rightarrow_1 x_{i+1} \\
x_i \rightarrow_2 x_{i+2}
\end{array} \]

this additional relation creates a circuit of dependency paths, thereby contravening Unique Path (237); \(x_{i+2} \leftarrow x_i \leftarrow x_{i+1} \leftarrow x_{i+2}\) in (242hi) and \(x_{i+1} \Rightarrow x_{i+2} \leftarrow x_i \leftarrow x_{i+1}\) in (242hii). Hence, these representations are both ill formed. An ex-dependency relation is maximally binary as a corollary of (242h) and (242j).

The well-formedness of (242i) is in contrast to the ill-formedness of (242b); it follows that ex-dependency can be recursive, allowing the unlimited extension of ex-dependency paths as shown below.

(243) \[ \begin{array}{c}
\bullet \\
x_i \rightarrow_1 x_{i+1} \\
x_i \rightarrow_2 x_{i+2} \\
x_i \rightarrow_{i-1} x_{i-1} \\
x_i \rightarrow_{i-2} x_{i-2} \\
x_i 
\end{array} \]

Recall that Anderson (1986: 72) proposes the Syllable Depth Condition to constrain a possibly infinite chain such as (243) by restricting the dependency from the root to two degrees (cf. §2.3.2). Notice that this constraint also holds in the licensing model; in the representation (238) with maximally extended licensing paths, no terminal position goes beyond two degrees of p-licensing from the ultimate head of a domain. The present theory adapts the condition without invoking the notion of counting as follows.

(244) Head licensing condition

Head licensing potential is not inherited.
Head licensing potential, designated as a particular type of p-licensing potential, is the ability of a position to have a head of an external domain as its dependent. Let me illustrate how this constraint restricts the extension of ex-dependency paths.

In (245a), the (ultimate) head \( x_i \) has the full stock of licensing potential including head licensing potential at its disposal — except for the a-licensing potential for stricture elements, which is not ready for discharge according to (205), but which need not concern us here. The dependent \( x_{i-1} \) thus can be either a head or a dependent of another en-dependency domain that excludes \( x_i \), as shown in (245bc). However, if \( x_{i-1} \) is to act as an ex-head of another position \( x_{i-2} \) to form another ex-dependency relation (246a), \( x_{i-1} \) must be an en-head (246b); if not, the resulting representation (246c) contains the an ill-formed relation (242fii).

By (244), \( x_{i-1} \) does not inherit head licensing potential, so \( x_{i-2} \) cannot be an en-head (247a) but must be an en-dep (247b).

Then, \( x_{i-2} \) in (247b) cannot be an ex-head of yet another ex-dependency domain (e.g. \( x_{i-3} \rightarrow x_{i-2} \)) for the same reason that (246c) is ill-formed. Hence, ex-dependency paths cannot be extended more than two degrees from the ultimate head.

Given the well-formed dependency relations illustrated above, let us consider how the constituent structures in the licensing model can be effectively represented in the present model. The en-dependency domains \( x_i (\Rightarrow x_j) \) in the representations (248a-c) correspond to the nucleus, the onset and the rhyme, respectively.
The parameters that determine whether a language allows the three constituents to branch can be reformulated in terms of whether an en-dep can appear in each of the designated environments. Note that, in the absence of the categorial labels, the relevant distinction can be made only if the dependency context is given; $x_i \rightarrow x_k$ (i.e. onset licensing) is necessary for the identity of an 'onset' in (248b), while $x_j \rightarrow x_k$ (i.e. coda licensing) distinguishes (248c) from (248a). This state of affairs underscores the redundancy-free nature of the en-/ex-dependency model. The constraints Onset Licensing and Coda Licensing must be postulated in the licensing model to exclude an onset without a following nucleus and a rhyme without a following onset from representations, but the en-/ex-dependency model cannot describe the equivalent configurations. I already claimed in §4.3 that Coda Licensing should be subsumed under Licensing Inheritance; the proposed model also dispenses with Onset Licensing.

Although I have been emphasizing the redundancy-free nature of the proposed model, another extrinsic constraint, in addition to Unique Path and the head licensing condition, is necessary in order to implement the idea that representations of syllabic structure contain sequences of an onset and a nucleus. As observed in Chapter 2, it seems to have been taken for granted that the nucleus or the mora is the only obligatory component of a syllable. However, in §4.2.2, I quoted Charette (1991: 25-26) as arguing that 'an interconstituent governing relation between a nucleus and a preceding onset is always present'. This amounts to positing that both the onset and the nucleus are obligatory in a syllable, given that onsets, as well as nuclei, can be empty. This assumption allows us to entertain a somewhat different interpretation of the constraint ONSET discussed in the previous chapter. In §3.4.4, I claimed that this constraint requires every nucleus to p-license an onset. If an onset is categorically present before a nucleus, what ONSET prescribes is that such an onset must have melodic content. To consider the absence of an onset as being marked amounts to nothing more than stipulation, yet the presence of empty positions is assumed to be marked in a more general sense; their appearance must be sanctioned by relevant active parameter settings and, even if permitted, the phonetic interpretation of empty positions is strictly controlled by the
Empty Category Principle. Considering this theory-internal advantage, the present theory adopts Charette's argument and restates it as follows.

(249) Syllabic structure comprises en-heads in ex-dependency.

I will call this ex-dependency relation, which is equivalent to the interconstituent p-licensing between an onset and a following nucleus, the CORE DEPENDENCY of syllabic structure. I stated above that (245a), reproduced in (250a), in which $x_i$ is the ultimate head of a domain (i.e. the nucleus head), can be analysed either as (250b) or as (250c).

(250) (a) (b) (c)
\[ x_{i-1} \rightarrow x_i \quad (x) \quad x \rightarrow x_{i-1} \rightarrow x_i \]

However, considering that $x=x_{i-1}$ in (250c) is equivalent to a rhyme constituent in the licensing model, as shown in (248c), (250c) denotes the state of affairs in which a coda is directly licensed by a following nucleus head. This configuration is excluded by (249), which ensures that (250a) can only be analysed as (250b) if $x_i$ is the ultimate head. The assumption (249) also allows us to circumvent the problem mentioned in §3.4.4, where I raised the question of whether the difference between the following configurations should be redundantly invoked.

(251) (a) (b)
\[
\begin{array}{c}
N' \\
O \\
x
\end{array}
\quad \quad
\begin{array}{c}
O' \quad N' \\
O \\
x \\
x
\end{array}
\]

The representation (251a) shows that the onset is p-licensed at the syllabic level, while (251b) indicates that the onset is not p-licensed at this level and is projected onto the foot level at which it is p-licensed. The latter case is ruled out by (249) since the core dependency between the onset and the following nucleus must be present at the syllabic level.

Based on the discussion so far, the representation of a sequence of two syllables with maximally expanded dependency paths in the en-/ex-dependency model (252a) shows the same dependency relations as that in the licensing model (212), reproduced as (252b) below.
Any addition or change to the dependency relations in (252a) results in the creation of ill-formed paths; therefore, the proposed model should be as restrictive as the licensing model in its descriptive power. Notice that the dual-level representation in (252b) is not necessary in (252a). Given the interpretation of locality as an intrinsic property of dependency, there is no need to posit the level of representation on which heads are ensured to be adjacent. I do not suggest that the notion of projection should be discarded altogether; I assume that this notion, or the alternative notion of display, as proposed in Clements & Keyser (1983), should play an important role in prosodic phenomena such as stress discussed in the previous chapter. However, at least within syllabic structure, the multi-storey mode of representation derived from projection, or subjunction in the dependency model, seems to be safely excluded without losing any generalisations.

In this section, I have demonstrated that the en-/ex-dependency model achieves the same degree of restrictiveness as the licensing model. Representations of syllabic structure are constructed solely in terms of dependency relations without recourse to constituency. The crucial information provided by the representation (252a), for example, is that the structure comprises two core dependency relations $X_1 \rightarrow X_3$ and $X_5 \rightarrow X_7$ with the extended paths $X_1 \Rightarrow X_2$, $X_3 \Rightarrow X_4$, $X_4 \leftarrow X_5$, $X_5 \Rightarrow X_6$, $X_7 \Rightarrow X_8$. The present theory has to stipulate three well-formedness constraints, but representations are mostly constrained in such a way that only well-formed ones are phonetically interpretable in accordance with the notion of en-/ex-dependency stated in (239). The stipulation of the constraints should not be so costly as to undermine the theory being proposed here. It is true that Unique Path (237) and the head licensing condition (244) need to be invoked to compensate for the loss of constituents, but these constraints in fact recapture specific generalisations that have been missed in the licensing model. The notion of the core dependency (249) is also not a new proposal, but rather, an explicit restatement of an assumption held in the licensing model. Furthermore, the present theory dispenses with Locality, Directionality, Onset Licensing, Coda Licensing, the Minimality Condition and the government convention, as has been discussed in this chapter. Above all, I argue that the
redundancy-free way of constraining syllabic structure in the proposed theory, which is inspired by the Kahnian notion of the constrained nature of the graphical representation, should receive further investigation.

Although the proposed model develops from the licensing model, resting on premises which include the theory of empty categories framed by Government Phonology, the theoretical assumptions I have put forward in order to achieve a mode of representation without constituents draw heavily on the tenets of the dependency model; the notion of en-/ex-dependency, Unique Path and the head licensing condition all owe their origins to this model. Indeed, the following representation couched in the dependency model, in which solid and dotted arcs represent en-dependency and ex-dependency, respectively, can be just as appropriate as (252a).

(253)

Considering that the concept of Syllable Theory without formal constituents harks back to the dependency model, there should be ample motivation to explore further theoretical and empirical implications of the proposed model in the context of an output-oriented version of Dependency Phonology. Of particular interest would be the investigation of whether the arguments developed above can be generalised in light of the structural analogy assumption (cf. §2.3.2). This is a matter for future research.

4.5 Summary

In this chapter, I have argued that the postulation of the onset, the nucleus and the rhyme constituents in syllabic structure is not substantively motivated in the licensing model. Reference to onsets can be trivially recast in terms of reference to non-nuclear positions, except for the analysis of h-aspiré, which is treated in the licensing model by postulating floating onsets. In contrast to the licensing approach, I have claimed, following Tranel (1995), that this phenomenon should instead be analysed as a case of morphological exceptions. The structural distinction between the nucleus and the rhyme is deemed necessary to make generalisations concerning different quantity-sensitive systems and melodic distribution. However, I have demonstrated that both can be recaptured by fully
exploiting relational structure. Whether a dependent position is required to be exclusively p-licensed by a nucleus head or not amounts to the distinction of whether only branching nuclei or both branching nuclei and branching rhymes make heavy syllables. As for distributional regularities, I have proposed the stricture element a-licensing condition (205), which allows us not only to account for the greater distributional freedom a rhyme dependent may enjoy in light of Licensing Inheritance but also to dispense with the Coda Licensing constraint. The ultimate conclusion is that the three constituents should be excluded from the representation of syllabic structure, in much the same way that the formal status of the syllable as a syllabic constituent was rejected in the previous chapter.

The alternative syllable theory outlined in the latter part of this chapter is couched solely in dependency, thereby dispensing with constituency altogether. I have proposed that syllabic structure is organised in terms of en-dependency and ex-dependency, which appear to correspond to the two types of dependency relation assumed in both the licensing model and the dependency model, but which are designated as functional primitives rather than as derived categories with extrinsically imposed headedness directions and locality. I have demonstrated that ill-formed representations are largely excluded in a redundancy-free way in the en-/ex-dependency model. However, it is necessary to involve three well-formedness conditions to achieve the same degree of restrictiveness as the licensing model. First, Unique Path (237), which draws on the notion of a proper tree in the dependency model, effectively replaces the Minimality Condition, but it also captures the generalisation that representations disallow a circuit of dependency paths. Second, the head licensing condition (244), inspired by the Syllable Depth Condition in the dependency model, prevents the infinite extension of dependency paths; this condition also captures the generalisation that dependency paths are, at most, two degrees away from the ultimate head in the licensing model. Third, as stated in (249), the obligatory part of a syllable is assumed to be not a nucleus head but an ex-dependency domain; the assumption restates the premise in the licensing model that an onset node always precedes a rhyme node. Consequently, the model achieves the same degree of descriptive capacity as that of the licensing model. It incorporates insights from the dependency model to an extent that the proposed model can be regarded as a constraint-based version of the dependency model.
This chapter discusses a number of theoretical issues surrounding the syllable theory proposed in the previous chapter. First, I suggest that the principles and parameters approach and the constraint ranking approach should be accommodated within a single framework in order to capture, respectively, categorical and relative well-formedness. Second, this chapter argues that lexical representations are fully syllabified, departing from the Optimality Theoretic conception of grammar in which syllabic structures are determined via Gen and Eval. More specifically, I claim that the input set and the output candidate set are wholly identical, well-formed in terms of universal principles and parametric conditions, and that the input-output mapping via the interaction of violable constraints holds a reflexive relation. Finally, this chapter argues that Structure Preservation holds over derivation as a universal principle.

5.1 Introduction

The preceding discussion has referred to both Government Phonology, which provided the theoretical basis of the proposed syllable theory, and Optimality Theory, which set the context for the analyses in Chapter 2. Although these two frameworks share a rejection of extrinsic ordering of rewrite rules, they differ considerably in the conception of grammar. This chapter endeavours to resolve some of the conflicts between the tenets of Government Phonology and Optimality Theory, in order to consolidate the theoretical foundation on which the proposed theory is to be based.

The chapter is organised as follows. §5.2 focuses on the differences in formalism that give rise to different notions of well-formedness, which has already been mentioned in §3.2.2. §5.3 claims that syllabification should be present in lexical representations, revising the Gen-Eval model of derivation proposed in Optimality Theory. §5.4 argues for Structure Preservation as a universal principle, and attempts to explicate the restriction this principle imposes on derivation.
5.2 Well-formedness

Government Phonology is couched in the principles and parameters formalism, which invokes the categorical notion of representational well-formedness. On the other hand, Optimality Theory maintains the view that well-formedness should be understood as a relative concept, which is implemented by the interaction of ranked violable constraints. Although I argued in §3.2.2 that this relative notion should also be formally incorporated into Government Phonology, this does not necessarily lead to the conclusion that the principles and parameters approach must be wholly rejected.

For example, Optimality Theory assumes the universally undominated constraint \text{Nuc}, which prescribes that 'Syllables must have nuclei' (Prince & Smolensky 2002: 93). Recall that, drawing on Charette (1991: 25-26) quoted in §4.2.2, an equivalent to this constraint was stipulated in §4.4.4: the presence of an ex-dependency relation is obligatory as the core component of a syllabic structure. It is possible to assume, expressed entirely within the constraint ranking formalism, that this is a universally undominated constraint (along with Unique Path and the head licensing convention, for that matter). Alternatively, however, we can claim that it is a universal principle, a constraint which is inviolable in nature, in the very sense intended in the principles and parameters approach. This should not be regarded as a trivially tautological assumption from a metatheoretical viewpoint; nor should the combination of the two theoretical approaches necessarily result in undermining the basic assumptions of either framework.

The postulation of universally undominated constraints is one way of achieving consistency within the constraint ranking model. However, the presence of such constraints inevitably compromises the claim in Optimality Theory that individual grammars are derived through all possible rankings of violable constraints. In this respect, it should be no less restrictive to formally distinguish inviolable constraints as universal principles from violable ones, so that the notion of constraint ranking is reserved only for literally rankable constraints. Making this formal distinction leads to the introduction of a metatheoretical condition that violable constraints on the ranking scale must contribute to factorial typology through unrestricted permutations of their rankings. This restriction should exclude not only universally undominated constraints but also universally fixed rankings of constraints (cf. McCarthy & Prince 1995: 278-279).

Now let us turn to parameters. McCarthy & Prince (1994a: 333) claim that the notion of parameterisation is not invoked in Optimality Theory because 'even in the languages where [a constraint] C is crucially dominated, it is not "turned off" or banished
from consideration' but may still have a role to play by giving rise to the 'emergence of the unmarked' effect. This acclaimed advantage of the constraint ranking formalism does not always hold, however.

For example, let us consider the branching onset parameter in the licensing model, which is also assumed in the proposed model (cf. §4.4.4). This parameter rules out complex onsets when its value is set to negative, while the occurrence of such onsets is not restricted when the parameter is set to positive. It is the latter that amounts to the 'turned off' state mentioned above; that is, the branching parameter has nothing to say about the appearance of complex onsets that are deemed more marked than simplex onsets. The equivalent to this parameter would involve the markedness constraint *COMPLEX(Onset) and the faithfulness constraint MAX in Optimality Theory. Branching onsets are excluded by *COMPLEX(Onset) \(\gg\) MAX, while the reverse ranking MAX \(\gg\) *COMPLEX(Onset) permits their appearance. In the latter case, the markedness constraint is crucially dominated, and the emergence of the unmarked is expected in such a way that, even when onsets are allowed to branch, there arise situations in which simplex onsets are preferred.

We discussed one such example in §4.2.2: reduplicants of Tagalog recent perfective may copy no more than one consonant even though their base may contain a complex onset. Harris (1997: 363) reports another example: in southern Brazilian Portuguese, only stressed syllables may contain complex onsets (e.g. *livreto li'vretu 'small book', *livro 'livu 'book'). These cases would be analysed in Optimality Theory by resorting to MAX constraints with a specific target, MAX-IO and MAX('\(\sigma\)'), the former being a member of the MAX constraint family (cf. McCarthy & Prince 1995: 370) and the latter adopting the notion of positional faithfulness (cf. Beckman 1997). The Tagalog recent perfective is accounted for by positing MAX-IO \(\gg\) *COMPLEX(Onset) \(\gg\) MAX, and southern Brazilian Portuguese by MAX('\(\sigma\)') \(\gg\) *COMPLEX(Onset) \(\gg\) MAX. However, notice that *COMPLEX(Onset) still dominates MAX in these rankings. In fact, the two constraints are in what Prince & Smolensky (2002: 88ff) call a Pāṇinian relation, so there cannot arise any instance of the emergence of the unmarked when *COMPLEX(Onset) is CRUCIALLY dominated by MAX. Therefore, constraints can indeed be 'turned off', effectively giving rise to parameterisation.\(^1\)

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\(^1\) The central point of the argument holds even if we postulate positional markedness constraints such as *COMPLEX(Onset, RED) and *COMPLEX(Onset, WEAKSYLLABLE); MAX has to be dominated by these *COMPLEX constraints.
Note that, all else being equal, parameters offer an intrinsically more restrictive typology than constraint ranking. Given five binary parameters, for example, combinations of their settings yield 32 (\(=2^5\)) systems. On the other hand, the same number of violable constraints yields a factorial typology of 120 (\(=5!\)) systems. Rankings in fact generate more systems because two or more constraints may share the same ranking. However, many of the constraint hierarchies are redundant since they are not all distinctive. For example, the ranking of \(\text{MAX}(\sigma)\) matters only when it dominates \(\text{MAX}\), giving rise to a parameterisation effect due to their specific-to-general relation. Therefore, effectively it may well be that the two approaches do not differ in the number of distinctive systems they predict. Yet posting a constraint in the ranking scale entails significant descriptive redundancy, which can be avoided by instead parameterising the relevant constraint.

There is another respect in which constraint ranking enjoys no special advantage over a parametric approach. Let us consider the positional constraint suggested above. It seems highly unlikely in any language that complex onsets are permitted only in recessive domains such as weak syllables. However, \(\text{MAX}\) does not intrinsically single out dominant domains such as strong syllables, so weak syllables need to be excluded, rather arbitrarily, from the inventory of the arguments of the positional \(\text{MAX}\). This gives rise to the problem of the fixed argument discussed in §3.4.4.1. In this regard, the analysis using the licensing model seems more restrictive. Harris (1997: 363-364) argues that the case of southern Brazilian Portuguese stems from an asymmetry in the stock of p-licensing potential between strong syllables and weak syllables (i.e. between heads and dependents) in accordance with Licensing Inheritance, and mentions that the restriction can be parameterised in terms of government licensing (cf. §3.2.2). This account should be much less prone to overgeneralisation, for the dominant behaviour of heads is well anticipated in dependency relations. Even if branching onsets are parametrically permitted, the marked status of dependent positions is invoked by the general relational mechanism.

Following this line of argument, the principles and parameters approach and the constraint ranking approach can be construed not as mutually exclusive but rather as complementary to each other. Accordingly, I have taken the decision to present this thesis in a framework that integrates the two approaches, thereby capturing, respectively, the categorical and relative well-formedness of representations in appropriate ways.

Given this assumption, the inviolable constraints of Government Phonology, which were introduced as the constraints of the licensing model in §2.5 and §3.2.2, are formally
acknowledged as principles in the present thesis, except for those which were dispensed with in the previous chapter. Among the universal principles, however, Structure Preservation gives rise to indeterminacy. I developed several arguments in favour of the view that it is inviolable, while I presented analyses that seemingly violate it by adding/deleting dependency paths in §4.4.2. Besides, although Structure Preservation naturally presupposes that there should be structures to be retained throughout derivation, Optimality Theory assumes that syllabic structures are provided by Gen and thus absent from inputs. The remainder of this chapter provides an argument for Structure Preservation as a universal principle, beginning with a discussion of syllabification in inputs.

5.3 Lexical representation

In standard Optimality Theory, a lexical representation comprises a string of melodic units with some degree of moraic specification (cf. §3.2.1). Moraic specification is needed to distinguish, for example, between iori 'hermitage' and jori 'gathering' in Japanese. The high front unrounded vowel i and the voiced palatal approximant j share the same melodic structure (cf. §3.3.4), so their distinction must be made in terms of a prosodic property. Moraic specifications are only required for this case and for underlying vowel length distinctions (cf. McCarthy & Prince 2001: 23), however; the moraic status of other melodic units, such as those that are to be syllabified as codas in outputs, is determined by individual grammars. Therefore, moraic specifications are generally absent from inputs, and syllabic structure, including these derivational morae, is provided by Gen and determined by Eval during derivation. Recall that we discussed and rejected a similar assumption in §4.2.2. I argued that, in the licensing model, not only is it redundant to assume that onsets are floating in lexical representations and non-nuclear positions are syllabified during derivation, but also this fails to conform to Structure Preservation. This section examines the Optimality Theoretic notion of lexical specification and concludes that lexical representations should be fully syllabified.

To begin with, let us review the notion of derivation with unsyllabified lexical representations. In Optimality Theory, the derivational burden is shifted away from input representations and processes and onto Gen and Eval. Therefore, it is no longer relevant to investigate what are possible inputs in a given language. Prince & Smolensky (2002: 209) make this point explicit under the assumption called Richness of the Base, stating
that 'all inputs are possible in all languages, [while] distributional and inventory regularities follow from the way the universal input set is mapped onto an output set by the grammar, a language-particular ranking of the constraints'. Given that lexical representations consist of the two kinds of representational objects, viz. melodic units and morae, the universal input set exhausts their possible combinations.

The shift of the derivational burden also makes it irrelevant to study what processes are possible in a given language. This point is reflected in the assumption that Gen contains no language-specific phonological processes. As already described in §3.2.1, Gen is granted Freedom of Analysis, within the limits imposed by the definitions of representational resources (e.g. the syllable is defined as the prosodic unit that directly dominates the mora, so Gen cannot provide a structural analysis in which a mora dominates a syllable). For a given input \(i_n\), Gen generates an arguably infinite number of output candidates \(cand_1, cand_2, \ldots\) by assigning various prosodic configurations and by modifying melodic structure. This set of candidates is inclusive to the point where it can effectively describe all conceivable processes. Eval selects one of the candidates as an optimal output \(\text{out}_{opt}\) in accordance with the constraint hierarchy of a given language.

The question is whether Gen has any function in this picture of derivation. Prince & Smolensky (2002: 111) assume that no elements in inputs are literally removed during derivation. In this view of the input-output relation, called Containment in McCarthy & Prince (2001: 21), Gen certainly has a role to play; it generates different sets of output candidates for different inputs. However, Containment is cast aside with the advent of Correspondence Theory (cf. §3.3.1), which treats an input and its output in derivation as discrete entities, like a base and its reduplicant in reduplication. This shift in approach allows us to generalise input-output faithfulness and base-reduplicant identity, but results in obscuring the raison d'être of Gen by significantly reducing its contribution to derivation, as I will now show.

Let \(a\) and \(b\) be melodic units. Suppose, for the sake of simplicity, that no other representational resources are available to Gen, and that output candidates may contain at most two parsed (i.e. to be phonetically interpreted) melodic units. Under Containment, Gen yields the sets of output candidates (254a) and (254b) for the inputs /aibj/ and /bjaj/, respectively (angled brackets and rectangles indicate unparsed and inserted melodies, respectively).
Notice that, as mentioned above, the two sets are mutually exclusive. Therefore, no two distinct inputs are mapped onto the same optimal output, although their respective outputs may receive identical phonetic interpretations.

In terms of Correspondence Theory, on the other hand, Gen generates the following set of output candidates for any given input.

Correspondence is denoted by the indices \( i \) and \( j \); \( a_{ij} \) indicates that two melodic units in an input coalesce into this single melodic unit (e.g. \( /aiaj/ \rightarrow a_{ij} \)); \( a_{ai} \) shows that a single melodic unit in an input splits into two (e.g. \( /ai/ \rightarrow a_{ai} \)); a melodic unit without an index has no correspondent in its input (e.g. \( /ai/ \rightarrow ai \)). Individual candidates in (255b) may have different correspondence relations with different inputs; for example, \( ai bj \) is the most faithful candidate for the input \( /ai bj/ \), but not for \( /bi aj/ \). However, differences such
as these do not concern Gen, which merely continues to generate the same set (255b) for every input and pass it to Eval with the record of the input for reference in the evaluation of faithfulness. Given that all representational resources are universal, it follows that the set of output candidates is also universal, no matter how large or unwieldy the full inventory of representational resources may have caused that set to become. Therefore, the output candidate set is not a function of inputs. Put differently, Gen does not need inputs to provide output candidates.

Accordingly, a grammar in fact maps the universal input set, which is posited under Richness of the Base, onto the universal output set, which is supposedly generated by Gen. Both the input set and the output candidate set being invariable across languages, however, there does not seem to be any cogent reason to assume that only the latter needs to be generated repeatedly. Instead, the universal output candidate set may well be regarded as an independent entity, all members of which are available to any given language, in much the same way as the universal input set. This state of affairs highlights the non-functionality of Gen, thereby rendering the Gen-Eval model untenable.

Given the above argument, it should be more plausible to collapse Gen and Eval into a single function, which is endowed with the set of universal output candidates and returns the most optimal one for a given input. That is, I claim that this function — let us call it Match — should directly map an input $in_i$ to one of those candidates $out_{opt}$ according to the constraint hierarchy $\Gamma^*_a$ in a given language, as shown below.

\[(256) \text{Match}(\Gamma^*_a, in_i) \rightarrow out_{opt}\]

Note that the notion of output candidates as a universally constant set does not merely reduce to this schematic simplification, however. I now go on to further discuss the relation between the input and the output in (256) and argue that they should invoke a different relation from that in the Gen-Eval model.

Optimality Theory is based on the orthodox dichotomy between input and output, which distinguishes two discrete types of phonological representation. Underlying forms (i.e. inputs) are abstract and less structured due to the absence of specifications that are assigned by Gen, while surface forms (i.e. outputs) are sufficiently well specified to be phonetically interpretable. In light of the present discussion, this dichotomy entails that derivation involves two universal yet distinct sets of representations; the input set only differs from the output candidate set with respect to the presence/absence of syllabic structure.
However, there seems to be no justification for maintaining a distinction between these two sets. One possible argument for the distinction might be related to the problem of resyllabification. In the rule-based, serial conception of derivation, it has been commonly assumed that representations are syllabified at every stage of derivation (cf. Itô 1986: 49) in accordance with the kind of syllabification rules based on phonotactic constraints on 'monosyllabic forms (or word-initial and word-final clusters in polysyllabic forms)' (Fujimura & Lovins 1978: 113). The final consonant of the English word absent, for example, is syllabified as a coda in the input representation of absentee /æb.sænt/+i:/ while it is syllabified as an onset in the output /æb.sænt.iː/. In this regard, the question arises as to the motivation for assuming that a process such as this takes place at all during derivation; it does not seem to offer any insight to posit a different syllabic structure in the input from that of the output. Since resyllabification is invoked on the premise that the input is syllabified independently of its output, the problem can be circumvented by rejecting this premise and positing no lexical syllabic structure, on the grounds that 'no languages have lexically distinctive syllabification' (Clements 1986: 318). However, there is an alternative way to avoid the problem; as described in §2.5.2, the licensing model argues that syllabic structure in inputs is preserved throughout derivation, thus banning resyllabification. Besides, the distinctiveness in inputs is no longer a matter of concern according to Richness of the Base, so the absence of lexically distinctive syllabification cannot sufficiently motivate the exclusion of syllabic structure from lexical representations in (256) (cf. Prince & Smolensky 2002: 191).

This last point also places a question mark over the assumption described at the beginning of this section, that a lexical representation comprises a string of melodic units with some degree of moraic specification. This assumption regarding the partial specification of inputs again harks back to the rule-oriented conception of derivation, whereby syllable structure is assumed to be 'largely rule-governed and thus predictable in most languages, once the distribution of underlying syllable peaks (vowels, syllabic consonants) is known' (Clements 1986: 317). However, this assumption based on predictability leads to circularity (cf. Harris & Lindsey 1995: 47). In much the same way that syllabic structure can be constructed using the information from segment structure, the latter can be obtained from the former. So the decision as to which representational resources are excluded from input representations has to be essentially arbitrary. Besides, removing predictable information from inputs does not reduce redundancy in the derivational model (256), for it necessitates two universal sets of representations, which are only trivially different with respect to predictable information.
Following the above discussion, I argue that input representations should exploit the same inventory of representational resources as that available to output representations. This claim not only blurs the underlying-surface distinction, but also it entails that the input set and the output candidate set are wholly identical, the input-output mapping holding a reflexive relation. This line of thinking is entertained by Lindsey & Harris (1990), and is reiterated by Harris & Lindsey (1995) and Kaye (1995). These authors reject the view that derivation is a process of preparing a phonetically interpretable surface representation from an abstract underlying representation. Instead, Harris & Lindsey (1995: 48-49) argue

... initial and final representations in phonological derivation are isotypic ... initial representations should be no less phonetically interpretable than final representations. In fact, initial representations can in principle be envisaged as being wholly indistinguishable in kind from final representations.

Although this argument is put forward in theoretical contexts that are quite distinct from those assumed in Optimality Theory, it should hold for the input-output relation in (256).\textsuperscript{92} Compared to the orthodox underlying-surface distinction that necessitates two distinct, arguably infinite sets of representations for no particular theoretical gain, as discussed above, the isotypic assumption achieves a degree of conceptual simplicity. Consequently, lexical representations are as fully syllabified as output representations.

In this section, I have proposed a model of derivation in which the function Match directly maps inputs onto outputs. Starting with a rejection of the assumption that output candidates are generated by Gen, I have presented an argument that supports the isotypic view of the input-output relation, whereby inputs and output candidates are envisaged as an identical, universal set of representations. Accordingly, a grammar defines mappings from one representation to another, both of which are properly defined in this universal set. In this notion of derivation, lexical representations, which also serve as output representations, are in fact the only type of well-defined phonological representations. Therefore, they must be fully syllabified. Note that, although this assumption differs from Optimality Theory, it sacrifices no special tenets of the framework. The proposed model of derivation neutralises the theoretical differences between Government

\textsuperscript{92} The original argument regarding interpretability is made with a specific focus on melodic structure, the aim being to reject the notion of underspecification and to argue for monovalent melodic primes. In the present discussion, reference to the interpretability of representations is made in a more general sense.
Phonology and Optimality Theory. As a result, the syllable theory proposed in the previous chapter is accommodated within a framework that integrates these two theoretical approaches.

### 5.4 Structure Preservation revisited

Given the premise that lexical representations are fully syllabified, this section argues that syllabic structures in inputs are preserved in outputs, and explores the implementation of this requirement in the present theory. Government Phonology rules out resyllabification by invoking Structure Preservation (or the Projection Principle) as a universal principle. Yet the interaction of violable constraints, in principle, may alter any lexically specified structure, albeit minimally, by forcing the violation of faithfulness constraints in favour of higher ranked markedness constraints. The question is whether Match in the present model (256) should be allowed, to whatever extent, to ignore input syllabification, as long as it ensures that outputs deviate from inputs only minimally and improve relative well-formedness by conforming to higher ranked constraints, thereby dispensing with Structure Preservation. In this section, I first argue that Structure Preservation needs to be retained as an inviolable constraint, and then claim that this universal principle permits Match to make only two kinds of modification to dependency relations in input representations.

Let me first argue for Structure Preservation as a universal principle. Suppose a language L permits empty onsets and branching nuclei. A lexical entry such as /ai/ is defined by the en-dependency relation a=i and the ex-dependency relation 0→a; recall that the presence of an ex-dependency relation is obligatory as the core component of syllabic structure. The input representation is depicted in (257a) (dotted and solid arrows continue to be used to show ex-dependency and en-dependency relations, respectively).

\[
\begin{align*}
(257) \quad & (a) \quad /ai/ \rightarrow [ai] \quad (b) \quad /ai/ \rightarrow [ja] \\
\end{align*}
\]

\[
\begin{align*}
\text{Figure 257 (a) and (b): Syllabic structure representation.}
\end{align*}
\]
If Match maps the input (257a) onto the same representation (interpreted as \(a_i\)), lexical dependency relations are all preserved and are manifested as the precedence relations \(\emptyset \ll a \ll i\) in phonetic interpretation. Although this case achieves the maximal degree of faithfulness, (257a) contains marked properties stemming from the en-dependency relation \(a = t l\) (i.e. branching structure) and the presence of the empty category \(x_i\) (i.e. empty onset). Compare this state of affairs with the case in which Match maps the input (257a) onto the output (257b) (interpreted as \(j a\)). This mapping involves the assignment of an ex-dependency relation \(a \rightarrow i\), as shown by the cornered broken arrow in (257b). It results in invalidating the lexically established dependency relations \(\emptyset \ll a\) and \(a = t l\); \((x_2 \rightarrow x_3 \land x_2 = x_3)\) gives rise to contradictory (i.e. uninterpretable) precedence relations \((x_2 > x_3 \land x_2 \ll x_3),\) and \((x_2 \rightarrow x_3 \land x_1 = x_2)\) contravenes the binarity restriction on dependency (cf. §4.4.4). Hence, although the output \(j a\) is less marked than \(a_i\) (i.e. it lacks the marked properties just mentioned), (257b) wholly fails to preserve the structure in the input (257a).

The problem is that, in terms of Optimality Theory, both outputs \(a_i\) and \(j a\) can be derived from the input /ai/ by ranking the relevant constraints accordingly: /ai/ \(\rightarrow a_i\) with faithfulness constraints generally dominating markedness constraints, and /ai/ \(\rightarrow j a\) with LINEARITY (i.e. "no metathesis", cf. McCarthy & Prince 1995: 371) crucially dominated. However, /ai/ \(\rightarrow j a\) does not seem to be attested in any language; for that matter, no language seems to satisfy ONSET by metathesis. Based on the discussion in §5.1, I argue that this state of affairs should follow from the universal principle of Structure Preservation, rather than from some universal fixed ranking of constraints. Accordingly, Match cannot possibly associate the input (257a) with the output (257b).

Having argued for Structure Preservation as a universal principle, let me restate it in the context of the proposed syllable theory as follows:

((258) Structure Preservation

Dependency conditions holding of lexical representations are preserved over derivation.

Given that syllabic structure comprises the two types of dependency relation discussed in the previous chapter, the statement (258) now draws on the prescription of the Dependency Preservation Condition proposed by Anderson (1986: 84).

Although I have claimed that (257b) cannot be the output of the input (257a) according to the principle (258), this does not mean that Structure Preservation always
requires outputs to contain exactly the same syllabic structure as that of their inputs. As already mentioned in §4.4.2, the literature in Government Phonology does present analyses that modify syllabic structure during derivation, although it has been left rather ambiguous as to how such modifications can be tolerated by Structure Preservation. In the remainder of this section, I discuss the interpretation of this principle and argue that only two types of modification are legitimate.

The present thesis assumes that the restriction imposed by Structure Preservation should be understood in the way described in Kaye et al. (1990: 221), which is repeated below from §4.2.2:

... for any two objects, either they stand in a government relationship defined at the level of lexical representation, or not. If they do not, no such relationship can be created in the course of a phonological derivation. If they do, the relationship is inalterable.

That is, for any two positions in a lexical representation, either they enter into a dependency relation or they do not. If not, no such relationship can appear in the output. If they do, the head-dependent relation is inalterable. With respect to this understanding of this universal principle, let me make the following two supplementary suggestions. First, Structure Preservation should only concern dependency relations holding within a nonanalytic domain, and should have nothing to say about a relation between two positions occupying separate domains. Morphological derivation must clearly be allowed to create non-lexical, cross-domain relations, as in suffixation, for example. Second, as for lexically present dependency relations, Structure Preservation should prohibit reversing their head-dependent status and replacing one type of dependency with the other, but should permit simply removing such relations in outputs.

Let me illustrate the point being made here with the example /l(a)+əami/ → lamı in French discussed in §4.2.2. The input and the output are represented as (259a) and (259b), respectively, in the proposed model of syllabic structure.

(259) (a) INPUT: 
\[ \begin{array}{cccccc} 
X_1 & X_2 & X_3 & X_4 & X_5 & X_6 \\
| & | & | & | & | \\
| a & | & | & α & m & i \\
\end{array} \]

(b) OUTPUT: 
\[ \begin{array}{cccccc} 
X_1 & X_2 & X_3 & X_4 & X_5 & X_6 \\
| & | & | & | & | \\
| a & | & | & α & m & i \\
\end{array} \]
Following the assumption suggested in §4.2.2, the lexical representation of the article *la*
is shown to contain the empty nucleus $x_2$ before a noun beginning with a true vowel. Match maps the input (259a) onto the output *lami*. The representation (259b) indicates that the derivation involves the assignment of an ex-dependency relation $x_1 \leftarrow x_4$, leaving the two empty positions $x_2$ and $x_3$ out of dependency paths. This unfaithful interpretation is forced by the dominance of anti-hiatus markedness requirements.

Let us first consider the ex-dependency relation between $x_1$ and $x_4$ in the output (259b), which does not appear in the input (259a). I argue that any two positions belonging to different analytic domains in inputs vacuously satisfy Structure Preservation. Positions such as $x_1$ and $x_4$ in (259a) occur in different input domains and therefore contract no dependency relation in input. Structure Preservation has nothing to say about the output relation between $x_1$ and $x_4$, since it has no lexical source. The creation of a lexically absent dependency relation contravenes Structure Preservation only when this relation involves positions within the same nonanalytic domain. Put differently, the assignment of new dependency relations is restricted to a derived environment, in conformity with the Strict Cycle Condition (cf. Mascaró 1976, Kiparsky 1982).

Hiatus-avoidance in /l(a)+∅ami/ → lami is achieved through the non-interpretation of positions $x_2$ and $x_3$ and with this the disappearance of the lexically established ex-dependency relations $x_1 \leftarrow x_2$ and $x_3 \leftarrow x_4$. I assume that input-output mappings infringe Structure Preservation when outputs contain dependency relations that contradict dependency relations in their inputs. Contradiction would be incurred if, for example, the ex-dependency relation $x_3 \leftarrow x_4$ in the input (259a) were to change into an en-dependency relation $x_3 \leftarrow x_4$ in the output (i.e. laa∅mi), or if headship were to be reversed so that the output contained $x_3 \rightarrow x_4$ (this relation is not interpretable because the melodic expression a cannot be an onset). However, I claim that contradiction does not arise when $x_3$ and $x_4$ do not enter into any kind of dependency relation in the output at all. I suggest that Structure Preservation should be construed as being parallel to the *Ident* constraints but not to the Max constraints in Optimality Theory — the removal of a lexically present relation leads to the violation of MAX constraints, but does not contravene Structure Preservation, in much the same way that the non-interpretation of melodic expressions does not incur the violation of *Ident* constraints. Therefore, the output representation (259b), which contains no relation between $x_1$ and $x_2$ and between $x_3$ and $x_4$, does not count as a violation of Structure Preservation.
Note that this last claim does not necessarily lead to the conclusion that Match can remove as many dependency relations in a given input as it would wish. Compare the following output li with (259b).

The assigned ex-dependency relation $x_1 \rightarrow x_6$ spans different domains, and there exists no dependency relation that contradicts any of the dependency relations in the input (259a). Therefore, in terms of the present interpretation of Structure Preservation, the mapping from (259a) to (260) is equally structure preserving as that from (259a) to (259b). However, in light of the faithfulness constraint MAX, (260) cannot outperform (259b). The former fails to parse four positions (i.e. $x_2$, $x_3$, $x_4$, and $x_5$) while the latter leaves only two positions (i.e. $x_2$ and $x_3$) out of dependency paths, so the output li incurs more violations of MAX than the attested output lamì. In this way, the deletion of dependency paths in inputs is constrained by the faithfulness constraint and thus must be kept to a bare minimum.

By the same token, /lanə-zi/ → lanzi in the Billiri dialect of Tangale discussed in §4.4.2 can be shown to preserve structure in the sense just outlined. The input and the output of this derivation are shown below.\footnote{Since the disappearance of a in the stem is morphologically conditioned by the presence of a following suffix, I assume that $x_5$ is empty in the input representation.}

\begin{equation}
(261) \begin{align*}
\text{(a) INPUT:} & \quad \text{(b) OUTPUT:} \\
\begin{array}{cccccccc}
\ldots & x_1 & x_2 & x_3 & x_4 & x_5 & x_6 & x_7 \\
\ldots & a & \varnothing & a & m & l & i
\end{array}
\end{align*}
\end{equation}

In the output representation (261b), both the assignment of the ex-dependency relation $x_1 \rightarrow x_6$ across the morpheme boundary and the removal of the two ex-dependency paths $x_3 \rightarrow x_4$ and $x_4 \rightarrow x_5$ are legitimate in accordance with the proposed interpretation of Structure Preservation. The deletion of the paths incurs two violations of MAX, but this violation is forced by the grammar of this dialect, which requires unlicensed empty
positions to be excluded from dependency paths even at the expense of sacrificing faithfulness, as discussed in §4.4.2. Now let us compare the following representations with the attested output (261b).

(262) (a) * 
[\[ X, X2 X3 X4 X5\] X7] 
\[ \[ Xi X2 X3 X4 X5\] X6 X7\]

(262a) indicates that the same degree of well-formedness could be achieved by assigning \(X4\) \(X7\). This output, *\(\text{landi}\), leaves the empty nucleus out of dependency paths at the cost of two violations of \(\text{Max}\), without contravening Structure Preservation. I assume that the preference for the attested output (261b) should be determined by the constraint \(\text{Max} (\text{Suffix})\) being ranked higher than \(\text{Max} (\text{Stem})\). The analysis (262b) yields \(\text{lan0zi}\). The stem-final empty nucleus \(X5\) does not act as a government licensor in this representation, so it can be properly governed by \(X7\). As a result, no unlicensed empty position resides on any dependency paths. Although (262b) incurs only one violation of \(\text{Max}\), it can never be the optimal output of (261a) under any ranking of constraints because it crucially fails to comply with the universal principle of Structure Preservation: \(X3\) and \(X5\) belong to the same lexical domain but they do not enter into any dependency relation in the input (261a), so any representation that contains a dependency relation between these two positions (i.e. \(X3 \rightarrow X5\), \(X3 \rightarrow x_5\), \(X3 \Rightarrow X5\) or \(X3 \Rightarrow X5\)) can never be selected as the optimal output.

This section has presented an argument for Structure Preservation as an inviolable constraint. I elaborated on the interpretation of Structure Preservation and proposed that Match is only allowed to assign dependency paths in derived contexts or to remove dependency paths in inputs without contravening this universal principle. I showed that this proposal does not undermine theoretical restrictiveness, for the arbitrary creation and deletion of dependency paths entail the violation of faithfulness constraints such as \(\text{Max}\), and violation must be minimal, as assumed in Optimality Theory.

5.5 Summary

In this chapter, I have explored a way of integrating the tenets of Government Phonology and Optimality Theory. On the grounds that representational well-formedness needs to
be captured in both categorical and relative terms, I first suggested that there is ample motivation for combining the principles and parameters approach of Government Phonology and the constraint ranking approach of Optimality Theory in a single framework. Then, demonstrating that Gen is redundant and the set of output candidates is universally fixed in Optimality Theory, I argued for a model of derivation whereby input-output mappings hold a reflexive relation, and claimed that lexical representations should be fully syllabified. Finally, I argued for the status of Structure Preservation as a universal principle, proposing that it permits only the following two kinds of modification to dependency structure in inputs: the assignment of dependency paths in morphologically derived contexts and the removal of lexically present dependency paths.
6 Conclusion

This thesis has proposed a theory of syllabic structure couched in exclusively relational terms without recourse to constituency. I have presented a model of syllabic structure that comprises bare positions supporting two types of dependency in accordance with universal principles and language-specific parameter settings.

Syllabic constituents have no place in this model of syllabic structure. The review of other models has shown that constituentiality is invoked by string-adjacent regularities and/or the compositional behaviour of melodies. With respect to the former, however, I have claimed that dependency represents a more appropriate analysis than constituency. Indeed, the theoretical validity of a constituent can be ensured only by the presence of a phonological event that requires collective reference to melodic units dominated by this constituent. In this respect, although the syllable is taken for granted as the maximal syllabic constituent in most models, I have demonstrated how evidence for such a node is distinctly lacking, by analysing reduplication and onset-sensitive stress, both of which allegedly require reference to syllables. The rejection of the syllable as a constituent motivates the use of the licensing model developed in Government Phonology, which dispenses with syllable nodes. This model still postulates the onset, the nucleus and the rhyme, but I have argued that these three constituents cannot be substantively motivated either. In this regard, I have proposed a condition on the a-licensing of stricture elements, which formally acknowledges an exception to Licensing Inheritance. This condition not only eliminates the distinction between the rhyme and the nucleus but also allows Coda Licensing to be subsumed under Licensing Inheritance.

I have proposed that syllabic structure is centred on two types of asymmetric relation: endocentric dependency (en-dependency) and exocentric dependency (ex-dependency). They effectively correspond to the two types of relation invoked in the licensing model as constituent licensing and interconstituent licensing. In contrast to the licensing model, the present theory distinguishes the two types of dependency categorically in such a way that en-dependency entails strictly immediate head-initial precedence while ex-dependency induces head-final precedence in phonetic interpretation. This assumption allows us to dispense with Locality and Directionality as
independent principles. I have also claimed that Onset Licensing is redundant since 'an onset without a following nucleus' is inconceivable in the proposed model, in which the identity of any position can only be established in terms of its relations with other positions. Accordingly, the recasting of constituent/interconstituent licensing as en-/ex-dependency is not merely a technical means of eliminating syllabic constituents but achieves a considerable degree of restrictiveness by intrinsically excluding ill-formed representations.

I have proposed that syllabic relations conform to three universal principles. First, Unique Path, which is adapted from the notion of a proper tree in Dependency Phonology, rules out a circuit of dependency paths in representations. Not only does this constraint effectively take the place of the Minimality Condition, but it also captures the generalisation missed in the licensing model regarding the absence of a circuit in licensing structure. Second, the head licensing convention, again adapted from Dependency Phonology, restricts dependency paths from the ultimate head to two degrees. This generalisation is no more than implicit in the licensing model. Finally, the presence of an ex-dependency relation is obligatory as the core component of syllabic structure. This constraint is in fact a formal restatement of the assumption shared by the licensing model in which syllabic structure comprises a sequence of O (onset) and R (rhyme), as well as by the dependency model, in which a new layer of subjunctive structure is created in syllable formation even if no onset consonant exists. These three universal principles not only desirably reduce the descriptive capacity of the proposed model, but also allow the present theory to dispense with Locality, Directionality, Onset Licensing, Coda Licensing, the government convention and the Minimality Condition.

The proposed theory is couched in a framework that integrates the tenets of Government Phonology and Optimality Theory, and I have discussed a number of theoretical issues that arise from the integration of the two approaches. One issue concerns the difference between the two theoretical approaches with regard to representational well-formedness. The principles and parameters approach of Government Phonology prescribes well-formedness categorically, while the constraint ranking approach of Optimality Theory invokes a relative notion of well-formedness. I have claimed that these approaches are not mutually exclusive but rather complementary, on the grounds that the grammar needs to capture both categorical and relative well-formedness. Second, I have discussed the relation between the input and the output of the grammar. I have demonstrated that abandoning Containment through the introduction of Correspondence Theory entails that the set of output candidates is
universal, independent of any particular inputs. Based on this assumption, I have put forward a model of derivation in which Match, the function that replaces Gen and Eval, maps the universal input set onto the universal output set. I have claimed that the two sets are wholly identical, with input-output mappings holding a reflexive relation. It then follows that lexical representations are fully syllabified. The third issue is related to the second, concerning the preservation of syllabic structure. I have argued that Structure Preservation holds over derivation as a universal principle, and have put forward an interpretation of this principle whereby only the following two operations are legitimate: the assignment of dependency paths in morphologically derived contexts and the removal of lexically present dependency paths. Other operations such as reversing head-dependent relations and replacing one type of dependency relation with another are categorically ruled out.

Finally, I suggest two specific directions for future research from among the range of issues arising from the proposals made in this thesis. First, the proposed syllable theory needs to be subject to more extensive empirical testing. The theory has been developed from the licensing model with the specific purpose of eliminating syllabic constituents, at least aiming to retain the tenets as well as the same empirical coverage of the original theory. Whether this attempt has been successful or not must be confirmed through the analysis of various phenomena from a wide range of data sources.

Second, the theoretical implications of structural analogy should be further explored. The proposed theory has drawn heavily on Dependency Phonology. Indeed, the resulting model of syllabic structure amounts to a constraint-oriented version of the dependency model. The model departs from orthodox Dependency Phonology in containing two distinct types of dependency relation. It is a matter for future research to determine to what extent this dichotomy generalises to other domains, such as melodic structure.
References

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