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CHAPTER 5

Weight and Prominence

In Ch 2 I discussed the stress patterns of words containing only monomoraic syllables. Ngalakgan is however a quantity sensitive language. In this chapter I present an analysis of this aspect of Ngalakgan's prosodic system.

The central issue in this discussion is the behaviour of geminates and homorganic nasal+stop clusters for the purposes of syllable quantity. In current linguistic theory (e.g. Hayes 1989), geminates have the representation in (1).



This representation implies that a geminate consonant should make the preceding syllable heavy, since prosodic 'weight', like segmental quantity, is determined by the number of moras associated to the syllable, or segment, respectively (e.g. Hyman 1985).

However, geminates in Ngalakgan do not always make the preceding syllable heavy, even though other codas may do so. Therefore, either moras are *not* the basis of quantity-sensitive stress, since not all moraic consonants make heavy codas, or else geminates are not universally moraic. I will argue for the second position here. In this respect I follow e.g. Selkirk (1988[1990]), Tranel (1991), Hume (1997) and others.

I propose that two parameters need to be taken into account in discussing syllable weight: syllable markedness as a function of acoustic complexity (e.g. Hamilton 1996, Steriade 1997), and syllable weight as a function of rhyme sonority (e.g. Zec 1988). The majority of quantity-sensitive stress systems seem to recognise both parameters. Ngalakgan also evinces examples where the sonority sequencing contour of

the syllable accounts for stress. I analyse stress on these syllables as a manifestation of syllable *prominence*, rather than syllable weight (Everett and Everett 1984, Everett 1988, Davis 1989, Blevins 1995:207).

The analysis of syllable weight in Ngalakgan proposed here to account for geminates, also makes sense of the behaviour of glottal stops in Ngalakgan. Glottal stops do not behave like other consonant codas for the purposes of word-minimality. I show that glottal stops are not visible to constraints regulating weight for stress in longer words.

I will first describe which syllables are and are not heavy in Ngalakgan, and show why the Ngalakgan facts do not follow from the Moraic Theory of weight. In §5.2 I propose a theory of weight based on the markedness of syllables according to their comparative perceptual difficulty, and argue that heavy syllables in Ngalakgan are bimoraic. §5.3 describes and analyses heavy syllables in various positions in the word in terms of well-attested processes such as destressing in 'clash' (Prince 1983). In §5.3.1 I discuss the extent to which the Ngalakgan pattern differs from quantity-sensitivity in other languages. §5.4 discusses prominence effects on stress in Ngalakgan, which I analyse as being derived from syllable sonority. In §5.5 I show that the analysis extends comfortably to an account of the behaviour of glottal stop for weight. §5.6 concludes the chapter, with a summary of the discussion.

5.1 The nature of weight

In Ch 2 I showed that metrical stress in Ngalakgan is trochaic, and aligned to the left edge of words and WORD-level morphemes. So the distinction between regular edge-based stress on the one hand, and quantity-sensitive or prominence-based stress in Ngalakgan is easiest to see in trisyllabic roots, where these systems are in conflict.

In trisyllabic roots, we find a consistent distinction between those with medial stress and those with initial stress. With a handful of exceptions, forms with medial

stress have a medial closed syllable (L: light syllable, H: heavy; bolding and preceding apostrophe indicates (some level of) stress).¹

(2)	a.	[buɖʒlɔ]	/pu ʈ olkoʔ/	L' HL	'brolga' (bird sp.)
	b.	[miɹárppu]	/miɹa r ppuʔ/	L' HL	'crab'
	c.	[luŋórwa]	/lu ŋ urwa/	L' HL	'vine sp.'
	d.	[moŋʒɛpɔr]	/mo ŋ ɔɛpɔr/	L' HL	'mud cod'
	e.	[waɹórkku]	/waɹu r kku/	L' HL	'club'
	f.	[gaɖáykka]	/ka ʈ aykkaʔ/	L' HL	'stringybark tree'
	g.	[buróʈci]	/pu r uʈci/	L' HL	'water python'
	h.	[ɹembárŋa]	/ɹem p aŋa/	L' HL	[ethno-linguistic group]
	i.	[ɹittárŋu]	/ɹit t aŋu/	L' HL	[ethno-linguistic group]

The reason for the stress pattern in words of this type will be discussed in the first half of the chapter. §5.4 examines other kinds of anomalous medial stress patterns.

I have represented the medial syllable in such cases as 'heavy' (H), in accordance with our current understanding of stress systems where aspects of syllable structure interact with stress (e.g. Hyman 1985, M&P 1986, Prince 1990, Hayes 1995). Roots of this form are rare, (2) contains all the attested trisyllabic examples.

Forms with *initial stress* fall into two groups. The first group is represented by roots where all syllables are open (CV):

(3)	a.	[bíjuɖu]	/p i cuʈu/	' LLL	'big wind'
	b.	[wáɖiya]	/wa ʈ iya/	' LLL	'multiparous woman'
	c.	[jéraɖa]	/ce r aʈa/	' LLL	'women's ceremony'
	d.	[jílara]	/ci l ara/	' LLL	'unidentified tree sp.'
	e.	[málaɖi]	/ma ʈ aʈi/	' LLL	'wedge-tailed eagle'
	f.	[múnaŋa]	/mu n aŋa/	' LLL	'European'
	g.	[múwaɖa]	/mu w aʈa/	' LLL	'canoe'
	h.	[ŋóʈiri]	/ŋu ʈ iri/	' LLL	'black duck sp.'
	i.	[wálama]	/wa l ama/	' LLL	'face'

Roots of this form are very common in the lexicon (see §2.1 for more examples).

¹These exceptions will be discussed in §5.4.

The second group of *initially-stressed* roots also have a medial closed syllable. But in these cases, the two consonants of the cluster are homorganic. The examples in (4a-f) below behave as if they consist of sequences of light syllables, and are stressed on the first syllable. The examples in (4a-f) contrast with those in (4g-j), which consist of heavy as well as light syllables, and are stressed on the heavy syllable.

- | | | | | | | |
|-----|----|------------|----------------------------|----|----------------|-----------------|
| (4) | a. | [móʎoppə] | 'LLL | g. | [monɔcpər] | L'HL |
| | | /moʎoppə/ | 'shovelhead catfish' | | /monɔcpər/ | 'mud cod' |
| | b. | [jábatta] | 'LLL | h. | [buɔɔlɔ] | L'HL |
| | | /capatta/ | 'freshwater tortoise sp.' | | /puɔlkoʔ/ | 'brolga' |
| | c. | [járuʔtu] | 'LLL | i. | [gibíʔkuluc] | L'HLL |
| | | /caruʔtuʔ/ | 'female agile wallaby' | | /kipíʔkuluc/ | 'frogmouth' |
| | d. | [mánappun] | 'LLL | j. | [gùrijáʔpɔŋgo] | LL'HLL |
| | | /manappun/ | 'echidna' (spiny anteater) | | /kuricatpɔŋko/ | 'olive python' |
| | e. | [móroʔtɪn] | 'LLL | k. | [jəradáʔpuwa] | LL'HLL |
| | | /morotɪnʔ/ | 'wild cassava' | | /caratpuwa/ | 'chestnut rail' |
| | f. | [gámakkun] | 'LLL | | | |
| | | /kamakkun/ | 'properly' | | | |

There are just two quadrisyllabic roots with a geminate between the second and third syllables, which are otherwise open-syllabled (5a-b). In these forms, the geminate does not attract stress. A syllable in this environment *does* receive stress if it is independently heavy because of another consonant preceding the geminate (5c-d):

- | | | | | | | |
|-----|----|-------------|-------------------|----|----------------|--------------------------|
| (5) | a. | [wáɪaccàra] | 'LLLL | c. | [gaŋdálppuru] | L'HLL |
| | | /waɪaccara/ | 'flood water' | | /kaŋtalppuru/ | 'female plains kangaroo' |
| | b. | [ɲámuccùlo] | 'LLLL | d. | [gulúykkuluy] | L'HLL |
| | | /ɲamucculo/ | [subsection term] | | /kuluykkuluyʔ/ | 'night owl' |

Syllables closed by geminates are not the only closed syllables which are not heavy; the same pattern is found with homorganic nasal-stop (NC) clusters.² Examples in (6) show that such syllables are not stressed in the medial position of trisyllabic roots (a-c), or in weak metrical positions in longer roots (d) (that is, in positions which would not be stressed because of foot structure).

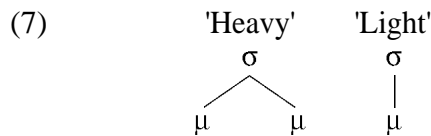
- | | | | |
|-----|----|-------------------------------------|----------------------------------|
| (6) | a. | [ŋólonŋgɔ]
/ŋolonkoʔ/ | 'LLL
'eucalyptus sp.' |
| | b. | [jáganda]
/cakanta/ | 'LLL
'female plains kangaroo' |
| | c. | [ŋórunɖuc]
/ŋurunɖuc/ | 'LLL
'emu' |
| | d. | [gáranŋgàŋaŋĩni]
/kaɹaŋkaŋaŋini/ | "LL'LL'LL
'macropod sp.' |

The examples presented here show that there is an association between place of articulation, syllable structure, and the placement of stress in roots. But it is not the kind of association that cross-linguistic patterns or Moraic Theory would lead us to expect. I will briefly explain why the Ngalakgan facts are significant, before offering my explanation for the Ngalakgan pattern and its relationship to other cross-linguistic patterns.

5.1.1 Geminates in a Moraic Theory

Geminates are expected to count for weight everywhere in Moraic Theory (e.g. Hyman 1985, Hayes 1989), so the Ngalakgan pattern contradicts general assumptions. As stated in the introduction, in a moraic theory of syllable 'weight', heavy syllables are bimoraic, and light ones monomoraic:

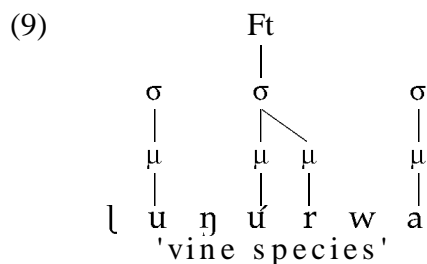
²Hereafter, in the interests of readability, these will simply be referred to as 'NC clusters', except where they are contrasted with heterorganic clusters.



In words with some heavy and some light syllables in a quantity-sensitive language, heavy syllables are stressed in preference to light ones, a condition which is dubbed the 'Weight-to-Stress Principle' in Prince (1990), I repeat the P&S (1993:53) version here:

- (8) Weight-to-Stress Principle (WSP):
 'Heavy syllables are prominent in foot structure and on the grid.'

Example (2c) above for instance, can be represented as in (9) below:



The medial syllable of (9) is associated to two moras, therefore it is a 'heavy' syllable, and WSP demands that any heavy syllable receive stress.

The WSP principle, and the proposal that heavy syllables are those which are bimoraic, is the standard way of accounting for quantity-sensitive stress systems (e.g. Hyman 1985, Hayes 1989, Prince 1990, P&S 1993, Hayes 1995).

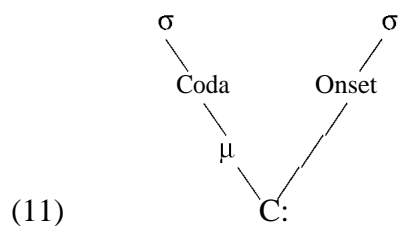
The Moraic Theory, as well as being a theory of prosodic *weight*, is also a theory of segmental *length*: long segments are associated to more moras than short segments (Hayes 1989:256-7):

(10)

UR:	μ t	t	μ i	$\mu\mu$ / i
SR:	[t:]	[t]	[i]	[i:]
	(a)	(b)	(c)	(d)

Representation of long segments in Moraic Theory: (a) geminate stop, (b) plain stop, (c) short vowel, (d) long vowel.

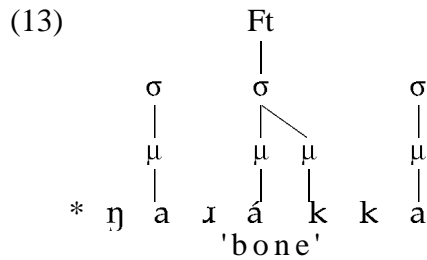
The geminate stop, in (10a) is associated to a moraic position. The geminate is syllabified ambisyllabically, one half (the moraic position) is associated to the preceding syllable node as a coda, and the other half (which is non-moraic) to the following onset:



Thus, geminates contribute a moraic coda to the preceding syllable and therefore they are expected to make the preceding syllable bimoraic (since vowels are always moraic). In a quantity-sensitive language then, the following should hold:

- (12) Syllables preceding a geminate should be bimoraic, and where stress is associated to heavy syllables (as in Ngalakgan), they should be stressed.

So in the word presented in (13), the medial syllable is expected to be heavy, and stressed, based on the prediction in (12).



Ngalakgan does not behave in this way, as we have seen.

Tranel (1991) and others (e.g. Lahiri and Koreman 1988; Selkirk 1990) have observed that the prediction in (12) is empirically false. Tranel proposed instead a principle of 'equal weight of codas', which states that '*ceteris paribus*, coda portions of geminate consonants behave in the same way as other coda consonants with respect to syllable weight' (1991:293). Tranel goes on to show that in Selkup for instance, CVV syllables are heavy, but any syllable closed by a consonant is light, including those closed by a geminate (Tranel 1991:294, citing Halle and Clements 1983:189). Stress falls on the rightmost heavy syllable, else the leftmost syllable in Selkup, where heavy syllables are those with long vowels, as shown in (14).

- (14)
- | | | |
|---------------------------------|--|-------------|
| <u>Heavy CVV syllables</u> | | |
| a. | qu.mooq.li. líi
'your two friends' | LHLH |
| b. | qu. móo .qì
'two human beings' | LHL |
| <u>Light CV, CVC syllables</u> | | |
| c. | quí.mi. ník
'human being' (dat.) | LLL |
| d. | á. mír .na
'eats' | LLL |
| e. | úŋ. ŋín .tì
'wolverine' | LLL |
| <u>Light CVG (G a geminate)</u> | | |
| f. | úú. crík .kak
'I am working' | HLL |

Examples (14a-b) show the stress pattern with heavy syllables, (c-e) with light syllables. Example (14f) shows that a syllable preceding a geminate does not act like a heavy syllable - it is not stressed in preference to the initial syllable.³ Hayes (1995:302) notes other languages in which geminates do not count for weight (in an otherwise quantity-sensitive system): some dialects of Yupik (Eskimo), Chuvash (Turkic), Ossetic (Iranian), and various Algonquian languages.

The content of Tranel's principle is that in quantity-sensitive languages, if codas are heavy, then the coda portions of geminates are also heavy. But again Ngalakgan does not fulfil this condition: some codas make a syllable heavy, others do not. Note that the weightlessness of geminates must be extended to homorganic NC clusters also. There appear to be no other languages where geminates behave in this exceptional way.⁴ While this may make it seem that geminates are treated like single segments in Ngalakgan (and note that this analysis was rejected in Ch 4), this explanation cannot be extended to NC clusters.⁵

Geminates and homorganic NC clusters have attracted theoretical interest, largely because these articulations often exhibit ambiguous behaviour. They behave like single segments for some phonological processes, and complex segments for others. Hayes (1986, following e.g. Kenstowicz and Pyle 1973, McCarthy 1979, Prince 1984) proposed that geminates are single segments on the melodic tier, but clusters for prosody (including the syllable). Therefore, processes which target melody (such as assimilation) should treat them as single segments, while prosodic processes should treat them as clusters. Stress is a prosodic process, and thus should treat geminates and other homorganic articulations as clusters. However, geminates and NC clusters behave

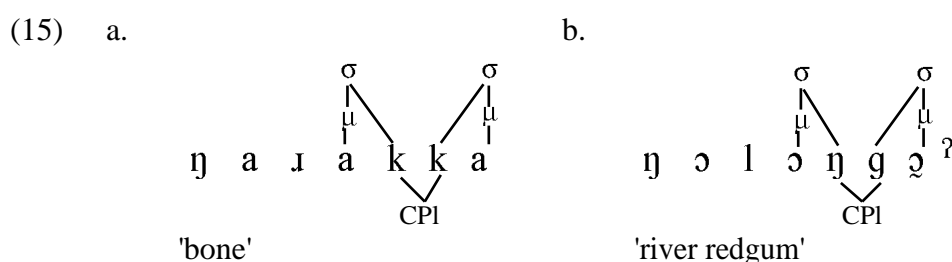
³On the basis of this kind of data Selkirk (1988[1990]) argued for a 'two-root theory' of segmental length: rather than representing geminates as being underlyingly moraic, they should instead be represented with two root nodes associated to a single place node.

⁴But there are some related patterns, which are explored in §5.3.2.

⁵One might propose that Ngalakgan has prenasalised stops. But again, NC clusters behave like clusters for all the tests presented in Ch 4.

like single segments in Ngalakgan: they do not have the same characteristics as other clusters for stress.

Both geminates and homorganic NC clusters are produced with a single articulatory gesture (Hamilton 1996), thus both clusters are termed 'place-linked' in what follows. Place-linking is represented by association to a single place node in a feature-geometry notation:



('CPI' stands for 'consonant place (of articulation)'). (15a) shows a place-linked geminate obstruent, and (15b) a place-linked NC cluster. I have shown moras associated to vowels, as per Moraic Theory conventions.

The fact that geminates and NC clusters are produced with a single articulatory gesture distinguishes them from all other supralaryngeal clusters in the language. There are no examples of tautomorphemic liquid+stop clusters in Ngalakgan which share place.⁶ Therefore, we can observe that closed syllables which are heavy for stress, are those in which a following cluster is bigestural, while closed syllables which are not heavy for stress, are those in which a following cluster is monogestural.

The Moraic Theory rests on the principle that stress refers only to the characteristics of the syllable node. The only thing that stress rules need to know is whether or not the syllable node dominates more than one mora. So the interesting question to be resolved in Ngalakgan is why stress should have anything to do with gesture, while apparently ignoring syllabic properties. In the following sections I argue

⁶Hamilton (1996) shows that these clusters are in any case not produced with a single gesture, since each segment in the cluster differs in tongue configuration.

for an analysis of stress based on syllable markedness: I will claim that the best kind of stressed syllable in the word is the syllable which is most marked.

5.2 Contextual markedness of segments and clusters

In this section I discuss the markedness of syllable structural types in Australian languages, and show why intervocalic monogestural consonant articulations are maximally unmarked. It has been shown that distribution of consonant place contrasts in Australian languages are best defined not in terms of the syllable positions 'onset' and 'coda', but in terms of their position in relation to surrounding consonants and vowels. This observation is due to Dixon (1980:159), whose summary I repeat here (*italics mine*).

Typically, every word in an Australian language must involve at least two syllables. It must begin with a single consonant and can end in a consonant or a vowel; between each pair of vowels there must be either one or two consonants. That is, disyllabic words have the form:

$C_1VC_2C_3V(C_4)$ or $C_1VC_5V(C_4)$

It is generally the case that every consonant can occur intervocalically, in the C₅ position. In contrast, the set of consonants that can occur at C₁ or C₄, or at C₂ or C₃ is usually severely limited...there are sometimes one or two consonants which can occur only at C₅ position (and maybe also in homorganic nasal-stop or lateral-stop clusters).

It is thus not possible, for an Australian language, to give a structure $C_1V(C_2)$ for syllables, and then to describe a word as a sequence of these syllables. The possibilities at C₃ may be similar to those at C₁, but they never coincide; similar remarks apply to C₂ and C₄. And the occasional occurrence at C₅ of phonemes that are found in no other position further discredits a monosyllabic model.

The important statement for our present purposes is that the intervocalic position is the *only* position in a word where every contrastive consonantal segment in an Australian language may be found. For example, it is almost universal in Australian

languages for a distinction in apicals (between alveolar and postalveolar/retroflex) to be neutralised in initial position, where usually this apical is alveolar in isolation but postalveolar following a vowel. Apicals are neutralised also in C₃ (post-consonantal), where the realisation is alveolar. The trill/tap/flap [r ~ ɾ] is likewise rare initially in words (Dixon 1980:167-8). Some languages also ban liquids in initial position, and/or ban alveolars entirely. Neutralisations in the laminal series between dental/alveo-dental and alveo-palatal/palatal are typically found word-finally, and in C₂ position (i.e. pre-consonantal) in a heterorganic cluster (Dixon 1980:169-170) (the neutralised realisation in these positions is more variable, and more dependent on surrounding vowels, than is the case for neutralised apicals). The retroflex glide [ɭ ~ ɻ] is rare in word-final position.

We can summarise Dixon's observations in the following statement:

- (16) The intervocalic single C position is the only position that licenses the full range of segmental contrasts in Australian languages. 'Single C' includes 'contour' gestures like geminates and nasal-stop clusters (Dixon 1980, Hamilton 1996).

If we assume that this position is the unmarked perceptual position, then this generalisation follows from this fact (Hamilton 1996:74).

Every Australian language allows homorganic nasal+stop clusters, though a couple do not allow heterorganic ones (Hamilton 1996:79). This accords with the cross-linguistic implicational (Prince 1984:243): that if a language allows heterorganic nasal+stop clusters then it also allows homorganic ones, but not necessarily the reverse. The frequencies of homorganic and heterorganic NC clusters within languages also differ. But, with one possible exception, in every Australian language homorganic nasal+stop clusters are more frequent in words than heterorganic ones (Hamilton 1996:82).⁷ These facts provide further confirmation for the claim in (16), on the

⁷The exception is Limilngan (Harvey, to appear), an extinct language once spoken to the east of Darwin, NT. This is not a serious exception, however, the lexicon of Limilngan collected before it became extinct is no more than a few hundred words. So the over-representation of heterorganic NC clusters may be a result of the sample size. This language has quite a divergent phonology to the

assumption that the comparative frequency of segments and clusters in words reflects their markedness.

The pre-consonantal position in a heterorganic cluster (i.e. C_2 in Dixon's terms) is more *marked* in Ngalakgan than the intervocalic position. Consonants in C_2 allow a limited range of contrasts. In the overwhelming majority of Australian languages, only coronals (apicals and neutralised laminals) are allowed in this position (Dixon 1980:170). Words with heterorganic clusters, as noted, are less frequent than those with homorganic clusters.

These patterns suggest that the following markedness ranking obtains in Australian languages:

$$(17) \quad \frac{\text{Consonant markedness according to place-linking}}{VC_iC_iV > VC_iC_jV}$$

This ranking reads: intervocalic heterorganic clusters are more marked than intervocalic segments and homorganic clusters.

In Ngalakgan, it is the former class of syllables - those with a coda which is not place-linked to a following onset - which is stressed in medial position in words, e.g. [puʈólkoʔ]. By contrast, syllables before an intervocalic homorganic cluster or single segment are not stressed in this way, e.g. [ɲáɹakka], [cákanta], [pícuʈu]. That is, the more marked syllable, according to (17), is the one which is stressed medially. The less marked syllables are not stressed in the same position. Based on this correlation between syllable markedness and stress, I claim that marked syllables make the best stressed syllables in Ngalakgan. In what follows I will derive the ranking in (17) from universal rankings on acoustic markedness, based on Hamilton (1996). I then propose a ranking which accounts for the association between stress, markedness and perception.

surrounding languages, and allows syllable structures which are unattested in Australian languages outside Cape York.

5.2.1 A perceptual theory of markedness

Hamilton (1996) argues that intervocalic monogestural articulations (i.e. single segments, or homorganic clusters) are maximally unmarked in perceptual terms. These articulations possess the full range of acoustic cues in both V-C ('attack') and C-V ('release') formant transitions and burst properties (Hamilton 1996:86-87). By contrast, consonants in the pre-consonantal position of a heterorganic cluster possess only attack cues. Moreover, they obscure the attack cues for the following consonant. Consonants in the post-consonantal position of a heterorganic cluster possess the more robust release and burst cues, but no attack cues.

Hamilton (1996:14) proposes the following universal ranking for acoustic features ('[f]') cued primarily in release, shown in (18):

- (18) Context-specific robustness of perceptual cues as a determinant of constraint ordering
[f] tied to release cues: *[f]^{VC} >> *[f]^{CV} >> *[f]^{VCV}

The ranking in (18) predicts that consonants in intervocalic position should show the widest range of contrasts, compared to other positions, since they possess both attack (V-C formant transitions) and release (C-V formant transition) cues, and are hence more perceptually recoverable. This prediction is confirmed empirically by the distribution of consonant contrasts in words, as discussed previously.⁸

The constraint ranking in (18) also helps us to understand the distribution of stress in roots. The medial syllable in (19), below, is 'marked' because it contains a coda and the coda is non-place-linked. A consonant in this environment is perceptually difficult, because it possesses only the cues tied to the V-C formant transitions. According to Hamilton (1996:13), attack cues are less robust than either burst properties or release cues.

⁸The only consonant place which is not cued primarily in release is apico-postalveolar ('retroflex'). These consonants are cued mainly by 'r-colouring' on the preceding vowel; they do not have release cues distinct from apico-alveolars.

(19) /moŋoɕpɔr/ [moŋɔɕpɔr] 'mud cod'

We might assume that the perceptually difficult syllable is stressed in order to enhance the perceptual cues, and make them more prominent. That is, stress assists in the perception of the syllable by enhancing the recoverability of perceptual cues to consonants, which might otherwise be obscured.

In comparison to the medial closed syllable in words like /moŋoɕpɔr/, the medial syllable in words like those in (20) is *less* marked, and the consonant is relatively easy to perceive.

(20) a. /ŋaɪakka/ [ŋáɪakka] 'bone'
 b. /cakanta/ [jáɡanda] 'female plains kangaroo'

Intervocalic geminates and homorganic NC clusters are 'robustly cued' for their acoustic features (Hamilton 1996:87). The most perceptually marked syllable in the above words is the *initial* one: because it has fewer acoustic features than the other two consonants. Therefore, stress in initial position in these words can again be seen as enhancing the cues for the initial consonant, which are easier to perceive in a stressed syllable.

To encode the intuition that cues are enhanced by stress, I propose a harmonic scale on acoustic features according to syllable stress:⁹

(21) ɔ|f| } ɔ̃|f|
 'Acoustic features in a stressed syllable are more harmonic than acoustic features in an unstressed syllable.' (Here I use the Latin *brevis* symbol '̃' as a way of encoding lack of stress, not necessarily of length).¹⁰

⁹The symbol '}' is to be interpreted as 'is more harmonic than', following e.g. P&S (1993:39).

¹⁰The fact that [f] follows the stressed syllable in these representations is not significant. We are considering the features associated with the stressed syllable as a whole.

I take it this is an uncontroversial observation that perception is enhanced in a stressed position. From this harmonic scale I derive the constraint ranking in (22):

- (22) * σ [f] >> * $\acute{\sigma}$ [f]
 'It is harder to perceive acoustic cues to features in an unstressed environment than it is to perceive them in a stressed one.'

This constraint ranking helps us to understand a number of generalisations about the relationship between stressed syllables and markedness. In English, it bans contrastive vowel features in unstressed environments, so we find contrasts like the following:

- (23) a. [s $\acute{\sigma}$ nə.ɪəs] 'sonorous'
 b. [sən $\acute{\sigma}$.ɪə.ti] 'sonority'

Contrastive vowels in English are found only in stressed syllables (Hayes 1995). In unstressed syllables vowels lose their contrastive features, and are neutralised to centralised vowels in this environment - [ə], [ɪ] in Australian English.

For Ngalakgan, the same constraints help us to make sense of the relationship between stressed syllables, and syllables which are perceptually marked. While the ranking given in (22) is expected to be universal, the particular markedness features picked out by the constraint may be language-particular. In English, the features 'f' referred to by the constraint are the contrastive features of vowels. In Ngalakgan, I will take the features 'f' to refer to the acoustic features of the following consonant place of articulation.

In order to show this result formally, I combine the two constraint rankings in (18) and (22), into the hierarchy in (24):¹¹

¹¹The raised circle diacritic in (24) is the IPA symbol for consonantal release (Pullum and Ladusaw (1986[1996])).

$$(24) \quad *[f]\check{V}C^{\uparrow} \quad \gg \quad *[f]C^{\uparrow}\check{V} \quad \gg \quad *[f]\check{V}CV$$

The ranking in (24) says that, for unstressed syllables, pre-consonantal Cplace cues are worse than post-consonantal Cplace cues, which are in turn worse than intervocalic Cplace cues. (To simplify the analysis, in the case of intervocalic consonants I will only consider *preceding* cues in unstressed/stressed positions.)

For the sake of readability I will not use the representations in (24), but rather the short-hand terms in (25) which have the advantage of being more iconic.

$$(25) \quad *Cues[\check{V}\underline{C}C] \quad \gg \quad *Cues[C\underline{C}\check{V}] \quad \gg \quad *Cues[\check{V}\underline{C}v]$$

The three constraints in (25) should be regarded as notational variants of the respective constraints in (24), and interpreted in the same way.

The constraint ranking in (25) dominates the ranking of constraints referring to cues in stressed syllables. The formal representation of these constraints is given in (26) (following Hamilton 1996), and in (27) I again give short-hand names for the constraints.

$$(26) \quad *[f]\check{V}C^{\uparrow} \quad \gg \quad *[f]C^{\uparrow}\check{V} \quad \gg \quad *[f]\check{V}CV$$

$$(27) \quad *Cues[\check{V}\underline{C}C] \quad \gg \quad *Cues[C\underline{C}\check{V}] \quad \gg \quad *Cues[\check{V}\underline{C}v]$$

It is to these constraint rankings that candidate stressed forms are referred for evaluation. Together, the constraint rankings in (25) and (27) state that, for any word, the best parse is one in which the most prosodically prominent syllable and the most perceptually difficult syllable coincide.

It is true that contextual cueing is important mainly for obstruents: sonorants have internal cues. I take it then that the constraints in (24) and (26) have *phonological*, rather than *phonetic*, effects in Ngalakgan. That is, they refer to *all* pre-consonantal

consonants, all post-consonantal ones, and all intervocalic ones, regardless of their features (as e.g. [+/- sonorant]).¹²

The point has been made by several authors that phonetic effects are not the same thing as phonological rules or constraints. Hayes for example notes (1997:6-7) that phonological realisations are categorical, and tend to exhibit symmetrical behaviour. Phonetic realisations are gradient and variable, and need not exhibit formal symmetry. One of Hayes' examples is contextually-determined neutralisations in consonant voicing. Voicing in obstruents is commonly neutralised to voiceless realisation preceding an obstruent. In languages which have this rule (e.g. colloquial German) *all* obstruents are voiceless in this environment. This is the case even though, for articulatory reasons, voicelessness is harder to achieve in the labial obstruent [p] than it is in the velar obstruent [k]. We do not typically observe asymmetric rules or constraints which mirror the asymmetries found in phonetic realisations and constraints.¹³ Since all syllables which are heavy for stress in Ngalakgan can be described simply in terms of the ranking in (26), then quantity-sensitive stress is a phonological and not a phonetic phenomenon in this language.

The tableaux in (28), (29) show how the constraint rankings in (25) and (27) derive the well-formedness of stress depending on contextual markedness.¹⁴ The ranking of perceptual constraints evaluates each of the syllables in a candidate for its well-formedness. A segment sequence corresponding to any given constraint is given as the violation of that constraint in the tables. In (28), for instance the (b) candidate violates the highest constraint shown: against pre-consonantal feature cues in an unstressed syllable (indicated as a violation in the tableau with the offending sequence: [ǔrɰw]). This is sufficient to make it ill-formed in comparison to the (a) candidate, where

¹²The case of glottal stop is exceptional, and is discussed in 5.5.

¹³There are exceptions, such as lenition (Foley 1970).

¹⁴For the sake of readability, I omit the constraint series in (27) (referring to stressed syllables) from the tableaux. The effects of this constraint series are always obscured by those of the higher-ranked constraints against unstressed syllables, since one of these constraints will always determine the most harmonic candidate.

the most marked syllable is the stressed one. I have shown only the constraints from (25) referring to cues in unstressed syllables.

(28)

/[uŋurwa/ 'vine sp.'	*CUES [ǂC̣C̣]	*CUES [C̣C̣ǂ]	*CUES [ǂC̣v]
☞ a. [[uŋúrwa]		[ǂ, rwǎ	ǂŋu
b. [[úŋurwa]	ǂrw!	rwǎ	

In (29), the most perceptually marked syllable is the initial one. In the (b) candidate, where this syllable is unstressed, it induces the worst violation, indicated with [ŋǎ]. The (a) candidate violates the lower-ranked constraint: against unstressed syllables before an intervocalic monogestural articulation.

(29)

/ŋaɬakka/ 'bone'	*CUES [ǂC̣C̣]	*CUES [C̣C̣ǂ]	*CUES [ǂC̣v]
☞ a. [ŋáɬakka]			ǎkka
b. [ŋaɬákka]		ŋǎ!	ǎɬa

The same constraint ranking that derives the difference between syllables which are heavy and light for stress can also derive initial-stress in (29a) [ŋáɬakka]. In the absence of pre-consonantal codas (the most 'under-cued' consonants), a word-initial segment is the least-robustly cued. Stress on the initial syllable in (29a) satisfies the same constraint as medial stress in (28a) [[uŋúrwa]].¹⁵

The analysis captures the generalisation that syllable 'weight' in Ngalakgan is dependent on the position of a consonant with respect to neighbouring vowels and consonants. It is not dependent on position in a coda or onset *per se*, nor does it imply that geminates and homorganic NC clusters are single segments. The analysis relies on the fact that monogestural articulations, when intervocalic, are perceptually less marked

¹⁵This explanation of initial stress will not generalise to the numerous languages which have penultimate stress.

than other consonant articulations in the word. Indeed, they are the least marked, since they possess the full range of acoustic cues in attack, burst, and release phases, while all other consonantal positions possess only a subset of these cues.

The approach taken to stress here is in line with recent work on the phonetics-phonology interface in the Optimality Theoretic framework. Steriade (1997) derives the cross-linguistic patterns of neutralisation of laryngeal contrasts in languages from the contextual robustness of perceptual cues. In Greek and Sanskrit for instance, voicing and aspiration in stops are contrastive only before sonorants. In other positions - word-finally, and before obstruents and fricatives - the contrast is neutralised. Steriade proposes that both the voicing and aspiration contrasts are cued primarily in the stop release. Exactly in contexts where a stop's release is inaudible or difficult to maintain - before an obstruent and word-finally - these contrasts are neutralised. Hayes (1997), based on phonetic evidence of this kind, proposes that children induce a phonological constraint ranking for their language. He suggests they do this in part by using an efficiency metric for deciding which constraints are active from the universe of possible constraints accounting for the phonetic effects.

Therefore, it is not unexpected that the distribution of stress in words, which is also a phonologically contrastive feature, should have some phonetic basis, even if indirect. The functional motivation, I suggest, is the maintenance of consonant distinctions by making them more prominent and hence more easily perceived. This is a similar kind of explanation to that advanced by Steriade and Hayes for the distribution of consonant contrasts in words.

The danger in this argument is circularity. How can we defuse the opposite interpretation of stress in Ngalakgan: that stressed syllables 'license' more segmental material? For instance, Beckman (1998) proposes that stressed syllables are positions of privilege, which allow a greater range of underlying contrasts to surface than unstressed syllables. This is a licensing argument: stressed syllables license more contrasts than other, unstressed positions.

There are two pieces of evidence that the relationship must be stated in the other way: it is not that stressed syllables allow more contrasts, but that more difficult contrasts are more easily perceived if they cooccur with stress. Firstly, in Ngalakgan, syllables which are heavy for stress do not always occur in the same position in the word. Furthermore, there are words with more than one heavy syllable, but only one stress. These examples show that there is not a pre-defined position in Ngalakgan words which licenses both stress and a greater number of segmental contrasts. I describe these other forms in §5.3. Some of the examples discussed by Beckman (1998:239), such as Tamil, can be seen as further evidence for the proposal made here. These examples are discussed in §5.3.2.

The second piece of evidence comes from stress in heteromorphemic words. Here, we can observe one stress pattern in a morpheme by itself, and a distinct, quantity-sensitive pattern when the morpheme occurs in a complex environment. (30) presents an example of this kind.

- (30)
- | | | |
|----|------------------------------|----------------------------------|
| a. | [gubúyppun]
/kupuy+ppu+n/ | 'rub sweat on'
sweat+[hit]+PR |
| b. | [gúbuy]
/kupuy/ | 'sweat' (Noun) |
| c. | *[gúbuppun] | |

The verb stem in (30a) always has medial stress, as shown. The related noun has initial stress. The stress on this root is only on the second syllable when it occurs in a complex form like (30a), where the second syllable [buy] is thereby made heavy. If stress and markedness were in a licensing relationship, as proposed by Beckman, we might expect some kind of deletion or assimilation in this environment, as in the ill-formed (30c). Forms like (30a) suggest that stress in Ngalakgan 'moves' to accommodate the most marked syllable. Further examples of this pattern are presented

in §5.5. Before extending the description, I first discuss the relationship between the theory of quantity-sensitivity proposed here and the Moraic Theory of quantity.

5.2.2 Markedness and moraicity

In this section I suggest that bimoraic, heavy syllables are also marked syllables. The Ngalakgan definition of syllable markedness for weight is somewhat different to that of syllable markedness for weight in other languages, but it is not a different phenomenon. And therefore, Ngalakgan can be analysed in terms of the well-established principles of Moraic Theory.

While it is not necessary to explain the Ngalakgan stress facts using Moraic Theory, it is desirable. It is desirable because Moraic Theory is a restricted theory of syllable weight. Constraints which are sensitive to weight - such as FTBIN - can only refer to moras, direct reference to syllable structure or segments is ruled out. Using moras allows stress rules or constraints to be stated in uniform terms such as 'every heavy (=bimoraic) syllable is stressed'. This proposal has been shown to have broad empirical support in e.g. McCarthy and Prince (1986), Hayes (1989, 1995). M&P (1993a) have shown that Moraic Theory is an elegant way to account not just for quantity-sensitive stress, but also for word minimality and reduplication typology. Hayes (1989) shows that Moraic Theory provides a simple account of compensatory lengthening processes.

How might the characteristics of syllables translate into OT constraints referring to stress? P&S (1993:38) observe that there are stress systems in which an edgemost syllable or foot is associated with main stress, regardless of the stressed syllable's inherent characteristics. Warlpiri (Nash 1980[1986]) is a language of this type. There are also languages in which main stress *is* associated with the inherent characteristics of syllables, regardless of the position of the syllable in the word. P&S (1993:38) suggest that in these languages, stress 'is a kind of promiential enhancement, that calls directly on contrasts in the intrinsic prominence of syllables'. In order to establish the 'relation

between the intrinsic prominence of syllables and the kind of elevated prominence known as stress', they propose the following constraint:

- (31) Peak Prominence(PK PROM): $\text{Peak}(x) \succ \text{Peak}(y)$ if $|x| > |y|$.

'By Pk-Prom, the element x is a better peak than y if the intrinsic prominence of x is greater than that of y . This is the same as the nuclear-harmony constraint HNUC ... which holds that higher sonority elements make better syllable peaks.'

I give P&S's HNUC constraint here for completeness (P&S 1993:16):

- (32) The Nuclear Harmony Constraint (HNUC).
A higher sonority nucleus is more harmonic than one of lower sonority.
I.e. If $|x| > |y|$ then $\text{Nuc}/x \succ \text{Nuc}/y$.

In this formulation, ' $|x|$ ' again means 'the intrinsic prominence of x ' (P&S 1993:16). In equating sonority and prominence in this way, P&S (1993) imply a relationship between sonority and syllable weight (cf. Blevins 1995).

In many cases this relationship holds: heavy syllables are those which are most sonorous, if we regard a long vowel as more sonorous than a short one. In most or all dialects of Yupik for instance, heavy syllables are those with long vowels; CVC syllables are light except in initial position (Jacobson 1985:25).

'Inherent prominence' is not the factor attracting stress in the Ngalakgan case. The syllables which attract stress are those which are in danger of being *least* prominent, if they were *not* stressed. In Ngalakgan, these syllables are stressed to make the syllable more prominent.

By itself, P&S's PKPROM constraint is a broad generalisation about the association between phonetics and prosody. It must be translated into a phonological system in order to account for the distributions that we find in languages. The link between the two lies in constraints such as the HNUC constraints proposed by P&S

(1993:§8). These constraints allow for a uniform statement of what constitutes a well-formed syllable in languages, according to its sonority profile. I explore a further extension of this program in §5.4.

The perceptual constraints presented above can likewise be seen as a decomposition of P&S's PKPROM into constituent constraints on the association between stress and syllable *markedness*, as opposed to sonority.

Apart from the ranking of syllable weight in the grammar, there also needs to be a constraint referring to the relationship between heavy syllables and the prosodic system in general. This is to account for languages such as Latin and Ngalakgan, where words are parsed into feet, and feet can either consist of one heavy syllable or two light ones. I pursue this question in the remainder of this section. I propose that heavy - that is marked - syllables in Ngalakgan are also bimoraic syllables on the basis that this interpretation provides the prosodic system with uniformity. At the same time, my analysis allows the fact that geminates do not make a syllable heavy to be explained without contradicting Moraic Theory.

P&S (1993:53; cf. Prince 1990) propose that the Weight-to-Stress Principle, already introduced, is a universal constraint on the relationship between syllable weight and the prosodic system.

(33) Weight-to-Stress Principle (WSP).
Heavy syllables are prominent in foot structure and on the grid.

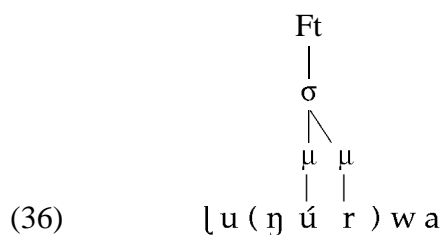
WSP prefers heavy syllables to be parsed into the strong positions of feet. The existence of WSP in the grammar forces the prosodic system to be uniform: if syllables are stressed because of their inherent characteristics (rather than their position in the word), then they must be considered bimoraic.

The constraints FTBIN and FTFORM(TR) have already been presented in Ch 2, I repeat them here.

(34) Foot Binarity (FTBIN): Feet are binary at some level of analysis (mora μ , syllable σ)

(35) Foot Form (Trochaic): Feet are left headed

Together, these three constraints in Ngalakgan prefer marked, stressed syllables to be parsed as bimoraic feet; as shown in (36).



This is shown in the tableau in (38) below. Ngalakgan is one of the languages characterised by P & S (1993) as associating stress with the inherent characteristics of syllables, regardless of their position in the word. Therefore, the perceptual constraints driving quantity-sensitive stress in Ngalakgan dominate the constraint preferring stress to be edge-based: ALIGNL(PRWD, FT). I repeat its definition here, from Ch 2.

(37) ALIGNL(PRWD, FT): 'Align the left edge of every Prosodic Word with the left edge of some foot.' (Assign a violation mark for every syllable separating a PrWd left edge from a foot left edge.)

In the tableau, ALIGNL(PRWD, FT) is ranked below the perceptual constraints. FTBIN and FTFORM I assume are undominated. WSP must be ranked higher than ALIGNL: it is more important for heavy syllables to be stressed than for stress to be initial in words. The ranking of WSP in relation to the perceptual constraints cannot be determined: these do not conflict with WSP.¹⁶

¹⁶Codas which are moraic at the surface are shown with superscripted ' μ '. I assume that all vowels are moraic.

(38)

/[uŋurwa/ 'vine sp.'	FTFORM	WSP	*CUES [ǂC̣C̣]	*CUES [C̣C̣ǂ]	ALIGNL (PRWD, FT)
☞ a. [[u(ŋúrwa)]				[ǂ, rwǎ	*
b. [(lúŋur)wa]			ǂrw!	rwǎ	
☞ c. [[u(ŋúr ^u)wa]				[ǂ, rwǎ	*
d. [(lŋúr ^u)wa]	*!			[ǂ, rwǎ	

FTFORM should be ranked above ALIGNL, otherwise we could allow parses of these forms with iambic feet, as in (38d). Since languages do not seem to, on the whole, possess both kinds of foot organisation simultaneously, this should be ruled out as a possibility. Given the existence of FTFORM in the grammar, a parse like that in (d) is the most ill-formed candidate.

What the constraint ranking does *not* capture is the notion that ALIGNL violation is 'licensed' in a sense by the WSP: a word which violates ALIGNL because it is satisfying WSP as in (38c) is better than a form which violates ALIGNL for no reason, as in (38a). It is not obvious how to make this difference explicit in the formalisation. But as the difference between (38a) and (38c) is a representational one, I will not attempt to force a solution.

By the same token, the best interpretation of geminates is the one where they are *non-moraic*, as in (a) below:

(39)

[ŋaɾakka] 'bone'	FTFORM	WSP	*CUES [C̣C̣ǂ]	*CUES [ǂC̣v]	ALIGNL (PRWD, FT)
☞ a. [(ŋáɾa ^u k)ka]				ǎkka	
b. [ŋa(ɾá ^u kka)]			ŋǎ!	ǎɾa	*
c. [(ŋáɾa ^u k ^u)ka]	*!	*		ǎkka	
d. [ŋa(ɾá ^u k ^u)ka]			ŋǎ!	ǎɾa	*

If geminates *were* universally moraic, then the relationship between quantity-sensitivity for stress, and the rest of the prosodic system in Ngalakgan would have no unified explanation. On the contrary, if geminates are considered to be surface clusters of two identical root nodes (as suggested in Selkirk 1988[1990]), then the source of confusion is removed. Thereby, the prosodic system in Ngalakgan can still be analysed in terms of Moraic Theory.

Allowing marked, stressed syllables to be considered as heavy ones makes Ngalakgan seem less unusual as a stress system. It lets us integrate the medial stress facts with the rest of the root-internal stress facts examined in the following section.

5.3 Heavy syllables elsewhere in the word

We have already seen examples where heavy syllables are medial in trisyllabic roots. This section describes and analyses the distribution of heavy syllables in other positions in words, showing that heavy syllables are stressed regardless of their position in the word, modulo the effects of other constraints.

Heterorganic clusters occur overwhelmingly in the initial position of roots. Of 166 occurring roots with a heterorganic cluster, 155 roots have a cluster in the initial syllable. Some examples are presented in (40).

- (40)
- | | | | |
|----|------------|------------|---|
| a. | /palkkɪn/ | [bálkkɪn] | 'salty' |
| b. | /ɲurku/ | [ɲórgu] | 'womb, belly' |
| c. | /parcaɹay/ | [bárjaɹai] | 'large paperbark (<i>Melaleuca</i> sp.)' |
| d. | /larwa/ | [lárwa] | 'bush pipe' |
| e. | /cetpeɽe/ | [jétpəɽe] | 'archer fish (<i>Toxotes</i> sp.)' |

This is what the perceptual constraints would predict: an initial closed syllable is more marked than a medial one, because both the initial consonant and the coda lack one set of cues. By being stressed, the initial syllable becomes prominent. This might be seen to be an instance of what P&S (1993:38) term 'prominence enhancement'. An

initial heavy, stressed syllable satisfies the perceptual constraints, ALIGNL(PRWD, FT) and WSP simultaneously.

A very small proportion of the vocabulary has clusters in a non-initial syllable - we have already encountered all the examples of trisyllabic roots with a medial cluster, which provide the strongest evidence of stress effects. In this section I consider the other positions in the word.

5.3.1 Word-final consonants

There is a strong bias against word-final stress in Ngalakgan, which can be formalised in constraint form as 'NONFINALITY' (P&S 1993:52; Walker 1996):

- (41) NONFINALITY: 'No final stressed syllables (in Prosodic Word).'

This constraint prevents both primary and secondary stress in PrWd-final syllables.¹⁷

We can see the effects of NONFINALITY in a number of environments. In roots with simple final codas, stress is initial rather than final (42):

- | | | | | |
|------|----|--------------|-------------|------------------------------|
| (42) | a. | /ciɬak/ | [jɪɬak] | 'coolamon' (container) |
| | b. | /cepaŋ/ | [jɛbaŋ] | 'line, row' |
| | c. | /kupuy/ | [gɔɓuy] | 'sweat' (n.) |
| | d. | /ŋoɬokoc/ | [ŋɔɬogɔc] | 'ankle' |
| | e. | /kayapam/ | [gáyabam] | 'wild orange' (Capparis sp.) |
| | f. | /calapir/ | [jálabr] | 'red ant sp.' |
| | g. | /caɬukal/ | [jádugal] | 'male plains kangaroo' |
| | h. | /centewerɛc/ | [jɛndewɛɛc] | 'willy wagtail' (bird sp.) |

Final coda clusters in disyllables have inconsistent properties. Two examples, shown in (43), vary between initial and final stress:

¹⁷ In P&S (1993:52) NonFinality is defined as 'No prosodic head of Prosodic Word is final in Prosodic Word'; where 'prosodic head' is defined as 'strongest foot' in a Prosodic Word, and by transitivity, strongest syllable of the strongest foot: the tonic. The prohibition is stronger than this in Ngalakgan, ruling out *any* prosodic head, including the head of any foot. This interpretation of NonFinality is made use of in P&S's (1993:54) discussion of secondary stress placement in Southern Paiute.

- (43) a. [jícíwkw, jícíwkw] /cicciwkw/ 'wren sp.'
 b. [bódéwkw, bódéwkw] /poṭewkw/ 'bad'

Four words consistently have initial stress:

- (44) a. [wáccaŋʔ] /waccaŋʔ/ 'mud'
 b. [ŋáwɔŋʔ] /ŋawɔŋʔ/ 'navel'
 c. [wórowkw] /worowkw/ 'hop' (open class verb stem)
 d. [gáppuɤk] /kappuɤk/ 'dry; not damp'

There are two words which show variation between a final velar and a final glottal stop, both have initial stress:¹⁸

- (45) a. [mádawk] ~ [mádaw] /maṭawk ~ maṭawʔ/ 'friarbird'
 b. [dárawk] ~ [dáraw] /ṭarawk ~ ṭarawʔ/ 'tree sp.'

Just three words of this form are stressed finally (46).

- (46) a. [giŋáŋk, gɤŋáŋk] /kiŋalk/ 'white ibis'
 b. [biccúrk] /piccurk/ 'edible tuber sp.'
 c. [giyærk] /kiyark/ 'tooth'

I regard the forms in (46) as exceptions to the general rule; their behaviour is discussed in §5.4.1.

In trisyllables a final syllable ending in a cluster receives secondary stress (these represent all the examples) - primary stress is initial:

¹⁸There are a few other roots with the same structure whose stress pattern I am unsure of:

- (120) a. /camolk/ 'for nothing'
 b. /cawelk/ 'grass sp.'
 c. /kuŋerŋ/ 'firewood'
 d. /kaŋurk/ 'deep'

- (47)
- | | | | |
|----|--------------|------------|------------------|
| a. | [bɛ̃ɾemɛ̀lk] | /peɾemɛlk/ | 'shoulder blade' |
| b. | [jæ̃jæbàŋʔ] | /cacapaŋʔ/ | 'yesterday' |
| c. | [gónuŋòrk] | /kunuŋuɾk/ | 'plant sp.' |
| d. | [jílɪwòrk] | /ciliwurk/ | 'guts' |
| e. | [páɾamòlk] | /paɾamulk/ | 'wild cucumber' |

There is just one disyllabic root with two heavy syllables - stress is initial. I do not hear a secondary stress on the final syllable.

- (48)
- | | | | |
|--|-----------|-----------|--------------|
| | [mélwɛrŋ] | /melwɛrŋ/ | 'insect sp.' |
|--|-----------|-----------|--------------|

Two trisyllabic roots have adjacent heavy syllables - stress is on the initial only:

- (49)
- | | | | |
|----|--------------|-------------|------------|
| a. | [jæ̀lbɔrgic] | /calpurkic/ | 'jewfish' |
| b. | [láɾgɔrja] | /laɾkurca/ | 'vine sp.' |

The weight-as-markedness approach taken above would predict final stress in roots like /cíʔak/ and /ŋóʔokoc/. A word-initial consonant has both burst and C-V formant transition cues. If a final consonant is unreleased it has only V-C formant transition cues. Hamilton (1996:13) claims that release and burst cues are more reliable for perceiving place than attack cues. If final consonants *are* released, then they are *more* robustly cued than pre-consonantal consonants, which lack release. My informal impression is that word-final consonants are released in isolation, before pause, but are otherwise unreleased.¹⁹

NONFINALITY must therefore be ranked above whatever constraints would otherwise prefer final closed syllables to be stressed rather than unstressed. Most of the effects observed in the examples above can be derived from the following ranking:

- (50) NONFINALITY >> WSP >> *CUES[VCC]

¹⁹Tendency for release in Ngalakgan also appears to differ according to the segment. The lamino-palatal stop [c] and velar stop [k] are usually released word-finally. Apicals and the labial stop tend more to be unreleased. Lamino-palatals pre-consonantally also tend to be released.

This ranking states that heavy syllables are stressed except where final in the word. This is the generalisation we observe in the forms described in this section.

The result is shown in tableaux (51) and (52) which follow. In (51), we observe that ranking NONFINALITY above *CUES[$\check{V}\underline{C}C$] derives the result that stress is not final, regardless of the fact that the final consonant is more difficult to perceive when stressless, than the initial consonant. The ranking between NONFINALITY and the perceptual constraint is decisive here.

(51)

/ɲotokoc/ 'ankle'	NON FINALITY	WSP	*CUES [$\check{V}\underline{C}C$]
☞ a. (ɲótɔ)koc			ót
b. (ɲòtɔ)(kóc ^μ)	*!		
c. (ɲótɔ)koc ^μ		*!	ót

In the majority of disyllables ending in a cluster, stress is initial. This pattern too falls out from the same constraint ranking. The best parse of these forms is one where the final cluster does not count for weight, and does not violate WSP. This is again regardless of the fact that the final syllable is perceptually more difficult than the initial syllable.

(52)

/worowk/ 'jump'	NON FINALITY	WSP	*CUES [$\check{V}\underline{C}C$]
a. wo(rów ^μ k)	*!		ówk
b. (wórow ^μ k)		*!	
☞ c. (wórowk)			ówk

Examples such as /páɾamùlk/, with a final 'super-heavy' syllable, are *not* accounted for under this constraint ranking, as shown in (53). In (53), the attested candidate (a) has final secondary stress, violating high-ranking NONFINALITY. The predicted output is (53c), with no stress. The difference between forms with final cluster and those, as in (51), with a final simple coda, may be due to final consonant extrametricality effects (this was the analysis in Baker 1997b). Such effects are common in languages (Hayes 1995 has numerous examples). Due to the limited data, I will not explore this possibility here.²⁰ Rather, the set of words with final stress will simply have to be entered into the lexicon as exceptions, under the current analysis.

(53)

/paɾamulk/ 'wild cucumber'	NON FINALITY	WSP	*CUES [ǂCC]
⦿ a. (páɾa)(mùlᵐk)	*!		
b. (pàɾa)(múlᵐk)	*!		
⦿* c. (páɾa)mulk			ǂlk

In disyllabic words where a final syllable ending in a cluster is stressed, such as [kiŋálk], the decision between initial and final stress is not due entirely to weight considerations but also to nucleus sonority. The fact that there is a greater degree of variation in disyllabic words ending in a cluster than in others I take to be evidence for this: variation is a characteristic of sonority effects on stress elsewhere in the Ngalakgan lexicon. Prominence-based effects deriving from sonority are examined in §5.4.1.

Examples like /mélwern/ and /cálpurkic/ show that adjacent heavy syllables cannot both be stressed. This characteristic, which is common cross-linguistically, is

²⁰ Ideally, the difference between (51) and (53) should fall out from the perceptual constraints discussed already. The motivation is fairly clear: syllables are heavy where a coda consonant (C₁) is followed by another, heterorganic consonant (C₂). If C₁ is not followed by a consonant (the word-final simple coda case), or if C₂ is not heterorganic (the geminate/NC cluster case), then the preceding syllable is not heavy. It is not immediately clear how to implement this intuition, however.

formally stated in terms of a constraint 'NoClash' (Liberman and Prince 1977) which was referred to briefly in §4.3.2.

(54) *CLASH(PRWD) 'Avoid adjacent stressed syllables in a PrWd.'

*CLASH encodes the metrical principle that strong beats should alternate regularly with weak beats. *CLASH is ranked above WSP in order to prevent adjacent heavies from receiving stress in (55). WSP is violated where heavy syllables are not stressed. NONFINALITY or ALIGNL (not shown) decides the outcome in favour of the leftmost. *CLASH and NONFINALITY do not conflict and are unranked in (55).

(55)

/melwɛŋ/ 'insect sp.'	*CLASH	NONFIN	WSP	*CUES [ŋCC]	*CUES [CCŋ]
☞ a. (mé1)(wɛŋ)			*	ěŋ	wě
b. (mɛ1)(wéŋ)		*!	*	ělw	mě
c. (mé1)(wèŋ)	*!	*			

The perceptual constraints do not decide the issue here, since both syllables are marked by being closed.

In this section we have seen that heavy syllables in Ngalakgan behave in ways which have been observed in other languages. Adjacent stresses are avoided (*CLASH), as are final stressed syllables (NONFINALITY). But wherever possible, *modulo* these conditions, heavy syllables are to be stressed (WSP).

The fact that heavy syllables behave in this way in Ngalakgan is a strong argument that they are part of the general metrical system of the language, not aberrant 'prominence' effects. For instance, Hayes (1995:272) makes the claim that stress rules which refer to intrinsic prominence, as distinct from (mora-based) syllable weight, should be irrelevant to foot construction.

The interaction between heavy syllables and the metrical system lends support to the hypothesis that quantity-sensitivity in Ngalakgan is not a drastically different kind of phenomenon from quantity-sensitivity in other languages. What differs in each case is the definition of 'heavy syllable' and the relationship between heavy syllables and the structure of syllables and words generally. In the following section, I discuss the implications of this approach further.

5.3.2 Syllable prominence and stress in other languages

In the next two sections, I consider the range of attested variation in 'quantity-sensitivity' for stress, in terms of the approach advocated here. I argue that universally, there are two criteria for weight in languages: (1) contextual markedness, (2) rhyme sonority, with languages commonly treating syllables which respect at least one or both criteria as heavy.

The proposal that syllable weight is a reflection of inherent sonority is not in dispute. It seems that in virtually all languages which are quantity-sensitive, and which have a vowel length distinction, CVV is universally heavy.

The quantity of CVC in such languages differs according to the language. The sonority of the coda can also contribute to overall syllable sonority and hence to weight. Zec (1988) proposed that moraic association to coda consonants could be constrained by consonant sonority. Her most convincing example of this distinction is Kwakw'ala, a Wakashan language of British Columbia described by Boas (1947), and analysed by Bach (1975). Zec's conclusion was that sonority is a component of syllable weight: heavy syllables are more sonorous. This appears to be the implication of P&S's PKPROM constraint also: since it has the form of the constraint accounting for syllable peakhood.

Nevertheless, it is not the case that in every quantity-sensitive language, heavy syllables are the most sonorous ones. In many languages, CVC counts as heavy regardless of the sonority of the coda (e.g. Arabic).

It is also true that in a number of languages, the *only* heavy syllables are CVC; CVV does not occur or is not distinctive. Hayes (1995:181ff) lists the following languages of this type. With trochaic stress systems there are: Tol (Hokan: Fleming and Dennis 1977), Manam (Austronesian: Lichtenberk 1983), and Inga (Quechuan: Levinsohn 1976). Among iambic systems there are: Hixkaryana (Cariban: Derbyshire 1985), Maidu (Penutian: Shipley 1964), and Axeninca Apurucayali (Payne, Payne, Sanchez 1982) (Hayes 1995:261). 'Unbounded' systems with only CVC and not CVV include Amele (Papuan; Roberts 1987).

This means that weight in these languages must be determined on some basis other than purely sonority: a CVC syllable is not necessarily more sonorous than a CV syllable.²¹ If anything, the reverse is true: vowels tend to be shorter in CVC syllables than in CV ones. In one sense then, a coda *reduces* overall syllable sonority, rather than increasing it. If sonority were the only component of syllable weight, we might universally expect that CV as well as CVV syllables would be heavier than CVC.

I propose that in languages where only CVC counts as heavy, and not CVV, then the prime criteria for syllable weight is contextual markedness, along the lines proposed here for Ngalakgan. This predicts a certain amount of language-specific behaviour: syllables are marked to the extent that their configuration violates high-ranking constraints in the language on perceptual difficulty.

CVC syllables are universally more marked than CV ones. There is no language that includes the former but not the latter. While it is true that there are languages possessing geminates but not heterorganic obstruent clusters (e.g. Japanese, Finnish) the reverse is also true: English is a language with heterorganic clusters, but no intramorphemic geminates. Therefore, it seems that languages differ in whether they treat geminates as part of a marked syllable class which includes closed syllables in

²¹In Manam and Axeninca, the only allowed CVC syllables are CVN, so the relevance of coda sonority to weight cannot be determined.

general (e.g. Arabic), or whether they treat geminates to be part of a class with other intervocalic monogestural articulations (e.g. Ngalakgan, Finnish, Malayalam).²²

In the case of Arabic and Italian, where geminates make the preceding syllable heavy, we can make an additional observation. In these languages, unlike Ngalakgan, Malayalam, and Finnish, geminates contrast for voicing. Maintaining a voicing distinction in obstruent geminates is articulatorily difficult, and by extension perceptually marked (Hayes 1997; Steriade 1997:14). In Ngalakgan, the place features of consonants are the main issue in perception (voicing is noncontrastive), and geminates are perceptually robust in this respect. Hence in the ranking in (18), repeated below, they are referred to by the lowest ranked constraint: that on intervocalic gestures. The fact that geminates are obstruent clusters is irrelevant to the determination of place features.

- (18) Context-specific robustness of perceptual cues as a determinant of constraint ordering: [f] is place of articulation.

[f] tied to release cues: *[f]^{VC} >> *[f]^{CV} >> *[f]^{VCV}

Where other features, such as voicing, come into play, we can predict that the markedness ranking of segmental configurations will change. If voicing, as well as place, features are at issue in Italian for instance, we might predict a ranking like that in (56). In this case, geminates are subject to both of the topmost marked categories: cues for [voice] in pre- and post-obstruent positions. Hence, we predict that in Italian, it is better to stress syllables preceding geminates than it is to stress post-geminate syllables, or syllables preceding or following a single obstruent, and indeed this is the case.

²²It is noteworthy that geminates in many languages - Arabic, Finnish, Estonian, Alabama (Hardy and Montler 1988) - have grammatical value: geminate/singleton alternations of stops derive inflectional or derivational meanings of words. And in a number of other languages - Japanese, Tamil, Hindi - at least some geminates correspond synchronically or historically to heterorganic clusters. It is possibly for reasons like these that syllables preceding geminates are classed with closed syllables in many languages. Geminates in Ngalakgan do not seem to have arisen in either of these ways.

- (56) Context-specific robustness of perceptual cues as a determinant of constraint ordering: [f] is [voice].

[f] tied to release cues: *[f]^{VC} >> *[f]^{CV} >> *[f]^{VCV}

This ranking, combined with the constraints on perception tied to syllable stress in (22), derive a stress system where unstressed vowels in closed syllables (including syllables preceding geminates) are less harmonic than unstressed vowels in open ones. In league with WSP and FTFORM, as in Ngalakgan, these constraints derive a stress pattern where all closed syllables constitute heavy, bimoraic syllables.

We might also expect, on this approach, to find languages in which coda markedness is distinguished more finely than in Ngalakgan. For instance, one might expect to find a language the opposite of Kwakw'ala: where the most marked codas - for example glottalised sonorants and obstruents - occurred in stressed environments, but other codas were unstressed. In fact, Cahuilla (Hayes 1995:132, citing Seiler 1957 *inter alia*) behaves something like this: Cahuilla has CV, CVV, and CVC syllables, but only CVV and CV[?] syllables count as heavy. The same distinction is found in Mam (England 1983). Languages like Kwakw'ala are rare: Zec (1988) notes no other examples of the same kind. The only other example mentioned in Hayes' (1995) survey is Inga (Quechua; Levinsohn 1976; Hayes 1995:181). Languages like Ngalakgan are also rare: most languages make a simple distinction between CV, CVV and CVC syllables, regardless of place-linking in the coda. Such distinctions are probably easier for children to learn than the finer distinctions found in Kwakw'ala and Ngalakgan.

As Tranel observed, in general geminates are treated in the same way as other clusters for stress. In at least one language, the two are distinguished in terms of an association with stress. In Tamil (Christdas 1988:247), the initial syllable is the only position in a word in which a coda may be heterorganic to a following onset. Other clusters in the word arising through compounding and suffixation undergo obligatory assimilation. Christdas (1988) does not discuss stress in these forms, but she describes

vowel reduction in short non-initial syllables. Mohanan (1986:112) regards vowel reduction in Malayalam to be diagnostic of stress, and mentions Tamil as a related case. Mohanan's rule is that stress is initial, unless the first syllable has a short vowel and the second a long vowel, in which case it is on the second syllable. All remaining long vowels have secondary stress.

I observed above that in the vast majority of Ngalakgan words, heterorganic clusters occur in the initial, stressed syllable. The difference between Tamil and Ngalakgan then is that heterorganic clusters are eliminated in Tamil, unless they are in a stressed, initial syllable, but in Ngalakgan syllables preceding heterorganic clusters make the best prosodic peaks, regardless of position in the word.²³ The distribution of heterorganic clusters at the surface however has the same correlation: heterorganic clusters occur only in stressed syllables (modulo *CLASH and NONFINALITY). This suggests that the Ngalakgan distinction of syllable weight may have a broader application.

In the following section, I turn to stress patterns which depend on sonority, rather than syllable markedness.

5.4 Prominence-based stress in Ngalakgan

In this section, I describe medial stress in another group of trisyllabic roots. The words in this group fall into several distinct stress patterns. Each of these patterns finds an explanation in terms of constraints already introduced. However, there are exceptions to most of these patterns in the lexicon, so they must be regarded as lexicalised to some degree, in the sense that the stress patterns they predict in words are not entirely borne out in the data.

²³If Tamil has the same stress rule as Malayalam, then heterorganic clusters would not be in a stressed syllable if they followed a short vowel and the following syllable had a long vowel. There appear to be no forms like this in Christdas, with the exception of those in which the first member of the cluster is a glide (Christdas 1988:230): /mayṇaav/ 'a bird', /paysaav/ 'a coin'. Possibly the initial syllables of these words are treated as long vowels also.

There are strong factors at work in the grammar which make trisyllabic roots 'hard to parse'. Ngalakgan belongs to a group of northern Australian languages in which primary stress is found in both word-initial and penultimate positions. That both of these patterns are imposed on roots can be seen by considering the stress patterns in roots with light syllables described in Ch 2. Disyllabics (with no heavies) are always initially-stressed: these satisfy both initial and penultimate constraints. Quadrisyllabics can be evenly footed bipedally: as noted, most quadrisyllabics vary between initial and penultimate primary.

Trisyllabics represent a special problem: the initial and penultimate motivations are in direct conflict, neither can be satisfied without violating the other. Therefore, it is to be expected that if quantity and sonority effects were to be found anywhere, it would be precisely in trisyllabic roots, where the grammar makes a special effort to regularise stress patterns across the lexicon.

We find a number of reflections of the 'hard to stress' problem. The first is the medial heavy syllables discussed in preceding sections. The second is that a number of trisyllabic roots *do* satisfy both initial and penult stress, by building two feet in the word with the pattern secondary^primary. Examples are shown in (57). The majority of these examples have an initial heavy syllable, followed by two light syllables. Example (57f) is exceptional, in this case a nasal stop cluster makes the initial syllable heavy (the issue of glottal stops is discussed in §5.5).

- (57)
- | | | |
|----|-------------------------------------|-----------------------------------|
| a. | [jírbili] ~ [jîrbíli]
/cirpili/ | 'bonefish' (?herring sp.) |
| b. | [gúrmu[y] ~ [gùrmú[y]
/kurmu[u?/ | 'blue tongue lizard' |
| c. | [màngáɖa]
/mankaʔa?/ | 'woolybutt' (<i>E. miniata</i>) |
| d. | [wàrmbáya]
/warmpaya/ | 'anywhere' |

- e. [yàrmáɖa]
/yarmaɖa/ 'marsupial sp.'
- f. [gàmbúma]
/kampuma/ 'estuarine ray'

Note that the doubly-stressed variants violate *CLASH. Note also that in every case where the initial syllable and the penultimate are stressed, the relationship between them is secondary^primary. This is the stress pattern associated with compounds, as discussed in Ch 2, such as the examples in (58).

- (58) a. [ɲòɔmɛme] 'got guts'
(ɲoʔ)-(meʔ+me) guts-RED+get.PP
- b. [ɹè:ɲóɔmɪɲ] 'took away'
(ɹe)-(ɲoʔ)-mi+ɲ) APPL-go.away-AUX+PP

In compounds, violations of *CLASH are also tolerated. In WORD-compounds, each MWd constitutes a PrWd (by MWd \approx PrWd). I have stipulated previously (in 54) that *CLASH is relativised to PrWd domains. The words in (57) then are treated by the prosody as compounds: they are 'prosodic compounds' corresponding to a single lexical item.

The same pattern is observed as a variant in the examples in (59) (these are the only monomorphemic examples).

- (59) a. /mɪɹppara/ [mɪɹppára] ~ [mɪɹppara] 'child'
- b. /palppaɹaʔ/ [pàlppáɹa] ~ [pálppaɹa] 'friend'
- c. /palccuɹaʔ/ [pàlccúɹa] ~ [pálccuɹa] 'lizard sp.'
- d. /purkkaci/ [pùrkkáji] ~ [púrkkaji] 'real'
- e. /wàlkkara/ [wàlkkára] ~ [wálkkara] 'fish sp.'

All these examples have an initial heavy syllable, followed by a geminate.

The examples in (60) below stand out as a different case. In these words, initial stress is *not* an allowed variant:

- (60)
- | | | | | |
|----|------------|------------|-------------|-------------------|
| a. | /wukkaɪa/ | [wukkáɪa] | *[wúkkaɪa] | 'frog sp.' |
| b. | /yippuɲca/ | [yɪppúɲja] | *[yíppuɲja] | 'a long time ago' |
| c. | /yukkaciʔ/ | [yukkáji] | *[yúkkaji] | 'for a long time' |
| d. | /akkaʔaʔ/ | [akkáɖa] | *[ákkaɖa] | 'late (tardy)' |

Syllable 1 in these forms has a glide onset, or no onset, and the first vowel is followed by a geminate. Syllable 1 is not heavy, and in three cases the first vowel is a high vowel.

One other root with the same syllable structure has a different stress pattern:

- (61)
- | | | |
|------------|------------|---|
| /waccuɲtu/ | [wáccuɲɖu] | 'goanna sp.' (<i>Varanus gouldii</i>) |
|------------|------------|---|

This word never has penultimate stress.

The penultimate-stressed forms may be contrasted with the three examples in (62), where stress is always on the initial syllable:

- (62)
- | | | | | |
|----|-----------|-----------|------------|---------------------|
| a. | /picciri/ | [bícciri] | *[biccíri] | 'file snake' |
| b. | /kappuci/ | [gáppuɟi] | *[gappúɟi] | 'old person' |
| c. | /kappu[a/ | [gáppu[a] | *[gappú[a] | 'old, blind person' |

These words all have an obstruent as their initial consonant, while those in (60) begin in glides, or are onsetless, as noted.

While the number of forms in (60) is small, and there is one exception to the pattern, I will nevertheless propose an explanation in the following section. Because the pattern is not extensive in Ngalakgan, the section should be treated as exploratory. I justify the analysis on the basis that the same method of explanation generalises to other languages such as Arrernte and Pirahã.

5.4.1 Excursus: the contribution of onsets to stress

In the case of (60), the stressed syllable may be regarded as the most harmonic syllable (comparing initial and penultimate).²⁴ In comparison to /wu/, for instance, /ka/ is a much better, more harmonic, syllable: not only does it have a more sonorous nucleus ($|a| > |u|$; where 'x' represents 'the intrinsic prominence (=sonority) of x'), it also has a less sonorous onset ($|k| < |w|$). That is, /ka/ better satisfies the Sonority Sequencing Principle (Clements 1990), in comparison to /wu/.

The nuclei of the initial syllables of examples (60a-c) are vowels of low sonority, and the following syllable contains a vowel of higher sonority. The constraints in (63), below, encode P&S's generalisation for PKPROM: 'the most sonorous vowel makes the best prosodic peak'. Note that the sonority scale is reversed depending on whether the vowel is in a stressed or unstressed environment. This is interpreted as: 'If you're going to leave a vowel stressless then the worst choice is [a]. Conversely, if you're going to stress a vowel, then the worst choice is [i].' Vowels of the same height are ranked according to backness: the front vowels in Ngalakgan are phonetically higher than the corresponding back vowels of the same phonological height.

- (63) $\frac{*NUC/\check{v} >> *NUC/\acute{y}}{* \check{a} >> * \check{o}, \check{u} >> * \check{i}, \check{e} >> * \acute{i}, \acute{e} >> * \acute{o}, \acute{u} >> * \acute{a}}$

I have previously noted the association between sonority and stress, as suggested by Prince (1990, P&S 1993). I propose that PKPROM refers, not just to the peak necessarily, but also to the onset of the syllable. The best syllable makes the best prosodic peak. Formally, this result can be achieved by combining the ranking in (21), repeated here, with the harmonic nuclei (P&S 1993:127) and onset constraints (Borowsky and Horvath 1997:13).

²⁴A similar claim is made by Berry (1999). Our analyses differ in the formalisation of syllable well-formedness, and the relationship between this and stress patterns.

- (21) $\acute{o}/f \rangle \check{o}/f$
 'Acoustic features in a stressed environment are more harmonic than acoustic features in an unstressed environment'.

The constraint ranking for onsets is similarly derived from sonority.

- (64) Harmonic onset (HONS) ranking
 $*ONS/A \gg *ONS/Y \gg *ONS/L \gg *ONS/N \gg$
 $*ONS/F \gg *ONS/D \gg *ONS/T$

Portions of the ranking have been omitted, and capital letters stand for sonority classes of consonants. The worst onset is any vowel [A], followed by glides [Y], followed by liquids [L], and nasals [N], which are worse than fricatives [F], voiced stops [D], and voiceless stops [T], which make the best onsets. I follow P&S (1993:129) in assuming that constraints on margins also refer to vowels as margins. I ignore distinctions of continuancy or voicing in what follows, as these are irrelevant in Ngalakgan. The voicing distinction has been shown to be relevant to syllable prominence for stress in Pirahã (Everett and Everett 1984), where a voiceless stop is less sonorant than a voiced one. The Pirahã pattern is discussed below.

A second set of constraints in (65) refers to the relative harmony of consonants to be onsets in stressed syllables. Again, the sonority order is reversed depending on whether the syllable is stressed or unstressed.

- (65) $*ONS/c\check{v} \gg *ONS/c\acute{v}$
 $*T\check{v} \gg *N\check{v} \gg *L\check{v} \gg *Y\check{v} \gg *Ø\check{v} \gg$
 $*Ø\acute{v} \gg *Y\acute{v} \gg *L\acute{v} \gg *N\acute{v} \gg *T\acute{v}$

From the bottom, the second half of the ranking states that it is better to have a stop onset to a stressed syllable, than it is to have a nasal onset, which is better than a liquid or glide onset, and an onsetless stressed syllable is worst of all. The constraints in the first half, referring to consonants in unstressed positions, are analogous to the

active constraints on perception of consonants in unstressed syllables which derive weight. The upper half of (65) is obscured perhaps for that reason. This half of the ranking will not be considered in the analysis which follows.

The interest lies in the way these two constraint rankings - *NUC/ǃ and *ONS/cǃ - are ranked in the grammar. The portion of the ranking that does the work of deriving prominence-based stress in Ngalakgan is presented in (66).

- (66) *Øǃ >> *Yǃ,*ǎ >> *ǃ, *ǃ >>
ALIGNL(PRWD, FT) >>
*ǃ, *ǃ >>
*Lǃ >> ... >> *Tǃ

The ranking states that stress is initial unless the stressed syllable would have a glide onset or no onset, and leave a low or back vowel unstressed. The following tables illustrate this result. Only the first half of the ranking on vowels in (63), and the second half of the ranking on consonants in (65) are active in Ngalakgan. The final portion of the constraint ranking in (66) [*ONS/Lǃ... >> ... *ONS/T] does no work in the examples, and will be omitted from what follows.

Tableau (67) shows an example of prominence-based stress. The combined factors of a glide onset to the initial syllable (the preferred stressed syllable otherwise) and the vowel sequence [u]^[a] force stress to find a better home: the second syllable.

(67)

/wukkaǃ/ 'frog sp.'	NON FINALITY	*ONS/Yǃ	*ǎ	*ǃ, *ǃ	ALIGNL	*ǃ, *ǃ
ǃ a. wukkǎǃ				ǃ	*	
b. wúkkǃ		wú	ǎ!			
c. wukkǎǃ	*!		ǎ	ǃ	*	

NONFINALITY must be ranked above the onset and nucleus constraints, to prevent final stress in these forms, as in the majority of Ngalakgan words. (Candidates with final stress will not be considered in the tableaux which follow.)

The constraint ranking works also for other sequences of vowels, as shown in (68).

(68)

/yippuŋca/ 'long ago'	*ONS/Y [́]	*ǎ	*ǔ, *Ǿ	ALIGNL	*ĩ, *e
☞ a. yippúŋca				*	ĩ
b. yíppuŋca	yí!		ǔ		

According to the ranking in (64), onsetless syllables, those where the margin consists of a vowel, make the worst stressed syllables of all. The same constraint ranking therefore also works for [akkáʔaʔ].

(69)

/akkaʔaʔ/ 'tardy'	*ONS/Ø [́]	*ONS/Y [́]	*ǎ	*ǔ, *Ǿ	ALIGNL	*ĩ, *e
☞ a. akkáʔaʔ			ǎ		*	
b. ákkaʔaʔ	á!		ǎ			

In (70) we see that if the first two conditions are not met, stress on a syllable later than the initial is ill-formed, because of intervening ALIGNL.

(70)

/picciri/ 'filesnake'	*ONS/Y [́]	*ǎ	*ǔ, *Ǿ	ALIGNL	*ĩ, *ě
☞ a. pícciri					ĩ
b. piccírì				*!	ĩ

If only one of these conditions is met, this is still not enough to force stress away from the initial syllable, as shown in (71).

(71)

/waʦiya/ 'multiparous woman'	*ONS/Yʋ	*ǎ	*ǔ, *ǒ	ALIGNL	*ĩ, *ě
☞ a. wáʦiya	wá				ĩ
b. waʦiya		ǎ		*!	

The constraint ranking shown here is not without exceptions, as noted previously, though some of the constraints filter through to other sets of forms in the lexicon. There does appear to be a general avoidance of stress on syllables where the nucleus is [high], and particularly [high, front], in Ngalakgan. In this group, we can include the forms presented previously in (46), and repeated below. Recall that these are unlike other disyllabic roots with final heavies, which typically are stressed on the initial in satisfaction of NONFINALITY. In the case of the forms in (46), NONFINALITY is overruled by the combined pressure of constraints on nucleus sonority and the Weight-to-Stress Principle.

- (46)
- | | | | |
|----|-------------------|-----------|--------------------|
| a. | [giŋálk, gɹəŋálk] | /kiŋalk/ | 'white ibis' |
| b. | [biccúrk] | /piccurk/ | 'edible tuber sp.' |
| c. | [giyærk] | /kiyark/ | 'tooth' |

There are also a group of forms like those in (72), where the initial sequence of segments is peripheral obstruent^high vowel^liquid. In forms like these, the first vowel is typically elided in casual speech (though it may be present in careful speech, and citation forms).

- (72)
- | | | | |
|----|----------|-----------|-------------------|
| a. | [bɹíŋuŋ] | /piɹiŋuŋ/ | [toponym] |
| b. | [bǎl] | /piǎl/ | 'waterlily leaf' |
| c. | [bǎrak] | /piǎarak/ | 'for a long time' |

Such patterns are also common elsewhere in Australia, the languages around Adelaide in particular (e.g. Yarlalde: McDonald 1977).

Finally, there appears to some correlation between stress and post-geminate medial syllables, hence the contrast between akkáʔaʔ and álakko. A similar correlation has been described for Ndjébbana (§4.3.3.2), and also appears in other Australian languages such as Warluwarra, a language of central Queensland. The following forms are from Gavan Breen (p.c.). I repeat Breen's remarks here in full:²⁵

Stops written voiceless tend to be long or geminate. Stress tends to shift back [forward?] to [a] vowel following one of these stops (if it is not word-final) but this may be inhibited by other factors such as two syllables coalescing into a diphthong or long vowel, which likes to have some stress, or maybe [a] tendency for /a/ to be stressed in preference to /i/ or /u/.

The sequences /ayi/ and /iyi/ Breen notes are pronounced as diphthong [ai], and long vowel [i:], respectively.

(73)	a.	múka 'good'	mukámaŋa 'made'	múkamaŋiɰa 'making'	múkara 'aunt'
	b.	ŋáʔa 'for me'	ŋáʔaŋu ~ ŋáʔaŋu ~ ŋáʔaŋu 'my'	ŋáʔala 'tongue'	
	c.	yapáŋa 'fell'	yápimàla 'didn't fall'	yápalàpariɰiɰa 'stumbling, reeling'	
	d.	mácu 'bad'	macúriŋa 'got bad'		

The evidence of Ngalakgan and Warluwarra suggest that post-geminate stress may be a wider characteristic.

²⁵Square brackets enclose my additions to Breen's notes.

5.4.2 Sonority-based prominence in other languages

Similar effects of onsets on stress have been described for Aranda [Arrernte] (Strehlow 1948; Berry 1999) Alyawarra (Yallop 1977), and the Northern Paman languages of Cape York (e.g. Uradhi; Hale 1976). These patterns can be derived through factorial ranking of the constraints proposed previously. The Arrernte and Alyawarra patterns can be derived from the ranking in (74).

(74) *ONS/Ø[✓] >> ALIGNL(PWD, FT) >> *ONS/Y[✓] >> *ONS/L[✓] ...

This ranking states that stress is initial, unless the stressed syllable lacks an onset, where the constraint [*ONS/Ø[✓]] refers to stressed, onsetless syllables. The only onsetless syllables are those in initial position in words (Berry 1999). I know of no effects on stress deriving from vowel sonority in Arrernte and Alyawarra.

A combination of conditions on onsets and nuclei for stress is described for Pirahã (Hayes 1995:285; Everett and Everett 1984). In Pirahã, Everett (1988; Hayes 1995:285) proposes the following ranking of syllable prominence for stress (where 'K' 'G' are voiceless, voiced stops, respectively). Main stress must fall within a three syllable span at the end of the word, and whichever of the syllables is strongest according to the hierarchy in (75) is stressed. (The rightmost wins in the event of a tie.)

(75) KVV > GVV > VV > KV > GV

This pattern evinces a combination of sonority conditions. One parameter of prominence is the distinction between long vowel and short vowels, where long vowels are more sonorous and make better stressed nuclei. The other parameter of prominence is like the one I have proposed for Ngalakgan: voiceless stops make the best onsets, and are better than voiced stops. If the stressed syllable should also be the best syllable,

sonority-wise, then the Pirahã pattern falls out. The two parameters of prominence are presented as partial constraint hierarchies in (76) and (77).

The ranking in (76a) states that voiceless stops as margins to unstressed syllables are worse than voiced stops as margins to unstressed syllables, and so on down the sonority hierarchy to onsetless syllables, which make the best unstressed syllables. The complementary ranking in (76b) states that onsetless syllables make the worst margins to stressed syllables, and so on, with voiced stops being worse than voiceless stops as margins to stressed syllables.

- (76) a. *T[̥] >> *D[̥] >> ... >> *Ø[̥]
 b. *Ø >> ... >> *D >> *T

The ranking in (77) states that long vowels as nuclei of unstressed syllables are worse than short vowels as nuclei of unstressed syllables, and conversely, short vowels make worse nuclei to stressed syllables than long vowels do. (I have used the underdot to represent short vowels, as opposed to colon, representing long vowels, since the brevis diacritic is already used to represent lack of stress here.)

- (77) a. *ṽ: >> *ṽ >> ...
 b. *ý >> *ý: >> ...

The Pirahã prominence hierarchy is a combination of (76) and (77), derived by factorial ranking, as shown in (78).

- (78) *T[̥]ṽ: >> *D[̥]ṽ: >> ... >> *Ø[̥]ṽ:
 *T[̥]ý >> *D[̥]ý >> ... >> *Ø[̥]ý

The constraint ranking in (78), which is derived from the sonority as prominence principles proposed in preceding sections, straightforwardly derives the Pirahã stress pattern; an example is presented in (79). The three syllable window for stress is

indicated by square brackets in the candidates, I will not attempt to account for it. I assume an AlignR(Pk, PrWd) constraint accounts for the default-to-right rule. Preceding apostrophe marks stress, acute accent marks contrastive tone, and syllable boundaries are indicated with periods. Candidate (c) is the winner here, since it is the only candidate which does not violate the topmost constraint, which demands that long syllables with voiceless onsets should not be stressless.

(79)

	*Tǃ:	*Dǃ:	*Øǃ:	*Tǃ	*Dǃ	ALIGNR
a. soi.['oá.ga.hai]	*!				*	*
b. soi.[oá.'ga.hai]	*!		*			*
c. soi.[oá.ga.'hai]			*		*	

Since the constraint ranking replicates Everett's (1988) prominence hierarchy, the other examples follow straightforwardly.

While there are differences between Ngalakgan, Arrernte, and Pirahã in terms of what counts as prominent, the principle in each case is the same. What counts as prominent is in every case the best syllable, the one with the maximal sonority sequencing contour: with the least sonorous onset available, and the most sonorous nucleus. The fact that the constraints on margins and nuclei according to stress extend so easily to these other examples is evidence that it is a valid principle of grammar.

The stress patterns here are evidence for a sonority-based distinction of prominence in Ngalakgan. This is distinct from the markedness-based one already described: the two do not intersect. Sonority and perceptual markedness then, are distinct parameters of syllable prominence, and syllable weight, respectively. Several languages of central Asia associate stress with 'full', 'peripheral' or low vowels, while 'reduced', 'centralised' or high vowels are unstressed. Hayes (1995:296) cites the following examples: Chuvash (Turkic; Krueger 1961), Cheremis (Finno-Ugric; Sebeok

and Ingemann 1961), Yaz'va Komi (Finno-Ugric; Itkonen 1955). In addition, Ossetic (Indo-Iranian: Abaev 1964) and Siraiki (Indo-Aryan; Shackle 1976) have this pattern synchronically.

These patterns imply a stress system based only on the intrinsic sonority and/or markedness of syllables, and not on their moraic quantity. Indeed, these systems argue against a moraic theory of stress. In at least two cases, Au (Torricelli; Scorza 1985) and Lushootseed (Salishan; Hess 1976, Odden 1979), a distinction in weight according to vowel peripherality/centrality co-exists with a distinction in vowel length, with vowel length making no difference to the computation of weight. Hence, in these languages it is not possible to accord bimoraic status to peripheral vowels (as Hayes 1995 suggests for other languages: p297) without disrupting the representation of vowel length.

In summary, the prominence-based pattern in Ngalakgan demonstrates a relationship between well-formedness conditions on nucleus sonority and stress. Stress shows an aberrant pattern when it would otherwise be realised initially on an ill-formed syllable.

5.4.3 Summary: markedness and sonority

I have claimed that there are two distinct factors at work in determining both weight-based and prominence-based stress systems: syllable markedness, and syllable sonority, and shown that in some languages, the two can be distinct. In Ngalakgan, both seem to occur as independent systems. Is there any way to connect the two?

The most common quantity-sensitive patterns make CVV a heavy syllable, all else light, or both CVV, and CVC heavy, all else light. I have suggested that CVC fits into a generalised perceptual markedness scheme: closed syllables are more marked than open ones, because coda consonants are more perceptually difficult than consonants in other positions. It is also true that long vowels are more marked than short ones. Cross-linguistically, there are fewer languages with a vowel length distinction than without one.

Hence we could also say that languages where CVV is heavy treat marked nuclei as heavy.

I think there is a more interesting connection between CVV syllables in other languages, and the heavy syllables in Ngalakgan: perceptual difficulty. In languages where long vowels are contrastive, it is important to maintain the distinction between these and short vowels. But the contrast between long and short vowels, I would claim, is difficult to perceive, particularly in unstressed syllables. In languages without a qualitative difference between long and short vowels, the only feature separating the two is duration. This makes the contrast between long and short vowels harder to distinguish than the contrast between most other minimally contrastive pairs of segments, such as voiced and voiceless stops. Two segments which are identical except for a duration distinction have identical spectral properties. Hamilton (1996:15) cites Kawasaki (1982) for this claim: '[Kawasaki] proposes that contrasting sounds with similar spectral properties incur perceptual confusion and thus are susceptible to merger' (i.e. neutralisation). The long vowel/short vowel contrast would appear to be an instance of this constraint.²⁶

If this claim is well-founded, then the basis of weight in both Ngalakgan and the majority of quantity-sensitive languages is similar: syllables which are perceptually difficult are made more prominent through stress.

If perceptually difficult, and/or sonorous syllables are the most eligible to receive stress, where does this leave Moraic Theory? Syllable lengthening as a concomitant of stress is observed in numerous languages, Prince (1990:389) suggests that there is a general constraint of the form that stressed syllables should be longer, the concomitant of the Weight to Stress Principle which we have already seen.

²⁶Given these two sounds, children are likely to infer that the least marked is the underlying form, and then neutralise the surface distinction, a process called 'Stampean Occultation' (after Stampe 1972[1980]). In Ngalakgan, geminates are not as easily confused with singletons, as long vowels are with short vowels, since geminates have additional features which are lacking in singletons (the [spread glottis] feature), and geminates are syllabified in separate syllables.

(80) Stress-to-Weight (SWP) 'Tonic syllables are long'

In this case, we achieve the desired range of effects. Ranked above Faithfulness constraints for example, this constraint will derive the surface pattern that stressed and unstressed syllables contrast for length. In Kukatj (Breen 1992) stress is initial, and all stressed syllables must have either a long vowel, or a short vowel and a long following consonant (an instance of post-tonic gemination). I propose the following ranking holds in Kukatj:

(81) FTBIN, FtFORM(Tr), IO-IDENT[μ] >> SWP >> IO-DEP

The ranking describes a grammar wherein stressed syllables must be bimoraic. Underlying short vowels cannot be lengthened to satisfy this constraint (IDENT[mora] is ranked higher than SWP), but underlying short consonants can be lengthened (I assume that consonant lengthening does not violate IDENT[mora]: McCarthy 1995).²⁷ This is the pattern we observe in Kukatj, and other languages with post-tonic gemination (e.g. Warumungu: Simpson 1998, Siraiki: Shackle 1976).

Languages in which CVV is long have perceptual constraints demanding that CVV syllables be stressed. I will simply represent this as a constraint ranking against stressless long vowels, over stressless short vowels. The ranking in these languages is presented in (82), sidestepping the issue of the perceptual constraints involved. (I again use the underdot to represent short vowels.)

(82) FTBIN, FtFORM(Tr), IDENT[μ], IO-DEP >>
 * \check{V} : >> * \check{V} >> SWP

²⁷McCarthy (1995) claims that surface geminate consonants corresponding to underlying singletons do not violate Ident[mora] because it is not the case that the surface mora makes a change in a corresponding underlying mora: there is no underlying mora to be identical to.

The ranking states that all stressed syllables must be bimoraic (FTBIN, SWP), but that no segments may be lengthened in order to satisfy the constraint (IDENT[μ], IO-DEP). Long vowels are stressed in preference to short vowels. The fact that these syllables can host two moras makes them especially well-formed, since Faithfulness is not violated. This is perhaps the reason why a CVV-based distinction of weight is so well-attested cross-linguistically.

The foregoing discussion, though necessarily brief, shows that the perceptual and sonority constraints regulating stress are compatible with a Moraic Theory of weight, and quantity. This is a satisfying result, because it enables us to retain the insights and wide applicability of Moraic Theory, without sacrificing the empirical gain of taking into account the factors of syllable sonority and syllable perceptual markedness I have proposed here.

A theory which combines the insights of moraic theory with conditions on the well-formedness of stressed syllables can achieve the desired range of patterns. This is not an unconstrained theoretical move: the rankings which have been proposed in this chapter are all well-founded universals of syllable structure. The ranking of constraints on consonant perceptual cues, and the rankings of constraints on syllable positions according to sonority, have well-attested effects in other languages.

In the final section of my discussion, I turn to the behaviour of glottal stop. Glottal stop behaves in an anomalous manner. This behaviour can be explained using the insights gained so far from the perceptual approach to weight.

5.5 The interaction of glottal stop and weight

Glottal stops do not count for weight anywhere in Ngalakgan, they are invisible for the perceptual constraints deriving syllable weight for stress. The perceptual cues for glottal stop overlap with those of preceding sonorants, making glottal stops more easily perceived than other codas. Their behaviour follows from the analysis, given their

perceptual status. The behaviour of glottal stops constitutes a further argument for the approach to weight taken here.

I will firstly discuss the phonetics of glottal stops. I then show that medial glottal stops do not make the preceding syllable heavy for stress in §5.5.2. In §5.5.3, I discuss the behaviour of monosyllabic, glottal-final MWds, where the vowel is long at the surface. The analysis is extended to reduplications with monosyllabic, glottal-final reduplicant, in §5.5.4.

5.5.1 The phonetics of glottal stops

Glottal stop in Ngalakgan is clearly phonemic (Merlan 1983:7), and is written as such in underlying forms. On the surface, the glottal stop is always realised on a preceding sonorant as laryngealisation ('creaky voice') of the sonorant articulation, with the timing of articulatory overlap varying a great deal (some figures in monosyllabic roots are given in §5.5.3). The presence of laryngealisation serves to distinguish minimal pairs. Some of these are given in (83).

- | | | | | |
|------|----|---|----|---|
| (83) | a. | [gumáa]
/ku-maʔ/
'it's good' | b. | [gumá:]
/ku-ma/
'he/she gets it' |
| | c. | [mánɿɿ]
/maɿɿ/
'help' | d. | [mánɿɿ]
/maɿɿʔ/
'make' |
| | e. | [nugumókkɔl]
/ɲu-ku-mokkol/
I-FAM-father
'my father' | f. | [nugumókkɔl]
/ɲuku-mokkol-ʔ/
1mS/2aO-father-VBSR
'I call you (pl.) 'father'' |
| | g. | [lɛr]
/lɛr/
'to fall' | h. | [lɛɾ]
/lɛrʔ/
'to set alight' |

The presence of laryngealisation is the only perceivable difference between these pairs of words.

The distribution of glottal stop is restricted; it can only follow sonorants: vowels, nasals and continuants {r, ɹ, l, ʎ, w, y}, and can only occur as the final element in a syllable coda. As noted, glottal stop is realised as creaky voice on the preceding vowel or sonorant. The glottal closure is optional.

- (84)
- | | | | |
|----|------------------|---------|--------------------|
| a. | [bɔ̃l̥ ~ bɔ̃l̥ʔ] | /polʔ/ | 'track' |
| b. | [wɛ̃ɛ̃ ~ wɛ̃ɛ̃ʔ] | /weʔ/ | 'water' |
| c. | [yérɛ̃] | /yereʔ/ | 'below; downriver' |

The transcription [l̥] in (84a) represents an articulation of [l] with an initial fully voiced period followed by a period of creaky voice. Throughout the thesis I have represented these simply as [l̥]. The transcription [ɛ̃ɛ̃ ~ [ɛ̃ɛ̃ʔ] in (84b) represents a long vowel articulation, the second half of which is articulated with creaky voice optionally followed by glottal closure. These articulations contrast with examples like (84c). Here, the final syllable is not long, and the transcription [ɛ̃] represents a short vowel followed a period of creaky voice. Final glottal constriction in words can be extremely long: 200 ms of creaky voice or constriction before audible release is not unusual in this position.

I have never heard these forms pronounced, as in (85), *without* coarticulation.

- (85)
- | | | | |
|----|--------|----|---------|
| a. | *[wɛʔ] | b. | *[bɔlʔ] |
|----|--------|----|---------|

Words such as those in (84), then, do not contain sequences of vowel or sonorant followed by glottal stop, but rather vowel or sonorant with coarticulated glottal constriction.

I have noted that the glottal closure (symbolised by raised [ʔ] in (84) above) is optional. Realisation of glottal closure depends on position of the syllable in the word and utterance, and the morphological environment. In MWds of the form CVʔ, /ʔ/ is typically realised as glottal closure. Glottal closure is especially frequent preceding obstruents (b):

- (86) a. [wεε ~ wεε¹] /we[?]/ 'water'
 b. [wεε[?]kεn] /we[?]-ʔkVn/ 'water-DAT'

Glottal closure tends to be maintained by monosyllabic MWds in all positions however. In (87), /ŋo[?]/ is a glottal-final MWd followed by a sonorant in the same word. Glottal closure is common in this environment.

- (87) [ŋuŋðo[?]máŋiŋ] 'I got the guts out'
 /ŋu-ŋo[?]-maŋ+iŋ/ 1mS-guts-get+PC

Realisation of glottal closure finally in MWds satisfies the 'No Obscure Boundaries' constraints proposed in §4.2, simultaneously #PRWD#, #FT1#, and #ó#. I return to this point below.

Where glottal stop does *not* correspond to a MWd boundary, glottal closure is optional preceding obstruents (a), and rare preceding sonorants (b):

- (88) a. [ŋáŋapay] ~ [ŋáŋa[?]pay] 'moreover'
 /ŋaŋa[?]pay/
 b. [buŋǰ[?]ŋaniŋ] 'they had (something)'
 /pur-ko[?]+ŋan+iŋ/ 3aS-have+[see]+PC

Obstruents following glottal stops are voiceless throughout closure and commonly aspirated (§4.1).

I now show that the articulatory and acoustic characteristics of glottal stops are reflected in their prosodic and phonological behaviour.

5.5.2 Light medial glottal-final syllables

Final clusters of sonorant plus glottal stop consistently fail to act as heavy for stress (89). In polysyllabic words ending in a sonorant+glottal cluster, stress is always initial.

- | | | | | |
|------|----|-------------|------------|------------------------------|
| (89) | a. | /canayʔ/ | [jánaɣ] | 'goanna sp.' |
| | b. | /muŋaŋʔ/ | [múŋaŋ] | [subsection term] |
| | c. | /yereʔ/ | [yéɾɛ] | 'downriver' |
| | | | | |
| (90) | a. | /kuttapiʔ/ | [gúttabi] | 'bird sp.' |
| | b. | /kamaciʔ/ | [gámaɟi] | 'swag (bedroll; belongings)' |
| | c. | /paʔikuluʔ/ | [báɟiɡùlu] | 'Eucalyptus sp.' |

If glottal stops were treated in the same way as supralaryngeal obstruents, we would expect final secondary stress in forms like (90a). This is shown in the following examples. Trisyllabic glottal-final forms contrast with trisyllabic roots ending in a cluster; as we have seen, the latter have a final secondary stress; examples are presented in (91).

- | | | | | |
|------|----|--|----|---|
| (91) | a. | [béɾemèlk]
/peɾemelk/
'shoulder blade' | d. | [bóɾoɡɔɾ]
/poɾoɡoɾʔ/
'casuarina' |
| | b. | [jíliwùrk]
/ciliwurk/
'guts' | e. | [wólukkɔɾ]
/wulukkɔɾʔ/
'sibling-in-law' |
| | c. | [páɾamùlk]
/paɾamulk/
'wild cucumber' | f. | [báɾakka]
/paɾakkaʔ/
'plant sp.; spear shaft' |

Glottals do not count for weight internally in words either. There is only one trisyllabic root with a medial glottal-final syllable, presented in (92). This form has initial stress.

- | | | |
|------|------------|------------|
| (92) | [ŋáŋpai] | 'moreover' |
| | /ŋaŋaʔpay/ | |

Further evidence comes from complex words. Complex words of a particular structural type display quantity-sensitive stress as one variant. The type in question is a trisyllabic Prosodic Word composed of a disyllabic stem plus monosyllabic suffix, clitic

or stem. In one variant, stress is initial, in the other, stress is on the penultimate if it is heavy, as in examples (93f-j). If the medial syllable is vowel+glottal stop, it does not count as heavy, and stress is initial in such forms (93a-e).

- | | | |
|------|---|---|
| (93) | a. [yáŋaŋkan]
/yanaʔ-ʔkVn/
'what'-DAT | f. [ɿagáɿkkan]
/ɿakalk-ʔkVn/
'sorcerer'-DAT |
| | b. [jándaŋka]
/cantaʔ-kkaʔ/
'tree'-LOC | g. [jambúɿkka]
/campuɿ-kkaʔ/
'sand'-LOC |
| | c. [gáŋaŋka]
/kaŋaʔ-kkaʔ/
'little'-LOC | h. [ŋaccáɿga]
/ŋaccal-kkaʔ/
'spring'-LOC |
| | d. [yíŋiŋkan]
/yiniʔ-ka+n/
'tell'-CAUS+PR | i. [mɔkkóɿgɔ]
/mɔkkol-kkoʔ/
'father'-DYAD |
| | e. [gáŋaŋwo]
/kaŋaʔ+wo/
'ask'+[give.PP] | j. [gubúɿppun]
/kupuy+ppu+n/
'sweat'+[hit]+PR |

The contrast between forms like those on the left, with vowel+glottal medial syllable, and those on the right, with a closed medial syllable, is consistent.

The lack of weight attested for glottal stop, in contrast to other codas, can be explained with reference to the perceptual constraints on stress proposed earlier. Since glottal stop is primarily articulated on a preceded sonorant, a vowel+glottal sequence is not as perceptually marked as a vowel+supralaryngeal consonant sequence.

One piece of evidence for this claim is that glottal stop is the only (heterorganic) consonant following which apicals can be post-alveolar (also noted by Merlan 1983:9). Recall from Ch 2 that the apical contrast is neutralised morpheme-initially, and that following all consonants except apico-postalveolars, apicals can only be alveolar. (94a, b) provide examples of root-medial and root-initial postalveolars preceded by glottal stop. Apicals cannot be postalveolar following other non-postalveolar consonants. They

(94) a. [wɛɪɖak] ~ [wɛɪ̯ɖak]²⁸ c. [jáganda]
/weʔɖak/
'dry, waterless'

b. [gɔ́ɪ̯nan] ~ [gɔ́nan]
/koʔ+na+n/
have+[see+]_{PR}

d. [bópnan]
/pop+na+n/
smell+[see+]_{PR}

²⁸This form is recorded as weɾ[?]dak in Merlan (1983:214), i.e. /weɾ[?]tak/ in my transcription. The fact that speakers clearly pronounced this word as [wɛ̠[?]dak] on more than one occasion indicates that the retroflexion belongs with the following stop, and is not a pre-glottal retroflex glide. The meaning of the word argues in favour of this analysis also: compare /weɾ[?]/ 'water'.

²⁹There are no instances of vowel+glottal stop+alveolar. This follows from two independent factors: the scarcity of morpheme-internal examples of glottal stop, and the neutralisation pattern applying to all stem-initial apicals, as well as those of WORD-level bound elements. The latter pattern means that all post-glottal apicals in the language are invariably postalveolar. The single class of exceptions comes from the inflection of thematic verbs. This large, productive verb class (it includes loans from English via Kriol) forms the Future and Potential inflections by copying the final consonantal segment of the stem. Final glottal stops are ignored for this process (McKay 1975:38; Merlan 1983:120): /wulup/ 'bathe', /wulup+pa/ 'bathe'+FUT; /maɲɪn[?]/ 'make', /maɲɪn[?]+na/ 'make'+FUT. When the final supralaryngeal consonant of the stem is an alveolar, the Future form ends in glottal+alveolar: /pawun[?]/ 'leave', /pawun[?]+na/ 'leave'+FUT; /tʊl[?]/ 'set alight', /tʊl[?]+la/ 'set alight'+FUT. This pattern can be attributed to the fact that adjacent apicals are never heterorganic in Ngalakan; the pattern does not alter the generalisation that apico-alveolars are not found after vowel+glottal stop sequences. But it is unclear whether this is an accidental fact. Evans (p.c.) claims that apicals following glottal stop in Mayali *must* be postalveolar, even where they are underlyingly alveolar. He provides the following example:

ka-[n]i	'(s)he sits'
ka-ʔ-[n]i	'(s)he sits (with Immediate marker-ʔ-)'

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I repeat the constraint ranking which determines contextual markedness in Ngalakgan:

- (18) Context-specific robustness of perceptual cues as a determinant of constraint ordering: [ʃ] is place of articulation.
[ʃ] tied to release cues: *[ʃ]^{VC} >> *[ʃ]^{CV} >> *[ʃ]^{VCV}

Recall that this constraint ranking distinguished the cues available for consonants (a) in C₁ of a heterorganic cluster, (b) in C₂ of a heterorganic cluster, and (c) in an intervocalic monogestural segment or cluster. Articulations consisting of V+?+C fit into the last category: monogestural articulations.

The primary cue for glottal stop in Ngalakgan is creaky voice, as I have observed. This is the only primary consonant cue which can be coarticulated with a vowel. While other consonants are cued by transitions in preceding and following vowels, these transitions are necessarily brief, and cannot affect the vowel so substantially that the vowel quality itself is obscured. But because laryngeal gestures can be made independently of those in the oral cavity, the cue for glottal stop can spread through preceding segments to a much greater extent than is possible for other consonants.

For these reasons then, the ranking in (18) treats /vowel+glottal stop+consonant+vowel/ sequences in the same way as /vowel+consonant+vowel/ sequences. Glottals do not obscure cues for following consonants, and these consonants have the same perceptual status (for the purposes of the phonology) that they do without a preceding glottal. In addition, the cues for glottal stops themselves are not perceptually difficult in the pre-consonantal position, although this is a perceptually marked context for other consonants.

A tableau presenting this analysis is shown in (95).

(95)

/yanaʔ-ʔkVn/ 'what'-DAT	*CUES [ʔC̣C̣]	*CUES [C̣C̣ʔ]	*CUES [ʔC̣V]	ALIGNL (PRWD, FT)
a. yánaʔ-kan			ǎʔka	
b. yanáʔ-kan		yǎ!		*

The output in (a) is well-formed for the same reasons that /ɲáɪakka/ 'bone' is: the stop between syllables 2 and 3 is 'robustly cued', there is no need to stress the medial syllable. That is, [yanaʔkan] has the much the same perceptual status as [yanakan] or [yanakkan]; all three are equally well-cued for the velar stop.

It is no doubt for this reason that geminates and glottal stops are found at morpheme boundaries, as discussed in Ch 4. They provide closed syllables to stems without obscuring perceptual cues in the salient initial syllables of suffixes and stems. Glottal stops in reduplicants are discussed in §5.5.4. In order to understand the behaviour of glottal stops in reduplication, it is necessary to discuss their attributes in monosyllabic PrWds generally. This is the subject of the following section.

5.5.3 The quantity of CVʔ roots

The preceding section showed that vowel+glottal+consonant+vowel sequences are treated by the phonology and prosody in the same way as vowel+consonant+vowel sequences. The glottal stop does not count as a coda for the phonological constraints on perceptual difficulty. Glottal stops are often not visible to phonological processes (cf. McKay 1975, Wood 1978, Morphy 1983, Wilkinson 1991, Harvey 1991). Closed, monosyllabic roots where the final consonant is a glottal stop are realised with a long vowel articulation, like CV roots. In the case of the weight effects, glottal stop does not count as a pre-consonantal coda because it is cued primarily and robustly on a preceding sonorant. In the case of monosyllabic, glottal-final roots, the reason for vowel lengthening appears to be incompatibility between glottal constriction and tonal contrasts. The 'invisibility' characteristics of glottal stops derive from independent

factors in each case, but both are ultimately due to the articulatory properties of glottal stop in Ngalakgan.

There are two arguments that the vowel is long in monosyllabic forms ending in vowel+glottal stop. The first argument is based on the duration of vowel and glottal articulations in CV? roots. The second argument comes from the distribution of vowel allophones in CV? roots.

Vowel measurements support the claim that the vowel in CV? roots must be long at the surface. All vowels in the final open syllables of citation forms are subject to phrase-final lengthening, which makes it difficult to compare monosyllabic words directly. Rather, I compare vowel durations in complex words, where we know that vowels are distinguished for length because of morphological factors (Chs 2, 3). Durations of vowels and codas were compared for the vowel /e/ in two sets of words, in both sets, the vowel occurs in a monosyllabic MWd with secondary stress, and a pitch accent.

The first form is given in (96). In this environment, the nasal+stop cluster of the enclitic /=ŋkore/ 'ours' closes the syllable of the preceding CV root, and the vowel is short.

- (96) a. [jèŋgóɾɛkka] 'in our noses'
/ce=ŋkore-kka?/ nose-1aDAT-LOC

In four measurements of this word in ordinarily-paced speech, the following figures were obtained for the vowel /e/ of the root /ce/ 'nose', all tokens were around 100 ms or less.

- (97) a. 93.51 ms
b. 99.84 ms
c. 85.5 ms
d. 72 ms

Now compare figures for the same vowel in a secondary stressed CV? root. The vowel duration is given next to the phonetic representation of each articulation involved.

- (98)
- Speaker A
- a. [ɲʊruwɛɛʔɲónagan] 'so we can drink'
 /ɲuru-weʔ-ɲu+na+kan/
 12aS-water-eat+FUT+PURP
 [ɛ] 64 ms
 [ɛ̃] 66 ms Total = 130 ms
 [ʔ] 62 ms
- Speaker B
- b. [ɲʊruwɛɛɲónagan] 'so we can drink'
 /ɲuru-weʔ-ɲu+na+kan/
 12aS-water-eat+FUT+PURP
 [ɛ] 100 ms
 [ɛ̃] 41 ms Total = 141 ms
- Speaker A
- c. [ɲuwɛɛʔɲáɪ] 'I'm dying of thirst'
 /ɲu-weʔ-ɲaɪʔ/
 1mS-water-die
 [ɛ] 44 ms
 [ɛ̃] 102 ms Total = 146 ms
 [ʔ] 106 ms
- Speaker B
- d. [wɛɛʔkén] 'for water'
 /weʔ-ʔkVn/
 water-DAT
 [ɛ]₁ 63 ms
 [ɛ̃] 49 ms Total = 112 ms
 [ʔ] 64 ms
 [ɛ]₂ 54 ms

All of the vowel articulations of the closed root in (96) are under 100 ms. By contrast, all of the vowel articulations of the CV? root in (98) are over 100 ms. I regard the modal and creaky voice articulations together to constitute the vowel in these syllables. The vowels in that case range between 112 and 146 ms, with the glottal closure itself averaging around 60 ms more.

A median of around 130 ms is consistent with measurements of CV roots in complex environments. Figures are given below.

(99)	a.	[bó:wi]	'along the river'
		/po-wi/	river-LAT
		[o:]	127-140 ms (Speaker A)
		[o:]	151 ms (Speaker B)
		[o:]	156 ms (Speaker B)

(100)		[bó:kká]	'to/at/in the river'
		/po-kaʔ/	river-LOC
		[o:]	164 ms (Speaker A)
		[o:]	189 ms (Speaker B)
		[o:]	127 ms (Speaker B)
		[o:]	137 ms (Speaker B)

So long vowels have durations of 120 ms and over, short vowels tend to fall in the range below 100 ms, averaging around 60-70 ms. Laryngealised vowels in monosyllabic roots fall into the former category: they are long vowels.

Monosyllabic, glottal-final roots are distinct from other closed monosyllabic roots; in the latter, the vowel is short. Two measurements for the CVC root /kot/ 'paperbark' are presented below.

(101)		[gɔt]	
		/kot/	'paperbark'
		[ɔ]	92 ms (Speaker B)
		[ɔ]	72 ms (Speaker C)

Although preliminary, I interpret the phonetic data as evidence that speakers treat the vowels of CVʔ roots as requiring a sustained articulation, like the vowels of CV roots, and unlike the vowels of other CVC roots.

The distribution of vowel allophony in CVʔ roots also argues that vowels in these roots are long. Recall that vowels have centralised allophones in closed syllables, and stressed syllables followed by a consonant. Peripheral allophones are realised in open word-final and open unstressed syllables.

Vowel quality preceding laryngealisation depends on the POA of the vowel, it is not uniformly centralised, which would be expected if glottal stops constituted a coda. A *front* mid vowel is centralised before laryngealisation (102a), like the quality before codas (102b) in general, and contrasts with the peripheral vowel in an open syllable not followed by a consonant (102c-d):

- | | | | | |
|-------|----|--|----|----------------------------|
| (102) | a. | [wɛɛ]
/wɛʔ/
'water' | c. | [je:]
/ce/
'nose' |
| | b. | [yɛkkɛ]
/yɛkkeʔ/
'Hey!' 'What about it?' | d. | [yɛle]
/yele/
'hole' |

A *back* vowel is peripheral, not centralised, preceding glottal stop, like the vowel in an open word-final syllable (103b-c), and contrasting with the vowel quality in other closed syllables (103d-e):

- | | | | | |
|-------|----|-----------------------------------|----|------------------------------------|
| (103) | a. | [ŋóʔ]
/ŋoʔ/
'guts' | d. | [ɪók]
/ɪok/
'pandanus' |
| | b. | [bó:]
/po/
'river' | e. | [yáwɔk]
/yawɔk/
'cheeky yam' |
| | c. | [wólo]
/wolo/
'cooked food' | | |

The evidence of mid-vowels is ambivalent, the front mid-vowel behaviour implies that glottal-final syllables are closed syllables, but the back mid-vowel behaviour implies that they are open syllables.

One way to think about these differences in vowel allophony is in terms of ATR/RTR ('advance/retract the tongue root'). Glottal stricture pulls the tongue root back and down, affecting vowels which are front and/or high. Since a centralised vowel is found before the velar stop (102b) and (103d-e) regardless of vowel POA, then [back]

articulation in consonants is not enough to condition the variation in vowel quality found in laryngealised vowels. I assume then that glottal stops differ from velars in possessing a feature of [low] as well as [back] (cf. Chomsky and Halle 1968).

In languages such as Tigrinya, Palestinian and Syrian Arabic, the class of gutturals (which includes laryngeals) lowers a preceding vowel. Rose (1996:80) proposes a feature [RTR] to characterise non-laryngeal gutturals (citing Halle 1995). The effects described here argue that, in Ngalakgan, [RTR] characterises laryngeals also. In Arabic, laryngeals pattern as a class with gutturals in this respect.

It has been observed previously that the front vowels in Ngalakgan are higher than the back vowels at corresponding positions. So RTR affects /e/, which is realised as the [RTR] allophone [ɛ]. The corresponding back mid-vowel /o/ is not affected, at least not to the same degree. This indicates that /o/ is already [back, low], and can agree with the glottal stop in terms of POA or RTR features. The spread of [RTR] features to neighbouring vowels cannot be the same process of centralisation that affects vowels in pre-consonantal stressed and closed syllables generally, since the latter affects all vowels in the same way, whereas [RTR] targets front vowels.

The evidence of vowel allophony suggests that glottal stop does *not* constitute a coda: the syllable has the allophonic form of an open syllable, modulo RTR effects. The evidence of examples such as (103) /ŋoʔ/ I take to be indicative of a closer correspondence between CVʔ roots and CV, than between CVʔ and CVC (C₂ supralaryngeal). Centralisation in /weʔ/ then is a phonetic by-product of the [low, back] or [RTR] articulation of glottal stricture. It is comparable to the raising of vowels before the lamino-palato-alveolar nasal /ɲ/ in words like /ceɲ/ [jeɲ], 'fish' and /koɲ/ [goɲ] 'kangaroo, wallaby'. Just as the latter process does not affect the generalisation that vowels are centralised in closed syllables, so the [RTR] realisation of [wɛɛ] does not affect the conclusion that CVʔ words are open, not closed.

If, on the other hand, glottal stops *did* constitute codas, we would expect centralised allophones of *all* vowels, not just the mid-front vowel. We would have no explanation of the allophonic difference between [wɛɛ] and [ɲoɔ].

Further evidence for this analysis comes from laryngealised mid-vowels in short syllables, shown in (104). These examples show that the back mid-vowel preceding glottal stop (104a-c) has whatever allophonic realisation it has in that environment without glottal stop (104d-f). That is, glottal stop has no allophonic effect on a preceding back mid-vowel.

- | | | | | |
|-------|----|--|----|--|
| (104) | a. | [gónanɪŋ]
/koʔ+ɲan+iŋ/
'have'+[see]+PC | d. | [gónɔŋ]
/koŋɔu/
'light sprinkling of rain' |
| | b. | [gónce]
/koʔce/
'that/there' | e. | [gónɔŋ]
/koŋce/
'alone' |
| | c. | [máɲɔŋ]
/mayɲoʔ/
'red ochre' | f. | [bílppo]
/pílppo/
'wide' |

Given that glottal stops do not constitute codas in glottal-final, monosyllabic roots, we require a phonological explanation of this characteristic, since other, supralaryngeal codas are weight-bearing in monosyllabic words, as in (105). In these monosyllabic words, unlike the glottal-final ones, the vowel is consistently short.

- | | | | | |
|-------|----|-------|-------|---|
| (105) | a. | /lel/ | [lel] | 'aquatic plant sp.' |
| | b. | /wom/ | [wɔm] | 'black plum' (<i>Vitex glabrata</i>) |
| | c. | /ker/ | [geɾ] | 'kurrajong' (<i>Brachychiton paradoxum</i>) |
| | d. | /pot/ | [bɔt] | 'fly' |
| | e. | /kot/ | [gɔt] | 'paperbark' |
| | f. | /rok/ | [ɾɔk] | 'pandanus' |
| | g. | /pok/ | [bɔk] | 'small creek' |

There are good cross-linguistic grounds for regarding glottal stop as a bad coda for syllables associated to prosodic contrasts: glottal constriction is incompatible with

the manipulation of pitch. Hyman (1977:76) claims that 'in tone languages it frequently is the case that contour tones, which require or at least "prefer" greater duration in their realisation, are not found in CV? syllables'. Hyman cites Ixtlan and Fe?Fe?-Bamileke as examples where a syllable closed by glottal stop can only have simple tones (high, low) and cannot realise contour tones. Silverman (1997) shows that contrastive tone is most robust when associated with a simple vowel in Otomanguean languages, and least robust when the vowel is coarticulated with laryngeal features (breathiness or creakiness). The effect is not limited to tone languages. Hyman (1977:49; citing Lindskog and Brend 1962:39) observes that in Cayapa (an Ecuadorian language), stress is quantity-sensitive: heavy syllables are CVV(C), and all CVC *except* CV?.

Syllables bearing contour tones are comparable to bimoraic syllables, at least in some tone languages. For example in Luganda (Clements 1986), only bimoraic syllables (i.e. closed syllables or syllables with long vowels) can bear contour tones (but see Odden 1995:449). In these cases, each tonal contrast docks to a single tone bearing unit which is a mora. Hence, the restriction against contour tones in CV? syllables in Bamileke is comparable to the restriction against bimoraic CV? roots in Ngalakgan. On the surface, Ngalakgan roots are realised as CVV?, where the second half of the long vowel carries the creaky voice feature.

Silverman (1997:247-249) observes that the restriction on laryngeal features and tone contrasts is phonetically-grounded: laryngeal articulations affect pitch in ways that are difficult to control. The articulatory demands of producing creaky or breathy vowels are incompatible with the demands of tone differences. Both pitch and creaky voice are produced with manipulation of the larynx, but in antagonistic ways. Tone differences are also more difficult to perceive in syllables with creaky or breathy phonation, for the same reason: the hearer needs to 'correct' for the effects of laryngeal activity, which may be variable.

Based on Silverman and Hyman's observations, I further propose an articulatory/perceptual constraint:

- (106) *TONE/[cg] ~ [sg] 'Tonal contrasts are incompatible with non-modal phonation (creaky or breathy voice).'

This constraint disallows tonal contrasts to be associated with vowels which have creaky or breathy phonation. We have seen that, in the normal case, vowel+glottal stop sequences are pronounced as laryngealised vowels at the surface. That is, as shown in (107), a laryngealised vowel is less marked than a phonetic implementation of vowel followed by glottal constriction. We can think of these two implementations as constraints on perceptual difficulty, in the ranking shown:

- (107) *CUE[vʔ] >> *CUE[ɰ]

The ranking states that it is easier to perceive cues for glottal stop when it is realised as creaky voice, than when it is separately articulated.

With the constraint *TONE/[cg] ranked above the constraints in (107), the implementation of /Vʔ/ as [ɰ] is ruled out where the vowel occurs in a syllable which is associated to a tonal contrast (i.e. in a monosyllabic open-syllable PrWd). The constraint ranking forces the vowel of CVʔ roots in Ngalakgan to lengthen, so that the first, non-creaky half can bear the contrastive tone associated with PrWds. Therefore, this constraint ranking must in turn dominate IO-IDENT[mora], which is violated by surface long vowels corresponding to underlying short vowels.

The effects can be seen in the following tableau, which presents a monosyllabic root ending in a vowel+glottal stop sequence. The Faithful form, and the form we would expect if glottal stops could be moraic codas, is (c). This is an impossible articulatory sequence in Ngalakgan. Formally, this candidate violates the constraint *CUE[vʔ]: a vowel followed by glottal stop, without articulatory overlap, is perceptually difficult. The normal articulation of vowel+glottal stop is that in (b), representing the coarticulated form. This candidate violates the constraint *TONE/[cg], since the vowel is both creaky

and associated with tonal contrast. This is an incompatible coincidence of features. Hence, the vowel lengthens, to provide the necessary duration to enable both tonal contrast, and realisation of glottal features.

(108)

/koʔ/ 'guts'	MWD ≈ PRWD	*Tone/ [cg]	*CUE [vʔ]	*CUE [v̥]	IO-IDENT [MORA]
ᐃᑦ a. [ŋóɔ]				*	*
b. [ŋó]		*!		*	
c. [ŋóʔ]			*!		

The analysis predicts that short vowels should never be associated with tonal contrasts and laryngeal features. In fact, this seems to be the case in Ngalakgan.

Example (109) presents an analysis of a ROOT-compound verb, where the initial syllable is associated with pitch accent. In this case, the creaky voice feature is carried by a retroflex off-glide, which has spread from the following postalveolar nasal into the preceding syllable. The attested form therefore manages to retain tonal contrast on the vowel, without sacrificing articulatory naturalness. I assume that the laryngealised glide violates either *CUE[v̥], or some related constraint referring to the perception of glottal coarticulation on sonorants, the difference is immaterial to the outcome here.

(109)

/koʔ+ŋan+iŋ/ have+[see+]PC	MWD ≈ PRWD	*TONE/ [cg]	*CUE [vʔ]	*CUE [v̥]	IO-IDENT [MORA]
ᐃᑦ c. [góŋaniŋ]				(*)	
b. [gónaniŋ]		*!		*	
c. [góʔaniŋ]			*!		

The analysis predicts vowel-lengthening (as in 108) or feature spreading (109) wherever vowels preceding glottal stop are in stressed, accented syllables. There are just a handful of monosyllabic roots ending in vowel+glottal stop. All except one of these - /koʔ/ - is a MWd and hence undergoes vowel lengthening. The bound root /koʔ/

occurs in just one ROOT-compound, shown in (109). There are two examples where this sequence occurs in a stressed, initial syllable: the deictics /koʔce/ 'there' and /koʔye/ 'here'. I have previously noted that in vowel+laminal stop and vowel+glide syllables, spreading of a palatal glide feature from the following onset to the preceding vowel is commonly observed. These examples satisfy the constraints by hosting laryngealisation on an off-glide, as in example (109). It may also be the case that the contour tone associated with PrWds is spread over more than one syllable in the latter cases.³⁰

A similar explanation may be advanced for the other languages mentioned previously. In Bamileke, *Tone/[cg] bans contrastive contour tones in laryngealised syllables. In Cayapa, it bans quantity-sensitive stress.

In Danish, the primary accent distinction is between syllables with *stød* and syllables without (Gårding 1977:6). The syllables with *stød* correspond to the acute, or Accent 1 of Norwegian and Swedish. Those without *stød* correspond to the grave, or Accent 2. Accent 1 is a simple accent associated with high tone, whereas Accent 2 is commonly a complex tone with two peaks, but in every case the peak falls late in the stressed syllable, if not in the following syllable (Gårding 1977:45). Therefore, *stød* in Danish is comparable to syllables with a simple tonal accent, and syllables without *stød* are comparable to those with complex tone. Syllables with *stød* are furthermore required to have a long vowel, or a short vowel followed by a sonorant, exactly as in Ngalakgan. Hence, the Danish facts back up the claim that non-modal phonation (in Silverman's terms) is incompatible with pitch contrasts.

The following section shows why CVʔ makes a good WORD-reduplicant, using the characteristics we have so far motivated for roots.

5.5.4 CVʔ WORD-reduplication

In this section I discuss one common WORD-reduplication pattern in Ngalakgan, where the reduplicant is a CVʔ stem. I follow M&P (1993a) and Urbanczyk (1996) in

³⁰I have insufficient acoustic data to test this hypothesis.

assuming that the shape of reduplicants is not stipulated, but is a consequence of constraint satisfaction. I argue that the reduplicant takes the unmarked shape of MWds in complex environments, using the boundary signal notion proposed in Ch 4.

5.5.4.1 Morphology of CV[?]-reduplication

CV[?] is one of the most common reduplicant shapes. Reduplication is prefixal in all except a couple of rare cases. This reduplicant shape is attested with polysyllabic inflected verb forms, adverbs, and quantifiers; but no nouns.

Reduplicants do not carry their own consistent, lexically-specified meanings. Rather, interpretation is partially dependent on the meaning of the Base, and to some extent on the rest of the context. In predicates of motion or action, and in adverbs of manner, reduplication is interpreted as Iterative: distribution in time, space, or occasionally participants. In stative or attributive predicates or modifiers, and in adverbs of time, reduplication is interpreted as Intensive. In nouns, reduplication is interpreted as Distributive: distribution of the referent over space.

The reduplicant is underlined in the phonemic representations in the examples which follow:

- | | | |
|----------|--|--|
| (110) a. | [màa [?] máŋɿŋ]
/ <u>m</u> a [?] -maŋɿŋ/
ITER-get+PC
'got here and there' | [máŋɿŋ]
/ma+ŋɿŋ/
get+PC
'got' |
| b. | [jùu [?] jóruwɛn]
/ <u>c</u> u [?] -curuwɛn/
ITER-rush+PR
'rushing here and there' | [jóruwɛn]
/curuwe+n/
rush+PR
'rushes' |
| c. | [wàa [?] wáŋgɿŋ]
/ <u>w</u> a [?] -waŋkiŋ/
ITER-one
'one at a time' | [wáŋgɿŋ]
/waŋkiŋ/
one
'one' |
| d. | [yàa [?] yappán [?] ja]
/ <u>y</u> a [?] -yappanca/
ITER-two
'two at a time' | [yappán [?] ja]
/yappanca/
two
'two' |

- | | | |
|----|--|---|
| e. | [yĩʔyippɔ́nja]
/yĩʔ-yippɔ́nja/
INTENS-long.ago
'a very long time ago' | [yippɔ́nja]
/yippɔ́nja/
long.ago
'a long time ago' |
|----|--|---|

The reduplicant constitutes a bound WORD-level stem: a MWd. Like other WORD-level operations - compounding and affixation - reduplication is (a) freely available, (b) does not take or select for idiosyncratic forms, and (c) has a regular, compositional interpretation.

There are other reduplication patterns, which are exemplified briefly here. They will not be analysed in what follows. A second major pattern is CVXV: a contiguous string of the Base ending in a vowel, where 'X' is a consonant or cluster. This shape is attested with nouns, verbs, and modifiers. Some examples are given in (111):

- | | | |
|----------|---|--|
| (111) a. | [bʊrʊbðdɛbɔ́dɛwk]
/puru- <u>pɔ́tɛ</u> -pɔ́tɛwk/
3aS-ITER-bad
'they are very bad'; or: 'they are habitually bad' | /pɔ́tɛwk/
bad
[3/7/96] |
| b. | [ɲɔrʊdðmʊdɔ́mʊɾa]
/ɲɔrʊ- <u>tʊmʊ</u> -tʊmurʔ-a/
12aS-ITER-break.up-FUT
'we will go around breaking up (sticks for the fire)' | /tʊmurʔ-a/
break.up-FUT
[2/7/96:1A] |
| c. | [bʊrʊwðrowɔ́rowkmɪɲ]
/puru- <u>worɔ</u> -worowk-mi+ɲ/
3aS-ITER-jump.along-AUX+PP
'they jumped along' | /worowk-mi+ɲ/
jump.along-AUX+PP
[KD: passim] |
| d. | [bʊrʊwðluwɔ́lʊppa]
/puru- <u>wulʊ</u> -wulup-pa/
3aS-ITER-bathe-FUT
'they are going to splash around' | /wulup-pa/
bathe-FUT |

The other major form of reduplication is total reduplication. For common nouns, this is interpreted as a literal count. This is shown by example (112), where the Kriol translation uses the same mechanism (and the speaker also counted off the tokens of 'catfish' caught on his fingers as he was saying the word). The equals sign '=' here represents a loose degree of morpho-phonological dependency.

- (112) *morlopborl=morlopborl=morlopborl* *ngu-bu-meh+me*
 catfish catfish catfish 1mS-3a-RED+get.PP
- ngu-bu-wakgiri+wo* *jajabarngh-gah*
 1mS-3a-return.with+[give]PP afternoon-LOC
cetfij cetfij cetfij ai bin bringimbek aftanuntaim
 'I caught three catfish and brought them back in the afternoon.' [27/6/96:1A]

That this kind of reduplication is (complete) word, rather than MWd, reduplication, is suggested by examples like that in (113), where a prefixed noun is reduplicated in entirety (several examples like this are attested in the texts).

- (113) *ngu-ngoh-me:::*, *gu-jiwi*
 1mS-guts-get.PP IV-liver
- yanh-yanah* ***gu-barnditj=gu-barnditj***
 RED-whatsit IV-kidney=IV-kidney
gejim gats, liva, kidni kidni
 'I got the guts, liver, and whatsit...two kidneys [Tx 1/6/96]

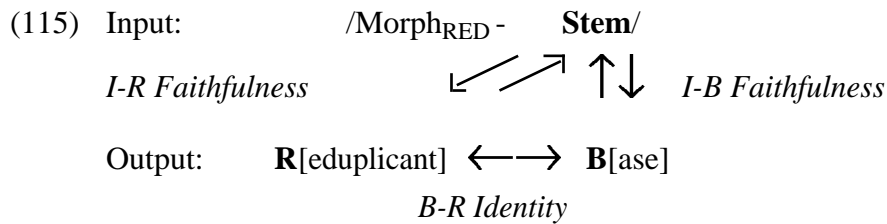
Reduplication is not common in nouns, except in the delimited class of kinship terms. Here reduplication has a special function: to derive the plural form of Dyadic-derived nouns. Since this is a semantically specialised domain, in contrast to the majority of occurring WORD-level reduplications, I will not examine these here; see Merlan (1983:19).

5.5.4.2 Prosodic characteristics of CV?-reduplication

I follow M&P (1986, 1993a, 1995b) in assuming that the reduplicant is a morpheme which is not specified for segmental material. Its form is derived from constraint satisfaction. Two principles regulate the form of reduplicants:

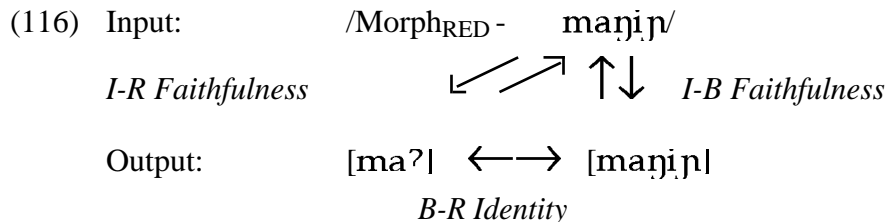
- (114) a. The reduplicant should be a copy of the base to which it attaches
 b. The reduplicant is subject to constraints on the interface between morphology and prosody

Principle (114a) entails that the reduplicant contain some or all of the segmental material of the Base. In M&P (1995b), reduplication is subject to a distinct set of Correspondence relations, which are schematically represented below (following M&P 1995b:252):³¹



Faithfulness between the input *stem* and the *base* of reduplication is regulated by IB-Faith constraints (which are not distinct from IO-Faith in M&P 1995b). A distinct set of BR-Faith constraints regulates the copying relation between the *reduplicant* and the *base* at the surface.

A particular instantiation is given for /maʔ-maɲiɲ/ 'kept getting' in (116):



The input consists of the word /maɲiɲ/ 'was getting (PC)' with a reduplicative morpheme which is phonologically unspecified for content but has some morphological annotation: its category is 'WORD-level stem' (MWd). The output consists of the Base, which is a perfect copy of the input word, plus the Reduplicant, which is required to be a stem which minimally differs from the Base.

³¹I have represented the reduplicant with a dummy morphological label 'morph' rather than M&P's 'affix' to reflect the Ngalakgan situation argued for here.

Condition (114b) - that reduplicants are subject to constraints on the morphology/phonology interface - leads to the frequently attested pattern that reduplicants are realised as one of the constituents of the Prosodic Hierarchy (M&P 1986, 1993a). In earlier work, M&P (e.g. 1986) proposed that reduplicants were specified to correspond to a prosodic constituent. So for example, the reduplicant in /ma[?]-manjɪn/ might be specified as 'bimoraic foot'.

This approach is not taken here. Rather, I follow (M&P 1993a, Urbanczyk:1996) who propose that:

- Reduplicants are specified as to morphological category ('stem', 'root', 'affix', 'word')
- The shapes taken by reduplicants reflect the unmarked shapes for morphological constituents

The form of CV[?] reduplicants, for example, can be derived from two conditions. The first takes the form of the following stipulation in the morphology:

(117) RED = MWD: 'Reduplicant is a MWD'

This requirement that Reduplicants be a MWD is not a constraint but rather a property of the input. The morphological structure of the input is assigned by the lexicon, and cannot be altered in the phonology.

Being a MWD, reduplicants are subject to whatever constraints other MWds are subject to. The one that concerns us here that MWds and other prominent constituents should be demarcated by boundary signals, as proposed in Ch 4; I repeat the constraints here.

(118) Constituent boundaries must be signalled ('No obscure boundaries')
 #PRWD# >> #FT1# >> #σ#
 "Delimit the Prosodic Word" >> "Delimit the strongest foot" >> "Delimit the tonic"

By being realised as monosyllabic PrWds, reduplicants can satisfy all three constraints simultaneously, since the constraints in (118) are relativised to PrWd in Ngalakgan (as I suggested in §4.2.2).

In Ngalakgan, the NO OBSCURE BOUNDARIES constraints are ranked below IO-DEP(MWD). The input form of MWds cannot be adjusted in order to conform to the ideal shape, as I showed in §4.3. But since the reduplicant has the same [constricted glottis]/[spread glottis] characteristics in final position as *suffixed* stems, this argues that the NO OBSCURE BOUNDARIES constraints are ranked above BR-DEP. Just in reduplication, then, MWds (reduplicants) are universally required to conform to the unmarked shape for MWds, as shown in tableau (119) below. (This characteristic behaviour of reduplicants is dubbed the 'Emergence of the Unmarked' in M&P 1995b).

Both the reduplicant and the base are subject to the constraint $MWD \approx PRWD$, because they are both WORD-level stems and hence MWds. Candidates (a), (b), (d) and (f) are ruled out on this basis, because they fail to parse one or the other as a well-formed PrWd.³² (PrWds are indicated with square brackets.) The only contenders then are (c) and (e). #PRWD# eliminates (e), even though in other respects it is more well-formed. The optimal candidate, (c), satisfies No Obscure Boundaries as much as possible (without violating IO-DEP), by inserting a glottal stop between reduplicant and base, demarcating both domains. The glottal stop is a segment which finds no correspondent in the input, and (c) thereby violates BR-Dep.

(119)

/STEM _{RED} -maŋiŋ/	MWD \approx PRWD	IO-DEP (MWD)	#PRWD#	#FT1#	#ó#	BR-DEP
a. <u>ma</u> ?#-[(máŋiŋ)]	*!				*	*
b. [(má?)#-maŋiŋ]	*!					*
c. [(mà?)#-[(máŋiŋ)]]					*	*
d. [(má?#-ma)ŋiŋ]	*!			*		*
e. [(mà:)]-[(máŋiŋ)]			*!	*	*	
f. [(mà)]-[(máŋiŋ)]	*!		*	*	*	

³²Candidate (f) violates FTBIN - not shown. The violation of $MWd \approx PrWd$ shown here is awarded because a monomoraic form does not constitute a well-formed PrWd.

Since the CV[?] reduplicant is a PrWd in these forms it behaves just like the CV[?] roots examined in the previous section. At the surface, CV[?] reduplicants must have a long vowel. I assume that vowel lengthening does not violate BR-Dep, but BR-Ident[mora] (M&P 1995b:265). (This constraint is not shown.)

In other respects, reduplicated words behave like compounds in terms of prosody. The reduplicant - the first MWd - takes secondary stress and a pitch accent, and the base - the second MWd - takes primary stress and a pitch accent. These characteristics follow from the same constraints given in Ch 2 in reference to compounds.

5.6 Conclusion

I have shown that Moraic Theory makes incorrect predictions with regard to Ngalakgan. However, Moraic Theory accounts for a large range of effects in other languages in a simple fashion. These considerations lead me to propose that Moraic Theory coexists with other sets of constraints demanding that syllables which are perceptually difficult be stressed.

In this chapter I have argued for two parameters of syllable weight or prominence. The first of these is weight based on perceptual markedness. To my knowledge, Ngalakgan and, to a lesser degree, neighbouring languages such as Rembarnga, Mangarrayi, Ngandi, present the clearest evidence for such a distinction cross-linguistically.³³ The perceptual constraints referring to stressed syllables make sense of the Ngalakgan stress system. I have suggested that languages where long vowels count as heavy may be using a similar metric of perceptual difficulty.

The other parameter proposed here is prominence based on syllable well-formedness, where well-formedness is derived from the constraint ranking of harmonic nuclei and margins in P&S (1993). Similar approaches to prominence have been proposed by other authors (e.g. P&S 1993, Berry 1999). Sonority-based prominence

³³The Tamil facts analysed by Christdas (1988) and Beckman (1998) may be related, if Mohanan's (1986) analysis of Malayalam stress can be generalised to Tamil.

can account for a small proportion of roots in the lexicon which have otherwise aberrant stress patterns. Other languages (e.g. Arrernte, Ossetic) appear to make similar distinctions of syllable well-formedness for the purposes of foot structure.

There are other examples of languages in which syllable weight for stress does not depend on sonority or quantity (i.e. duration). Several languages have been described with systems wherein CVC is a heavy syllable (along with CVV) or the only heavy syllable. CVC syllables are not more sonorous than CV ones. In many languages, syllable weight is based on vowel *quality*, rather than vowel quantity. These cases are not easily accounted for under a moraic theory of weight. They *can* be described in terms of sonority, markedness or both.

Moraicity has previously been shown to depend on segment sonority in some languages (Zec 1988). The evidence of Ngalakgan and other languages argues that markedness considerations also play a role in deciding the eligibility of syllables to be heavy. The stress patterns of these languages do not follow directly from a theory where syllables are automatically heavy if they are closed. Therefore, I conclude that further constraints on the relationship between the prosodic system and the structure of syllables, apart from WSP and the like, are empirically justified.

This concludes the phonological chapters of the thesis. Ch 6 which follows is a summary of the descriptive contributions and theoretical claims of the thesis.