

## **CHAPTER 6**

### **LEFT EDGE SYLLABLE PROMINENCE AND FOOT ALIGNMENT**

#### **6.0 Introduction**

Previous chapters have been concerned with foot alignment and adjacency where foot alignment may be determined by morphological or prosodic edges, by rhythmic considerations or lexical marking. Under examination in this chapter is the influence of prominence at the left edge of a syllable on foot alignment, on stress assignment in prominence driven systems, on reduplication and allomorphy.

I propose a theory of left edge syllable prominence to account for a range of prosodic processes which previously appeared disparate and unrelated within and across languages. The problem has been to account for behaviour influenced by onsets where such influence is not frequently encountered.

One interesting result of the examination into left edge syllable prominence is the discovery of an additional dimension of rhythm, created by left edge syllable prominence which, it is claimed, can be independent from the rhythm patterns created by the alternation of stressed syllables.

In the section that follows, I present a theory for interpreting prominence exhibited at the left edge of the syllable. This is followed by a description of Arrernte,<sup>1</sup> which is the language focussed on in this chapter. This description is lengthy as I present a case for a CV syllable structure analysis rather than the VC structure analysis that has previously been argued for. I provide an analysis of stress in Arrernte in section 6.2.2, followed by analyses of stress in other languages with left edge prominence phenomena such as Spanish, Pirahã and Ngalakan. The analysis is extended to account for other prosodic processes: reduplication in Arrernte and Nunggubuyu in section 6.3, and allomorphy in Kaytetye and Arrernte in section 6.4. Alternative analyses are considered in each section. The chapter finishes with some concluding remarks.

#### **6.1 Syllable prominence**

A theory for interpreting prominence exhibited by onsets is presented in this section. I propose that prominence as determined by sonority in onset position is accessed by prosodic processes which scan the left edge of a syllable. Following Prince & Smolensky' (1993) (henceforth P&S) account of prominence in rhymes, the prominence at the left edge is determined by syllable position and by the sonority that is harmonic for this position.

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<sup>1</sup> The name Arrernte (Aranda) covers Western, Eastern and Central Arrernte varieties which are members of the Arandic language group. This language group also includes Anmatyerre, Alyawarra and Kaytetye. Central Arrernte is also known as Mparntwe Arrernte. These languages are spoken in central Australia.

In terms of structure it is well known that segments in coda or long vowels can make a syllable heavy and that different segments contribute to weight in different languages. This gives rise to the distinction of heavy and light syllables.

Some languages make a syllable weight distinction for the purposes of stress and reduplication. In such languages, constraints must make reference to syllable weight. These constraints may state something along the lines of: stress heavy syllables; a heavy syllable is the reduplicative template, or the minimum size of a word. An example is reduplication in Mokilese (Harrison & Albert 1976) where heavy syllables (ie CVC) are reduplicated.

- (1) a. podok pod-podok 'plant'  
b. kaso kas-kaso 'eat'

In assessing syllable weight, reference is made, not to the segments directly, but to the mora, an intermediate structural level. It is argued that prosodic structure, particularly feet and reduplicative templates, make reference to moras. While this is not disputed, others argue for syllable weight to be enhanced to account for phenomena that cannot be captured by a binary heavy/light weight distinction (including Steriade 1982). For instance, stress may be sensitive to sonority, pitch or tone, in addition to weight/length, in determining prominence. Low vowels, heavy syllables, high toned syllables can sound louder and are thus more perceptually salient, ie prominent. Given such distinctions, Hayes (1991) claims that it is necessary to differentiate weight from prominence (perceptual saliency).

Cited in Hayes (1991) are languages which assign stress to syllables with a high tone, Golin (Bunn & Bunn 1970) and Fore (Nicholson & Nicholson 1962). Such syllables are not bimoraic. In Sanskrit, Russian, Lithuanian (Halle & Kiparsky 1977, 1981; Halle & Vergnaud 1987), strong syllables are those with high tones or accents.

Sonority of the vowel may determine the location of stress. Examples include Mordwin (Mokson dialect), a Finno-Ugric language of Central Russia (Tsygankin & DeBaev 1975) where syllables with the vowels [e,o,ɤ,a] are strong, those with [i,u,ɤ] are weak (cited in Kenstowicz 1994). Hayes (1991) cites Ashenica (Pichis dialect) as having the following prominence hierarchy CVV > Ca,o,e,iN > Ci.

In previous metrical theory analyses, prominence attributed to sonority was accounted for by marks in a grid structure and these, combined with grid marks for weight, generated stress patterns. Prominence due to sonority has been claimed for both rhyme and onset positions.

In OT, prominence in rhyme is accounted for by assessing the inherent prominence of a segment through a non-binary constraint called Peak-Prominence (P&S). In prominence-driven systems, feet are not required for the assignment of primary stress.

(2) **Peak-Prominence (PK-PROM)**

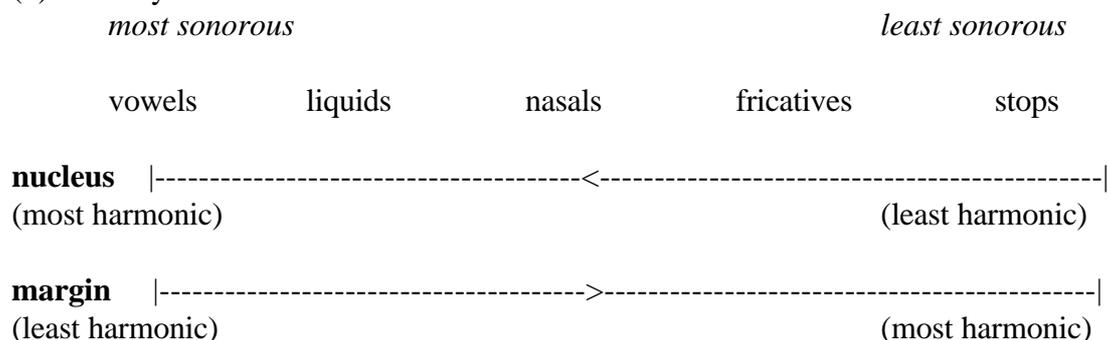
Peak (x)  $\gg$  Peak (y) if  $|x| > |y|$

This constraint translates as ‘... the element x is a better peak than y if the intrinsic prominence of x is greater than that of y.’ (P&S p39). A peak is the syllable nucleus which contrasts with the margin. This notion of prominence is derived from two phonological scales: the inherent prominence of segments according to sonority and the prominence of positional structure in the syllable. As observed in a wide range of

literature (including Clements 1990, Hooper 1976, Jespersen 1904, Kiparsky 1981, Lowenstamm 1981, Saussure 1916, Selkirk 1984, Steriade 1982, Zwicky 1972), the location of segments within a syllable is determined by sonority; the most sonorous segments in peak position and the less sonorous towards the margin. Sonority is a contributing factor to syllabic well-formedness. According to P&S (p67) ‘...when a segment occurs in a structural position such as nucleus, onset or coda, its intrinsic sonority in combination with the character of its position gives rise to markedness-evaluation constraints ...’

If we relate sonority scale to syllable position, the most harmonic nucleus will be one with the most sonorous segment. In contrast, the most harmonic onset or coda will be one which is least sonorous. Compare the two harmony scales below:

### (3) Sonority Scale



The sonority of the nucleus and that of the margin are assessed on the sonority scale but in reverse order, depending on syllable position. Given these scales, a syllable is more prominent (perceptually more salient) if the sonority distance between margin and nucleus is big. For instance, *ki* is a more prominent syllable than *wi* because a stop is the least sonorous segment and *i* is in the set of most sonorous segments. In contrast, the sonority distance between *w* and *i* is very small.

#### 6.1.1 Onsets and prominence

It has been claimed that onsets in some languages determine stress placement; the sonority of an onset or the absence of an onset influence where stress is located. In Pirahã (Everett 1988), syllable prominence is dependent on the presence, absence or voicing of an onset, as well as vowel length. Main stress in Pirahã falls on the strongest (or most prominent) of the final three syllables in a word. A hierarchy of syllable prominence (Halle & Vergnaud 1987, Hayes 1991) is given in (4), where C = voiceless consonant; G = voiced consonant.

$$(4) \quad CVV > GVV > VV > CV > GV$$

There are no syllables consisting of a single vowel. The hierarchy of syllable prominence accounts for the location of main stress in the following words.

- (5) a. ?ɪbogi 'milk'  
 b. ?abapá (proper name)  
 c. soi.oa.gahái 'thread'  
 d. po:gáihí.ai 'banana'  
 e. ?apabá:si 'square'

If there are two syllables with voiceless stops, as in (5b), the right-most one is stressed. If there are two heavy syllables, the one with an onset is stressed, as in (5c,d). In terms of sonority, the consonants which are least sonorous are the voiceless consonants. It would appear therefore that the least sonorous onset consonants are preferred in stressed syllables.

In Pirahã, the lower the sonority of the onset, the higher the chance the syllable will have of being stressed. If a syllable has an onset and that onset is low in sonority, then the inherent prominence of the syllable is more than if there were no onset or the onset was higher in sonority. Under these conditions, it is logically better to stress a syllable which has higher inherent prominence than to stress an adjacent syllable which has lower inherent prominence. This would be to avoid adjacent prominent syllables and to ensure that prominence alternation occurred – a stressed syllable adjacent to a syllable with high inherent prominence may be perceived to have a similar level of prominence.

In some previous analyses of the Pirahã stress pattern, direct reference to onsets is avoided by representing prominence as marks on a grid. The syllable with the most marks is the one that receives the stress (Hayes 1991, Levin 1985, Davis 1988).

Other analyses have objected to claims that onsets determine stress placement (argued for by Davis, among others), as it is argued only prosodic categories, ie syllables, rather than segments, can be directly accessed in the assignment of stress. It is also argued that onset consonants do not license a mora (Hayes 1991) and that prominence is typically only read from the rhyme. In systems which are prominence-driven, where stress assignment is scalar, there is typically only one stress in a word. Therefore, it is claimed that prominence, not feet, is responsible for stress. However, in general, feet are responsible for stress assignment when more than one stress occurs in a word. In foot-based systems presumably only a heavy/light distinction is available via moras. Feet read moras, so to speak, and are not able to read at the level of segments.

While it is generally agreed that onsets do not count for weight, the question is how prominence of the onset is read in prominence-driven or foot based stress systems. I advocate that the right edge of the syllable is read for weight/sonority, while the left edge is read for sonority, but not weight. The prominence on the left edge is different from that required on the right edge; there are different sonority requirements for different syllable positions.

In theory, a syllable where the onset has the lowest sonority (ie a voiceless stop) followed by a vowel is robust because of the sonority distance between vowel and onset. Syllables where the onset has a higher sonority will be more marked. Such markedness is reflected in the prominence dimension of Pirahã; syllables with high sonority onsets or edges are the least favoured for stress

If an onset is absent, that is, a vowel is at the left syllable margin, this translates as least prominent syllable on the prominence dimension. Here the left margin has a sonority that is equal to the peak – this fact reflects on structure and an onsetless syllable is the least preferred syllable. It is not only because ONSET is violated, but

also because the sonority required by onset is absent, and not just whether an onset is there or not.

Where prominence is interpreted at the left word edge, then the constraints on prosodic words, and syllables interact. This edge is a meeting point of Alignment (F,PW) and Prominence (onset, sonority). We will see that in Arrernte, feet will not align with a PW if onset sonority is equal to nucleus sonority. Likewise, for stress assignment via prominence as in Pirahã, stress is avoided on syllables if there is no sonority distinction between the syllable edge and the nucleus.

I argue that this fine-grained assessment explains the prosodic processes in a number of languages, including Arrernte and Pirahã, and that to generate the patterns a prominence constraint on the left syllable edge is required.

Syllable prominence can depend on sonority of the rhyme (nucleus and coda) and of onset, or a combination of rhyme and onset. The evidence from Piraha bears this out where the preference is, in addition to weight considerations, to stress syllables containing voiceless stops in onset.

I propose that a dimension<sup>2</sup> exists, which may or may not be accessed depending on the language, which I call Left Edge Syllable Prominence (LESP). LESP evaluates information about the sonority of the onset or of the sonority of the left edge of the syllable. The prominence that may be exhibited by the left edge is not necessarily confined to a segment. We know that information about a preceding consonant can be found in the syllable peak due to coarticulation and that the robustness of the perception of the vowel is due to factors of syllable structure (Strange et al 1976, cited in Clark and Yallop 1990:264). A consonant+vowel sequence is more acoustically salient than vowel+consonant sequences because of the consonant release. There is also evidence that the sonority of the onset affects the pitch/tone of the syllable. According to Baker (1997), geminate stops, analysed as fortis, in Ngalakan, an Australian language, affect surrounding vowels giving phonological prominence to syllables. Baker's claim is supported by evidence from Butcher (to appear), which finds that fortis stops have a greater maximum of intra-oral pressure, as well as a greater rise than lenis consonants.

The constraint for assessing LESP is based on the sonority scale and Peak Prominence proposed by P&S (1993), but with a crucial difference.

- (6) **LESP:** x is better than y if the intrinsic sonority at the left edge of x is less than that of y.

LESP works like PK-PROM in assessing the sonority of segments. The difference is that while PK-PROM looks for segments with high sonority levels, LESP targets syllables with left edges that have low sonority levels.<sup>3</sup> This will account for the pattern of stress in Pirahã which is influenced by syllable weight and LESP, and provides an explanation of the different pattern of stress in words like **?ibogi** and

<sup>2</sup> I use this term to differentiate the prominence characteristics at different syllable edges.

<sup>3</sup> There have been some proposals to include [COR] as part of the sonority scale (Selkirk 1984, among others), but these have met with some objections (Clements 1990, Rice 1992). Arguments in support of including [COR] on the scale are based on evidence from languages like Madimadi (Hercus 1969, Davis 1985, 1988) where it is claimed that coronals in onset attract stress. It is possible that a language determines that a particular feature of segments contributes to prominence of a syllable. I leave this question to further research.

**?abapá.** In the former example, the syllable with the voiceless stop is stressed, and in the latter example where two syllables have voiceless stops, the one closest to the right edge of the word receives stress. Thus, the sonority of the onset is a significant factor in stress in Pirahã.

I propose that LESP can be used to analyse not only feet or the location of stress, but also other prosodic processes such as reduplication. It provides a way to analyse those languages which distinguish sonority of onset to determine stress placement (Pirahã), and languages which distinguish between absence or presence of onset (Arrernte). LESP can capture behaviour exhibited by the left edge of the syllable evidenced in a range of languages.

## 6.2 Phonology of Arrernte

The bulk of the data on Arrernte presented here is from Breen (1990), Breen and Henderson (1992), Henderson (1993), Henderson and Dobson (1994), Wilkins (1984;1989) and consists mostly of Central, Western and Eastern Arrernte.

Changes that have occurred in Arandic languages have made it difficult to establish the nature of the relationship with other Pama-Nyungan languages, such as neighbouring Warlpiri or Pintupi (see Koch (1995) for a current reconstruction analysis). These changes include stress reassignment<sup>4</sup>, loss of initial consonants and sometimes the first syllable, loss of distinction in word-final vowels, pre-stopping of nasals, and labialised consonants. In addition to the consonant series present in Warlpiri, Arrernte has lamino-dental series prestopped nasals and a series of labialised consonants<sup>5</sup>. The orthography used for Arrernte is consistent with that for Warlpiri, with one exception. The palatal stop written as *j* in Warlpiri, is written as *ty* in Arrernte. Words are written with a final *e* which, as argued in Breen (1990), is not present underlyingly.

The vowels in Arrernte are /u,i,a,e/.<sup>6</sup> The *e* represents a placeless vowel, ie a schwa and according to Henderson and Dobson (1994), it is typically shorter in comparison with the other vowels. Central, Eastern or Western Arrernte have the four vowel system just described. Kaytetye is analysed as having a two vowel system (Koch 1990).

Consonant clusters are frequent and some, such as the nasal-stop clusters, labialised homorganic nasal clusters and lateral-stop clusters, may occur word-initially; **ntange** ‘flour seed’, **mpege** ‘ripe,cooked’ . The smallest words, of which there are few, consist of a consonant which surfaces with an epenthetic vowel. These words are imperatives: **we** ‘hit (with a missile) imperative; **me** ‘here (take this)!; **mpe** ‘come on’; **ngke** ‘give it to me’. The greatest number of words have the structure VCe.

<sup>4</sup> Dixon (1980:fn197) and Hale (1976b:44) note the relationship between word-initial consonant dropping and stress shift from the first to second syllable. Dixon claims that the deletion of the consonant is due to stress shift. As pointed out by Blevins & Marmion (1994), this does not explain languages which underwent initial-dropping, but not stress shift, such as Yaygir (Crowley 1979) (see also Alpher 1976).

<sup>5</sup> Lamino-dentals are written as **th, nh, lh**; prestopped nasals as **pm, kng, tn**, etc and labialised consonants as **Cw**.

<sup>6</sup> There is some debate about whether /u/ is part of the underlying vowel inventory in Arrernte (see Breen 1990). Henderson (1993) gives a 3 vowel inventory /e,a,i/. This is not a relevant issue for the analysis presented in this chapter.

### 6.2.1 Syllable structure

Breen (1990), Breen & Henderson (1992), Breen & Pensalfini (1999)<sup>7</sup> argue that syllable structure in Arrernte is VC. There are problems with this argument and following Wilkins (1989), I maintain the view that the basic syllable structure in Arrernte is CV: a view consistent with universal patterns of syllable structure. I show that there is little evidence for VC syllable structure, nor is there compelling evidence for **e** in morpheme-initial or final position in the underlying phonological representation of morphemes. This means that I differ from Wilkins, who posits **e** morpheme-finally in underlying representations and that I differ from Breen & Henderson, Breen & Pensalfini, who claim that **e** is underlying morpheme-initial but not word-final. The arguments presented below support my analysis.

In a widely circulated paper, Breen (1990) argues that VC is the underlying syllable type in Arrernte, that there are no onsets, and that a CV structure is not valid in the main because:

- (1) there is variability in the number of phonetic syllables.
- (2) there is a bond between vowels and following consonants.
- (3) CV syllables are not relevant when speakers segment words when helping others to learn the language, eg **utnathete** ‘mulga blossom’ could be segmented as **utne-athete**; **arlalperre** ‘yellow ochre’ could be **arl-al-perr**.
- (4) if **e** was final, it would be necessary to have a rule to delete **e** before preceding vowels.
- (5) there is a number of bound morphemes with initial vowels and the description of all morphemes would be simpler if all were underlyingly vowel-initial.

Each of these arguments is addressed in turn. With regard to the first claim, variability in the number of phonetic syllables in an output is due to vowel deletion/epenthesis at a morpheme edge. Word-final vowel deletion/epenthesis is very common across languages and does not constitute evidence for a particular syllable structure. In fact, some languages have a constraint requiring words to be consonant-final, eg Final-C: every prosodic word is consonant final (M&P 1994)<sup>8</sup>. This is the requirement in Uradhi (Dixon 1980) /ama/ > **amang** ‘person’.

Word-final vowels are optional in Arrernte, probably due to a low level of salience and lack of phonological distinction in this position. Only **e** is permitted in this position, and is thus predictable.

Vowel deletion/epenthesis occurs at morpheme boundaries when syllable constraints would be violated. For instance, when consonants occur across a morpheme boundary, epenthesis occurs to avoid violation of NOCODA or ComplexONS (more than one consonant in onset); vowel coalescence occurs when vowels come together, avoiding violation of ComplexNUC (more than one vowel in nucleus). The operation of such constraints explain variability in syllable numbers of

<sup>7</sup> Pensalfini (1998) has since altered his analysis and argues for CV syllables.

<sup>8</sup> M&P (1993) report that consonant-final words are required in Makassarese and P&S report that the same requirement also exists for Lardil. However, both reports are incorrect as pointed out by Nick Evans (pc). Makassarese requires vowels, the velar nasal, or the glottal stop word finally, and in Lardil many vowel-final words exist, for example, **kurrihu** ‘will see’, **dibirdi** ‘rock cod’.



movements are found where during the vowel there is movement towards the second C.

The bond that Breen discusses is a phonetic phenomenon, but is not evidence necessarily for phonological syllable structure. Evidence from other languages shows bonding with following segments, but this has no effect on, nor does it determine, syllable structure. Vowel harmony shows a bonding between vowels in adjacent syllables which is not determined by the kind of syllable structure present.

The third claim is that speakers segment words not according to a CV structure when helping others to learn the language: eg **utnathete** ‘mulga blossom’ could be segmented as **utne-athete**; **aralperre** ‘yellow ochre’ could be **arl-al-perr**. This is an interesting situation and would need to be examined in more detail. A personal observation of segmentation of English words into syllables by non-linguists showed that there was variation. In some cases, segments were placed into coda and the medial syllable began with a vowels, eg **wind.ow.**, **test.ing**, **in.ter.est**. Some divisions show that speakers tend to be more aware of morphological divisions, as is the case in Warlpiri stress patterns, which would explain syllables divisions such as **test.ing**. If a language has a number of VC morphemes, as in Arrernte, then VC syllable divisions would be expected.<sup>9</sup> It would seem that psychological evidence for syllable structure is somewhat inconsistent and not useful support for phonological structures.

The fourth claim Breen makes is if **e**’s were morpheme-final, it would be necessary to have a rule to delete them before a preceding vowel. As he objects to this rule, he claims the underlying representation of morphemes is with **e** occurring initially rather than finally. According to his final claim, this representation is simpler. However, there is no reason that **e** should be underlyingly present morpheme-initially or finally. Epenthesis occurs at morpheme boundaries to separate consonants and optionally word-finally. Because of the variability of **e**, which is predictable, positing it as underlying at morpheme edges is not warranted. It is true that **e** is present in underlying representations when it occurs within a morpheme (it is consistently present), but not true that it exists underlyingly at morpheme edges. Part of the motivation for VC syllable structure is the representation of morphemes as **e** initial. Since this is unnecessary, the claim for VC syllables is not validated.

Other arguments against VC syllable structure are based on expectations if in fact syllables were of a VC structure. Firstly, there is no reason why epenthesis (if final V is not an underlying segment) would apply word-finally. Consider a form /VCVC/ which has VC syllables; epenthesis in this context would be illogical as there is nothing to syllabify with the epenthetic vowel, [VC.VC.e]. **e** is not permitted word-initially, suggesting that, amongst other factors, **e** cannot occur as a syllable on its own, unlike other vowels. A form /CC/ which surfaces as [CCe] might be expected under a VC syllable analysis to surface as [CeC], thereby satisfying VC requirement which is not satisfied in [CCe].

Secondly, there is no explanation for word-initial vowel deletion and not word-initial C deletion to achieve VC syllable structure word-initially. We would not expect word-initial vowel deletion if syllables were VC; however, we would expect word-initial C deletion.

Finally, a VC analysis cannot say why some roots are realised as C(C)e and not V(C)C. While **e** cannot occur in word-initial position, there would be no reason why

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<sup>9</sup> Thanks to Chris Manning for this insight.

another vowel could not occur here. We would expect to find minimal words of the form VC, which are consonant-final and not CV or VCe.

An additional problem with a VC syllable analysis is that syllable structure constraints would need to be revised, as well as theories on segment sequencing in onset and coda positions. Breen does not suggest how consonant clusters are to be interpreted, nor how a word-initial consonant is syllabified. The pattern of consonant sequencing in Arrernte is compatible with other languages, ie the first consonant is less or just as sonorous as the following consonant and, as is typical, the first consonant is a subset of the other consonants. Codas are coronal sonorants or sonorants which are place-linked to a following onset. If there are no onsets, it is not clear how to interpret  $C_1$  in  $C_1VC$ .

If we accept Breen's argument, we would need to introduce constraints on syllable structure specifically for Arrernte, which would weaken the theory. I will show that this is unnecessary as the already existing constraints can account for the data. For prosodic processes, having VC syllable structure would mean language specific constraints and an unsatisfactory, or a lack of, explanation for the patterns.

Arguing for VC syllable structure would be difficult to maintain in the light of the behaviour of stress and reduplication. Stress is assigned to the first syllable following a consonant or consonant cluster, as in **tyélpme** 'two', **alénye** 'tongue'. If VC was the syllable type, then we would expect that stress locates on such syllables word-initially. Since it does not, we assume that somehow VC syllables are faulty word-initially, or that there is no such syllable structure. If stress is not placed on word-initial VC syllables, what would be the explanation for it occurring on a following syllable with the same syllable structure, [aC.áC.]? There would be no explanation for the difference in behaviour between word-initial and non-word-initial VC syllables. Given that stress does occur on word-initial CV or CVC syllables, we would have to say that stress occurs on all syllables except VC word-initially, and that the  $C_1$  in  $C_1VC_2$  has something to do with stress appearing word-initially, but is otherwise ignored elsewhere. I argue that CV(C) syllables have no particular or special status in comparison to other syllables, nor does  $C_1$  have a special status word-initially.

Breen and Pensalfini (1999) claim that all words in Arrernte are underlyingly vowel-initial and that stress is assigned at a level when initial **e** is present. Such an analysis is rejected on the grounds that there is no justification for an additional level of processing, and that it is implausible to posit an underlying word-initial **e** which does not surface,<sup>10</sup> but not a word-final **e** which may. If either is predictable then neither should be underlying.

In their analysis, the output of /emp/ is **mpe** which is unexpected in a VC syllable analysis. The location of the epenthetic vowel is a strong indicator of syllable structure and the facts from Arrernte point to CV syllable structure.

Reduplication provides additional evidence for CV syllable structure. The following examples are of prefixing reduplication where for consonant-initial roots CV is copied, while VCV is copied in vowel-initial roots. Vowels are neutralised to **e**

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<sup>10</sup> B&P claim that **e** surfaces in all words that are not phrase-initial. Citation forms are phrase initial and thus do not surface with initial **e**. Given this context dependency, under their analysis, **e** is predictable, behaving as an epenthetic segment and not like the **e** that occurs within morphemes, which is not variable.

morpheme-finally and that *e* morpheme-final is an epenthetic vowel. The words in italics are the representation of morphemes advocated by Breen and Henderson and show a different morphological breakup from the analysis presented here.

- |        |                           |                         |                        |
|--------|---------------------------|-------------------------|------------------------|
| (8) a. | <i>tnye-me</i>            | <i>tny-eme</i>          | 'falling'              |
|        | <i>tnye-lpe-tnye-me</i>   | <i>tnyelpetny-eme</i>   | 'staggering' [GB:1991] |
| b.     | <i>mpware-me</i>          | <i>mpwar-eme</i>        | 'making'               |
|        | <i>mpwe-lpe-mpware-me</i> | <i>mpwelpempwar-eme</i> | 'making' [GB:1991]     |
| c.     | <i>itirre-me</i>          | <i>itirr-eme</i>        | 'thinking'             |
|        | <i>ite-lp-itirre-me</i>   | <i>itelpitirr-eme</i>   |                        |
| d.     | <i>atwe-me</i>            | <i>atw-eme</i>          | 'hitting'              |
|        | <i>atwe-lp-atwe-me</i>    | <i>atwelpatw-eme</i>    |                        |

I argue that word-initial onsetless syllables are prosodically inferior and thus do not satisfy targets in prosodic processes; however, in reduplication they cannot be skipped over and so are included in the reduplicant but not counted. Under a VC syllable analysis, syllable reduplication would entail reduplicating a (C)VC syllable in consonant-initial words, thus generating \***mpware-lpe-mpware-me**, instead of the attested **mpwe-lpe-mpware-me**. Given that (C)VC copying is not attested, I maintain that the pattern is CV.

An alternative would be to argue that prefixing reduplication is consonantal, involving copying the initial consonant of the word, and that the *e* in the reduplicant is a result of epenthesis. As I discuss in 6.3, a consonantal reduplication analysis is faced with accounting for a variable number of segments being copied and, therefore, is unable to construct a generalisation for the pattern which a syllable analysis is able to do.

The suffixing reduplication pattern is to copy a foot and suffix it to a fixed reduplicative segment /-p-/.

- |     |                                     |                        |                    |
|-----|-------------------------------------|------------------------|--------------------|
| (9) | Suffixing reduplication - Iterative |                        |                    |
| a.  | <i>are-me</i>                       | <i>ar-eme</i>          | 'looking'          |
|     | <i>are-p-are-me</i>                 | <i>arepar-eme</i>      | 'keeps looking'    |
| b.  | <i>atwerre-me</i>                   | <i>atwerr-eme</i>      | 'fighting'         |
|     | <i>atwerre-p-erre-me</i>            | <i>atwerreperr-eme</i> | 'keeps fighting'   |
| c.  | <i>mpware-me</i>                    | <i>mpwar-eme</i>       | 'making'           |
|     | <i>mpware-p-are-me</i>              | <i>mpwarepar-eme</i>   | 'keeps making'     |
| d.  | <i>kemirre-me</i>                   | <i>kemirr-eme</i>      | 'getting up'       |
|     | <i>kemirre-p-irre-me</i>            | <i>kemirrepirr-eme</i> | 'keeps getting up' |

This pattern does not support the VC syllable claim simply because the initial syllable in the copied portion has not carried over the onset. The fixed segment in Arrernte provides an onset for the copy effectively overwriting any onset. In partial reduplication, VC copying is well attested; examples are given below.

- |      |   |                |                  |
|------|---|----------------|------------------|
| (10) | a. Tzeltal (cited in Broselow & McCarthy 1983). |                |                  |
|      | <i>nit</i>                                      | <i>nititan</i> | 'push'           |
|      | <i>haš</i>                                      | <i>hašašan</i> | 'feel with palm' |

b. Warumungu (Simpson & Heath 1982)		
kartt-l	karttart-l	'keep making'
jarrppi-l	jarrparrpi-l	'keep entering'
c. Yir Yoront (Alpher 1973)		
worn	wororn	
mom	momloml	
d. Nakanai (Williams 1984)		
hilo	hililo	'seeing'
baharu	bahararu	'widows'

Both prefixing and suffixing patterns of reduplication are consistent with universal reduplicative patterns. The typical prefixing syllable reduplicant (the copied portion) is of the form CV, while for suffixing it is VC. The difference is that, in Arrernte, onsetless syllables do not meet syllable reduplicative requirement and the reduplicant shape is slightly obscured by the presence of neutralised and epenthetic vowels.

The Arrernte language game, Rabbit Talk, involves moving material up to and including the onset (somewhat like Pig Latin) from one end of the word to another, for example, **war** > **arewe** 'only', **arraty** > **atyarre** 'right'. The aim of a language game is to disguise the original form of the word. In Arrernte, transposition occurs to ensure that disguise forms are vowel-initial, except if this results in word-initial **e** which is not permitted (see Berry ms for a full analysis of this and other language games). While moving segments from one word edge to another will generally achieve effective disguise, in monosyllabic words or words that are underlyingly consonantal this is not the case, eg **ur** > **ure** which is the output for non-Rabbit Talk forms. Instead, a prefix /y-/ is added to the word, eg **ur** > **yure**, **mp** > **yempe**. Under a VC analysis, we might expect a vowel or VC to be prefixed.<sup>11</sup>

Finally, distribution of **e** requires explanation. If it occurs morpheme-initially, what explanation is there for its absence word-initially? What explanation is there for vowel neutralisation in morpheme-final but not morpheme-initial position, and for variability in word-final vowel epenthesis? I argue that the vowel distribution is due to a requirement for place features morpheme-initial, but not morpheme-final. And that variability in word-final epenthesis is because of the low perceptual salience in this position concurrent with absence of vowel-place features. This correlates with the positional prominence asymmetry noted of word edges, ie neutralisation, or reduction in word-final position, but not word-initial.

The claims Breen makes are not sufficient to warrant positing VC syllables in Arrernte. The essential problems are: the non-universality of VC syllables; the lack of strong evidence for VC syllables; the lack of explanation for the difference between

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<sup>11</sup> Breen & Pensalfini (1999) argue that the prefix is /ey-/ which shows up when non-phrase initial. Breen & Pensalfini claim that the problem for a CV analysis in accounting for Rabbit Talk is that it would have to say a word is split after the first onset. Though they cite Pig Latin as doing this as well, they then conclude by saying that language games are not good indicators of phonological parsing. Contrary to their claim, language games show that the same constraints on syllable structure, to name just one feature, are in fact maintained in language game forms. In addition, isolating an onset or splitting a syllable is not uncommon in language games and, where it occurs, concern is with the output not the input.

VC and CVC syllables in prosodic processes; no explanation for the distribution of and the variability of *e* at morpheme edges. I believe my arguments presented decide against VC syllables in Arrernte. Since all prosodic processes can be accounted for using CV syllables, this can be considered better than those advocating VC syllables.

Before moving onto the next section, mention should be made of the claim by Wilkins (1989) that /a/ is epenthetic word-initially in a number of words. I assume along with Breen that /a/ is not epenthetic, but that it is underlying. As discussed in the section on variation, I propose that words with variable initial /a/ indicate that there are two underlying forms, one with /a/ and one without.

### 6.2.1.1 Syllable structure in OT

On the basis of universal evidence into the structures of syllables, it is accepted that CV is the basic syllable shape. Some languages may have CVC and/or V syllables, but no language has only V or only CVC. All languages have CV syllables. To account for basic syllable structure, (P&S 1993, M&P 1993) introduce the following constraints:

- (11) **ONSET:** A syllable must have an onset.  
**NOCODA:** Syllables must not have codas  
**\*COMPLEX:** No more than one consonant or vowel may associate to any syllable node position

ONSET requires all syllables to have onsets. Syllables with onsets are universally unmarked syllables, while syllables without onsets are marked. If ONSET is undominated in the grammar of a particular language, it will ensure that only unmarked syllables emerge as optimal, ie CV. \*Complex rules out a sequence of vowels or more than one segment syllabified into onset, nucleus or coda.

A difference in ranking generates the following scales:

ONSET >> NOCODA            -        CV > CVC > V > VC  
 NOCODA >> ONSET            -        CV > V > CVC > VC

Segmental epenthesis and deletion are governed in OT by the faithfulness constraints FILL and PARSE (they are also known as DEP and MAX respectively (M&P 1995)). These constraints ensure that input representations are parsed.

- (12) **FILL:** Epenthetic structure is prohibited.  
**PARSE:** Unsyllabified structure is prohibited.

In order to satisfy syllabic requirements, epenthesis or deletion may occur, which will thus violate FILL or PARSE. Segments which are not parsed into syllabic structure receive no phonetic interpretation, which means they are deleted. The constraints thus far discussed are ranked as follows for Arrernte: PARSE, NOCODA >> ONSET, FILL. Segments in '<>' have not been parsed.

(13a) therr 'two'	PARSE	NOCODA	ONSET	FILL
%a. the.rre				*

b. therr		*!		
c. <th>e.rre	*!		*	*

(13b) aleny 'tongue'

%a. a.le.nye			*	*
b. a.leny		*!	*	
c. <a>le.nye	*!			*

Variation of outputs occurs in Arrernte; I will assume that the standard citation form is that where initial vowels are parsed and where epenthesis occurs word-finally and between consonants at morpheme boundaries. The issue of variation warrants discussion and I leave this until section 6.2.5. Where *e* occurs morpheme-finally, I assume that it is epenthetic.

I assume that epenthesis can only occur at morpheme boundaries and not within a morpheme, such as between medial consonant clusters. Thus an input /CC/ can only be syllabified as [CCe]. This output violates \*COMPLEX, in that two segments are parsed into onset. However, a higher ranked correspondence constraint, such as O-CONTIG (M&P 1995:310), would rule out [CeC]. O-CONTIG rules out internal epenthesis. This explains why epenthesis does not occur within morphemes to separate consonant clusters, but does occur at morpheme boundaries. Epenthesis is forced in these locations by NOCODA, but elsewhere NOCODA is overridden by constraints like O-CONTIG.

*e* is not permitted word-initially, presumably because it is a placeless vowel. All other vowels occur word-initially. A constraint requiring place features at the left edge of a morpheme is necessary. This contrasts with the right edge of the prosodic word which does not require vowel place at this edge.

- (14) LE-Place: -V  
 |  
 μ  
 |  
 place

To account for the pattern of vowel neutralisation at the right edge of morpheme boundaries, as evidenced in reduplication, a constraint barring vowel place is required. As consonants can be found at this edge, place in this position cannot be ruled out altogether.

- (15) RE-NoPlace: V- (At the right edge of a morpheme, vowels are placeless)  
 |  
 μ

LE-Place and RE-NoPlace account for the fact that morphemes cannot consist only of a vowel; for instance, a full vowel would violate RE-NoPlace and a schwa would violate LE-Place. The fact that such constraints are required indicates that word-initial onsetless syllables are not invisible to prosodic constraints and that they are parsed into the prosodic word.

### 6.2.1.2 Onsetless syllables

With regard to phonological processes, some morphological edges behave differently depending on whether they are word-internal or word-edge. Typically, word-internal morphological edges tolerate segmental epenthesis and deletion, but word edges do not. This may mean that onsetless syllables are found only in word-initial position.

The fact that onsetless syllables may occur word-initially and nowhere else is attributed to the relationship between the stem and prosodic word. This is argued by M&P (1993a) for Axininca Campa where epenthesis occurs word-internally, but not word-initially. T = epenthetic consonant

- (16) a. /i-N-koma-i/ ingkomaTi 'he will paddle'  
 b. /i-N-koma-ako-i/ ingkomaTakoTi 'he will paddle for'

Onsetless syllables cannot occur within words but may occur at the left edge of a word. Under the constraint AlignL (introduced in Chapter 2), the left edges of a stem and prosodic word are required to correspond. Any attempt to satisfy syllabic well-formedness at the left edge, either by epenthesis or non-parsing, would incur violations of AlignL. A conflict between AlignL and the syllabic constraint ONSET is evident word-initially.

- (17) **AlignL:** The left edge of the stem aligns with the left edge of the prosodic word.

An onsetless syllable may be found at the left edge of words in some languages. However, if a consonant is inserted to fill the onset of a syllable in word-initial position, this would de-align the stem with respect to the prosodic word. While the epenthetic consonant would be part of the prosodic word, it is not part of the underlying representation of the stem, and thus the edges of the prosodic word and stem would not correspond.

The dominance of AlignL over ONSET accounts for a large number of languages where epenthesis or deletion in word-initial position is not permitted, but where both epenthesis and deletion may be found word-internally and finally.

Consonantal epenthesis does not occur in Arrernte, although it is noted that vowel deletion may occur in words commencing with /a/. Wilkins (1989) mentions that the presence or absence of /a/ is restricted to certain words and that not all /a/ initial words undergo /a/ deletion. I analyse words which may or may not surface with initial /a/ as having two variants underlyingly and that word-initial vowel deletion does not occur for reasons discussed in section 6.2.5. I assume that the general pattern is where word-initial vowels are parsed, indicating that AlignL and PARSE are dominant over ONSET. The operation of the constraints is illustrated below in an example from Arrernte **atwerr** 'to fight'. |=stem edge; <>=unparsed

(18) atwerr	AlignL	PARSE	ONSET
%a. [atwerre]			*
b.  <a>[twerre]	*!	*	

The optimal output is where the stem and prosodic word are aligned in (18a). In (18b) the initial vowel is not parsed, which avoids violation of ONSET, but violates AlignL and PARSE. Note that if a word-initial consonant was not parsed both AlignL and ONSET would be violated.

This section outlines the explanation under OT for onsetless syllables in word-initial position. Any attempt to generate a syllable with an onset will violate the higher ranked AlignL.

### 6.2.2 *Stress*

Main stress in Arrernte is on the first syllable with an onset. The exception is when the word is disyllabic and vowel initial, in which case stress can be either on the initial onsetless syllable or the final syllable. Stress alternates on every other syllable. The examples presented in this section are mostly from Mparntwe Arrernte (Wilkins 1989). Some examples are from Henderson & Dobson (1994) indicated by the initials H&D.<sup>12</sup>

The difference in stress patterns between vowel-initial and consonant-initial words is shown in (19).

- |      |                 |                           |
|------|-----------------|---------------------------|
| (19) | a. inárlenge    | 'echidna'                 |
|      | b. alénye       | 'tongue'                  |
|      | c. ulpmérnte    | 'dust storm'              |
|      | d. arrénelhéme  | 'sit yourself down' (H&D) |
|      | e. urrtyálthe   | 'liar' (H&D)              |
|      | a. yéparènye    | 'k.o.caterpillar'         |
|      | b. téngkwelkngé | 'snot; a cold'            |
|      | c. mártème      | 'is closing'              |
|      | d. thérré       | 'two'                     |
|      | e. tyélpme      | 'chips'                   |

When the word is vowel-initial, stress is on the second syllable. In quadrisyllabic words this means only one syllable is stressed. In contrast, when the word is consonant-initial, stress is on the first syllable, as well as the third syllable. The rhythmic pattern of words is affected by the structure of the word-initial syllable.

There is some variation in stress placement in vowel-initial disyllabic words. Stress may be located only on the initial syllable as in the word (20), or only on the final syllable as in (21).<sup>13</sup>

- |      |          |       |
|------|----------|-------|
| (20) | a. ámpwe | 'old' |
|      | b. írlpe | 'ear' |

<sup>12</sup> Wilkins' may represent vowels differently compared to those in the dictionary and in Breen and Henderson due to differences in perception and analysis.

<sup>13</sup> According to Breen (1990), Eastern Arrernte speakers and older speakers of other varieties of Arrernte tend to stress the final vowel in vowel-initial disyllabic words. Breen does not clarify whether this tendency is subject to contextual conditions or whether there is free variation. The different patterns of stress for vowel-initial disyllabic words may represent a change in progress, or the existence of words with lexically marked stress. This area requires further investigation.

- (21) c. álknge 'eye'  
 a. arltwé 'empty'  
 b. ankwé 'asleep'

Stress on word-final syllables only occurs in vowel-initial disyllabic words, while stress on onsetless syllables appears to be lexically conditioned.

The stress pattern may also vary in words, depending on vowel quality. According to Wilkins (1989), if the initial segment is /a/ and the second vowel is a schwa e, then some words may have stress on either the first or second syllable.

- (22) árrernte ~ arrérnte 'Arrernte'

Breen reports that, in some words with a word-initial full vowel, followed by a schwa in the next syllable, stress on the first vowel in such words is more likely for younger speakers. He gives **árrernte**, **úrreke** 'wait on' and **írretetye** 'support, frame' as examples, noting that in all cases the consonant following the vowel is /rr/, but that it is a doubtful conditioning factor.

Henderson & Dobson note that some other disyllabic words also show free variation, eg **urrpmé** ~ **úrrpme** 'chest scar', **ámpe** ~ **ampé** 'child', but in **ampéke** 'for a child' there is no variation. The variation in disyllables perhaps reflects preferences dependent on speaker age and/or dialect.

Words of four or more syllables in Arrernte are typically polymorphemic or frozen reduplications, and follow the general stress pattern described above.

- (23) a. knwenge-ipere knwéngipére  
 2sgDAT-AFTER 'after you; from you'  
 b. iperte-iperte ipértipérte  
 hole-hole 'rough; bumpy'  
 c. atere-althe atéralthe  
 afraid-BadCHAR 'coward'  
 d. atne-iwe-me atníweme  
 guts-throw away-NPP 'gutting an animal'

In sum, the following observations can be made regarding the stress patterns in Arrernte:

- (a) Stress is on the first syllable with an onset.  
 (b) Onsetless syllables may be stressed if the word is disyllabic or is of the form [VCe...]. In other environments they are ignored.  
 (c) Stress alternates on every other syllable, but not on the final syllable, except when the word is both disyllabic and vowel-initial.

### 6.2.2.1 An Analysis

The location of feet within words depends on whether the word-initial syllable has a consonant or not. If the initial syllable has a consonant, then a foot will be aligned to the left edge of the word, eg **(téngkwel)knge** 'snot; a cold'. If, on the other hand, the initial syllable is without an onset, a foot is aligned with the second syllable, and not the initial one, as in **a(lénye)** 'tongue'.

In previous metrical accounts of Arrernte (including Levin 1985, Archangeli 1986, Halle & Vergnaud 1987), initial onsetless syllables are analysed as extrametrical.<sup>14</sup> Extrametrical syllables are marked by rule, and are ignored or are invisible to prosodic processes. When syllables are parsed into feet, the extrametrical syllable is left out because it is invisible. Marking an onsetless syllable as extrametrical can account for stress appearing on the second syllable in words commencing with a vowel.

The marking of certain prosodic constituents as extrametrical is confined to the edges of words. A segment, syllable or a foot at the left or right edge of a word may be marked as extrametrical. For the Arrernte facts, not just any syllable at the left edge of a word can be extrametrical; only onsetless syllables can be extrametrical.

While marking an onsetless syllable as extrametrical prevents it being incorporated into a foot, it does not explain why this should be the case. There is also no evidence from other prosodic processes in the language to indicate that onsetless syllables are extrametrical.

Given that stress is not located on vowel-initial syllables, at least in words longer than two syllables, it is reasonable to assume that there is a particular relationship between the structure of syllables and the foot. If the initial syllable in the word does not have an onset, the foot will align to the next syllable that does.

We may suppose that onsetless syllables are ignored because they are the least well-formed or least harmonic syllable available. In general, prosodic processes target or attempt to achieve the most well-formed or optimal constituent. This is particularly evident in reduplication, where in syllable reduplication, a reduplicated syllable must satisfy syllabic well-formedness conditions, or the complete output best satisfies these conditions. Satisfaction of the conditions is ensured by various means in different languages. For example, in Timugon Murut reduplication (Prentice 1971), initial onsetless syllables are ignored and the first CV syllable is copied.

(24) Timugon Murut reduplication

a. bulud	bu-bulud	'hill/ridge'
b. limo	li-limo	'five/about five'
c. ompodon	om-po-podon	'flatter/always flatter'
d. abalan	a-ba-balan	'bathes/often bathes'
e. ulampoy	u-la-lampoy	no gloss

In consonant-initial words the initial syllable is copied and prefixed to the root. However, in vowel-initial words the first syllable is ignored and the next syllable is copied instead. In words with closed syllables such as (24e), only the onset and nucleus are copied. These facts indicate that reduplication targets the least marked syllable, ie CV. V syllables are ignored and in CVC syllables only CV is copied.

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<sup>14</sup> Extrametricality is formally proposed in Hayes (1979) and subsequently developed in numerous works, including Hayes (1981), Harris (1983), Archangeli (1984), Inkelas (1989). The term 'invisibility' (Poser 1984) is often used to cover phenomena which are variously referred to as 'extrametricality' (Lieberman and Prince 1977; Hayes 1981), 'extratonicity' (for tone, Pulleyblank 1986), and 'extraprosodicity' (for vowel harmony, Kiparsky ms). Idsardi (1992) adopts a different approach to extrametricality through the use of boundary markers. Word edges are marked with boundaries by rule. In his analysis for Arrernte, a rule places a left boundary to the right of the left-most element where the left-most element is a vowel, ie V(CVCV).



words. The conclusion is that trochaic feet are responsible for assigning feet, but that the foot is sensitive to LESP, which results in second syllable stress because of Prominence.

The left edge of the word is also the position of prominence. If a non-prominent syllable is in this position, stress is forced to locate on another syllable. Also note that the placeless vowel *e* in Arrernte is not permitted word-initially, suggesting that a certain degree of prominence is required in this position. It is possible that prominence is a factor in the variability in stress location when an onsetless syllable is followed by a syllable with *e*.

The most prominent syllables in Arrernte are those with an onset. This generates the following scale: CV (C) > V(C). Note that this prominence scale is significant only word-initially as onsetless syllables elsewhere are not permitted.

- (26) LESP: prominence hierarchy  
CV (C) > V(C)

The constraint based on this hierarchy is LESP.

- (27) **LESP**: Assign stress to prominent syllables.

The other constraints required are:

- (28) **FootForm**: SyllableTrochee  
**AlignPW**: Align a foot to the left edge of the prosodic word  
**RA**: Unfooted syllables must not be adjacent

The ranking is: RA, LESP >> FtForm, AlignPW

LESP must be ranked above AlignPW to have any effect, and is also ranked above FtForm to ensure that iambic feet cannot be generated in optimal outputs other than disyllables as a result of LESP. LESP evaluates syllables according to the hierarchy. To avoid confusion only the first two syllables are presented in the tableau; other syllables do not compete.

(29) inarleng

	LESP	FootForm	AlignPW
%a. i(nárle)nge	i, ná		*
b. (ína)(rlènge)	í!,na		
c. (iná)(rlènge)	i, ná	*!	

(29a) is the optimal output, even though the foot is not aligned to the left edge of the prosodic word and two syllables are not parsed into feet. Any outputs with a sequence of unfooted syllables would be ruled out by RA. Violation to ONSET has no effect on the outputs as the following tableau shows:

- (30) inarleng
- |  | ONSET | LESP | AlignPW |
|--|-------|------|---------|
|  |       |      |         |

%a.[i(nárle)nge]	*	i, ná	*
b.[(ína)(rlènge)]	*	í! na	

All outputs violate ONSET, but because (30a) does not violate LESP, it is the optimal output.

In consonant-initial words, LESP has no effect since all syllables are prominent and so the decision on the optimal output will be determined by FtForm and AlignPW. In disyllabic words, the LESP will ensure that final syllables are stressed, as shown below with the word **urrpme** 'chest scar'.

(31)	LESP	FtForm
a. (úrrpme)	úrr!, pme	
%b. (urrpmé)	urr, pmé	*

Note that reversal is not an option in longer words as seen in (29) where the optimal output does not violate either LESP or FootForm.

As previously discussed, some dialects or age groups allow stress variation in disyllabic vowel-initial words and words with initial onsetless syllables followed by Ce. To account for this a specific additional ranking needs to be added to the Prominence Hierarchy. Under the current Prominence Hierarchy, this variation could not occur since any CV syllable is better than V syllables. The variability in [VCe...] contexts is context dependent, that is, it is only in this context that either V or Ce can be stressed. Thus V and Ce are equivalent in terms of prominence in this context. Since Ce syllables would be assessed as better than V syllables in the general hierarchy, a specific ranking where V is better than Ce is needed. This is shown in (33), where the ranking is linked to a dialect:

- (32) Prominence Hierarchy: CV(C) > V(C);  
 Dialect (a): in [VCe...], V(C) > Ce

Dialect (a) can represent any group or individual that shows variation and we can say that variation occurs when a speaker uses Dialect (a). For our purposes this simplifies the issues surrounding variation, such as the degree of frequency of variants. In (33) and (34), the optimal output is determined by LESP's Dialect (a) condition.

(33) Dialect (a)	LESP	FtForm
%a. (úrrpme)	úrr, pme	
b. (urrpmé)	urr, pmé!	*

(34) /arrernt/

LESP

AlignPW

a. a(rrérnte)	a, rré!	*
%b. (árrern)te	á, rre	

It is debatable as to whether V and Ce syllables should be equivalent or ranked in Dialect (a). If there is no ranking of these syllables, the output will be determined by FtForm in disyllables or by AlignPW in longer forms, in which case the optimal output will have initial stress. Thus the same output is generated regardless of whether V and Ce syllables are ranked or are equivalent. FtForm decides on the optimal form in (35).

(35)

	LESP	FtForm
%a. (úrrpme)	úrr, pme	
b. (urrpmé)	urr, pmé	* !

For the moment I will assume that in Dialect (a), V is ranked above Ce syllables. The benefit is that prominence is determined by LESP rather than FootForm or AlignPW.

### 6.2.2.3 Discussion

Arrernte is an example of where prominence and foot alignment interact at a word edge. This phenomenon may have arisen as a result of sound changes in the language which affected the structure of word-initial syllables. When syllable structure cannot be changed or improved then prominence requirements attached to the left edge of the prosodic word may come into play. Feet align with edges and such edges are prominent because of that, particularly if the head of the foot is at the edge. The edge may be less prominent if stress is on the second syllable, but in Arrernte this is better than stressing an onsetless syllable.

The evidence that prominence influences the stress patterns in Arrernte includes the distribution of vowels (**e** morpheme-final and not morpheme-initial), avoidance of stress on onsetless syllables, stress on word-final syllables in VCV words, variation in vowel-initial words when the second syllable contains **e**.

Prominence is relevant not only for position in a syllable but also for position in a word. Much evidence exists for the prominence of syllables in word-initial position (see Beckman 1998 for a survey of psycholinguistic and phonological evidence). According to Steriade (1994, cited in Beckman 1998) there are some linguistic positions which are privileged in that phonological contrasts which are perceptually difficult are maintained and such positions are less likely to be subjected to phonological processes such as neutralisation. Word-initial position is a position of prominence and contrasts with word-final position where neutralisation is commonly found.

Stress is commonly found at word edges and Hyman (1977:41) reports that stress on an initial or final syllable involves less calculation for both speaker and hearer. According to Prince (1983:90), word edges are salient positions receiving enhancement from a relationship with the intonation contour which starts high then gradually drops.

Morpheme-final position in Arrernte is not a privileged position as it is susceptible to neutralisation. For instance, when a CV syllable is reduplicated the vowel neutralises to **e**, as in **mpwe-lpe-mpware-me** from **RED-lp-mpwar-m**. This contrasts with morpheme-initial position.

The tendency for vowel neutralisation or deletion may explain why some languages have a requirement that words are consonant final. This tendency is reflected in the constraint previously mentioned, ie Align-C. P&S (1993) claim that such a constraint is required to account for the prosodic weakness of final open syllables evidenced by instances of destressing, devoicing, shortening.

It is interesting to consider why word-initial segment deletion occurred in Arrernte if the edge is indeed prominent. Blevins and Marmion (1994) offer a proposal for Nhanta, a Kartu language of Western Australia, which underwent initial bilabial deletion leaving many words vowel-initial. They claim that onsets of stressed syllables underwent shortening, which affected consonants with a short VOT and weak bursts, ie bilabials. These, as a consequence, weakened gradually to the point where place of articulation cues were no longer auditorily significant, effectively deleting.

### 6.2.3 *LESP in other languages*

Other languages with similar conditions to stress assignment as Arrernte are Banawa↔ (Buller, Buller & Everett 1993) and Iowa-Oto (Robinson 1975) as cited in Downing (1996). While stress is placed on word-initial CV syllables, stress on word-initial onsetless syllables is avoided. Examples from Iowa-Oto are **páxoce** ‘Iowa’ and **aháta** ‘outside’. Languages related to Arrernte show a similar pattern, for instance Alyawarra (Yallop 1977), but where only CV syllables are stressed, as in **kwátja** ‘water’, **ilípa** ‘axe’ and **athá** ‘I (ERG)’, and Andegerebena (Breen 1977) **káge** ‘bit’, **atwákay** ‘wild orange’. Other Australian languages include Uradhi (Hale 1976b), which shows the following patterns, **yúkuk**, ‘tree’, **amáng** ‘person, as well as some Yolngu languages, such as Djapu, where stress is typically on word-initial syllables but may occur on a second syllable if that syllable has an apical consonant in onset (Evans 1995). In this section, other languages showing LESP, Spanish, Pirahã and Ngalakan are examined.

#### 6.2.3.1 *Spanish*

The interaction of prominence and the left edge of the prosodic word can be seen in Spanish. In Spanish, word-initial **e** which is epenthetic before sC clusters cannot be stressed (Harris 1983, Alderete 1995)<sup>15</sup>. Epenthesis occurs in the following loan words:

(36)	/sfera/	esfera	‘sphere’
	/slavo/	eslavo	‘slavic’
	/spirar/	espirar	‘to breathe’

The typical stress pattern is stress on the penultimate syllable, but this pattern is disrupted when **e** is initial. This is illustrated in the verb **estar** where stress may occur

<sup>15</sup> The claim that **e** is epenthetic in roots is based on the fact that there are no word-initial sC clusters in Spanish.

on the final syllable and this contrasts with the patterns for the verb **hablar**. Examples are from Alderete (1995).

(37)	a. indicative		subjunctive	
	estóy	háblo	esté	háble 1perSG
	estás	hablas	estés	hábles 2perSG
	está	habla	esté	háble 3perSG
	estámos	hablámos	estémos	hablémos 1perPL
	estáis	habláis	estéis	habléis 2perPL
	están	hablan	estén	hablen 3perPL

The only exception to this pattern of avoiding stress on word-initial **e** are the demonstratives, eg *éste*. In non-initial position **e** can be stressed:

(38)	/aBr-to/	aBjérto	‘open’
------	----------	---------	--------

Other vowels can be stressed word-initially. Examples from Halle & Vergnaud (1990:94):

(39)	el áma	‘the mistress’
	el álma	‘the soul’

I propose that **e** word-initially cannot be stressed because its inherent prominence is less than that for other vowels and because there is no onset. Thus, preference is given to more prominent syllables. Given that it can be stressed elsewhere then there is a case for LESP at the left edge of the prosodic word.

In an analysis of the stress transparency of **e** word-initially, Alderete (1995) advocates that an initial stressed **e** is ruled out by a constraint (HEAD-DEP) which only allows input segments to be included in a metrically prominent category, such as in the main stress foot of the prosodic word. He argues that in disyllabic words with initial **e**, this constraint forces monosyllabic feet, such as in *es(tás)*, thereby avoiding inclusion of **e** into the main stress foot and violating the higher ranked HEAD-DEP.

It is clear that a relationship exists between syllable prominence and prosodic word prominence, hinted at in Alderete’s constraint. A combination of factors seem responsible; lack of an onset, a prominent word edge in disyllables (due to penultimate stress), a non-prominent vowel at this edge. I propose that a prominence hierarchy, such as  $CV(C), V_{place}(C) \gg e(C)$ , is referred to by the LESP constraint, and this will generate the optimal output in disyllabic words. CV syllables include any vowel, but for VC syllables it is necessary to distinguish between vowels with place features and the epenthetic vowel, which by its nature lacks place. In longer words, LESP combined with a constraint on word-final stress (NONFIN) will generate optimal outputs.

(40)	LESP	NONFIN
% a. <i>está</i>	es, tá	*
b. <i>ésta</i>	és!, ta	
% a. <i>estámos</i>	es, tá, mos	
b. <i>éstamos</i>	és!, ta, mos	
c. <i>estamós</i>	es, ta, mós	*!

Under a prominence analysis, it would not matter if *e* was underlying or epenthetic, as, in either case, in onsetless syllables *e* is the least preferred syllable.

### 6.2.3.2 *Pirahã*

In *Pirahã*, stress is sensitive to syllable weight and to LESP. Voiceless consonants are less sonorous, but more prominent than their voiced counterparts and syllables with voiceless onsets are preferred over voiced onsets. The hierarchy of prominence can be represented on a single scale, but LESP assesses left edge prominence, while PK-PROM assesses syllable weight.

(41) CVV >> GVV >> VV >> CV >> GV

Since weight is more important than onset prominence, PK-PROM is ranked above LESP. These are ranked above a requirement to align stress to the right.

(42) <i>soioagahai</i> ‘thread’	PK-PROM	LESP
%a. <i>soi.oa.ga.hái</i>	ái, a, oa	h, g
b. <i>soi. óa.ga.hai</i>	óa, ai, a	o!, g, h,
c. <i>soi.oa.gá.hai</i>	oa, ai, á!	h, g

The two prominence dimensions interact ensuring that optimal stressed syllables are heavy syllables with an onset of the lowest sonority which is thus maximally distant from the sonority of vowels. Interaction between heavy syllables and syllables with a particular onset occurs in *Ngalakan* discussed in the next section.

### 6.2.3.3 *Ngalakan*

Another language where voiceless consonants have some influence over stress patterns is *Ngalakan*, a Non-Pama-Nyungan Australian language of the Gunwinjguan family. According to Baker (1997a), heavy syllables are those with heterorganic codas, but not those with homorganic codas, including geminates. This geminate behaviour has been noted by Tranel (1991), who reports that geminates are non-weight bearing in languages where CVV is heavy, such as in *Selkup* and *Malayalam*.

Geminates are analysed as fortis and are longer than the corresponding lenis stop. It would seem that this factor influences some of the stress patterns. For instance, when a glide is in onset of the word-initial syllable and there is a geminate, stress goes on to the second syllable, shown in (43).

- (43) wukká□a                    ‘frog sp.’  
 yippú□ca                    ‘a long time ago’  
 yukkácih                    ‘for a long time’  
 wakkéna                    ‘return.FUT’  
 akká□ah                    ‘late’

However, if a geminate is present and the word-initial consonant is not a glide, stress is on the first syllable, shown in (44):

- (44) pícciri                    ‘file snake’  
 káppuci                    ‘old person’  
 káppu□a                    ‘old, blind person’

When the first syllable is heavy and the next syllable commences with a geminate, there is variation in the stress pattern.

- (45) mi□ppára/mí□ppara                    ‘child’  
 palppá□a?/pálppa□a?                    ‘friend’  
 palccú□a?/pálccu□a?                    ‘lizard sp.’  
 purkkáci/púrkakaci                    ‘real’

In some words there is no variation, as shown in (46). Baker suggests that this may be because the final syllable is closed by a sonorant.

- (46) káykkupu□?                    ‘early’  
 wúrkki□i□                    ‘macropod sp.’

There is no variation in stress assignment when a light syllable precedes one with a fortis onset, as the words in (44) show. If these syllables were heavy, we would expect stress consistently on the first syllable and not on the second syllable, as in the words in (43) and (45). We may suppose along with Baker (1997b) that prominence is a factor in assigning stress, although how this is formalised differs. I propose that stress is assigned according to LESP and PK-PROM considerations.

The data indicate a LESP prominence hierarchy where syllables with glide onsets are least preferred, and a PK-PROM hierarchy where heavy syllables are preferred. In one of these hierarchies it is necessary to combine the two prominences because of the variation between heavy syllables and syllables with an initial fortis consonant. This can be interpreted as a conflict between LESP and PK-PROM, ie different kinds of prominence, but needs to be expressed in a single prominence hierarchy, PROM. I assume that this conflict expressed as variation is dealt with in the same way as for Arrernte, that is, through a dialect/variant ranking.

- (47) PK-PROM: CVC > CV(C<sub>no place</sub>);  
 Dialect (b): In [CVCC<sub>fortis</sub>V...], C<sub>fortis</sub>V > CVC  
 LESP: In [C<sub>glide</sub>V C<sub>fortis</sub>V...], C<sub>fortis</sub>V > C<sub>glide</sub>V

Homorganic consonants in coda position have no independent place specification (the details of which I will not formalise here) in contrast to heterorganic

codas. Alternatively, homorganic consonants and a geminate are not syllabified into coda. Both options are feasible; however, there is not the space here to debate the benefits of one over the other. For the moment I will indicate homorganic consonants as having ‘no place’.

With PK-PROM and LESP ranked over AlignFt, prominence takes precedence, but is constrained so that stress is as close as possible to the left edge of the prosodic word. The tableaux below show the operation of the constraints.

(48) wukkara	LESP	AlignFt
%a. wukkára	wu, kká	$\sigma$
b. wúkkara	wú!, kka	

(49) /kaykkupu	PROM	AlignFt
%a. káykkupu	káy, kku	
b. kaykkúpu	kay, kkú !	$\sigma$

(50) Dialect (b)	PROM	AlignFt
%a. palppára?	pal, ppá	$\sigma$
b. pálppara?	pál!, ppa	

Under conditions for Dialect (b), a syllable with a fortis onset will be stressed over a heavy syllable and thus (50a) is the optimal candidate in the tableau above.

In many languages, prominence is expressed either through LESP or PK-PROM, with PK-PROM being the more frequently attested prominence type. Arrernte provides evidence that an LESP requirement is needed, separate from PK-PROM. In Ngalkan, we see that both types of prominences are merged together into a single hierarchy in Dialect (b) to account for variation.

Evidence that fortis consonants are recognised as prominent comes from their distribution in suffixal domains. In these domains, the distribution of fortis consonants is dependent on the distance of fortis consonants from each other. If they are within two syllables, degemination of a morpheme initial fortis consonant occurs. Degemination also occurs if there is a glottal-obstruent cluster in the root or if the fortis consonant is adjacent to a stop.

- (51) cangku-cci                    ‘no meat’  
ku-we?-ci                    ‘no water’  
mi□ppara-ci                   ‘no children’  
ɛu-kaykka-pulu               ‘[those] uncles’  
NC-MoBr-PL<sup>16</sup>  
kaykka-Ɂini-ppulu           ‘my uncles’  
MoBr-1SGPOSS-PL

Baker (1997a) analyses this as a requirement for alternation of prominence with a constraint similar to RA, where prominent syllables are those with geminates and stressed syllables.

<sup>16</sup> Abbreviations: NC: noun class prefixes; MoBr: mother’s brother; PL: plural; POSS: possessive; SG: singular.

### 6.2.3.4 Discussion

In the analysis presented here, a prominence distinction is made between the different edges of syllables. LESP is sensitive to prominence at the left edge, in contrast to PK-PROM, which is sensitive to the right edge. The right and left edges show different prominence. This asymmetry is observed in what contrasts are available in onsets and codas, and in what undergoes phonological processes. For instance, onsets typically have a greater range of featural contrasts than codas, and onsets typically fail to undergo phonological processes like assimilation, unlike codas.

An asymmetry is also observed in word edges. Typically the right edges of word undergo phonological reduction or deletion processes, while the left edges are resistant to such processes.

Additional support for syllable edge asymmetry in terms of prominence, where different kinds of prominence are required for different edges is illustrated in Koniag Alutiiq (Leer 1985). In this language, consonants in foot-initial position or the left edge of iambic feet ( $\sigma\sigma\text{[X]}\text{[X]}$ ) undergo fortition. The crucial facts are that word-initial consonants strengthen, but there is no strengthening (lengthening) of vowels in an onsetless syllable word-initially. Note that the alternation of fortis consonants is similar to that in Ngalakan. Examples are from Hewitt (ms) and do not have glosses<sup>17</sup>.

- (51) /-quta-/ ‘be going to V’
- |  |                       |
|--|-----------------------|
| [ <u>p</u> i.sú:.qu. <u>t</u> a.qú:.ní]              | /pi-su-quta-quni/     |
| [ <u>m</u> a.ngár.su. <u>g</u> u.tá:. <u>g</u> u.ní] | /mangar-su-quta-quni/ |
| [át.sar. <u>s</u> u.qú:. <u>g</u> u.ní]              | /atsar-su-quta-quni/  |
| [ <u>p</u> i.sú:.qu. <u>t</u> a.qú:.ní]              | /pi-su-quta-quni/     |
| [ <u>m</u> a.ngár.su. <u>g</u> u.tá:. <u>g</u> u.ní] | /mangar-su-quta-quni/ |
| [a.gá:. <u>y</u> u.tém.máng]                         | /agayute-maang/       |
| [a.gá:.yu. <u>t</u> e.lég.mek]                       | /agayute-leq-mek/     |
| [a.kú:. <u>t</u> a.tún.nir.túq]                      | /akutaq-tu-nnir-tuq/  |

The data highlights the difference between prominence due to weight and left edge syllable prominence. Strengthening a vowel would result in a long vowel and in this language only stressed vowels are long. Strengthening an onset consonant has no effect on the weight of the syllable, but it does, however, contribute to the prominence of the syllable.

These facts suggest that stress prominence and LESP are different entities. The rhythm based on stressed syllables is different from that created by LESP, particularly when fortis consonants are in onset. Languages with geminates have distinctive rhythmic patterns compared to languages which do not have geminates. And after listening to languages as diverse as Finnish and Djambarrpuynu (Wilkinson 1991), both with geminates/fortis consonants, it seems that such languages have similar rhythmic characteristics. Another observation is that in Italian, the words **capélli** ‘hair’

<sup>17</sup> e=schwa, g=voiced velar fricative, x=voiceless velar fricative, X=voiceless uvular fricative, R=voiced uvular fricative, L=voiceless lateral, C=fortis C, :=lengthened short vowel, VV=underlying long vowel

versus **cappélli** ‘hats’, and **capellíno** ‘hair (DIM)’ versus **cappellíno** ‘hat (DIM)’ have almost exactly the same segmental structure and the same stress pattern, yet have a different rhythmic pattern. From this we can conclude that there are different kinds of rhythmic patterns, LESP, PK-PROM or both. Tone is another rhythmic dimension and quite possibly other rhythmic dimensions exist which are expressed in different ways and in different combinations of patterns. LESP has expanded our understanding of rhythm and opens up an avenue for further investigation.

#### 6.2.4 *Alternative stress analyses*

Previous rule-based analyses of Arrernte have assumed that onsetless syllables are invisible and use extrametricality to achieve this. Extrametricality is a mechanical device carrying no explanation for the invisibility of units so marked. I have argued that evidence from syllable structure constraints, and from variation in stress placement, that such syllables are not invisible, although they are prosodically inferior.

In a rule-based analysis of Arrernte stress, Davis (1988) argues that stress is sensitive to the presence of onsets. His rule states that main stress falls on the first syllable with a syllable node that branches (into an onset). As the rule refers to syllable branchingness (not nucleus branching), Davis argues that no direct reference to onsets is required.

A more current rule-based analysis is that of Breen & Pensalfini (1999); although no rules are actually stated, stress is assigned at the level where word-initial *e* is still present. If, as Pensalfini (pc) claims, feet are iambic, refooting would have to apply after *e* deletion, for instance,  $eCeCeC > (eCé)CeC > (Cé)CeC > (CéCeC)$ . The resulting foot is trochaic. A simpler analysis would be to assign trochaic feet from the outset since refooting would not be required as a result of *e* deletion, but because Breen & Pensalfini argue for VC syllables they are virtually forced into a rule-based analysis which will allow a series of derivations where a word-initial syllable can start out as *eC* but ends up being CVC.

Onset sensitivity in OT analyses of Arrernte include those by Goedemans (1996), Downing (1996) and Takahashi (1994).

Goedemans (1996) proposes a constraint that requires feet to align to onsets. This constraint avoids mention of segments and captures the fact that prosodic processes involve prosodic constituents, ie, syllable, foot, prosodic word.

Downing (1996) proposes that onsetless syllables are excluded from the prosodic word domain, but are syllabified into an M-domain, a concept due to Inkelas (1993). This exclusion is achieved through constraint conjunction of ONSET and Align $\sigma$  (the left edge of each syllable must align with the left edge of the prosodic word). To satisfy a constraint conjunction neither constraint in the conjunction can be violated. An independent ONSET constraint occurs, as well as the one in the conjunction. Based on my knowledge of Arrernte, introducing a different domain just to account for the stress patterns seems an unnecessary complication and does not contribute to our understanding of the behaviour of onsetless syllables. In addition, a constraint conjunction is not in keeping with the goals of OT.

Takahashi (1994) uses the notion of licensing to account for stress. It is argued that the head of a prosodic domain must license a prehead, ie an onset, and thus if a prehead is absent, stress is not licensed and a violation is incurred. Stress on a syllable with a prehead will be preferred. This analysis is similar to Goedemans', in that stress can only occur on syllables with onsets.

These analyses end up with a language specific constraint. The advantage of my analysis is that an account of onset sensitivity evident in a number of languages is formally accounted for through the LESP constraint, although the details vary from language to language. This constraint is responsible for determining the location of stress. Constraints which require foot alignment with onsets, or exclude onsetless syllables from prosodic words are not entirely explanatory and are not able to account for other prosodic processes in the language such as reduplication and allomorphy discussed in later sections.

With reference to analyses by Goedemans and Takahashi, the issue is not just whether onsets are present but rather what they contribute in terms of sonority/prominence to the syllable, which is what is evident in Spanish, Piraha) and Ngalakan. If onsets are absent, then nothing additional is contributed to syllable prominence, but if onsets are present, the level of syllable prominence can be affected, depending on the sonority of the onset. The prominence of the syllable is contributed to by the prominence dimension of the margin.

A further advantage of my analysis is that by recognising that prominence is relevant an asymmetry in Arrernte is uncovered, that is, prominence at left edges where full vowels are allowed, but non-prominence at right edges where vowel neutralisation occurs; prominence at the left edge of the word and non-prominence at the right edge. In addition, the hierarchy of LESP prominence correlates with the preferred syllable structure. The only position onsetless syllables are found in is word-initially, which indicates that CV is the preferred syllable structure. The preferred syllable structure is also the preferred stressed syllable. An onsetless syllable is the least preferred syllable and stress avoids such syllables. Given that prominence is associated with word-initial position, the preferred syllable will be targetted in this position. If an onsetless syllable is in this position, the next best move is to stress the second syllable.

A prominence analysis enables us to understand that stressing an onsetless syllable is not an optimal option; it is the least preferred syllable and the least prominent.

### 6.2.5 Variation

As discussed in section 6.2.1, variation in outputs frequently occurs in Arrernte. Breen (1990) suggests that there is a change in progress from rounded onset (anticipatory rounding) found in the speech of older speakers to rounded release for younger speakers. Such a change appears evident in the deletion and epenthesis of vowels and in the stress patterns of certain words, which accounts for the variation. It is possible that four acceptable outputs are generated from a single input. An input /akem/ may be realised as: **akeme**, **akem**, **kem**, **keme**, where deletion of the initial vowel is possible if it is /a/ (John Henderson,pc). However, in a tableau only **akeme** would be the optimal candidate.

(53) /akem/	PARSE	AlignL	NOCODA	ONSET	FILL
%a.  [akeme]				*	*
b.  [akem]			*!	*	

c.  <a>[keme]	*!	*		*
d.  <a>[kem]	*!	*	*	

Note that (c,d) violate more constraints than the other outputs and are the least preferred.

Accounting for variation can be achieved through partial ranking where certain constraints are reranked as argued for by Anttila (1994). This is possible when there is competition between two constraints X and Y in generating an optimal output. If X and Y are not ranked with respect to each other, two optimal outputs would be generated. This, according to Anttila, should not be permitted because allowing more than one output does not capture the fact that, in Finnish at least, some variant outputs are less frequent than others. This latter point regarding frequency of variants is relevant and it may be that future research on variation in Arrernte concentrates on what the frequency of variants is. This information would allow for a better analysis.

If for the moment we assume that all variants are equal in frequency, because sufficient data is not available to do otherwise, then the problem is how to account for them. If the solution put forward by Anttila was adopted, then a number of rerankings would be required because three rankings would be involved. From the base ranking in (54a) the other rankings are shown in (b-d):

(54) *Base and rerankings*

(a) PARSE, AlignL >> NOCODA >> ONSET, FILL

(b) ONSET, FILL >> PARSE, AlignL >> NOCODA

(c) NOCODA >> ONSET, FILL >> PARSE, AlignL

(d) PARSE, AlignL >> ONSET, FILL >> NOCODA

The reranking of constraints (54b-d) are shown in the following three tableaux.

(55)

	ONSET	FILL	PARSE	AlignL	NOCODA
a.  [akeme]	*!	*			
b.  [akem]	*!				*
c.  <a>[keme]		*!	*	*	
%d.  <a>[kem]			*	*	

	NOCODA	ONSET	FILL	PARSE	AlignL
a.  [akeme]		*	*!		
b.  [akem]	*!	*			
%c.  <a>[keme]			*	*	*
d.  <a>[kem]	*!				

	PARSE	AlignL	ONSET	FILL	NOCODA
a.  [akeme]			*	*!	
%b.  [akem]			*		*
c.  <a>[keme]	*!	*		*	
d.  <a>[kem]	*!	*			

To generate all the variants, four tableaux are required. Another option is to drop the rankings altogether, as shown in (56), but not all the variants can be generated.

(56)	PARSE	AlignL	NOCODA	ONSET	FILL
a. <a>[kame]	*	*			*
b. <a>[kam]	*	*	*		
c. akame				*	*
d. akam			*	*	

If the violations for each output are counted, then (a,b) would be ruled out as they have more violations than the other two outputs.

Still another option is to say that violations incurred by a particular set of constraints are rendered irrelevant. The only problem with this option is that an output may incur four violations of one constraint and yet still be generated as an optimal output.

Reranking constraints or dropping the rankings are not satisfactory solutions since they can be unconstrained. A better solution is to deal with the problem outside of the ranking system. We might consider whether the underlying representation of morphemes can be revised. Given that only some words with initial /a/ undergo /a/ deletion, we could assume that two variants for these words are present underlyingly. Thus, **akem** has an underlying variant **kem**. This would effectively mean that there is no /a/ deletion, which then simplifies the analysis as only NOCODA and FILL would be involved in assessing candidates. Given the current ranking of NOCODA over FILL, optimal outputs are those with a final vowel. This is desirable and is consistent with claims that isolated words are pronounced more frequently with final vowels. However, another way to account for variants without final vowels is required.

Note that it is the syllable and faithfulness constraints determining the outputs. But what if we assumed that prominence played a role here. Vowels are required to satisfy NOCODA, although not always word-finally. Vowels are not distinctive at this edge; their feature value in this position is predictable. This contrasts with vowels in word-initial position whose features are not predictable. Feature contrast is not required of word-final vowels, which reflects the fact that word-final position is less prominent.

Because it is less prominent, it allows variation and because it is an edge phenomenon, an independent constraint is needed. This constraint is similar to Align-C, mentioned in 6.1.1. I propose to modify it so that it ranks consonant-final words and vowel-final words according to whatever variant a speaker is using. The variant requiring consonant-final words will be referred to as Dialect (a) and has this constraint ranked above NOCODA, ensuring that vowels do not occur word-finally.

(57) **RE Align:** The right edge of a prosodic word aligns with a vowel or a consonant.

Dialect (a): The right edge of a prosodic word aligns with a consonant.

Under typical circumstances, NOCODA will decide on outputs, even if ranked below RE Align. But if Dialect (a) is in use then RE Align ensures final vowels do not occur.

I have shown that variation can be accounted for by assuming particular morphological representations underlyingly and by incorporating hierarchies within a constraint. This avoids complicated rerankings which can destabilise a grammar.

In the following section prominence in reduplication in Arrernte and Nunggubuyu is examined.

### 6.3 Reduplication

In this section the role of onsetless syllables in reduplication and the effect they have on the reduplicative template is examined. The analysis for prefixing reduplication in Arrernte is given first, followed by analysis of the suffixing reduplication pattern where I show that the template is the same as that for the prefixing pattern. The analysis is compared to reduplication patterns in other languages involving onsetless syllables. Finally, the prominence analysis is applied to reduplication data in Nunggubuyu in section 6.3.4.

The prefixing pattern of reduplication varies, depending on whether the root initial syllable has an onset or not. If the root is consonant-initial, a single syllable is copied, as in (58a), but if the root is vowel-initial, two syllables are reduplicated, as in (58b). Vowels neutralise to *e* morpheme-finally.

- (58) a. kutye-me 'is gathering'  
ke-lpe-kutye-me  
b. itirre-me 'is thinking'  
ite-lp-itirre-me [DW 1989]

These patterns suggest that the reduplicative template targets a prominent syllable and that onsetless syllables do not meet this template requirement. However, onsetless syllables must be reduplicated to avoid violating a constraint on skipping. This shows that onsetless syllables are visible to prosodic processes. In this section I am concerned with constraints on the size of the reduplicant.

Reduplication applies in both nominals and verbals. The most common pattern of reduplication for nominals is total reduplication.

- (59) a. ahiye 'breath'  
ahiye-ahiye 'fontanelle'  
b. kwatye 'water'  
kwatye-kwatye 'a clear translucent appearance' [DW 1984]

Partial nominal reduplication is attested, but only in frozen reduplications, where there is no unreduplicated counterpart. This form of reduplication is very common among flora and fauna terms, as in:

- (60) a. artityerre-ityerre 'willy wagtail (bird)'  
b. kwepale-pale 'bellbird' [DW 1984]

The focus of discussion in this section is on verbal reduplication. Reduplication in verbs is productive and indicates aspectual information, in which all or part of the event referred to in the verb stem is repeated in some way (Wilkins 1989:242). There are some examples of full reduplication, but the most frequent is partial reduplication. In both cases, 'linking' morphemes occur between the base and its copy. These linking morphemes occur in a number of Australian languages (eg Yir Yoront, Nunggubuyu) and have been variously referred to as a ligature, connective, augment or linking morpheme. In Arrernte, the form of



feet align to prominent syllables. Evidence is also based on the process of allomorphy, which I argue is conditioned by word size defined in terms of prominence.

The more unusual reduplication pattern is exhibited by vowel-initial roots, where two syllables are reduplicated, ie VCV, but note that only one of these is a prominent syllable. If the reduplicated element consists of a vowel, the requirement that a prominent syllable be copied is not satisfied. I argue that this is because prominent syllables are targeted in prosodic processes.

The prefixing reduplication pattern in Arrernte is consistent; a single syllable is copied in consonant-initial words, and two syllables are copied in vowel-initial words. Like the stress patterns a prominent syllable is targeted. However, rather than specifying that a prominent syllable must be copied, we can specify that a minimal prosodic word is copied. Based on the pattern of allomorphy in Kaytetye (Koch 1990;1995), where VCV and CV words pattern the same, the evidence is that the minimal word is (V)CV (see section 6.4 on allomorphy). The single characteristic of VCV and CV forms is that they each contain a prominent syllable. This contrasts with disyllabic words of the form CVCV which contains two prominent syllables and patterns with VCVCV and longer words. The statement on the minimal word for Arrernte is:

(63) **Minimal Word:** The minimal word includes a single prominent syllable: (V)CV.

The minimal word requirement allows for the minimum word size, ie CV and for the maximum size, ie VCV. The reduplicative template can then be expressed as follows:

(64) **RED=MinPW:** The reduplicant is a minimal prosodic word.

While onsetless syllables on their own do not satisfy the reduplicative template, they cannot be skipped. The templatic constraint (RED=MinPW) allows for them, and, in addition, reduplicating CV syllables from VCV inputs would violate the reduplicative constraints ANCH and CONT. In fact, the template could specify that a prominent syllable be copied, given these latter constraints, except that the minimal prosodic word template can also account for allomorphy and for this reason is preferable. While VCV does not constitute a prosodic constituent, I show that it satisfies the requirement for a single prominent syllable which is a valid prosodic constituent in the language. The generalisation is that a prominent syllable is copied and this is sufficient, and it is also a simpler description of the process.

It is worth noting that there are very few examples of consonantal reduplication. Languages reported with this pattern typically allow consonants, including obstruents, in nucleus, or complex consonant clusters. Some, like Bella Coola (a Salish language), have been referred to as lacking syllables altogether (Newman 1947) based on words such as **tfktstt** ‘you sprained it (fem) and then you gave it (fem)’ and sentences such as **sqcctx** ‘thats my fat over there’ (cited in Bagemihl 1989). However, Bagemihl argues convincingly against this and against obstruent syllabicity with reference to Bella Coola. Obstruent-only words show reduplication, but with the addition of a sonorous segment, n or i, and in words with consonant clusters, the sonorous segment serves as the nucleus.

(65) Bella Coola reduplication (nasals are syllabic)  
a. obstruent only words

⊙□ <sup>←</sup> -	‘slap’	⊙■□⊙■□ <sup>←</sup>	‘slap continuously’
◆✕	‘peel’	◆)(✕◆✕	‘peel continuously’
b. clusters			
□ <sup>←</sup> ⊙⊙-	‘wink, bat the eyes’	□ <sup>←</sup> ⊙⊙⊙⊙-	‘wink, bat the eyes contin.’
tqn□k-	‘be under’	tqn□qn□k-	‘underwear’

Consonantal reduplication has been reported in some Mon-Khmeric languages, although this is contested by Sloan (1988), who claims that reduplication is syllabic and involves two kinds of obstruent-only syllables, one with a single obstruent, the other with two.

- (66) a. Semai (Diffloth 1976a) – a copy of the initial and final consonant are prefixed to the base.
- |        |           |                         |
|--------|-----------|-------------------------|
| d.noh  | dh.d.noh  | ‘appearance of nodding’ |
| sibi:t | st.sibi:t | ‘squinting eyes’        |
- b. Temiar (Benjamin 1976) – similar to Semai
- |     |        |                   |
|-----|--------|-------------------|
| kow | kw.kow | ‘calling (CONT)’  |
| lug | lg.lug | ‘laughing (CONT)’ |
- c. Kammu (Svantesson 1983) - a copy of the final consonant is infix
- |        |          |                            |
|--------|----------|----------------------------|
| sté:n① | ◆■①◆é:n① | ‘small steady still light’ |
| lma:c  | lcma:c   | ‘be stuck’                 |

Another example of apparent consonant reduplication is Spokane, an Interior Salish language (Bates 1990, Bates & Carlson 1990-91). As mentioned for Bella Coola, Salish languages are known for their large consonant inventories and long strings of consonants. Spokane has an internal reduplication pattern known as Out-of-Control:

- (67) hek<sup>w</sup> ‘opened a crack’ (strong root)  
 hék<sup>w</sup>k<sup>w</sup> ‘it came open a crack without my knowing it’  
 qic’ ‘braided; woven’ (weak root)  
 qc’íc’ ‘it got tangled up [ as a thread might during sewing]’

The reduplication patterns are conditioned by stress and vowel deletion, which are dependent on whether roots are strong or weak. Strong roots must be stressed, while, in weak roots, stress is placed on suffixes. Unstressed vowels delete, giving a different pattern of reduplication for strong and weak roots, and the impression of consonantal reduplication.

Given the pervasive nature of syllables as opposed to consonants in reduplication, together with evidence of syllable structure in Arrernte, and the fact that the same template can account for allomorphy, I adopt the template analysis.

Reduplication is an example of a prosodic process that dominates morphology, that is, the size of the reduplicated morpheme is determined prosodically (M&P 1986 et seq). Reduplication involves copying the prosodic constituents, syllable, foot and prosodic word. The underlying form of a reduplicative morpheme is unspecified for phonetic content, and in OT, is indicated by ‘RED’. The reduplicative element is derived by stating that it is equivalent to a foot or syllable. The output of RED will have phonetic content, which is governed by constraints that require certain correspondence between the root and the copy. These constraints are discussed below.

There are general constraints which require a particular relationship between the root or base and the reduplicant, as well as between the input and the output. From M&P (1995):

- (68) **MAX-BR:** Every segment of the base has a correspondent in the reduplicant.  
(Reduplication is total)
- DEP-BR:** Every segment of the reduplicant has a correspondent in the base.  
(Prohibits fixed default segmentism in the reduplicant)
- IDENT-BR(F):** Reduplicant correspondents of a base [ $\gamma$ F] segment are also [ $\gamma$ F].

More specific correspondence input and output constraints ensure that there is no skipping of segments, and that the left or right edges of the reduplication correspond with those in the base. Following M&P (1993a, 1995), the constraints are **CONT** and **ANCH**.

- (69) **I-Contiguity (CONT):** The Reduplicant corresponds to a contiguous substring of the Base.

Under this constraint, segments cannot be skipped. The elements in the copy must be phonologically identical to the elements in the base. For example, in a reduplication **paka-paka** of a hypothetical string **plaka**, the /l/ is skipped which violates **CONT**. In prefixing reduplication, Anchor is specified for the left edge.

- (70) **Anchor,Left (ANCH):** Any element at the left edge of the base has a correspondent at the left edge of the reduplicant.

**ANCH** requires that, in prefixing reduplication, the elements in the reduplicant are the same as those in the initial portion of the base. If there are three segments in the reduplicant, then these three segments must be identical to the first three segments in the base. **CONT** ensures that segments in the copy are in the same sequence as the base. The same requirement applies to the elements in suffixing reduplication. If a reduplicant is specified as a suffix but is prefixed, this will also incur a violation of **ANCH**.

M&P (1993a) point out that these constraints have evolved from the association constraints in autosegmental theory. **CONT** is like one-to-one association, and **ANCH** resembles directionality of association. M&P propose that **ANCH** and **CONT** are universals of reduplication and that these constraints are generally located at the top of constraint hierarchies. M&P find that for Axininca Campa, **ANCH** and **CONT** are unviolated, and that this is typically the case for many other languages.

The reduplication patterns show no evidence that segments are skipped, or that the reduplicated element attaches to the right edge rather than the left. This means that **CONT** and **ANCH** are dominant constraints. The operation of these two constraints is illustrated in the following tableau. The reduplicant is underlined.

(71) /RED-lp-iterr-m/	CONT	ANCH
a. <u>te</u> -lp-iterre-me	*	*

b. <u>eti</u> -lp-iterre-me		*
c. <u>itrr</u> e-lp-iterre-me	*	

When the initial syllable of the root is not copied, as in (71a), both CONT and ANCH are violated. CONT is violated because an initial segment has been skipped over, and ANCH is violated because the initial element in the copy does not correspond to the initial element in the root. The initial two syllables have been copied in (50b), which does not violate CONT, since they have not been skipped over, but does violate ANCH. There is no correspondence between the root and copy in the order of segments. (50c) violates CONT, as the second syllable has been skipped.

In many languages with reduplication, it is only the root that is copied, other morphemes or segments from other morphemes are ignored. M&P (1993a) capture this behaviour in the following constraint.

(72) **R=root:** The reduplicant contains only the root.

The benefit of this constraint for our purposes is that it rules out the copying of onsets that are not part of the root. In reduplicated words, the root and copy are separated by the linking/aspect morpheme, for example, **atwe-lp-atwe-me**. This means that any root-initial onsetless syllable will be syllabified with a preceding consonant, as in:

(73)

σ    σ    σ    σ    σ  
|    / \    / \    / \    / \  
a tw e-l p-a tw e - m e

The initial vowel in the root **atw** is syllabified with a consonant from the linking morpheme. If this syllable was copied, it would satisfy the requirement to reduplicate a syllable. However, since the copied syllable consists of material that does not belong to the underlying form of the root, it would be ruled out by R=root.

Evidence from suffixing reduplication suggests that R=root is a dominant constraint. The suffixing pattern involves copying a VCV sequence, but if the root is monosyllabic only the root copies. For example, **tn-m** 'is standing' is reduplicated to **tne-pe-tne-me** 'keeps standing'. Non-root material is not copied in order to satisfy the template.

Of the three patterns of verbal reduplication, the continuous aspect is the only one which is prefixing. This requires a specific constraint on the location of the continuous reduplicative prefix and is stated as:

(74) **Align Red:** The continuous reduplicant R is a prefix.

The constraints ANCH, CONT and R=root are dominant constraints in Arrernte and are ranked above RED=MinPW. Other highly ranked constraints which are relevant are LE-Place, RE-Place and \*COMPLEX (P&S 1993). Non-violable constraints will be confined to one column in the tableaux below. RED=MinPW is ranked above MAX-BR and DEP-BR.

- (75) ANCH, CONT, R=root, LE-Place, RE-Place, \*COMPLEX, Align R Left >>  
RED=MinPW >> MAX-BR, DEP-BR

(76) /RED-lp-kutyE-mE/

	RED=MinPW	DEP-BR	MAX-BR
%a. <u>ke</u> -lpE-kutyE-mE			**
b. <u>kutye</u> -lpE-kutyE-mE	*!		
c. <u>kE</u> -lpE-kutyE-mE		*!	**
d. <u>ku</u> -lpE-kutyE-mE	*!RE-PLACE		
e. <u>kutyeme</u> -lpE-kutyE-mE	*!R=root		
f. <u>kuty</u> -lEpE-kutyE-mE	*!O-CONTIG		
g. <u>kuty</u> -lpE-kutyE-mE	*!COMPLEX		

(76a) violates the constraint on the correspondence of feature identity between base and reduplicant (IDENT(F)-BR), but this constraint is ranked below MAX-BR and does not have a say. In contrast, IDENT(F)-IO is highly ranked, guaranteeing exact feature correspondence between input and output. (b) contains two prominent syllables, violating RED=MinPW. (c) contains a consonant reduplicant followed by an epenthetic segment which violates DEP-BR.

(77) /RED-lp-itirrE-mE/

	RED=MinPW	DEP-BR	MAX-BR
%a. <u>ite</u> -lp-itirrE-mE			**
b. <u>te</u> -lp-itirrE-mE	*!ANCH		***
c. <u>i</u> -lp-itirrE-mE	*!RE-Place	*	***
d. <u>itirre</u> -lp-itirrE-mE		*!	

ANCH ensures that a syllable is not skipped to get a LESP syllable, which explains why an onsetless syllable is copied as well. R=root ensures that non-root material cannot be included in the reduplicant. Thus, while the reduplicated syllable in **pi-lp-iterre-me** satisfies LESP, it includes the consonant from the linking morpheme violating R=root.

### 6.3.2 Comparison with Suffixing Reduplication

There are two kinds of suffixing reduplication in Arrente, iterative and habitative, where a VCV sequence is copied. In the iterative pattern, the aspect morpheme **-p-** occurs between the base and the copy.

- (78) Iterative reduplication
- |    |                   |                    |
|----|-------------------|--------------------|
| a. | unte-me           | 'running'          |
|    | unte-p-unte-me    |                    |
| b. | atwerre-me        | 'fighting'         |
|    | atwerre-p-erre-me | 'keeps fighting'   |
| c. | mpware-me         | 'making'           |
|    | mpware-p-are-me   | 'keeps making'     |
| d. | kemirre-me        | 'getting up'       |
|    | kemirre-p-irre-me | 'keeps getting up' |
| e. | tne-me            | 'standing'         |

tne-pe-tne-me 'keeps standing'

In suffixing reduplication, a single syllable or two syllables are reduplicated, depending on the size of the root. In polysyllabic roots, two syllables are reduplicated, as, for example in **atwerre-p-erre-me**. If the root is monosyllabic, only CV is copied, as in **tne-pE-tne-me**.

The aspectual maker **-nh-** occurs in the habitual reduplication patterns. I assume that the final morpheme **nhe** is not reduplicated, but that behaves like the tense markers.

(79) Habitual reduplication

a. arlkwe	'eat'	arlkwe-nh- <u>arlkwe</u> -nhe	'food'
b. atwere	'talk'	atwere-nh- <u>ere</u> -nhe	'talker'
c. rake	'to snatch'	rake-nh- <u>ake</u> -nhe	'snatcher'

In contrast to prefixing reduplication, the patterns for suffixing reduplication are consistent, ie VCV, whether the root is consonant-initial or vowel-initial, except for monosyllabic roots. Recall that the number of syllables in prefixing reduplication varies, depending on whether the root is vowel-initial or not. While it is possible to invoke the prefixing reduplicative constraint to account for the suffixing ones, I claim that, in keeping with the partial reduplication forms (albeit frozen) which clearly involve a foot and in keeping with the claim that prominence is relevant word-initially, a foot template is required for the suffixing patterns. The reason that the initial consonant in the reduplicated foot is absent is that it is overridden by the aspectual marker, which is a fixed morphological segment (see Alderete, Beckman, Benua, Gnanadesikan, McCarthy & Urbanczyk 1997 for a convincing distinction between phonological and morphological fixed segments). Fixed morphological segments align simultaneously with the copy and contrast with phonological fixed segments whose features are often context dependent, as determined by phonological markedness constraints. Phonological fixed segments are typically unmarked. The fixed segment is treated like any affix and is thus subject to assessment by the faithfulness and alignment constraints.

The reduplicative constraint is expressed in (80). An additional constraint on the location of the reduplicant is required, stated in (81).

(80) **REDsfx=Foot**

(81) **Align R right:** The Iterative and Habitual reduplicant is a suffix.

Since overlapping of the aspect morpheme is required in the reduplicant, it is necessary to specify that it aligns to the left of the prosodic word. Aligning to the left edge of the entire word would violate AlignL, but aligning to the left edge of the reduplicant which is a prosodic word will not. The alignment will allow overlapping as stated in (82) which is specified for the iterative, but is also applicable for the habitual marker.

(82) **Align -p-:** Align -p- at the left edge of the prosodic word.

This constraint, together with MAX-IO, which requires exact identity between inputs and outputs will ensure VCV sequences are copied. Both constraints must be ranked above O-CONTIG.

To allow for clear representations the aspect morpheme is kept separate using '-' and it will be placed before RED in the underlying form, though normally it should be after RED. Only outputs with reduplicants consisting of a foot are considered in the tableau below.

(83) mpwar-p-RED-m	Align/-p-/	MAX-IO	O-CONTIG	MAX-BR
a. [mpware]-[p-are]-me]		**	*	*
b. [mpware-pe-[mpware]-me]	*!	***		
c. [mpware]-[mpware]-me]		****!		

Where larger words undergo reduplication and three syllables are reduplicated, then REDsfx=FOOT will determine the optimal output.

Suffixing reduplication shows a fairly straightforward pattern of foot reduplication where fixed segments override the initial onset in the reduplicant. Thus the only place where prominence is an issue is word-initially.

### 6.3.3 Reduplicating onsetless syllables in other languages

As previously noted, syllabic constraints frequently determine the form of the reduplicative element. Cross-linguistically, word-initial onsetless syllables often behave differently in prosodic processes, compared to syllables with consonants. In Arrernte, reduplication patterns involving onsetless syllables contrast with those of other languages where satisfying ONSET is crucial. Whether a single V or VCV sequence is copied in Arrernte, there will only be a single ONSET violation and thus something more than ONSET is required to ensure well-formedness.

Onsetless syllables in Timugon Murut are ignored in reduplication, as shown in the following examples.

#### (84) Timugon Murut reduplication

- |            |             |                          |
|------------|-------------|--------------------------|
| a. bulud   | bu-bulud    | 'hill/ridge'             |
| b. limo    | li-limo     | 'five/about five'        |
| c. ompodon | om-po-podon | 'flatter/always flatter' |
| d. abalan  | a-ba-balan  | 'bathes/often bathes'    |
| e. ulampoy | u-la-lampoy | no gloss                 |

In Timugon Murut, ANCH and CONT are dominated by ONSET, which means that a syllable can be skipped in order to copy a syllable with an onset. This contrasts with Arrernte, where ONSET is dominated by the two reduplicative constraints.

Another strategy is to copy an onset from another syllable, as in Mokilese (Harrison and Albert 1976; M&P 1986). In Mokilese the reduplicant is a heavy syllable. The following are reduplications of words with word-initial consonants.

- |               |           |         |
|---------------|-----------|---------|
| (85) a. podok | pod-podok | 'plant' |
| b. kaso       | kas-kaso  | 'eat'   |
| c. pa         | paa-pa    | 'weave' |

d. caak    caa-caak    'bend'

Consonants in coda position contribute to the weight of a syllable. The examples in (85a,b) have a coda consonant in the reduplicant, making the reduplicant heavy. If there is no consonant available for copying into coda, the vowel lengthens, as in (85c). If the stem is vowel-initial, lengthening of the copied consonant occurs, as opposed to vowel lengthening, shown in (86).

- (86) a. ir            irr-ir            'string'  
 b. onop        onn-op        'prepare'  
 c. alu         all-alu        'walk'  
 d. uruur      urr-uruur    'laugh'

M&P argue that the consonant lengthens to fulfil the requirements of the reduplicative template, as well as to provide an onset. Lengthening of the consonant ensures that there is an onset for the word-internal root.

- (83)  $\begin{array}{cc} \sigma & \sigma \\ \wedge & \wedge \\ \mu & \mu \\ \wedge & \wedge \\ i & r \end{array}$      $\begin{array}{cc} * \sigma & \sigma \\ \wedge & \wedge \\ \mu & \mu \\ \wedge & \wedge \\ i & r \end{array}$

The difference in the reduplication patterns between consonant-initial and vowel-initial roots is due to the need to resolve the word-internal vowel hiatus. Reduplication of vowel-initial roots differs from that of consonant-initial roots because of the requirement on onsets.

In Arrernte, it is possible to copy an onsetless syllable without violating the requirement for an onset for the following syllable. This is due to the morphological organisation of words in reduplication, where an aspect morpheme intervenes between the reduplicant and the root. These aspect morphemes are consonantal and provide an onset for any vowel initial root.

Constraints on syllable structure account for the variation in the reduplication patterns in Mokilese. However, this analysis cannot extend to Arrernte. Compare the following two reduplications, where in (88a) the reduplicant consists of one syllable, a marked syllable, and in (88b) where the reduplicant consists of two syllables, the first one marked.

- (88) a.  $\begin{array}{ccccc} \sigma & \sigma & \sigma & \sigma & \sigma \\ \wedge & \wedge & \wedge & \wedge & \wedge \\ i & -l p & -i & t i & r r e - m e \end{array}$     b.  $\begin{array}{cccccc} \sigma & \sigma & \sigma & \sigma & \sigma & \sigma \\ | & / \wedge & \wedge & \wedge & \wedge & \wedge \\ i & t i & -l p & -i & t i & r r e - m e \end{array}$

In both (88a,b) there is one syllable that lacks an onset. /l/ from the linking morpheme **-lp-** syllabifies into coda position of the reduplicated syllable in both cases. /p/ of the linking morpheme provides an onset for the vowel in initial position in the root. Each output has one violation of ONSET, and ONSET is not able to enforce well-formedness of the reduplicant.

Constraints on syllable structure do not affect the form of the reduplicant in Arrernte. This contrasts with the other languages discussed here, where the syllabic

constraints are responsible for the form of the reduplicant. For this reason the notion of prominence must be explicit in the reduplicative constraint, which accounts for the behaviour of onsetless syllables in reduplication in Arrernte.

### 6.3.4 Reduplication in Nunggubuyu

According to Heath (1984), the pattern of reduplication in Nunggubuyu is sensitive to the quality of the initial onset in the root. Roots commencing with stops undergo syllable reduplication, while roots commencing with all other consonants undergo foot reduplication.

- (89) a. Nunggubuyu monosyllabic reduplication
- |           |                                 |               |
|-----------|---------------------------------|---------------|
| dhudabada | 'white (person) non-Aboriginal' | dhu-dhudabada |
| galga     | 'warrior'                       | ga-galga      |
| jawulba   | 'old (man or woman)'            | ja-jawulba    |
| junggayi  | 'ritual manager'                | ju-junggayi   |
- b. Disyllabic reduplication
- |           |                        |                   |
|-----------|------------------------|-------------------|
| mardbal   | 'expert, master'       | mardba-mardbal    |
| numa:du   | 'wounded, injured'     | numa-numa:du      |
| rnamir    | 'expert, very good'    | rnama-rnamir      |
| rlandhurg | 'dog'                  | rlandha-rlandhurg |
| adharwara | 'late afternoon, dusk' | adha-adhawara     |

The size difference in the reduplication pattern is due to a sonority distinction made of segments in root-initial position. Stops are the least sonorous segments and their presence root-initially affects the size of the reduplicated element. Disyllabic reduplication is the general pattern, while monosyllabic reduplication is more specific, as it requires that roots with initial stops undergo monosyllabic reduplication.

Given the pattern of reduplication, a hierarchy of syllable prominence can be proposed as follows:

- (90) LESP: CV > CV  
           |  
           stops

The constraints are:

- (91) RED= $\sigma$ : RED is a prominent syllable  
 RED=Foot: RED is a foot

Ranking the more specific constraint over the more general will generate the reduplicative patterns. I assume that syllabic and correspondence constraints determine the syllable structure of the final syllable of the reduplicant. Since the constraint RED= $\sigma$  specifies that the reduplicant is a prominent syllable as defined by the LESP, there is no need for LESP to occur in tableaux.

(92) galga

	RED= $\sigma$	RED=Foot
%a. ga-galga		*
b. galga-galga	*!	

(93)

%a. mardba-mardbal	*	
b. ma-mardbal	*	*!

Nunggubuyu shows that the sonority of an onset is a contributing factor to differences in prosodic processing. The sonority scale is based on universal patternings and whether languages make reference to it or not for prosodic processes is language specific. In the next section, I propose that the syllable prominence affects the definition of minimal word and thus the process of allomorphy.

### 6.3.5 Alternatives

The reduplication patterns indicate that onsetless syllables are not extrametrical. In prefixing reduplication onsetless syllables are copied and depending on the size of the word may also be copied in suffixing reduplication. If onsetless syllables were extrametrical, invisible to reduplication, then only CV syllables would reduplicate. An extrametrical analysis would therefore be unsuitable to account for reduplication patterns.

Previous models of reduplication have problems in accounting for the variable reduplicative template in Arrernte reduplication. In a segmental templatic analysis, such as Marantz (1984), the root reduplicates and the melody of the copy associates to a pre-determined segmental template. To ensure the right outputs two templates would be required, one for the onsetless roots, eg VCV, and one for those with onsets, eg CV. A single template would be unable to derive both VCV and CV patterns. The segmental template analysis will derive the attested forms but lacks any explanation for the different reduplicative patterns, and thus gives the impression that the patterns are arbitrary.

A full-copy analysis (Steriade 1988) avoids the problems of association to segmental templates, but also lacks an explanatory account of the reduplication patterns. In a full-copy analysis, the full root is copied and then reduced, by rule, to meet template requirements. Two rules would be required to derive the prefixing pattern, given as:

- (i) delete the final syllable in copies that are trisyllabic or longer when the root has an initial onsetless syllable.
- (ii) delete the final syllable in copies that are disyllabic or longer.

(94)	a.	/itirre-me/	b.	/therre-/
		itirre-lp-itirre-me		therre-lpe-therre-me
	Rule (i):	ite-lp-itirre-me		n/a
	Rule (ii):	n/a		the-lpe-therre-me

In the suffixing reduplication patterns, different rules would be required and would need to make reference to onsets. Recall that VCV copies in suffixing reduplication whether the initial syllable in the root is onsetless or not. The rules would state:

- (iii) in disyllables delete the first onset.
- (iv) in trisyllables delete the first syllable and following onset.





Arrernte has the same pattern for allomorphy in the plural and reciprocal forms as those evidenced in the Kaytetye ergative forms, shown in the examples from Henderson (1998; cited in Breen & Pensalfini 1999).

(100) <i>disyllabic consonant initial words</i>			
tangke-war	‘be pleased (PL1)’	tangk-ir	PL2
mpware-war	‘make (PL1)’	mpwar-ir	REC/PL2
<i>disyllabic vowel initial words</i>			
are-rir	‘watch (PL1)’	are-r	REC/PL2
angke-rir	‘talk (PL1)’	angke-r	REC/PL2
<i>trisyllabic vowel initial</i>			
inngelhe-war	‘be like (PL1)’	inngelh-ir	PL2

The process of allomorphy in Kaytetye and Arrernte lends further support to the claim that a distinction in prominence of word-initial syllables plays a role in prosodic processes. It is also clear that a prosodic constituent has to be specified and that it is possible to generalise as to what this constituent is.

An alternative would be to specify that the ergative attaches to VCV or CV sequences. Referring to the number of syllables would not work since, while VCV and CVCV have the same number of syllables, they have different ergative markers. I have shown that VCV and CV sequences have one feature in common: they consist of a well-formed or prominent syllable. By using this feature, it is possible to account for the allomorphy patterns.

Allomorphy is an intriguing process across languages and I hypothesize that prominence, whether of syllables or of edges, plays a role in the process. In a number of Australian languages, a foot may be marked out in some way, for instance Hale (cited in Dixon 1980) reports that in some dialects of Anmatjera, a velar nasal is added only to disyllabic words. In Dyirbal (Dixon 1972), stress influences nasal insertion and allomorphy: /n/ is inserted at morphological boundaries usually after a stressed syllable, and the dative suffix varies **-gu** or **-ngu** where **-ngu** occurs after a stressed syllables. Nasal allomorphs are frequently attested on disyllabic words in other languages, including Warlpiri and Kaytetye, discussed above. It is worthwhile considering that in many languages the right edge is the least prominent edge and that it is at this edge that allomorphy occurs, that it is frequently noted with suffixes. Formalising the role of prominence requires substantial discussion and analysis which is not possible here. I leave it for further research.

### 6.4.1 Alternatives

An alternative analysis of the allomorphy processes in Arrernte has been proposed in Breen & Pensalfini (1999). They claim that all morphemes are vowel-initial and that word-initial **e** does not surface unless preceded by a word; in other words, **e**'s appearance is phrasally determined. This means that a CVC word is underlyingly /eCVC/. Based on this they claim that disyllables and longer words take the glide allomorph analysed as **-ewar**, while monosyllables /VC/ take the rhotic allomorph **-erir**. No derivations are given, but under their rule-based analysis for other processes, I assume that the allomorph would have to be attached after syllabification and before **e** deletes. This order is necessary so that **e** can be counted as a syllable before it deletes. Presumably stress is assigned after **e** deletion.

They claim that if analyses do not recognise that *e* is underlyingly initial, they would be forced to say that onsets had weight to account for the patterns. While the full implication of this is not made explicit, I have shown that recourse to an onset weight analysis is not needed to account for the patterns.

As has been shown in this thesis, simultaneous operations provide better and more explanatory accounts of processes and are not plagued by paradoxical rule applications. Therefore, I reject Breen & Pensalfini's analysis.

Templates are used to account for reduplication, minimal word size and allomorphy and I believe that, despite the move away from a dependency on templates (Alderete et al 1997), some languages are more reliant on templates or grouping phenomena than others. With regards to allomorphy, Kager (1995) points out that there are three common conditioning factors: (1) syllable structure - C or V final; (2) syllable count; (3) stress on final syllable or not. This fact suggests that reliance on only a template or only a non-templatic analysis would be unsuccessful to account for the range of patterns.

Providing an explanation for all the prosodic processes in Arrernte is possible if it is acknowledged that prominence plays a role in determining optimal outputs. Such an analysis is more successful since it also accounts for a range of phenomena. While alternative analyses, such as extrametricality or onset alignment, may account for stress, they are unable to extend the analysis to account for allomorphy and reduplication in the same language, nor onset sensitivity in other languages. I have argued that these syllables must be visible in order to explain all the prosodic processes in the language.

As a result of historical changes, the phonology of Arrernte contrasts with the phonology of many other languages. For instance, the alignment of feet with the edge of the prosodic word must always occur in neighbouring languages, like Warlpiri, but in Arrernte, this is dependent on the presence of onsetless syllables. As I have shown, the analysis of the behaviour of onsetless syllables is captured straightforwardly in OT, which allows for constraint ranking and violation.

Arrernte is unusual in comparison to other languages with initial onsetless syllables because the constraints on syllable structure cannot explain the behaviour of these syllables. This behaviour can only be explained by an analysis that distinguishes prominent and non-prominent syllables.

## ***6.5 Concluding Remarks***

This chapter provides an analysis of the behaviour of onsetless syllables in Arrernte and of onset sensitivity in other languages with regards to stress, among other prosodic processes. I introduced the notion of LESP, which is used to construct hierarchies of syllable prominence. It is claimed that syllable prominence exists at the left edge, which is supported by languages showing onset sensitivity, by saliency factors and by prominence dimension which combines position with sonority.

Some languages pay more attention to the left edge because of the kinds of things that happen at the left edge of the prosodic word. In Arrernte, the left edge of the prosodic word is prominent and prosodic processes are generally read on that edge. This is also the case for Nunggubuyu, and, for Spanish, can explain why *e* is not stressed word-initially. The prominence of the left edge of the word and the left edge of the syllable can sometimes be in conflict, which can explain variation in stress placement in Arrernte and in Ngalakan where the left edge can be less important when prominent syllables are nearby.

There are two kinds of prominence relevant to prosodic processes, Peak-Prominence and LESP, which may be in conflict with alignment constraints. For instance, in Arrernte, foot alignment is overridden by LESP. There are a number of instances when foot alignment to the left edge of the prosodic word is overridden as discussed in this thesis; these are when there is lexical stress, morphological boundaries, and in connected speech. In general, foot alignment is morphologically or lexically determined, even with alignment to the left edge of the prosodic word, as this edge is typically also the edge of the word/stem. However, morphological alignment is sometimes overridden by rhythmic considerations. Recall from Chapter 4, if foot alignment results in a sequence of unfooted syllables, Rhythmic Alternation (RA) takes over, ensuring such unfooted sequences are not generated. Thus RA, like LESP, overrides alignment. Given this fact, it could be assumed that LESP is like a rhythmic constraint, although of a markedness kind. While RA is concerned about where prominence is, LESP (and PK-PROM) is concerned about what is prominent. A sequence of CV syllables may be equally prominent as determined by LESP, while RA will determine which one will be more prominent, or which one will be stressed.

That LESP should be considered a markedness-rhythmic constraint is interesting if we consider the constraint that prohibits word-final stress, Non-Finality (NON-FIN), purported to be a rhythmic constraint (Hung 1993). Languages which do not allow word-final stress or where segments in word-final position do not contribute to weight in this position have NON-FIN as a highly ranked constraint. NON-FIN is required in languages with one stress and where PK-PROM is an active constraint.

NON-FIN operates at the right edge of the word, a position which is less prominent. In fact, it could be stated that NON-FIN is an anti-prominent constraint (ruling out prominence) required to account for the invisibility of syllables and segments at the right edge. It contrasts with LESP which accounts for invisibility of syllables at the left edge.

The fact that there is this relationship lends support to LESP – the prominence at the left edge of the word is expressed in LESP and the absence of prominence at the right edge is expressed in NON-FIN. Spanish is one example which requires both constraints: LESP to account for absence of stress on word-initial *e* and NON-FIN to account for absence of stress word-finally. There is also right edge prominence of syllables expressed in PK-PROM. Given that left edge prominence exists, we expect to find right edge prominence features, ie NON-FIN and PK-PROM. There is support for a typology where prominence dominates alignment:

Prominence >> Alignment

This ranking accounts for languages where prominence or non-prominence at the left or right edges of words influences foot alignment, if any, or placement of stress. Prominence, like alignment, can be tied to edges and in this sense they are similar. The difference is that prominence is based on markedness. This is evident in the fact that prominence may influence the shape of prosodic structure or prosodic templates, as in Nunggubuyu where LESP determines whether the reduplicant is a foot or a syllable; and as in Arrernte where minimal word is based on a LESP definition. To some extent this is also true of PK-PROM, which influences the location of a foot, if any, and the shape of one (ie, heavy syllable, two light syllables).

In sum, prominence can account for the location of and the shape of a prosodic constituent. Prominence constraints may be thought of as markedness constraints and as a subset of rhythmic constraints.

In Chapter 4, a typology where prosodic considerations, such as rhythm, dominated interface constraints, that is, alignment between phonological and morphological constituents, is advocated and is similar to the typology that has emerged here. The conclusion from this is that when there is conflict between interface constraints and prosodic ones, it is the prosodic/rhythmic ones that win.

I have proposed a theory on left edge syllable prominence, LESP, which can be used to account for various prosodic processes. It is a formal way to express various kinds of behaviour which previously were thought to be unrelated. Prominence has typically been accounted for through syllable structure, that is, a heavy syllable has two moras and a light syllable one mora. I have identified another type of prominence which cannot be expressed in structural terms and it is only this prominence which can explain behaviour evidence in Arrernte, Spanish, Pirahã, Ngalakan, and Nunggubuyu.

In this thesis I have shown that alignment constraints combined with those on adjacency and prominence can account for vowel harmony, as well as a range of stress patterns: morphological, lexical, variable, those involving binary and ternary rhythm, and prominent syllables. The fact that all processes can be accounted for in OT lends support to this theory.

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