PART II

MARKEDNESS
3.1 Introduction

The aim of this chapter is to show that scale-referring markedness constraints must be freely rankable. The proposal that scale-referring markedness constraints are stringently formulated – i.e. that they refer to ranges of scales (ch.2§2.2.1) – follows from free ranking; without free ranking the constraints would be unable to express hierarchical relations, as established in chapter 2.

As Prince (1997 et seq.) shows, evidence that scale-referring markedness constraints are freely rankable comes from category conflation – the elimination of category distinctions for a particular process. To introduce conflation, the complementary notion ‘categorization’ will be discussed first (from de Lacy 1999a).

‘Categorization’ refers to the distinctions that languages can potentially make between different categories for some process. For example, the Papua New Guinea language Kobon distinguishes amongst peripheral low, mid, high, and central mid and high vowels in stress placement, with stress falling on the most sonorous vowel available (Davies 1981, Kenstowicz 1996). The Kobon system shows that each of the mentioned types is a different category for stress purposes.

However, not every language makes the full range of possible category distinctions. Some collapse – or ‘conflate’ – categories, treating them in the same way for stress purposes. Kenstowicz (1996) was the first to recognize the significance of conflation for a theory of scales.

As an example, stress in Gujarati is sensitive to sonority but makes no distinction between high and mid vowels. Like Kobon, stress seeks out low vowels (1b), and avoids stressed schwa (1c), but it does not avoid high vowels for mid vowels or vice-versa (1d), showing that the two categories are effectively treated as one.

(1) Gujarati stress in brief
(a) Default stress on penult

\[
\begin{array}{ll}
[aw:\text{\textipa{a}}] & \text{‘coming’} \\
[p\text{\textipa{\textipa{\textipa{a}}}}] & \text{‘kite’} \\
[s\text{\textipa{\textipa{\textipa{a}}}}] & \text{‘plus ½’}
\end{array}
\quad
\begin{array}{ll}
[b\text{\textipa{o}}] & \text{‘speak (imperf.)’} \\
[j\text{\textipa{\textipa{r}}}] & \text{‘Europe’} \\
[k^b\text{\textipa{m\textipa{s\textipa{\textipa{a}}}}}] & \text{‘shirts’}
\end{array}
\]
(b) Avoidance of stressed non-low vowels

\[\text{[he\text{n}] ‘distressed’ [ji\text{k}r] ‘a hunt’}\]
\[\text{[boli\text{[j] ‘is/are spoken’ [nuks\text{s}n] ‘damage’}\]

(c) Avoidance of stressed schwa

\[\text{[k\text{j}\text{[dli] ‘little cuckoo’ [wism\text{[ran] ‘forgetfulness’}\]
\[\text{[b\text{UK\text{[ro] ‘a mouthful’ [p\text{UK\text{[ke]n] ‘book’}\]

(d) No avoidance of stressed high vowels

\[\text{[t\text{UK\text{[ro] ‘girls’ [k\text{UK\text{[ro] ‘inkstand’}\]

Categorization and conflation are relevant for phenomena apart from stress. The same issues arise in syllabification and every other sonority-related prosodification process. For example, tonal distinctions can also be conflated for stress purposes (ch.4, de Lacy 1999a), and distinctions between different types of prosodic structure are often collapsed in stress assignment (de Lacy 1997a). In short, not only must scale-referring constraints capture the hierarchical relations implicit in scales, they must also allow for elements of a scale to be treated identically in some grammars.

Conflation is key evidence for the stringent approach (Prince 1997 et seq., de Lacy 1997a, 2000a). In fact, conflation casts a different light on what a scale informally expresses. A scale such as \(| x \succ y |\) does not imply that “\(x\) is always more harmonic than \(y\)”. Instead, it expresses the idea that “\(y\) is never more harmonic than \(x\)”, allowing for the possibility that \(x\) and \(y\) can be equally harmonic in some grammar. More concretely, the partial sonority scale \(| e,o \succ a |\) does not imply that stressed [a] will always be treated as more harmonic than stressed mid vowels, since in some languages (e.g. Nganasan – §3.3) they are treated in the same way. Instead, it implies that stressed mid vowels will never be more harmonic than stressed [a]: stress will never actively avoid [a] in favour of mid vowels.

This chapter explores the significance of conflation and characterizes the general differences between the stringent approach and one with constraints in a fixed ranking (cf Prince & Smolensky 1993 – sonority-driven syllabification, Kenstowicz 1996 – sonority-driven stress, de Lacy 2002b – tone-driven stress).

The aims of this chapter are:

(1) To show the need for freely rankable constraints. This is achieved through an analysis of sonority-driven stress in the Uralic language Nganasan in §3.3. A brief synopsis of why constraints in fixed rankings cannot produce all attested conflations is discussed in §3.3 and expanded in §3.6.

(2) To show that the particular constraints proposed here are needed, as opposed to some other theory with stringent constraints. Section 3.4 is devoted to this point; it contains an analysis of ‘environment-specific’ conflation in Gujarati stress. This type of conflation excludes systems that are only partially stringent, and certain approaches that generate stringent constraints through constraint operations (e.g. constraint encapsulation – Prince & Smolensky 1993, disjunction – Crowhurst & Hewitt 1997).
(3) To identify the typology of conflations possible with the present theory’s constraints. Section 3.5 shows that some conflations are required, others optional, and yet others impossible.

(4) To identify precisely which conflations Fixed Ranking theories cannot produce – discussed in §3.6.

Section 3.7 contains a summary.

To start, §3.2 discusses the sonority scale, the markedness constraints that refer to it, and which of these are relevant for sonority-driven stress.

3.2 The sonority scale and constraints

The vocalic part of the sonority scale is relevant in this chapter, so this section presents proposals about sonority distinctions between vowels and how they relate to the present theory’s constraints.

In broad terms, there is a good deal of consensus about the ranking of elements in the sonority hierarchy (see discussion in Parker 2002). In contrast, there is a great deal of disagreement over how many sonority distinctions there are (Sievers 1881, de Saussure 1915, Hooper 1972, Kiparsky 1979, Steriade 1982, Selkirk 1984, Venneman 1988, Clements 1990, Rice 1992, Gnanadesikan 1997, Parker 2002). This dissertation takes the view that the sonority hierarchy encodes a relatively large number of distinctions. The basis for the ones made in Figure 3.1 is processes that are commonly considered to be sensitive to sonority: i.e. syllabification and sonority-driven stress (see Crosswhite 1999 for vowel neutralization).

Among the vowels the categories in Figure 3.1 are distinguished here, analogous to Kenstowicz (1996:9).21 Scale (Figure 3.1a) gives the category labels, and (Figure 3.1b) lists the members of the categories.

![Figure 3.1: Vowel sonority scale](Image)

The sonority distinctions among vowels relate to two dimensions: height and peripherality. The primary distinction is peripherality, which separates the central vowels from the others. Within the classes of ‘peripheral’ and ‘central’, vowels are distinguished by height: lower vowels are more sonorous than higher vowels. So, [a] is more sonorous than [e] and [o], which are in turn more sonorous than [i] and [u]; similarly, mid [ə] is more sonorous than the high central vowel [i].

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21 See Parker (2002) and references cited therein for discussion of possible substantive bases for the sonority scale, or lack thereof (Clements 1990, Dogil & Luschützky 1989, Kawasaki 1982, Ohala 1974, 1990). This issue is not of concern here; the aim of the present theory is to provide an account of the formal expression of scales, not whether and how they are substantively grounded.
Voiceless vowels and the tense-lax distinction are not mentioned above, primarily because the cases in the following chapters contain no evidence for their sonority ranking. I have found no evidence that nasalisation or glottalisation affect the sonority of vowels, nor have I found compelling evidence for sonority distinctions in terms of frontness and backness.  

Phonological evidence for the sonority distinctions made above will be presented in the following sections.

3.2.1 The constraints

As discussed in chapter 2, the sonority hierarchy is considered to be a multi-valued feature [Sonority]. With the vowel and consonant hierarchies combined, the sonority scale above distinguishes thirteen categories. Accordingly, the value returned by the [Sonority] feature is a string of length 12. So, the low vowel [a] is [xxxxxxxxxxxSonority], while [p] is [ooooooooooooSonority] and [ŋ] is [xxxxxooooooo] Sonority.

For expository convenience, the fully articulated form of the [Sonority] feature will not be used here. Instead, a more transparent terminology will be employed: [≥X] means “equally or more sonorous than a category of type X”, where X is one of the sonority categories. For example, [≥Nasal] refers to all segments that are either nasal or more sonorous than nasals. Conversely, [≤Nasal] refers to all segments that are either nasal or less sonorous than nasals.

The conditions on scale-referring constraints laid out in chapter 2 and the sonority distinctions made above allow several sets of sonority-based constraints to be identified. All DTE-referring constraints have the form *Δα≤[X] “Incur a violation for every DTE of α which is less or equally as sonorous as X”. All non-DTE constraints have the form *-Δα≥[X] “Incur a violation for every non-DTE of α which is more or equally as sonorous as X”.

There are series of constraints for every possible value of α. For example, there is a series of sonority-referring constraints for DTEs of syllables: e.g. *Δa≤ is violated when any segment that is equally or less sonorous than schwa appears inside a syllable DTE (i.e. is the head of a syllable). Similarly, *ΔPrWd≤{e,o} is violated when the head of the main-stressed syllable is a mid vowel or is some less sonorous segment. The result is a series of such stringent constraints.

In the following sections, the primary focus will be on the set of constraints that relate to DTEs and non-DTEs of Prosodic Words (PrWd) and Feet (Ft) since these constraints relate directly to prominence-driven stress and stress-conditioned neutralization. As a reminder, the DTE of a PrWd (ΔPrWd) is the nucleus of the syllable with primary (i.e. word-level) stress. In contrast, the DTE of a foot (ΔFt) is the nucleus of the stressed syllable within a foot – i.e. both secondary and primary stressed nuclei.

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22 Some researchers consider front vowels less sonorous than back vowels (Jones 1918, Pike 1943, Hooper 1976, Foley 1977, Howe & Pulleyblank 2001). Reasons for this sonority distinction often appeal to epenthesis facts; chapters 4 and 5 argue that there is no need for such a distinction to be encoded in sonority terms. Sonority-driven stress offers evidence that there is no front back distinction: if there were such a distinction, we could expect a language where stress avoided front vowels for back vowels of the same height. To my knowledge, no such language exists.
The analysis of Gujarati does not require reference to any other types of DTE constraints. Evidence for the necessity of reference to non-DTEs is provided in chapter 4.

3.3 End-conflation: Nganasan

The aim of this section is to illustrate the ability of the present theory’s constraints to conflate categories. This is done through an analysis of the stress system of the Uralic language Nganasan ([ŋanásan]). This language is particularly interesting because it has conflation at both ends of the sonority scale – the more sonorous categories ‘low vowel’ and ‘mid vowel’ are conflated for stress purposes, as are high vowels with central vowels.

Section 3.3.1 presents relevant data, followed by an analysis in §3.3.2. Section 3.3.3 discusses what it means for two categories to be conflated in Optimality Theoretic terms. Section 3.3.4 considers representational approaches to sonority-driven stress. Since the aim of this section is to show the need for freely rankable constraints, constraints in a fixed ranking are discussed at appropriate junctures; a full discussion of fixed ranking theories can be found in §3.6.

3.3.1 Nganasan

This section presents an analysis of the Avam dialect of the Uralic language Nganasan, also known as Tawgi or Tawgi-Samoyed. The description of stress presented here is from Helimski (1998, p.c.) and fieldwork by Olga Vaysman (p.c.), with data supplemented by Castrén (1854), Haydú (1964), and Tereńenko (1979).

Nganasan has the vowels listed in Table 3.1.

<table>
<thead>
<tr>
<th>Vowel</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>Front short</td>
</tr>
<tr>
<td>y</td>
<td>Front long</td>
</tr>
<tr>
<td>i</td>
<td>Back short</td>
</tr>
<tr>
<td>e</td>
<td>Back short</td>
</tr>
<tr>
<td>o</td>
<td>Back short</td>
</tr>
<tr>
<td>a</td>
<td>Back long</td>
</tr>
</tbody>
</table>

Syllables have the shape CV(V)(C). Rimes may contain a diphthong or a long vowel.

Helimski (1998:486) describes stress as falling on a final CV: syllable, else the penult, as shown in (2). Each root and its affixes form a separate stress domain; compounds form two domains, one for each root.

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23 I am indebted to Eugene Helimski and Olga Vaysman for discussing Nganasan’s stress system with me and providing additional facts and data from their fieldwork. The most recent work on Nganasan phonology is found in Helimski (1998) and Vaysman (2002, in prep.).

24 There are some restrictions on vowels. For example, the front vowels do not appear in the first syllable after dentals. The mid vowel [o] only appears in non-initial syllables when flanked by labial sounds [b m], and non-initial [e] only occurs after palatals. Neither of these restrictions is significant for stress, so they will not be discussed further here. Helimski (1998) and Vaysman (2002, p.c.) differ as to whether Nganasan has palatalized coronals [t̠ d̠ s̠ n̠ l̠] (Helimski) or true palatals [c̠ j̠ ʃ̠ ɲ̠] (Vaysman); the latter approach is adopted here.
(2) **Nganasan Default Penult Stress**

- [kʰyːmáː] ‘knife’
- [kóɾu?] ‘house’
- [káŋdə?] ‘sledge’
- [kuhúmi] ‘our (dual) skin’
- [bátʃə] ‘master, chief’
- [bə.Ɂóu.ka] ‘a kind of moveable dwelling on runners’

However, stress can optionally fall on the antepenult if it contains a non-high vowel and the penult contains a high or central vowel in a mono-vocalic syllable.

(3) **Nganasan Antepenult Stress**

(a) Antepenult [e o], Penult [i y u i]
- [jémbiʔi] ‘dressing’
- [ŋónjiʔə] ‘going out’
- [kóntuʔa] ‘carries’

(b) Retraction to [a], Penult [i y u i]
- [nánuŋa] ‘1p.sg.locative’
- [bárui] ‘devil’
- [ŋajagajcy] ‘2 younger sisters’
- [hásirə] ‘fishing rod’

Importantly, central and high peripheral vowels are not ‘unstressable’: e.g. [kándə?] ‘sledge’, [ṇintiʔi] ‘aux.neg.3dual’, [kuhúmi] ‘our (dual) skin’.

The Nganasan pattern shows that there is a distinction between [a e o] on the one hand and [i y u i] on the other. Importantly, there are no distinctions within these sets. Stress does not retract from a penult [e o] onto a low vowel: e.g. [jánbómti] ‘7th’, *[jánbomti]. Similarly, stress does not retract from a central vowel onto a high vowel, as in (4).

(4) **No retraction from central to high vowels**

- [ŋitáŋi] ‘below’
- [ŋiŋiʔi] ‘I still’
- [hysáŋi] ‘trunk’
- [hursáŋi] ‘returning’
- [ṇintiʔi] ‘aux.neg.3dual’ cf [ṇínti]‘skin {3sg locative}’

Stress does not retract from a high vowel to a central vowel either: e.g. [nánsuʔə] ‘stands up’, *[nánsuʔә], [nədũʔə] ‘scours’, [tənũni] ‘there (locative)’.

58
In other words, Nganasan has two conflations: it conflates mid with low vowels for stress purposes, and high with central vowels.25

3.3.2 Analysis


While stress retraction to the antepenultimate syllable – and sensitivity to sonority – is optional, Eugene Helimski (p.c.) reports that it is the prevalent pattern. Accordingly, the grammar in which stress shift takes place is the focus of this section.

Words with vowels of the same sonority show that the default position for stress is the penult: e.g. [kuhúmi] ‘skin, hide’. To deal with default stress placement, the constraints in (5) will be used.

(5) ALIGNFtR “The right edge of every foot must be aligned with the right edge of a PrWd.” (McCarthy & Prince 1993a)

FTBIN “Every foot is binary at the syllabic or moraic level.” (McCarthy & Prince 1986)

TROCHEE “Every foot is left-headed” [i.e. ALIGN-L(6,Ft)] (McCarthy & Prince 1993a)

The constraint FTBIN deserves some brief discussion. Feet are assumed to be maximally disyllabic – trisyllabic and unbounded feet do not exist (Hayes 1995).26 So, the role of FTBIN is to ban monomoraic – i.e. ‘degenerate’ – feet. As shown in tableau (6), FTBIN, ALIGNFtR, and TROCHEE produce penult stress.

(6) Nganasan default stress

<table>
<thead>
<tr>
<th>/kuhumi/</th>
<th>FTBIN</th>
<th>ALIGNFtR</th>
<th>TROCHEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) ku(húmi)</td>
<td></td>
<td></td>
<td>*!</td>
</tr>
<tr>
<td>(b) ku(humí)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) (kúhu)mi</td>
<td></td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>(d) kuhu(mí)</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

25 The Uralic language Moksha Mordvin has been reported as having the same conflation of vowel qualities as Nganasan (Paaasonen 1938:114-119, Kenstowicz 1996). However, Kenstowicz notes that crucial data is missing from published sources (i.e. words that show conflation of high vowels and schwa – [CSC{I,u}]). Jack Reuter and Aleksandr Feokstitov (p.c.) report that words with such a shape do not exist in the standard dialect, but appear in south-east dialects. There is some evidence that high vowels are not conflated with schwa: stress moves off the default initial position if there is a high vowel in the second syllable in Feokstitov’s dialect: [pati] ‘put {3sg}’. Thus, at least one dialect of Moksha has the scale | o > i,u > e,o,a |, without conflation of the schwa and high vowels.

26 In OT the statement that an output structure “does not exist” means one of two things: (i) GEN never creates it, or (ii) it is harmonically bounded by some other structure (i.e. binary feet). For a discussion about which one is more appropriate for foot size, see Hyde (2001).
The dotted line indicates that the ranking of the constraints cannot be determined at this point. In order for a ranking argument to be established, constraint conflict must occur: the winner and a competitor must incur violations of distinct constraints. In the situation above, the winner does not incur any violations of the relevant constraints, so – just as with local harmonic bounding – ranking between them is indeterminate. This situation will change once the interaction of the sonority-stress constraints is considered.

### 3.3.2.1 Avoidance of stressed high and central vowels

Stress does not fall on a monomoraic penult when two conditions are met: (i) the penult contains a high or central vowel and (ii) the antepenult contains a non-high non-central vowel. The avoidance of high and central vowels in stressed syllables is expressed by the constraint $\text{PrWd} \leq \{i,u\}$. This constraint is violated when a PrWd DTE – i.e. a main-stressed syllable nucleus – contains a high vowel or anything less sonorous (i.e. [ə i]). As a reminder, the notation “$\leq \{i,u\}$” refers to all segments with the same sonority or less than peripheral high vowels; this includes the Nganasan vowels [i y u ə i].

The avoidance of stressed high and central vowels forces the foot to retract from the right edge of the PrWd: i.e. [(hótə)ja] ‘writes’, [(kóntu)ja] ‘carries’. Such a footing violates ALIGNFrR, indicating that $\text{PrWd} \leq \{i,u\}$ must outrank this constraint.

<table>
<thead>
<tr>
<th>/kontuja/</th>
<th>$\text{PrWd} \leq {i,u}$</th>
<th>ALIGNFrR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) kon(tú)ja</td>
<td>*!</td>
<td>*</td>
</tr>
<tr>
<td><code>еп</code> (b) (kóntu)ja</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The constraint $\text{PrWd} \leq \{i,u\}$ is violated by candidate (7a) because it contains a primary-stressed high vowel. In contrast, (7b) avoids violating this constraint by stressing a mid peripheral vowel. It is important to emphasize that “$\{i,u\}$” is an abbreviation for “peripheral high vowels”, including [i y u]. This ranking therefore accounts for antepenult stress in words like [(náky)ry?] as well.

The ranking in (7) accounts for the fact that stress avoids [ə] for mid and low vowels, as shown in tableau (8).

<table>
<thead>
<tr>
<th>/hóta/ja/</th>
<th>$\text{PrWd} \leq {i,u}$</th>
<th>ALIGNFrR</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>еп</code> (a) (hótə)ja</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(b) ho(tâ)ja</td>
<td>*!</td>
<td></td>
</tr>
</tbody>
</table>

Analogous to the situation in tableau (7), candidate (b) violates $\text{PrWd} \leq \{i,u\}$ because it contains a stressed schwa.

The ranking arguments supplied above indicate a general schema for sonority-driven stress. As shown in tableau (8), the ranking of the DTE-sonority constraint
*Δ_{PrWd}≤\{i,u\} over the foot-parsing constraints is a necessary component of sonority-driven stress. Without such a ranking, no sonority influence on stress would be visible.

In general terms, then, sonority-driven stress arises when some (non-)DTE-sonority constraint outranks some active stress-placement constraint. Of course, the extent of the constraints’ influence depends on the details of the ranking. In Nganasan, the constraint *Δ_{PrWd}≤\{i,u\} is so highly ranked that its influence is transparently obvious. However, other sonority-stress constraints have less influence.

At the other extreme is a language that has no sonority-sensitivity at all. The ranking necessary for sonority-driven stress is discussed further in §3.5.1 (see de Lacy 2002b for analogous rankings for tone-driven stress).

### 3.3.2.2 Low-end and high-end conflation

The ranking presented above accounts for the fact that stress avoids a penult or central high only when the antepenult contains a mid or low vowel. If the antepenult contained a high or central vowel, there would be no reason to stress it since doing so would not improve on violations of *Δ_{PrWd}≤\{i,u\}.

\begin{table}[h]
\begin{tabular}{|c|c|c|}
\hline
\text{Dagut} & \ast \Delta_{PrWd} \leq \{i,u\} & ALIGNFrR \\
\hline
(a) \text{yûsà} & \ast & \ast ! \\
\hline
(b) \text{yûsà} & \ast & \\
\hline
\end{tabular}
\end{table}

The tableau above shows that ALIGNFrR can be decisive in choosing the winner when more than one candidate incurs equal violations of the sonority-stress constraints. Since *Δ_{PrWd}≤\{i,u\} assigns the same violations to candidates (a) and (b), the vowels \[\text{û} \text{a} \text{u}\] are conflated for stress purposes – they are treated in exactly the same way.

High and central vowels are similarly conflated in Nganasan. In words with an initial high or central vowel in the penult, for example, stress falls on the penult as usual: e.g. [hursáji] ‘returns’. The present ranking accounts for this pattern, as illustrated in tableau (10).

\begin{table}[h]
\begin{tabular}{|c|c|c|}
\hline
\text{Dagut} & \ast \Delta_{PrWd} \leq \{i,u\} & ALIGNFrR \\
\hline
(a) \text{hûrsá} & \ast & \ast ! \\
\hline
(b) \text{hûrsá} & \ast & \\
\hline
\end{tabular}
\end{table}

Crucially, both candidates (a) and (b) incur the same violations of *Δ_{PrWd}≤\{i,u\}. Since *Δ_{PrWd}≤\{i,u\} is not decisive, the violations of ALIGNFrR become relevant, favouring the penult-stressed (b).

By assigning the same violations to stressed central and high vowels, *Δ_{PrWd}≤\{i,u\} effectively conflates the two categories. Since neither is preferred over the other, the footing constraints take over, preferring the default stress position.
So, for stressed high and central vowels to be treated the same, it is crucial that no constraint that favours one over the other outranks ALIGNFtR. More concretely, the constraint \( \star \Delta_{PrWd} \leq \emptyset \) must be ranked below the footing constraints. Since \( \star \Delta_{PrWd} \leq \emptyset \) favours stressed high vowels over stressed schwa, any other ranking would make an unwanted distinction between the two categories. This point is made in tableau (11).

\[
\begin{array}{|c|c|c|}
\hline
\text{/hursəji/} & \text{ALIGNFtR} & \star \Delta_{PrWd} \leq \emptyset \\
\hline
(a) (hûrsə)ji & \star! & \emptyset \\
\hline
(b) hur(səji) & & \emptyset \\
\hline
\end{array}
\]

As the tableau shows, the constraint \( \star \Delta_{PrWd} \leq \emptyset \) is crucially ‘inactive’ – it does not assign a violation that is relevant in determining the winner for stress purposes. At this point, it is possible to make a general statement about conflation: if two categories are conflated, there is no ‘active’ constraint that favours one over the other.

- ‘Active’

The term ‘active’ is used in a very limited sense here. A more general sense of the term ‘active’ is found in Prince & Smolensky (1993), in which a constraint is active if it bifurcates the candidate set into winners and a non-empty set of losers for some competition. For example, ALIGNFtR is active in Nganasan because it relegates candidate (b) in (11) to loser status in the competition between candidate forms from the input /hursəji/.

The term ‘active’ is used in a much more local sense here, applying solely to competitions relating to stress placement. For example, \( \star \Delta_{PrWd} \leq \emptyset \) is inactive for stress purposes: it never distinguishes winners from losers that differ just in terms of stress position. As tableau (11) shows, by the time candidate evaluation reaches \( \star \Delta_{PrWd} \leq \emptyset \), the position of stress has been determined (i.e. all remaining forms have stress in the same position). Thus, \( \star \Delta_{PrWd} \leq \emptyset \) is inactive in a very local sense, relating to stress position. However, it is possible that \( \star \Delta_{PrWd} \leq \emptyset \) is active in the general sense: \( \star \Delta_{PrWd} \leq \emptyset \) may make a crucial bifurcation in determining the quality of epenthetic vowels, for example (i.e. a TETU effect – McCarthy & Prince 1994).

In contrast, \( \star \Delta_{PrWd} \leq \{i,u\} \) is active for stress placement. As shown in tableau (8), this constraint makes a crucial determination between candidates that differ in stress position. The term ‘active’ will be used in the local sense from now on; its scope of reference in this chapter will be to stress position: so, constraint C is active in relation to stress if it eliminates candidates (i.e. assigns them ‘loser’ status) that differ from winning forms in terms of stress position.

- Summary

As an interim summary, the ranking needed to deal with conflation of the low-sonority categories in Nganasan is \( \| \star \Delta_{PrWd} \leq \{i,u\} \| \text{ ALIGNFtR } \star \Delta_{PrWd} \leq \emptyset \| \). This sort of ranking involves a general constraint outranking a more specific one, dubbed ‘anti-
Paninian’ in Prince (1997 et seq.). A constraint \( C_1 \) is more general than \( C_2 \) if \( C_1 \) incurs a superset of \( C_2 \)’s violations.

This is not the only ranking needed, though. Although stress avoids the less sonorous high and central vowels for the more sonorous mid and low vowels, it makes no distinction between mid and low vowels. Specifically, stress does not avoid a mid-vowel penult for a low vowel: e.g. [fájbmóti] ‘seventh’, *[fájbmóti]; of course, stress does not avoid a low vowel penult for a mid vowel: e.g. [konáʔa] ‘going’. This type of conflation is ‘high-end conflation’ – conflation of categories at the unmarked end of the scale.

As discussed above, two categories are distinct when no active constraint assigns them different violations. Since the constraint \(*\Delta_{PrWd}\leq\{e,o\}\) favours [á] over [é] and [ó], it must be inactive. In the present case, this means that it is ranked below ALIGNFtR.

\[
\begin{array}{|c|c|c|}
\hline
\text{}/fájbmóti/ & \text{ALIGNFtR} & \text{}/*\Delta_{PrWd}\leq\{e,o\}/ \\
\hline
\text{(a)} & \text{Ja} & \text{Ja} & \text{Ja} & \text{Ja} \\
\text{(b)} & \text{fájbmóti} & \text{Ja} & \text{Ja} & \text{Ja} \\
\hline
\end{array}
\]

This is ‘high-end conflation’ – conflation of categories at the unmarked end of the scale. As shown in tableau (12), high-end conflation has the same character in ranking terms as conflation of the low-end categories. So, \(*\Delta_{PrWd}\leq\{e,o\}\) occupies the same position as \(*\Delta_{PrWd}\leq\varnothing\) in the ranking established so far: \( \| *\Delta_{PrWd}\leq\{i,u\} \supseteq \text{ALIGNFtR} \supseteq *\Delta_{PrWd}\leq\{e,o\} \| \).  

Before moving on to consider why the present theory can successfully conflate categories, some other interactions of footing constraints with the sonority-stress constraints will be identified.

3.3.2.3 The interaction of sonority and prosodic conditions

There are two situations in which sonority conditions fail to force stress retraction. One relates to long vowels in penultimate and final position, and the other relates to pre-antepenultimate position.

• *Long Vowels*

Sonority does not take precedence over stress on a long vowel. For example, stress does not fall on the antepenult in [ŋonáʔáː] ‘once again’, even though doing so would result in a more sonorous stressed vowel (e.g. *[ŋonáʔáː]). In [kýːʔæʔ?] ‘they died’, stress does not fall on the ultima, though doing so would also improve sonority-stress markedness (e.g. *[kýːʔæʔ?]?).

This follows from foot form considerations. If stress appeared on the ultima in \( kýːʔæʔ? \) the foot would either be degenerate \(*[kýːʔæʔ?]\) or trimoraic \(*([kýːʔæʔ?]\); both candidates violate FTBIN.\(^{27}\)

\(^{27}\) The constraint NONFINALITY could also be used to block final stress (Prince & Smolensky 1993). Since FTBIN is independently necessary and appears in subsequent analyses, it will be used here.
The same reason accounts for the lack of retraction to the antepenult in /gónaxáðə/. If stress fell on the antepenult, the result would be a degenerate or trimoraic foot: *[ŋ(ŋ)ɔnaxáðə], *[ŋ(ŋ)ɔnaxáðə].

Thus, FTBIN outranks *��PrWd≤{i,u}, as shown in tableau (13).

<table>
<thead>
<tr>
<th>/gónaxáðə/</th>
<th>FTBIN</th>
<th>*��PrWd≤{i,u}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (ŋó)naxáðə</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>(b) (ŋónaxá)ðə</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>(c) ŋo(núxá)ðə</td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

This still leaves such words with the form [Ca:Cá:] to be accounted for, since stress on the [a:] would form an acceptable foot (i.e. *[Cá:Cá:]). The lack of such forms will fall out from consideration of the lack of pre-antepenult stress.

As a typological note, one may wonder if stress ever avoids long vowels for shorter vowels purely for sonority reasons. It can: sonority takes precedence over length in Kara, where stress seeks out a low vowel [a] even if the default position has a long vowel (Schlie & Schlie 1993). For a description and analysis, see de Lacy (1997a).

- **Limits on stress retraction**

While main stress appears on the antepenult under the right sonority conditions in Nganasan, it never appears on other positions. For example, the ultima never bears main stress, even when it contains a more sonorous vowel: e.g. [jygúsa] ‘get lost’, *[jusá]. Similarly, main stress never retracts to the pre-antepenult: e.g. [nagátənə] ‘stands up {elative}’, *[nágatána]. Eugene Helimski (p.c.) reports a more complex effect: stress retraction to the antepenult is the norm in three syllable words (e.g. [nákyry?] ‘three’), but is less common in four-syllable words: e.g. [námˈaːˈcýmə]~[námˈáˈcymə] ‘nine’. The limits on stress placement will be argued to follow from the interaction of footing constraints and the sonority-stress constraints.

As with heavy syllables, the constraints FTBIN and TROCHEE provide the reason why stress cannot appear on the final syllable. For stress to fall on a final light syllable, either the foot would have to be iambic – e.g. *[ju(qusá)] – or degenerate – e.g. *[jugu(sá)]. With both FTBIN and TROCHEE outranking *��PrWd≤{i,u}, final stress will be blocked even when it contains a more sonorous vowel.

<table>
<thead>
<tr>
<th>/jugsá/</th>
<th>TROCHEE</th>
<th>FTBIN</th>
<th>*��PrWd≤{i,u}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) ju(gúsa)</td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>(b) jugu(sá)</td>
<td></td>
<td></td>
<td>*!</td>
</tr>
<tr>
<td>(c) ju(gusá)</td>
<td></td>
<td></td>
<td>*!</td>
</tr>
</tbody>
</table>
A similar fact accounts for the lack of retraction to pre-antepenult position. Again, footing constraints override the avoidance of high and central stressed vowels. Two constraints are relevant in preventing pre-antepenult stress.

(15) \text{PARSE-}\mathbf{\sigma} \quad \text{"Every syllable is associated to a foot" (Prince \& Smolensky 1993)} \\
\text{HdFtR} \quad \text{"The rightmost foot is the head." (Tesar 1996)}

The constraint \text{PARSE-}\mathbf{\sigma} requires exhaustive footing. It outranks \text{ALIGNFtR} in Nganasan, as evinced by the presence of secondary stress in longer words: [kintalabtikuńiŋ] ‘you are smoking’.

(16) \begin{tabular}{|c|c|c|}
\hline
/s\text{intalabtikuńiŋ}/ & \text{PARSE-}\mathbf{\sigma} & \text{ALIGNFtR} \\
\hline
(a) (ki\text{nto})(lābti)(kuńiŋ) &  & * * \\
(b) kintalabti(kuńiŋ) & * * *! &  \\
\hline
\end{tabular}

The constraint \text{HdFtR} requires the rightmost foot to be the head. Together, \text{PARSE-}\mathbf{\sigma} and \text{HdFtR} ensure that main stress does not retract to the pre-antepenult. This is illustrated with the word /nți\text{nta}/ in tableau (17).

(17) \begin{tabular}{|c|c|c|c|c|}
\hline
/s\text{nți\text{nta}}/ & \text{HdFtR} & \text{PARSE-}\mathbf{\sigma} & *\mathbf{\Delta}_{pw}\leq\{i,u\} & \text{ALIGNFtR} \\
\hline
(a) (nā\text{go})(tā\text{na}) &  & * &  & * * \\
(b) (nā\text{go})tā\text{na} &  & * *! &  & * \\
(c) (nā\text{go})(tā\text{na}) & *! &  &  & * * \\
\hline
\end{tabular}

The ranking shows the difficulties that arise with pre-antepenult stress. If main stress falls on the pre-antepenult as in (b) and (c), either \text{PARSE-}\mathbf{\sigma} or \text{HdFtR} are violated. In (b), \text{PARSE-}\mathbf{\sigma} is violated because there are unfooted syllables; in (c), \text{HdFtR} is violated because the head foot is not the rightmost one. With these constraints outranking *\mathbf{\Delta}_{pw}\leq\{i,u\}, it is more harmonic to stress a low sonority vowel, as in (a).

The ranking given above has one interesting effect: it accounts for Helimski’s observation that stress retraction does not take place in four-syllable words (e.g. [ṇam\text{lyácyma}], *[ṇam\text{lyácyma}]). If stress did appear on the antepenult, the output form would have two unfooted syllables: *(nā(m\text{lyácy})mə). In comparison, the penult-stressed form has no unfooted syllables: ([ṇam\text{ly}a)(c\text{y}mə)]. This result is illustrated in tableau (18).

(18) \begin{tabular}{|c|c|c|}
\hline
/s\text{ṇam\text{lyácy}mə}/ & \text{PARSE-}\mathbf{\sigma} & *\mathbf{\Delta}_{pw}\leq\{i,u\} \\
\hline
(a) (ṇam\text{ly}a)(c\text{y}mə) &  & * \\
(b) ṇa(m\text{lyácy})mə & * *! &  \\
\hline
\end{tabular}
Importantly, the ranking does not affect trisyllabic words. In trisyllabic forms, either antepenult or penult stress will incur the same violations of PARSE-σ, allowing the influence of \( *\Delta_{PrWd} \leq \{i,u\} \) to emerge. This situation is illustrated in tableau (19).

\[
\begin{array}{ccc}
/nakyry\tilde{y}/ & \text{PARSE-σ} & *\Delta_{PrWd} \leq \{i,u\} \\
(a) (náky)ry & * & * \\
(b) na(kýry?) & * & *!
\end{array}
\]

In short, the limitations on stress retraction in Nganasan follow from the interaction of footing and the sonority-stress constraints. The resulting ranking is summarized in Figure 3.2.

**Figure 3.2: Nganasan sonority-driven stress ranking summary**

\[
\begin{array}{c}
\text{F Tf B IN} \\
\text{PARSE-σ} \\
*\Delta_{PrWd} \leq \{i,u\} \\
\text{ALIGNFtR} \\
*\Delta_{PrWd} \leq \{e,o\} \\
*\Delta_{PrWd} \leq \{e,o\}
\end{array}
\]

With the ranking details aside, the properties of the present theory that allow it to produce conflation in Nganasan will be discussed.

Before moving on to consider the details of conflation, a brief discussion of the ranking needed for non-retraction will be given. The ranking in Figure 3.2 deals with the system in which stress retracts to the antepenult. However, retraction is optional in Nganasan: stress may remain on the default penult position. This sonority-insensitive pattern comes about by having ALIGNFtR dominate \( *\Delta_{PrWd} \leq \{i,u\} \) as well as \( *\Delta_{PrWd} \leq \{e,o\} \) and \( *\Delta_{PrWd} \leq \{e,o\} \). For approaches to optionality involving ‘tied’ constraints, ALIGNFtR and \( *\Delta_{PrWd} \leq \{i,u\} \) would be unranked with respect to each other (Anttila 1997, and references cited in McCarthy (2001b:233)).

### 3.3.3 The essentials of conflation

This section is devoted to showing that unfettered ranking permutation is essential in allowing conflation, building on Prince (1997 et seq.). To do this, an argument that constraints in a fixed ranking cannot produce conflation is presented, regardless of whether the constraints are stringently or non-stringently formulated.

Categorization and conflation are antagonistic requirements on a theory of scale-referring constraints. The former requires the theory to make distinctions between...
categories, while the latter requires them to be conflated. The discussion above showed that two categories are conflated when they are assigned the same violations by active constraints (see §3.3.2.2 for discussion of ‘active’). For example, stressed central and high vowels are conflated in Nganasan because the only relevant active constraint is \(*\Delta_{PrWd}\ll\{i,u\}\) and it assigns the same violations to both types. The relevant tableau is repeated in (20).

\[
\begin{array}{ccc}
\text{/hurs\textsuperscript{a}ji/} & *\Delta_{PrWd}\ll\{i,u\} & \text{ALIGNFrR} \\
(a) \text{(hürs\textae)\textipa{ji}} & * & *! \\
\text{ë} & (b) \text{hur(s\textae)\textipa{ji}} & *
\end{array}
\]

The observation that conflation comes about when two categories incur the same violations of active constraints necessitates that a theory of scales have constraints that refer to ranges of elements on a scale. To prove this point, consider a theory with constraints that refer to points on a scale (Prince & Smolensky 1993, Kenstowicz 1996).

\[
|| *\Delta_{PrWd}/\textae \gg *\Delta_{PrWd}/\{i,u\} \gg *\Delta_{PrWd}/\{e,o\} \gg *\Delta_{PrWd}/a ||
\]

No constraint assigns the same violations to both [ɨ] and [í ú]. Therefore, the two categories cannot be conflated with just these constraints. This point is illustrated in the following tableau. Since [í ú] is favoured over [ɨ], the ranking incorrectly predicts that stress should always avoid [æ] for high vowels.

\[
\begin{array}{cccc}
\text{/hurs\textsuperscript{a}ji/} & *\Delta_{PrWd}/\textae & *\Delta_{PrWd}/\{i,u\} & \text{ALIGNFrR} \\
\bullet & (a) \text{(hürs\textae)\textipa{ji}} & * & * \\
\text{ë} & (b) \text{hur(s\textae)\textipa{ji}} & *! & *
\end{array}
\]

There is no ranking of the Fixed Ranking constraints that can produce the result attested in Nganasan and is consistent with the ranking in (21). The only other option is to rank both *\Delta_{PrWd}/\textae and *\Delta_{PrWd}/\{i,u\} below ALIGNFrR. However, such a ranking eliminates all sensitivity to sonority; stress is incorrectly predicted to always fall on the penult: 28

\[
\begin{array}{ccc}
\text{/kan\textae\textipa{m}tu/} & \text{ALIGNFrR} & *\Delta_{PrWd}/\textae & *\Delta_{PrWd}/\{i,u\} \\
\bullet & (a) \text{(kán\textae\textipa{m})tu} & *! & * \\
\text{ë} & (b) \text{ka(n\textae\textipa{m})tu} & *
\end{array}
\]

There is no way to fix the problem identified above by introducing other constraints. It is crucial in Nganasan that some active constraint (or constraints) favour [é

---

28 Fixed Ranking theories can effect some conflation. For detailed discussion, see §3.5.
ó á] over [á í ú] while no active constraint favours [í ú] over [á]. While the Fixed Ranking theory has constraints that do the former, those same constraints do not satisfy the latter condition.

It is not enough that a theory have constraints that refer to ranges of a scale. In order for conflation to take place, the ranking of the constraints must be freely permutable. Nganasan illustrates this point well. In Nganasan *Δ_PWd≤{i,u} outranks both *Δ_PWd≤{e,o} and *Δ_PWd≤ə. This ranking allows central and high vowels to be conflated, and mid and low vowels to be conflated (see tableaux (11) and (12)). If either *Δ_PWd≤{e,o} or *Δ_PWd≤ə had to always outrank *Δ_PWd≤{i,u}, the Nganasan confluations would be impossible.

In fact, §3.4 shows that Gujarati employs the exact opposite to the Nganasan ranking: both *Δ_PWd≤{ə} and *Δ_PWd≤{e,o} outrank *Δ_PWd≤{i,u}. This ranking allows conflation of high and mid peripheral vowels (since *Δ_PWd≤{i,u} is inactive). The activity of *Δ_PWd≤{ə} ensures that central vowels are treated distinctly from peripheral vowels, and *Δ_PWd≤{e,o} prevents conflation of [a] with other vowels. For a full analysis, see §3.4.

To put the observation above in slightly different terms, the problem with constraints in a fixed ranking is that they impose implicational relations between confluations. For example, if the ranking || *Δ_PWd≤ə » *Δ_PWd≤{i,u} || were universal, no language could both avoid stressed high vowels and conflate them with [á]. If schwa is conflated with high vowels, then no constraint that favours the latter over the former can be active. Therefore *Δ_PWd≤ə must be inactive. However, if *Δ_PWd≤ə is inactive, then every lower-ranked constraint is also inactive, including *Δ_PWd≤{i,u}. The effect is that stress is not sonority sensitive. In other words, this theory predicts that if category x is actively penalized by some constraint, x is not conflated with any other category.

The opposite fixed ranking || *Δ_PWd≤{i,u} » *Δ_PWd≤ə || incorrectly predicts that if [á] is avoided and not conflated with [í ú], then [í ú] will also be avoided. If [á] is not conflated with [í ú], then some constraint that distinguishes the two categories must be active – i.e. *Δ_PWd≤ə. If *Δ_PWd≤ə is active, though, then every higher ranked constraint is also active. So, *Δ_PWd≤{i,u} must be active, so predicting a distinction between stressed high vowels and other types. In short, such a fixed ranking rules out languages in which stress avoids schwa but is conflated for the other categories.

Section 3.6 provides a more detailed characterization of the limitations on conflation in the Fixed Ranking theory.

### 3.3.4 Representational theories

Up to this point, Nganasan stress has been assumed to be sensitive to sonority rather than some other property. The alternative is a ‘representational’ theory in which stress cannot refer to sonority, but only to structural distinctions. In one version of such a theory, stress’s avoidance of [ə i y u i] for [e o æ a] in Nganasan would reduce to the claim that the vowels in the former set have fewer moras than the latter. Stress preference for syllables with greater moraic content would produce the observed stress system.

There are problems with the implementation of the representational approach, not just in Nganasan but in most other cases of sonority-driven stress. One relates to
proliferation of structure. Nganasan has both long and short vowels: e.g. [ti] ‘we (dual)’ cf [hi:] ‘night’. Therefore, if the difference between high vowels and schwa on the one hand and non-high vowels on the other were moraic, one would be forced to posit a ternary moraic distinction in Nganasan. Not only does such a proposal have unattested effects on phonetic realization, but it opens the door for many more moraic contrasts than are attested. In effect, such an approach reduces moras to serving as little more than a diacritic device that is effectively synonymous with sonority.

Representational theories also make strong predictions about other processes in the grammar. Proposing that [a] and high vowels have fewer moras than other vowels predicts that they can – and perhaps must – be treated differently for other mora-referring processes. For example, there is a minimal word restriction in Nganasan – every content word is minimally CVC or CV(C)V: e.g. [tu] ‘fire’, [bi] ‘water’, [nəsa] ‘scours’. For word minima all moras count as the same: [nəsa] is not monomoraic. This point is discussed at length by Gordon (1999).

• ‘Schwa is special’ theories

Another popular representational theory relates specifically to the opposition between schwa and peripheral vowels. Oostendorp (1995) and many others have claimed that schwa is phonologically distinct from all other vowels in that it lacks features. With additional theoretical devices, this fact makes schwas ‘weak’, and consequently unable to bear to stress. This theory is one of a class that considers schwa to be fundamentally different from all other vowels, in a phonological sense.

The present work denies that schwa is significantly different from other vowels in phonological terms – the only difference is that schwa is lower on the sonority scale than (most) other vowels. The fact that Nganasan treats high vowels and schwa in the same way supports this proposal: Nganasan clearly does not make a division between schwa and peripheral high vowels.

Problems for the ‘featureless schwa’ approach also arise when considering the high central vowel [i]. In Nganasan (and Pichis Asheninca too – Payne 1990), [i] acts like schwa – it repels stress at every opportunity. If lack of features accounts for repulsion of stress, [i] must also be featureless, rendering [i] and [a] phonologically indistinct; this is a significant problem for languages that contrast the two vowels (e.g. Nganasan, Maga Rukai – Hsin 2000:32ff).

In short, stress does not show that schwa is fundamentally different from other vowels, phonologically speaking. Schwa is simply low on the sonority hierarchy; its behaviour in phonological processes follows from this fact.

• Generalizing the critique

The same type of criticism not only applies to representational approaches to sonority-driven stress, but to representational approaches to scales in general. For example, a representational approach to the PoA scale has it that non-coronals have Place features while coronals are featureless. Such an approach has been criticized for the implications it has elsewhere in the grammar – this approach predicts that coronals should be transparent to place assimilation and fail to condition any process (assuming that default
rules are the last ones to apply). As McCarthy & Taub (1992) point out, though, this prediction is not borne out (also see ch.7 in Prince & Smolensky 1993: ch.9, Steriade 1995b). Similar arguments have been made for the tonal scale; these again are inadequate, as discussed in ch.6§6.5.2.3.

3.3.5 Summary

To summarize, the full range of attested conflations can only be produced by constraints whose ranking is freely permutable. Nganasan’s conflation of stressed central and high peripheral vowels necessitates a constraint that assigns the two categories the same violations while favouring mid- and low vowels – i.e. \( *\Delta_{PrWd} \leq \{i, u\} \). It also requires all constraints that distinguish between the categories – i.e. \( *\Delta_{PrWd} \leq \sigma \) – to be inactive, and therefore lower ranked than \( *\Delta_{PrWd} \leq \{i, u\} \). Since other languages require the opposite ranking (e.g. Gujarati – §3.4), it is clear that ranking of scale-referring constraints must be freely permutable.

Constraints in fixed rankings cannot produce all possible conflations. By having a fixed ranking between constraints, implicational relations are set up between categories: the conflation of one set of categories comes to depend on the conflation of others.

Many of the results in this section depend on the claim that any group of contiguous categories can be conflated. To demonstrate the validity of this claim, the stress system of Gujarati is analyzed in the next section; unlike Nganasan, Gujarati conflates the ‘middle’ vowel sonority categories i/u and e/o. A full typology of attested conflations is presented in §3.5. Section 3.6 explores the consequences of fixed rankings for conflation in more detail.

3.4 Medial conflation: Gujarati

As mentioned in the introduction, Gujarati [gɔ(d)ɛr̥ati] stress is sensitive to sonority distinctions. In terms of conflation, Gujarati complements Nganasan: instead of conflating categories at the ends of the vowel sonority scale, the medial categories ‘mid vowels’ and ‘high vowels’ are conflated instead.

Gujarati has eight vowels, given in Table 3.2.

<table>
<thead>
<tr>
<th>Table 3.2: Gujarati vowels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front</td>
</tr>
<tr>
<td>i</td>
</tr>
<tr>
<td>e</td>
</tr>
<tr>
<td>e</td>
</tr>
<tr>
<td>a</td>
</tr>
</tbody>
</table>

I am grateful to my consultant Shimauli Dave for her native speaker intuitions and help with the data presented in this section.
Table 3.3: Gujarati consonants

<table>
<thead>
<tr>
<th></th>
<th>labial</th>
<th>dental</th>
<th>alveolar</th>
<th>(alveo-) palatal</th>
<th>retroflex</th>
<th>velar</th>
<th>glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td>-vd stops</td>
<td>p</td>
<td>t</td>
<td></td>
<td>tʲ</td>
<td>t</td>
<td>k</td>
<td></td>
</tr>
<tr>
<td>+vd stops</td>
<td>b</td>
<td>d</td>
<td></td>
<td>dʒ</td>
<td>d</td>
<td>g</td>
<td></td>
</tr>
<tr>
<td>fricatives</td>
<td>s (z)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>nasals</td>
<td>m</td>
<td>n</td>
<td></td>
<td>(n)</td>
<td>η³</td>
<td>N⁻³⁰</td>
<td></td>
</tr>
<tr>
<td>laterals</td>
<td>l</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>flap</td>
<td></td>
<td>r</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>glides</td>
<td>w~v</td>
<td>j</td>
<td></td>
<td></td>
<td></td>
<td>h</td>
<td></td>
</tr>
</tbody>
</table>

• Symbols in brackets are marginal.
• For [N], see ch.5§5.3.1.

Gujarati syllables can be described by the template (C¹)(C²)V((C³)C₄). Onsets are optional, as shown by [a.po] ‘give’, and [pi.e] ‘he drinks’. C² must be one of [j h], while C³ must be a nasal homorganic with a following stop (e.g. [hɪnʃ], [təŋɡ]). Geminate consonants are allowed: e.g. [chά]:ŋ] ‘56’, [gusʊ:]: ‘anger’.

The following description of stress placement is based on my own fieldwork and Cardona (1965).

For stress purposes, distinctions between syllable types prove to be of little relevance. The primary determinant of stress is sonority. Cardona (1965) describes some variation that my consultant did not exhibit. The following description is therefore based on my results; Cardona’s work is discussed in §3.4.1.4. Only stress in di- and tri-syllabic words is described because there are few Prosodic Words of more than three syllables in length.

Stress is realized as raised pitch and amplitude. Phonological evidence that stress is located as described below comes from intonation and allophony. For intonation, stressed syllables are the locus for the pitch accents of intonational melodies. Allophonic alternations between high peripheral and non-peripheral vowels [i u]~[i u] are also conditioned by stress (Cardona 1965:20-1). The non-peripheral allophones appear in non-final open syllables, except when they are stressed.

(24) Gujarati vowel allophony

<table>
<thead>
<tr>
<th>Stressed [i ú]</th>
<th>Unstressed [i u]</th>
</tr>
</thead>
<tbody>
<tr>
<td>[bɪdɨ] type of cigar</td>
<td>[niʃá] ‘school’</td>
</tr>
<tr>
<td>[sʊdʰi] ‘until’</td>
<td>[otáwə] ‘rush, hurry’</td>
</tr>
</tbody>
</table>

[N] is a nasal glide. See chapter 5 for discussion.
Cardona (1965:31) also mentions that C² may be [r] or [d], though this varies depending on the dialect.
Words with more than three syllables are typically morphologically complex, with PrWd divisions coinciding with morpheme boundaries. Other long forms contain prefixes or enclitics, neither of which counts in stress placement. To account for this latter fact, I take it that the PrWd in Gujarati encloses only the root and suffixes, excluding prefixes and clitics (a common pattern – see Nespor & Vogel 1986).
The following table describes the position of primary stress; there is no secondary stress. This data expands on (1).

(25) Gujarati Stress

(a) Stress a syllable with [a]
(i) in the penult

<table>
<thead>
<tr>
<th>Syllable</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>[awːánɑ]</td>
<td>‘coming’</td>
</tr>
<tr>
<td>[mubárak]</td>
<td>‘New Year’</td>
</tr>
<tr>
<td>[azádí]</td>
<td>‘freedom’</td>
</tr>
<tr>
<td>[sáðɑ]</td>
<td>‘plus ½’</td>
</tr>
<tr>
<td>[dʒája]</td>
<td>‘let’s go’</td>
</tr>
<tr>
<td>[betálɪs]</td>
<td>‘42’</td>
</tr>
<tr>
<td>[pətʃásmʊ]</td>
<td>‘50th’</td>
</tr>
</tbody>
</table>

(ii) else in the initial syllable

<table>
<thead>
<tr>
<th>Syllable</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>[táðʒetɛɾ]</td>
<td>‘recently’</td>
</tr>
<tr>
<td>[lájbrɛɾi]</td>
<td>‘library’</td>
</tr>
<tr>
<td>[mánɪto]</td>
<td>‘I want’</td>
</tr>
</tbody>
</table>

(iii) else in the final syllable

<table>
<thead>
<tr>
<th>Syllable</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>[sinemá]</td>
<td>‘movie theatre’</td>
</tr>
<tr>
<td>[pəheːlán]</td>
<td>‘year’</td>
</tr>
<tr>
<td>[ɔpʰɪsmá]</td>
<td>‘office’</td>
</tr>
<tr>
<td>[tʃəpəɾá]</td>
<td>‘girls’</td>
</tr>
<tr>
<td>[dekhɑtʃ]</td>
<td>‘can be seen’</td>
</tr>
</tbody>
</table>

(b) Else stress a non-final syllable with one of [ε ə o i u]
(i) in the penult

<table>
<thead>
<tr>
<th>Syllable</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>[tʃʰɔkrɪo]</td>
<td>‘girls’</td>
</tr>
<tr>
<td>[tʃʰumɔtɛɾ]</td>
<td>‘74’</td>
</tr>
<tr>
<td>[pəheːlʊ]</td>
<td>‘first’</td>
</tr>
<tr>
<td>[ɔpʰɔs]</td>
<td>‘office’</td>
</tr>
</tbody>
</table>

(ii) else in the initial syllable

<table>
<thead>
<tr>
<th>Syllable</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>[pʊstəkʰ]</td>
<td>‘book’</td>
</tr>
<tr>
<td>[ɔɾkʰɔwʊ]</td>
<td>‘know’</td>
</tr>
<tr>
<td>[bʊkɑɾɔ]</td>
<td>‘a mouthful’</td>
</tr>
</tbody>
</table>

(c) Else stress penult [ə]

<table>
<thead>
<tr>
<th>Syllable</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>[kɑɾɛ]</td>
<td>‘does, do’</td>
</tr>
<tr>
<td>[dʒɑɾmin]</td>
<td>‘land’</td>
</tr>
<tr>
<td>[pɑɾɔŋɡ]</td>
<td>‘kite’</td>
</tr>
<tr>
<td>[pəɾɑntʊ]</td>
<td>‘but’</td>
</tr>
</tbody>
</table>

The description can be informally cast in terms of two interacting preference scales, one relating to sonority, and one relating to position.
With regard to sonority, stress is attracted to the highly sonorous vowel [a] over every other type. So, if a word contains an [a], it always ends up stressed, while the other vowels miss out: e.g. [tádʒətəɾ] ‘recently’, [sinəmá] ‘cinema, movie theatre’. Similarly, stress tends to avoid schwa for higher sonority vowels: e.g. [ólkʰəwû] ‘to know’, [kójəldi] ‘little cuckoo’. However, stress does not avoid [ə] entirely: when the only other syllable is final, stress will rather stay on the schwa: e.g. [ʃarú] ‘beginning’, [parəntu] ‘but’.

Of present interest is the fact that stress does not prefer mid peripheral vowels over high peripheral vowels. For example, stress falls on the penult in [tʃʰəkrío] ‘girls’, and not on the more sonorous mid vowel: *[tʃʰəkrío]. In other words, the open mid, close mid, and high vowels are conflated for stress purposes in Gujarati.

The other preference scale relates to position. The penult is clearly the most unmarked stress position: in words where all vowels are identical, the penult receives the stress: [awːána] ‘coming’, [wakʰatsəɾ] ‘on time’. The next most favoured position is the antepenult.33 This is evident from words with both an initial and final [a]: e.g. [páktʃən] ‘Pakistan’; since stress must fall on an [a] but the penult is not available, it can fall on either the antepenult or ultima here, but chooses the antepenult.

The final position is clearly the least desirable position. Stress only falls on an ultima [a] if there are no other [a]’s present: e.g. [sinemá] ‘cinema, movie theatre’. This is the only situation where stress falls on the ultima. Stressing a final syllable is deemed less desirable than stressing a schwa: e.g. [kær] ‘does, do’, [parəbdj] ‘water-dispensing shed’. This fact will be shown to follow from the interleaving of a constraint banning degenerate feet – McCarthy & Prince’s (1986) FTBIN – with the DETE/sonority constraints. Specifically, FTBIN will dominate all constraints that seek to avoid stressed schwa alone (i.e. *$\Delta_{PrWd} \leq \{ə\}$), so preventing stressed schwa from forcing final stress; in contrast, *$\Delta_{PrWd} \leq \{e,o\}$ will outrank NONFINALITY, meaning that the desire to avoid non-low stressed vowels will disregard the final stress prohibition.

So, Gujarati stress can be described informally as resulting from two interacting preference hierarchies: the sonority preference ranking of | $a \succ e, ə, e, o, i, u \succ ə$ | and the position hierarchy of | penult $\succ$ antepenult $\succ$ ultima |. The following section casts these hierarchies, and their interaction, in terms of the present theory.

3.4.1 Analysis

The unmarked position of stress is the penult, as shown by words where all syllables have vowels of the same sonority: e.g. [awːánə] ‘coming’, [ekóter] ‘71’, [wakʰatsəɾ] ‘on time’. This fact follows if Gujarati has a trochaic (left-headed) foot aligned with the right edge of the PrWd: i.e. [e(kóter)]. This is the same pattern as found in Nganasan, so the same constraints and analysis are employed here:

33 Or the initial syllable – it is impossible to tell given the restrictions on PrWd-length noted above.
The formal expression of markedness – ch.3

As in Nganasan, the footing constraints are violated in some situations, namely when there is a non-penult [a] or when the penult contains a [ə]. The following two sections deal with both of these situations in turn.

As in Nganasan, a constraint requiring left-headed feet (i.e. TROCHEE) outranks all sonority-stress constraints. Importantly, this constraint does not ban monosyllabic (i.e. degenerate) feet – this is FTBIN’s job, as illustrated in (26). As we will see, FTBIN is crucially violated in certain words with final [a] (e.g. [sine(má)]).

3.4.1.1 Avoidance of stressed non-[a]

Stress does not always appear on the penult in Gujarati: it is attracted to an initial [a] when the penult contains a mid vowel (e.g. [tádʒetər] ‘recently’), high vowel (e.g. [mánito] ‘respected (masc.)’), or schwa (e.g. [máŋəski] ‘swift mare’). Of course, [a] is the most sonorous vowel, so this departure from the default stress position indicates that sonority has an overriding influence on stress in this language.

For stress to avoid the penult in favour of stressing an [a], two conditions must hold: (i) some constraint must favour stressed [a] over all other stressed vowels, and (ii) that constraint must outrank ALIGN F T R. The latter ranking is crucial since initial stress means that the foot cannot be right aligned: i.e. [(tádʒe)tər].

The present approach provides such a constraint: *ΔPrWd≤{ε,ɔ} “Assign a violation to the DTE of a PrWd if it contains a vowel with less sonority than a low vowel.” Only [á] does not violate this constraint. Tableau (27) shows the necessary ranking.

34 I assume that TROCHEE is undominated, eliminating candidates with iambic feet (e.g. [(jikár)]).
Paul de Lacy

(28) Gujarati III: \( \Delta_{PrWd} \leq \{ \varepsilon, \sigma \} \rightarrow \text{FTBIN} \\

<table>
<thead>
<tr>
<th>/ji'kar/</th>
<th>( \Delta_{PrWd} \leq { \varepsilon, \sigma } )</th>
<th>FTBIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (ji'kər)</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>(b) ji'kər</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

Even though the stress-sonority constraint \( \Delta_{PrWd} \leq \{ \varepsilon, \sigma \} \) outranks ALIGNFrT and FTBIN, this does not mean that the two foot-locating constraints are irrelevant to stress placement. They can have an emergent effect, determining the hierarchy of positional preference identified in the preceding section. For example, when all vowels in a word are [a], the constraint \( \Delta_{PrWd} \leq \{ \varepsilon, \sigma \} \) will not determine the winning form. In this situation, the foot-locating constraints play a decisive role:

(29) Gujarati IV: Emergence of ALIGNFrT and FTBIN

<table>
<thead>
<tr>
<th>/awwanã/</th>
<th>( \Delta_{PrWd} \leq { \varepsilon, \sigma } )</th>
<th>ALIGNFrT</th>
<th>FTBIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (áwwa)nã</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) aw(wánã)</td>
<td></td>
<td></td>
<td>*!</td>
</tr>
<tr>
<td>(c) awwa(nã)</td>
<td></td>
<td></td>
<td>*!</td>
</tr>
</tbody>
</table>

In this way, the foot-locating constraints establish a hierarchy of positional preference: when sonority is not at issue, stress prefers to fall on the penult. The next most favoured position is the initial syllable; when only the initial and final syllables contain [a], the initial wins: [(pákis)tan] ‘Pakistan’, *[pákis(tán)]. This fact allows us to establish a further ranking: since the final-stressed form violates FTBIN while the initial-stressed form violates ALIGNFrT, the former must outrank the latter:

(30) Gujarati V: FTBIN \( \rightarrow \) ALIGNFrT

<table>
<thead>
<tr>
<th>/pákistán/</th>
<th>( \Delta_{PrWd} \leq { \varepsilon, \sigma } )</th>
<th>FTBIN</th>
<th>ALIGNFrT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (pákis)tan</td>
<td></td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>(b) pakis(tán)</td>
<td></td>
<td></td>
<td>*!</td>
</tr>
<tr>
<td>(c) pa(kístan)</td>
<td></td>
<td></td>
<td>!</td>
</tr>
</tbody>
</table>

To summarize, the ranking \( \Delta_{PrWd} \leq \{ \varepsilon, \sigma \} \rightarrow \text{FTBIN} \rightarrow \text{ALIGNFrT} \) not only accounts for the fact that stress avoids syllables without [a], but accounts for the hierarchy of preference in position: the constraints determine that the most harmonic position is the penult, then the antepenult, then finally the ultima.

3.4.1.2 Avoidance of stressed schwa

Attraction of stress to [a] is not the only visible effect of sonority-stress interaction in Gujarati. Stress also avoids the lowest sonority vowel [ə]: e.g. [pústkan] “book”, [wísmàn] ‘forgetfulness’, [kójald] ‘little cuckoo’.

Schwa is not ‘unstressable’. Stress falls on [ə] in two situations: (i) when there are no other non-[ə] vowels (e.g. [pátsəŋg] ‘kite’, [wakbástar] ‘on time’), and (ii) when the
only other option is final stress on a non-low vowel (e.g. [káře] ‘do’, [náwo] ‘new’, [járu] ‘beginning’, [pářbdjí] ‘water-dispensing shed’). This latter situation contrasts with the influence of [a] on stress: Gujarati prefers a final stressed [a] over a penult of lower sonority, while it does not prefer a final higher sonority stressed vowel to a low sonority penult [s]. This restriction will prove significant in evaluating the adequacy of scale theories below. For the moment, the focus will be on presenting an account that employs the constraints proposed so far.

Stressed [ə] in Gujarati is clearly less harmonic than other stressed vowels. The relevant constraint is *ΔPrWd≤ə, a constraint that assigns stressed schwa a violation, but no other stressed vowels.

The word [(kójəldi)] provides a clue to the ranking of *ΔPrWd≤ə with respect to the foot-locating constraints. Since the foot is not right-aligned in this word due to the desire to avoid a stressed schwa, *ΔPrWd≤ə must outrank ALIGNFr:

(31) Gujarati VI: || *ΔPrWd≤ə » ALIGNFr ||

<table>
<thead>
<tr>
<th>kojəldi/</th>
<th>*ΔPrWd≤ə</th>
<th>ALIGNFr</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (kójəldi)</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(b) ko(jəldi)</td>
<td>*!</td>
<td></td>
</tr>
</tbody>
</table>

This leaves the ranking of *ΔPrWd≤ə and FTBIN to be determined. In this respect, the form [(káře)] is illuminating. Its competitor is *[kə(ře)], with a higher sonority ΔPrWd, but a FTBIN violation. Clearly, the FTBIN violation is not worth avoiding a stressed schwa in Gujarati. Therefore, FTBIN must outrank *ΔPrWd≤ə.

(32) || FTBIN » *ΔPrWd≤ə ||

<table>
<thead>
<tr>
<th>káře/</th>
<th>FTBIN</th>
<th>*ΔPrWd≤ə</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (káře)</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(b) kə(ře)</td>
<td>*!</td>
<td></td>
</tr>
</tbody>
</table>

As in Nganasan, the competitor [(kəře)], with an iambic foot, is eliminated through the undominated constraint TROCHEE; this constraint bans right-headed feet.

In summary, the ranking for avoidance of stressed schwa is || TROCHEE, FTBIN » *ΔPrWd≤ə » ALIGNFr ||. This ranking is interesting because it shows how the influence of sonority on a stress system may be restricted to specific environments. Unlike *ΔPrWd≤{e,ə}, *ΔPrWd≤ə does not outrank every relevant foot-locating constraint; its domination by FTBIN precludes sonority-sensitivity in every environment.35

In other words, the ranking interaction of the sonority-stress constraints and foot-locating constraints not only determines whether stress will be influenced by sonority, but the extent of that influence. One other point is that the ranking || FTBIN » ALIGNFr || has been proven both directly (in (30)) and by transitivity.

35 Gujarati contrasts with Chukchi in this regard: Kenstowicz shows that avoidance of stressed schwa can motivate final stress in Chukchi, while avoidance of stressed high vowels cannot. See Kenstowicz (1996) for an analysis, which can be straightforwardly converted into the present constraints.
The remaining relevant constraint is $\Delta_{\text{PrWd}} \leq \{i,u\}$ – this constraint is violated when the $\Delta_{\text{PrWd}}$ contains a segment with the sonority of a high vowel or less. Since every grammar contains the same constraints, it is not possible to say that this constraint is irrelevant in Gujarati – it must be ranked somewhere. This ranking is the subject of the next section.

### 3.4.1.3 Conflation of medial categories

There are three sonority distinctions in Gujarati stress: [a] vs [ɛ ə e o i u] vs [ə]. Of present interest is the fact that mid and high peripheral vowels are treated in the same way. Mid and high vowels both lose stress to [a]: e.g. [mánito] ‘I want’, [nuksán] ‘damage’, [boláj] ‘is spoken’, [tádétar] ‘recently’. Similarly, they both attract stress away from [ə]: [pústakné] ‘book’, [wísmrán] ‘forgetfulness’, [kójáldí] ‘little cuckoo’. However, mid and high vowels do not attract stress away from each other. Stress does not avoid high vowels for the more sonorous mid vowels: e.g. [tʃʰɔkríne] ‘boys’, [kʰedí] ‘inkstand’. Nor does stress avoid mid vowels for high vowels: e.g. [tʃumőtér] ‘74’. In short, mid and high vowels form a single unified category for stress purposes.

As discussed in §3, categories are distinct if they incur distinct violations of active constraints (see §3.3.2.2 for discussion of ‘active’). Therefore, for [í ú] to be distinct from [é ó], some constraint that favours one over the other must be active. The relevant constraint is $\Delta_{\text{PrWd}} \leq \{i,u\}$; this constraint is violated by stressed high vowels (and everything of lesser sonority), but not stressed mid vowels. So, in any grammar that distinguishes the two – e.g. Nganasan – $\Delta_{\text{PrWd}} \leq \{i,u\}$ must be active. Conversely, if [í ú] and [é ó] are conflated, it follows that $\Delta_{\text{PrWd}} \leq \{i,u\}$ must be inactive. In Gujarati, then, $\Delta_{\text{PrWd}} \leq \{i,u\}$ must be sufficiently low-ranked so as not to be crucial in choosing the winner.

As the analysis in the preceding section shows, the sonority-stress constraints conflict with constraints on stress placement and footing. So, to render $\Delta_{\text{PrWd}} \leq \{i,u\}$ inactive, it must be outranked by such conflicting constraints: i.e. ALIGNFtR and FTBIN in Gujarati. With such a ranking, no distinction is made between mid vowels and high vowels. This is demonstrated in tableau (33): if mid vowels were favoured over high vowels, stress should appear on the initial syllable in [tʃʰɔkríne].

(33) Ranking of $\Delta_{\text{PrWd}} \leq \{i,u\}$

<table>
<thead>
<tr>
<th>/tʃʰɔkríne/</th>
<th>ALIGNFtR</th>
<th>$\Delta_{\text{PrWd}} \leq {i,u}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) tʃʰókřine</td>
<td>*!</td>
<td>$\Delta_{\text{PrWd}} \leq {i,u}$</td>
</tr>
<tr>
<td>(b) tʃʰokříne</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

Importantly, there is no active constraint that distinguishes between [í ú] and [é ó]. Specifically, no sonority-stress constraint that outranks the foot-form constraints favours stressed mid vowels over stressed high vowels: they both incur the same violations of $\Delta_{\text{PrWd}} \leq \{e,ə\}$ and $\Delta_{\text{PrWd}} \leq \{e,ə\}$. Tableau (34) aims to clarify this point by showing the full ranking of constraints.
Stressed mid and high vowels incur a violation of *Δ_{PrWd}≤{ε,ɔ} because they both have the sonority of mid vowels or less, while both avoid violating *Δ_{PrWd}≤ɔ because they are both more sonorous than [ə]. The only constraint that does make a distinction is inactive – it never makes the crucial determination of winner status for stress placement.

In contrast to Gujarati, Nganasan does not conflate high and mid vowels with regard to stress. The resulting ranking for Gujarati is summarized in Figure 3.3.

3.4.1.4 Variation

Cardona (1965) reports a few instances of free variation in his description of Gujarati stress. The most major variation is in avoidance of stressed penult [ə]. Like the dialect described in this section, stress can fall on the penult if it contains a schwa and the ultima a non-low vowel: e.g. [kɛɾə] ‘does, do’. However, Cardona reports that if the penult [ə] is in an open syllable, stress may fall on the ultima:
(35) **Free Variation: Ca.CV^{1,ow} (Cardona 1965:33)**

[jómin] ~ [jómn] ‘land’
[[járu] ~ [járú] ‘beginning’
[káre] ~ [káré] ‘does, do’
[náwo] ~ [náwó] ‘new’

However, stress will not fall on the final syllable if the penult is closed:

(36) **Penult stress: CVC.CV**

[gów.rí] ‘a name of Parvati’, *[gów.rí]*
[wáš.tú] ‘matter’, *[wáš.tú]*
[pán.de] ‘personally’, *[pán.de]*
[sáN.tʃo] ‘a machine’, *[sáN.tʃo]*

There are two differences between the grammars. One is in the ranking of the constraint TROCHEE. In the dialect without final stress, TROCHEE is undominated. It therefore rules out forms like *[(káré)], with an iamb; FTBIN – as usual – rules out *[kár(é)], so resulting in [(káré)]. It still will not rule out words like [ʃi(kár)] and [sine(má)] – these forms do not violate TROCHEE, having left-headed feet, and *ΔPrWd≤{ε,σ} outranks FTBIN.

In the grammar with final stress in [jómn], TROCHEE is outranked by *ΔPrWd<ε. With this ranking, stress can fall on a final syllable to avoid a penult ο, producing an iamb. This is illustrated in tableau (37).

(37)

<table>
<thead>
<tr>
<th>/káré/</th>
<th>FTBIN</th>
<th>*ΔPrWd&lt;ε</th>
<th>TROCHEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (káré)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) (káré)</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) kár(é)</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The second difference between the grammars is in weight-by-position (Hayes 1989). Codas count as moraic in the grammar with [káré] but not the grammar with [gówrí]. It is significant that FTBIN still outranks *ΔPrWd<{a}; this ranking explains why stress will not leave a penult closed syllable with a. In /gówrí/, for example, candidates with final stress are either *[(gów.rí)] or *[gów(rí)]. Both violate FTBIN – the former because it has an uneven (σµµσµ) foot and the latter because it has a degenerate foot. So, final stress is ruled out by FTBIN, producing penult stress. This situation is illustrated in tableau (38).
In short, the difference between the grammars is in the ranking of TROCHEE. In the dialect described here, TROCHEE is undominated; in contrast, the dialect that avoids penult [ə] in open syllables has TROCHEE crucially outranked by \( \Delta_{PrWd} \leq \sigma \).

### 3.4.2 Environment-specific conflation

Gujarati is not only interesting in terms of the categories it conflates, but also in that conflation varies depending on the environment. In non-final syllables, [ä] is less harmonic than any of [í ú é ó ã], which in turn are less harmonic than [á]. However, in final position, [ä] is conflated with non-low vowels for stress: they are all equally avoided. For example, [kãře] shows that final [é] is not more harmonic than penult [ä]. This is ‘environment-specific’ conflation, where the conflation of categories varies depending on their position.

Environment-specific conflation is important in distinguishing the stringency approach from theories that combine constraints. These include Crowhurst & Hewitt’s (1997) constraint disjunction and Kenstowicz’ (1996) proposal that scale categories may be conflated before producing constraints. I also include Prince & Smolensky’s (1993) ‘constraint encapsulation’ with the caveat that this was intended as a purely abbreviatory device (Alan Prince p.c.), and not as a theory of constraint combination.

The first step is to show how environment-specific conflation is done in the present theory. A discussion of how it differs from the ‘encapsulation’ approaches just mentioned is then provided.

In the present theory, environment-specific conflation comes about when a constraint C renders an otherwise active sonority-stress constraint inactive in a specific competition. In Gujarati, C is FTBIN. It renders \( \Delta_{PrWd} \leq \sigma \) inactive when one candidate has final stress and the other does not. Such a situation happens for [kãře], for example. The winner is not \( *[k\sigma(ré)] \) because FTBIN rules out the degenerate foot, rendering \( \Delta_{PrWd} \leq \sigma \) inactive.

<table>
<thead>
<tr>
<th>/gɔwɾi/</th>
<th>FTBIN</th>
<th>( \Delta_{PrWd} \leq \sigma )</th>
<th>TROCHEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (gɔwɾi)</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(b) (gɔwɾí)</td>
<td>*!</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>(c) gɔwɾí̃</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(39)

FTBIN only renders \( \Delta_{PrWd} \leq \sigma \) inactive in this specific competition. FTBIN is irrelevant in other competitions that do not involve final stress (e.g. [kɔjäldí]). \( \Delta_{PrWd} \leq \sigma \) makes the crucial choice in such situations, as shown in tableau (40).
Environment-specific conflation provides evidence that the ranking of the sonority-stress constraints must be freely permutable. The evidence is best explained with reference to a fixed ranking theory, such as the one in (41), adapted from Kenstowicz (1996) and Prince & Smolensky (1993).

(41) Fixed Ranking stress-sonority constraints
\[ || *\Delta_{PrWd}/\emptyset || \leq *\Delta_{PrWd}/\{i, u\} \leq *\Delta_{PrWd}/\{\varepsilon, \sigma\} \leq *\Delta_{PrWd}/a || \]

In Gujarati, FTBIN renders \( *\Delta_{PrWd}/\emptyset \) inactive in final syllables: FTBIN outranks \( *\Delta_{PrWd}/\emptyset \) to prevent final stress in words like [k\(\emptyset\)re]. This ranking means that FTBIN also outranks \( *\Delta_{PrWd}/\{i, u\} \), and by transitivity all the other sonority-stress constraints in (41). However, if FTBIN outranks all sonority-stress constraints, stress will not fall on a final [a] as in [(j\(\emptyset\)k\(\emptyset\))], \( *[(j\hat{k}\emptyset)] \), as shown in tableau (42).

(42)

<table>
<thead>
<tr>
<th>/j(\hat{k})ar/</th>
<th>FTBIN</th>
<th>( *\Delta_{PrWd}/\emptyset )</th>
<th>( *\Delta_{PrWd}/i, u )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \checkmark ) (a) (j(\hat{k})ar)</td>
<td></td>
<td></td>
<td>( *)</td>
</tr>
<tr>
<td>(b) j(\hat{i})(k(\hat{a}))</td>
<td></td>
<td></td>
<td>( *)</td>
</tr>
</tbody>
</table>

The problem illustrated in (42) follows from transitivity of ranking. FTBIN effectively renders \( *\Delta_{PrWd}/\emptyset \) inactive in situations of final stress; in other words, in the competition [(k\(\emptyset\)re)] vs \([k\sigma(\emptyset)]\), FTBIN alone determines the winner, rendering \( *\Delta_{PrWd}/\emptyset \)’s violations irrelevant. Since \( *\Delta_{PrWd}/\emptyset \) – and by transitivity FTBIN – outranks \( *\Delta_{PrWd}/\{i, u\} \), FTBIN also renders \( *\Delta_{PrWd}/\{i, u\} \) inactive in final stress competitions, as illustrated in tableau (42). Thus, FTBIN’s predominant position in the ranking incorrectly prevents sonority from being a factor in any competition involving final stress – i.e. in the \( *[(j\hat{k}\emptyset)]~[j\hat{i}(k\hat{a})]\) competition.

Because the ranking of the present theory’s constraints is freely permutable, the same implication does not hold. If \( || \text{FTBIN} \Rightarrow *\Delta_{PrWd}/\emptyset || \), it is not necessarily the case that \( || \text{FTBIN} \Rightarrow *\Delta_{PrWd}/\{\varepsilon, \sigma\} || \). As established above, it is necessary that \( *\Delta_{PrWd}/\{\varepsilon, \sigma\} \) outranks FTBIN in this language; the relevant tableau is repeated in (43).

(43)

<table>
<thead>
<tr>
<th>/j(\hat{k})ar/</th>
<th>( *\Delta_{PrWd}/{\varepsilon, \sigma} )</th>
<th>FTBIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (j(\hat{k})ar)</td>
<td>( *)</td>
<td></td>
</tr>
<tr>
<td>(b) j(\hat{i})(k(\hat{a}))</td>
<td>( *)</td>
<td></td>
</tr>
</tbody>
</table>
This point about environment-specific conflation not only rules out theories with constraints in a fixed ranking, but also theories in which such constraints can be combined through some operation. For example, a theory in which constraints can be combined to form a single constraint through a disjunction operator would amalgamate \(*_{\Delta_{PWd}/i.u}\) and \(*_{\Delta_{PWd}/\{\varepsilon,\sigma\}}\) to form a single constraint that assigned a violation to a stressed syllable with either a high vowel or a mid vowel (see e.g. Crowhurst & Hewitt 1997).\(^{36}\) Such a constraint will be called \(*_{\Delta_{PWd}/\{i,u\}\lor *_{\Delta_{PWd}/\{/G28/G0F/G6F\}}}\) here, and the general type of constraint as ‘encapsulated’.

Certainly, encapsulated constraints can produce conflation. For Gujarati, for example, the ranking would be \(|| *_{\Delta_{PWd}/\emptyset} \gg *_{\Delta_{PWd}/\{i,u\}\lor *_{\Delta_{PWd}/\{\varepsilon,\sigma\}}} \gg *_{\Delta_{PWd}/a} ||\), with the high- and mid-vowel constraints encapsulated. The problem is that the encapsulation approach cannot produce the type of environment-specific conflation seen in Gujarati. Since FTBIN outranks \(*_{\Delta_{PWd}/\emptyset}\), it also outranks \(*_{\Delta_{PWd}/\{i,u\}\lor *_{\Delta_{PWd}/\{\varepsilon,\sigma\}}}\); the result is that FTBIN renders the latter inactive in the same environments as the former. /jikar/ is incorrectly predicted to surface as \(*_{/G36\ ika/G35}\).

\[(44)\]

<table>
<thead>
<tr>
<th>/jikar/</th>
<th>FTBIN</th>
<th>(*<em>{\Delta</em>{PWd}/\emptyset})</th>
<th>(*<em>{\Delta</em>{PWd}/{i,u}\lor *<em>{\Delta</em>{PWd}/{\varepsilon,\sigma}}})</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (jikar)</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) i(ká)</td>
<td>!</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Again, there is no ranking that will produce the attested [jikár]. For this to happen, FTBIN would have to rank below the encapsulated constraint, producing a ranking contradiction.

To summarize, fixed ranking theories make strong predictions about the environments in which constraints will be inactive. In a fixed ranking theory, if scale-constraint C is rendered inactive in environment E, then all scale-constraints ranked lower than C will also be rendered inactive in that environment. This prediction makes a system with environment-specific conflation like Gujarati’s impossible to produce. In contrast, the freely permutable constraints proposed here do not have any such implications. The properties of Fixed Ranking theories are discussed in more detail in §3.6.

This section has shown that the present theory can account for stress systems in which medial categories are conflated. It also showed that the theory can account for environment-specific conflation, where different conflations apply in different environments.

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\(^{36}\) Prince & Smolensky (1993:ch.9) combine constraints in this way; their term ‘encapsulation’ is used here. Kenstowicz (1996) suggests a similar approach, proposing that “grammars may differ in the granularity with which sonority distinctions are recognized”. Kenstowicz (1996) also suggests an approach with unranked constraints; this proposal will not be discussed here. Crowhurst & Hewitt (1997) propose that constraints can be combined in a disjunctive relation, as here. Prince & Smolensky’s (1993) PKROM has a similar effect, and similar problems – see de Lacy (1997a) for discussion of this constraint in particular.
3.5 Typology
This section addresses two issues relating to empirical coverage. One is whether the stringent constraints can produce every attested conflation. The other is whether they are restrictive – are they unable to produce impossible conflations?

While this section explores these two issues within the context of sonority-driven stress, it is worth noting that the constraints that motivate sonority-driven stress are only a small part of the present theory. In fact, the constraints discussed here are only those that refer to sonority combined with PrWd and foot DTEs. Remaining are all those constraints that refer to other categories – the syllable, mora, phonological phrase, and so on – and other scales, such as tone, Place of Articulation, and so forth. In addition, constraints on non-DTEs have yet to be discussed, even though these do have an effect on sonority-driven stress (discussed in detail in ch.4§4.3).

Even so, the typology of conflation for sonority-driven stress will be the focus of this section because it is a self-contained microcosm of the present theory: the issues that arise in sonority-driven stress – hierarchy and conflation – also arise in every other scale-related empirical phenomenon. The same issues arise for tone-driven stress (de Lacy 1999a, 2002b) and for syllabification (Prince & Smolensky 1993); the effects of hierarchies and conflation are even evident in neutralization, as discussed extensively in chapters 6 and 9.

In short, sonority-driven stress is useful for examining the predictions of the present theory since its effects are largely duplicated in other domains. So, what the present theory predicts for hierarchies and conflation in sonority-driven stress also holds for every other related phenomenon.

• Section 3.5.1 examines the ranking needed for a grammar to exhibit sonority-driven stress.
• Section 3.5.2 discusses factors that never play any role in stress assignment, such as Place of Articulation.
• Section 3.5.3 asks whether a set of binary scales can produce the same result as a single multi-valued scale.
• Section 3.5.4 deals with the typology of conflation. It identifies two different types of conflation and discusses their empirical effects.
• Section 3.5.5 discusses the relation between conflation and hierarchical implications.

3.5.1 Ranking for sonority-driven stress
Two independent rankings are necessary to produce sonority-driven stress. Both rankings involve constraints on stress placement, such as ALLFtL. One involves the sonority-stress constraints, and the other faithfulness constraints. Both rankings will be discussed in turn.

For stress to be sensitive to sonority, some sonority-stress constraint must outrank some stress-locating constraint. In the hypothetical example below, *ΔPrWd≤σ outranks ALIGN-σ-L to produce avoidance of stressed schwa; the opposite ranking would render *ΔPrWd≤σ inactive, and therefore stress would ignore sonority.
It is necessary for some sonority-stress markedness constraint to outrank some active stress-locating constraint for sonority-driven stress to work, but this ranking is not sufficient. The ranking of faithfulness constraints is also relevant.

A candidate not considered in tableau (45) is [páti], where the /ʌ/ has changed to [a]; this change effectively avoids violating *\( \Delta_{PrWd} \leq \alpha \), and so offers an alternative response to sonority-driven stress. To eliminate such a candidate, faithfulness constraints must at least outrank the stress-locating constraints. The relevant constraint is IDENTV, which preserves input vowel feature specifications (after McCarthy & Prince 1995).

The tableau shows that the ranking between IDENTV and the sonority-stress constraint is irrelevant: sonority-driven stress comes about when IDENTV and some sonority-stress constraint both outrank stress-locating constraints.

The ranking between IDENTV and the sonority-stress constraint does have some effect. If the latter outranks the former, neutralization will take place in words where stress must inevitably fall on a vowel banned by the sonority-stress constraint. An example is the word [p\( \alpha \)tə] – stress cannot help but fall on a schwa. With *\( \Delta_{PrWd} \leq \alpha \) outranking IDENTV, though, whichever vowel receives stress changes.

If IDENTV outranks the sonority-stress constraint, neutralization does not take place. This is the situation in Nganasan, for example.

If the stress-locating constraints dominate either IDENTV or the sonority-stress constraints, sonority-driven stress does not take place. If both the stress-locating constraints and the sonority-stress constraints outrank IDENTV, neutralization takes place:
If the stress-locating constraints and IDENTV both outrank the sonority-stress constraints, neither neutralization nor sonority-driven stress happens:

\[
\begin{array}{|c|c|c|}
\hline
\text{Ranking} & \text{IDENTV} & \text{ALIGN-6-L} \\
\hline
\Sigma & \Sigma & \Sigma \\
\hline
\end{array}
\]

The rankings are summarized in Table 3.4. Σ stands for ‘some sonority-stress constraint’, while ‘stress’ stands for some stress-locating constraint.

<table>
<thead>
<tr>
<th>Table 3.4: Ranking Typology</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ranking</strong></td>
</tr>
<tr>
<td>Σ IDENT stress</td>
</tr>
<tr>
<td>IDENT Σ stress</td>
</tr>
<tr>
<td>Σ stress IDENT</td>
</tr>
<tr>
<td>stress Σ IDENT</td>
</tr>
<tr>
<td>stress IDENT Σ</td>
</tr>
</tbody>
</table>

The ranking schema can be generalized for all prominence-driven stress cases by replacing Σ with some constraint that relates Δₚₚₕ­ₖ to some property. For further discussion, see de Lacy (1999a, 2002b).

3.5.1.1 Positional markedness vs positional faithfulness: Telling the two apart

One of the crucial properties of the rankings identified in Table 3.4 is that the constraints that motivate sonority are of the ‘positional markedness’ sort – they refer to a combination of a prosodic position and a property. Since there has been some controversy over whether positional markedness constraints are necessary – i.e. whether they can be entirely supplanted by positional faithfulness constraints (Beckman 1998 cf Zoll 1998). This section aims to identify the general properties where positional markedness and positional faithfulness differ.

Positional markedness constraints that are relevant mention at least two distinct elements, having the general form *x/y; this constraint assigns a violation for candidates that have a position x and property y in combination. For example, violations of the
constraint \(-\Delta_{PrWd} \geq \{i,u\}\) can be eliminated by either moving the DTE or altering the quality of the vowel, as shown in tableau (50); the exact outcome is determined by the relative ranking of faithfulness and stress constraints and the properties of the candidate under evaluation.

\[(50)\]

<table>
<thead>
<tr>
<th>/pətə/</th>
<th>(-\Delta_{PrWd} \geq {i,u})</th>
<th>IDENTV</th>
<th>ALIGN-(\sigma)-L</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) pəta</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) pətá</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) pətə</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The faithful candidate (a) has a high-sonority unstressed vowel [a], so fatally violates \(-\Delta_{PrWd} \geq \{i,u\}\). This leaves candidates (b) and (c). Candidate (b) avoids violating \(-\Delta_{PrWd} \geq \{i,u\}\) by shifting stress onto the [a]. Candidate (c) also avoids \(-\Delta_{PrWd} \geq \{i,u\}\), but instead by reducing /a/ to [ə].

Both of these responses are attested. Candidate (b) wins in the Papuan language Kara: stress avoids [ə] for higher sonority vowels (Schlie & Schlie 1993, p.c., de Lacy 1997a). Candidate (c) wins in New Zealand English (my native dialect): all unstressed vowels reduce to [ə], and [ə] can be stressed (e.g. [bərə] ‘bitter’).

This ‘symmetrical effect’ of positional markedness constraints is explicitly discussed in de Lacy (1999a, 2000a, 2002b) and Smith (2002).

The symmetrical effect property can be used to determine whether a positional markedness or positional faithfulness constraint is appropriate. Since both vowel centralization and stress shift are possible ways to avoid stressed schwa, the constraint(s) that ban(s) stressed schwa must be of the positional markedness variety.

- **Positional faithfulness**

Beckman’s (1998) positional faithfulness constraints have quite a different effect from positional markedness ones. Positional faithfulness constraints do not promote unfaithfulness, but can only block certain unfaithful mappings; in contrast, a positional markedness constraint can favour unfaithful candidates over faithful ones. However, as shown by Beckman (1998), a positional faithfulness constraint in combination with a context-free markedness constraint can produce much the same result as a positional markedness constraint (also see Zoll 1998). For example, the ranking || \(\sigma\)-IDENTV » \(* \geq \{i,u\}\) || (where \(* \geq \{i,u\}\) bans all vowels with equal or more sonority than high vowels) can produce vowel reduction in unstressed syllables, after Beckman (1998).

\[(51)\]

<table>
<thead>
<tr>
<th>/pitaki/</th>
<th>(\sigma)-IDENTV</th>
<th>(* \geq {i,u})</th>
<th>IDENTV</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) pítaki</td>
<td></td>
<td>** *!</td>
<td></td>
</tr>
<tr>
<td>(b) pítakə</td>
<td></td>
<td>*</td>
<td>**</td>
</tr>
<tr>
<td>(c) pítakə</td>
<td>**!</td>
<td></td>
<td>**</td>
</tr>
</tbody>
</table>
Unlike positional markedness constraints, though, positional faithfulness constraints cannot interact with context-free constraints to trigger changes in prosodic structure. The reason for this difference relates to the fact that faithfulness is not an issue in the sonority-driven stress systems of the sort encountered above. In other words, the primary competing forms do not differ in terms of faithfulness, but only in stress position.

For example, in Gujarati the form /heəran/ has output candidates *[heəran] and [heərən]. These candidates do not differ in terms of faithfulness, so no faithfulness constraint can distinguish them – the entire responsibility falls on markedness constraints. If all markedness constraints were context-free, there would be no way to distinguish the two candidates; stress will fall on the default position. Thus, a theory without positional markedness constraints – and only positional faithfulness and context-free constraints – incorrectly predicts that sonority-driven stress systems of the type discussed above cannot exist. Positional markedness constraints are therefore necessary.

In short, positional faithfulness constraints of the form $p\text{-IDENT}[f]$, where $p$ is a prosodic position and $f$ is a feature, cannot interact with context-free markedness constraints to cause $p$ to change. Thus, they cannot motivate sonority-driven stress, or any prosodic change without attendant unfaithfulness (see §3.5.2 for a rather indirect exception to this statement).

### 3.5.1.2 Hierarchy and form stringency

Prince (1997a,b,c, 1999) identifies a potential problem with freely rankable stringent constraints. Constraints that have a stringency relation on elements of structure may turn out to be in straightforward conflict when entire structures are compared. The problem is illustrated with respect to the sonority-stress constraints here.

The constraints considered here are $\Delta F_t \leq \{i,u\}$ and $\Delta F_t \leq \{\theta\}$. As shown in tableau (52), the constraints are in conflict in competition between two candidates from the input /pitakita/.

<table>
<thead>
<tr>
<th>/pitakita/</th>
<th>$\Delta F_t \leq {\theta}$</th>
<th>$\Delta F_t \leq {i,u}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (pɪtə)kɪtə</td>
<td>*</td>
<td>**</td>
</tr>
<tr>
<td>(b) pi(táki)tə</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

If $\Delta F_t \leq \{\theta\}$ outranked $\Delta F_t \leq \{i,u\}$, candidate (a) would win; in the opposite ranking, candidate (b) would win.

Of course, for this to be a real conflict, other candidates must be eliminated. Most notably, [(pɪtə)kɪtə] and [pɪtə(kɪtə)] must be dispensed with as both are local harmonic bounds for (a) and (b) in terms of the constraints above (they only incur one violation of $\Delta F_t \leq \{i,u\}$). A constraint like LAPSE will do the job (Prince 1983, Selkirk 1984, Green &

---

37 This statement disregards constraints that preserve stress. However, if such constraints were active, the system would be a lexical stress one, not prominence-driven.
Kenstowicz 1995); this constraint penalizes sequences of unstressed syllables. The following discussion will assume that LAPSE is high-ranked.

The concern is with the ranking in which candidate (b) wins: \( || \Delta F_t \leq \{i,u\} \gg \Delta F_t \leq \{\text{o}\} || \). Under this ranking, it seems that stress avoids high vowels (as in \([\text{pit} \text{a})(\text{kita})]\)) for schwa (as in \([\text{pit} \text{a})(\text{ita})]\)). In other words, this ranking seems to create a scale reversal.

Prince (1999) shows that this problem arises with freely rankable stringent constraints, as outlined above. In contrast, it does not happen with constraints in a particular fixed ranking – namely where constraints that ban marked elements outrank all those that ban more marked elements: e.g. \( || \Delta F_t \leq \{\text{a}\} \gg \Delta F_t \leq \{i,u\} \gg \Delta F_t \leq \{\text{o}\} \gg \Delta F_t \leq \{\text{a}\} || \). Because \( \Delta F_t \leq \{\text{a}\} \) always outranks \( \Delta F_t \leq \{i,u\} \), a candidate with stressed [a] will always incur a more serious violation than any without stressed schwa, regardless of the number of stressed [i]'s it contains. To make one thing clear, it makes no difference whether the constraints in a fixed ranking are stringent or not. This is evident from tableau (52): if \( \Delta F_t \leq \{\text{a}\} \) universally outranked \( \Delta F_t \leq \{i,u\} \), the candidate \([\text{pit} \text{a})(\text{ita})]\) would never win.

Potential solutions and conflation

Prince (1999) identifies four potential solutions to this problem, one of which will be discussed here.\(^{38}\) This solution retains the stringent form of constraints, but keeps a fixed ranking between them. If \( \Delta F_t \leq \{\text{a}\} \) universally outranks \( \Delta F_t \leq \{i,u\} \), then \([\text{pit} \text{a})(\text{ita})]\) will never beat \([\text{pit} \text{a})(\text{kita})]\) for sonority reasons alone.

However, a fixed ranking – even of stringent constraints – eliminates the ability to conflate freely (see §3.6). More concretely, the ranking \( || \Delta F_t \leq \{i,u\} \gg \Delta F_t \leq \{\text{a}\} || \) is needed in Nganasan to conflate high vowels and schwa. If \( \Delta F_t \leq \{\text{a}\} \) universally outranks \( \Delta F_t \leq \{i,u\} \), schwa cannot be conflation with high vowels.

Generalizing, in order to get conflation of central and high vowels there must be some markedness constraint that assigns the same violations to stressed schwa and stressed high vowels. This fact makes the potential for \([\text{pit} \text{a})(\text{ita})]\) to be favoured over \([\text{pit} \text{a})(\text{kita})]\) inevitable if the theory is to deal with conflation.

Reconsidering the effect

The particular problem of \([\text{pit} \text{a})(\text{ita})]\) vs \([\text{pit} \text{a})(\text{kita})]\) will be the focus here since the sonority scale is the focus of this dissertation. To recap, the fear is that \( \Delta F_t \leq \{i,u\} \) causes a reversal of the sonority hierarchy: stress seemingly avoids high vowels for schwa. However, this is only superficially so.

\( \Delta F_t \leq \{i,u\} \) has two effects: (i) it favours mid and low peripheral vowels over high vowels and schwa and (ii) it promotes minimization of structure (specifically, minimization of the number of stressed syllables). In its second property, it is like every other negatively formulated markedness constraint: \( f \) favours candidates with fewer instances of \( f \) over those that contain more \( f \)'s.

\(^{38}\) The critique below also applies to the other three solutions in Prince (1999), some of which are too complex to discuss briefly here – see Prince (1999:4ff) for discussion.
To illustrate $\Delta_F \leq \{i, u\}$’s structure-minimizing effects, compare two candidates from input /pitikiti/: (a) [(píti)(kìti)] vs (b) [pi(tíki)ti]. Candidate (a) violates $\Delta_F \leq \{i, u\}$ twice, while (b) violates it only once. Sonority clearly plays no crucial role here; the winner is solely determined because $\Delta_F \leq \{i, u\}$ – like all negative markedness constraints – prefers a minimum of structure (i.e. stressed syllables, in this case).

Returning to the central case, it is clear that $\Delta_F \leq \{i, u\}$ prefers [pi(táki)ta] over [(píta)(kíta)] for two reasons: (i) [pi(táki)ta] has less structure than [(píta)(kíta)] and (ii) $\Delta_F \leq \{i, u\}$ conflates schwa and high vowels. Point (ii) is the source of the apparent problem: because high vowels and schwa are conflated, the structure-minimization aspect of the constraint can show through. So, the effect of $\Delta_F \leq \{i, u\}$ can be informally described as “In a word with only high vowels and schwa, minimize feet.” The fact that a less sonorous vowel ends up stressed is an entirely incidental side effect of the structure-minimization aspect of $\Delta_F \leq \{i, u\}$.

So, $\Delta_F \leq \{i, u\}$ plays much the same role in this case as FTBIN does in Gujarati. As shown for Gujarati, FTBIN bans final stress. In a competition like [(kâre)] vs *[kâ(ré)], the surface effect is as if the scale has been reversed: stress seems to prefer [a] for the mid peripheral vowel [e]. However, this apparent reversal is only incidental – it is a side effect of the pressure for binary left-headed feet.

In short, a language in which $\Delta_F \leq \{i, u\}$ alone is active in the particular way described above will produce an effect such that (i) stress will avoid high vowels and schwa for mid and low peripheral vowels (as in Nganasan) and (ii) in words with only high vowels and schwa the candidate with the minimum number of stressed syllables will win.

To sum up, the potential problem identified by Prince (1999) does not apply in the narrow confines of the sonority-driven case applied here. The apparent problem is simply analogous to cases attested in natural language: constraints may eliminate sonority-sensitivity in particular environments. $\Delta_F \leq \{i, u\}$ inherently eliminates sensitivity to the distinction between schwa and high vowels, allowing its structure-minimization aspect can show through in this particular case.

As a concluding note, Prince’s (1999) problem is more generally applied to stringent constraints, as he shows with a ‘structural’ scale of the type | CC|σ > C|σ. Since such structural scales are not considered in this dissertation, the implications of this fact will not be considered here.

3.5.1.3 Positive and negative constraints

At this point it is timely to consider positively formulated constraints, since they have properties that seem to deal with the issue raised in the preceding section. However, positive constraints raise other problems, identified for non-stringent constraints in de Lacy (1999a, 2000a), and extended to stringently formulated constraints here.\(^{39}\)

The constraints proposed in this work are negatively formulated: they ban structures rather than require them. In other words, the constraints assign a violation to a

\(^{39}\) My thanks to Moira Yip and the audience at the Tone Workshop in Tromsø for their comments on a paper that closely relates to the points in this section. For further critical discussion of positive constraints of the type discussed here and their properties, see Yip (2000).
candidate if it contains some structure $\Sigma$. In contrast, positive constraints require certain structures: they assign violations to a candidate if it does not contain some structure $\Sigma$. For example, the constraint $\Delta_{\text{FT}} \rightarrow [a]$ requires all stressed syllables to contain the vowel $[a]$.

To put the negative-positive distinction in more formal terms, negative constraints have the form $^*\Sigma$, where $\Sigma$ is some structure. Negative constraints are evaluated by taking the ‘power structure’ of a candidate (i.e. the set of all possible substructures of a candidate’s prosodic and featural structure); the number of violations incurred is the same as the number of distinct structures in the power structure that are identical to $\Sigma$. In contrast, positive constraints with the form $x \rightarrow y$ require that every $x$ be related to $y$ (usually through the association relation); every $x$ that is not so related incurs a violation.

For sonority-driven stress, positively formulated non-stringent constraints have been proposed by Crosswhite (1999); positively formulated stringent constraints are employed in de Lacy (1997a).

- **The pile-up problem**

A difference between positive and negative constraints is the ‘pile-up’ effect: where greater complexity in relation to a property $p$ (usually more instances of $p$) is preferred over less complexity.

Negative constraints favour less structure over more – this property was at the core of the issue discussed in the preceding section. In contrast, positive constraints favour more structure over less. The tone-DTE constraints in (53) illustrate this point well; $H$ stands for ‘high tone’, $M$ for ‘mid tone’, and $L$ for ‘low tone’. The constraints in (53) are non-stringent since positive non-stringent constraints exhibit the pile-up problem in a far more transparent manner; the result will be extended to positive stringent constraints below.

\[
\begin{align*}
(53) \quad & (a) ^*\Delta_{\sigma}/L \gg ^*\Delta_{\sigma}/M \gg ^*\Delta_{\sigma}/H \\
& (b) \Delta_{\sigma} \rightarrow H \gg \Delta_{\sigma} \rightarrow M \gg \Delta_{\sigma} \rightarrow L
\end{align*}
\]

As an example, the constraint $\Delta_{\sigma} \rightarrow H$ requires syllable DTEs to be associated to a high tone. The problem with these constraints is that they do not simply favour higher tone over lower tone, but contour tones over simplex tones. This is because a contour tone as in $[p\dot{a}]$ satisfies both $\Delta_{\sigma} \rightarrow H$ and $\Delta_{\sigma} \rightarrow L$ (i.e. it violates $\Delta_{\sigma} \rightarrow M$ only), while $[p\acute{a}]$ violates both $\Delta_{\sigma} \rightarrow M$ and $\Delta_{\sigma} \rightarrow L$.

The following tableau illustrates this point. In this grammar, an underlyingly toneless syllable is required to have tone on the surface. The ban on contour tones is ranked below $\Delta_{\sigma} \rightarrow L$, with the consequences seen in (54).
In short, positive constraints predict a language where the epenthetic tone is a contour tone, not a singleton. Moreover, if the positive constraints are ranked above `DEP-T` – a constraint prohibiting tone epenthesis (Myers 1997) – they will produce a language in which all syllables bear contour tones, and none have singletons.

This result is clearly undesirable. No language is reported to have contour tones on all syllables (Cheng 1973, Pike 1948, Ping 1999).

The same problem arises in many other situations as well. For example, Prince & Smolensky’s (1993) sonority-margin constraints are formulated negatively (*MAR/glide » *MAR/liquid » *MAR/nasal » *MAR/fricative » *MAR/stop). The constraints’ positive counterparts would cause a pile-up problem for margins. The best onset and coda would be [tsfnlj], as it satisfies all the constraints MAR→glide, MAR→liquid, MAR→nasal, MAR→fricative, MAR→stop. More generally, positive margin-sonority constraints favour complex margins over simplex ones. This also raises a significant typological problem: there is no language that requires complex margins but bans single-segment ones.

In contrast, negative constraints do not produce the pile-up result. Since negative constraints favour less structure over more, they universally prefer singletons to contour tones, as shown in tableau (55).

The same argument holds for sonority. Positive constraints prefer DTEs that contain rising diphthongs to those with singletons. For example, the structure in (56a) satisfies both $\Delta_\sigma$→[a] and $\Delta_\sigma$→[i,u], while (56b) does not (the structural assumptions for rising diphthongs follow McCarthy 1995). This predicts – among other things – that rising diphthongs could be epenthetic.

(55) Diphthong Pile-Up
The formal expression of markedness – ch.3

(a) \[ \mu \]  

(b) \[ \mu \]

\[ i \rightarrow a \]

\[ a \]

The same can be argued for positive constraints for Place of Articulation: the coarticulated [kp] satisfies both [Place]→[labial] and [Place]→[dorsal], so being more harmonic than just [k], [p], or even [t].

- **Stringency and the pile-up problem**

  The problem identified above also arises for positive stringent constraints. Negative and positive stringent tonal constraints are provided in (57).

  \[ \text{(57) Stringent DTE-tone constraints} \]
  
  (a) \[ *\Delta_{\sigma}\{L\}, *\Delta_{\sigma}\{L,M\}, *\Delta_{\sigma}\{L,M,H\} \]
  
  (b) \[ \Delta_{\sigma}\rightarrow\{H\}, \Delta_{\sigma}\rightarrow\{H,M\}, \Delta_{\sigma}\rightarrow\{H,M,L\} \]

  As an example, the constraint \[ \Delta_{\sigma}\rightarrow\{H,M\} \] requires syllable DTEs to be either high- or mid-toned.

  The pile-up problem does not arise as directly with the positive stringent constraints. For example, the competitors [pá] and [pâ] both do equally well on the constraints in (57).

  However, the pile-up problem re-emerges when both DTE and non-DTE constraints are considered. As discussed at length in chapter 4, and mentioned in chapter 2, a segment can be both a DTE and a non-DTE. For example, in [ˈpati], [i] is a DTE of a syllable, but a non-DTE of a foot. The problem arises when the conflicting conditions on DTEs and non-DTEs are both active. For example, \[ \Delta_{\sigma}\rightarrow\{H\} \] requires [i] to bear a high tone, but the non-DTE constraint \[-\Delta_{PrWd}\rightarrow\{L\} \] requires [i] to bear a low tone. Thus, the most harmonic form for [i] to take is again the contour tone [î]. With positive constraints, the tonally optimal form of /pati/ is therefore [(ˈpátî)].

  So, positive DTE and non-DTE constraints can work together to create the unattested situation whereby all unstressed syllables bear a contour tone while all stressed ones bear a simplex one (tableau (58)).

  \[ \text{(58)} \]

  \begin{tabular}{|c|c|c|c|}
    \hline
    /pati/ & \[ \Delta_{\sigma}\rightarrow\{H\} \] & \[ -\Delta_{PrWd}\rightarrow\{L\} \] & *contour \\
    \hline
    (a) ˈpátî & & \[ *! \] & *!
    \hline
    (b) ˈpátî & & & *
    \hline
    (c) ˈpátî & & & * *
    \hline
  \end{tabular}

  In contrast, negative constraints cannot produce such a pattern. Consider the constraints \[ *\Delta_{\sigma}\{L\} \] and \[ -\Delta_{PrWd}\rightarrow\{H\} \]. These constraints cannot both be satisfied by having
a contour tone on a PrWd non-DTE. It is most harmonic to minimize tones in this situation, inevitably violating one or the other constraint.\(^{40}\)

In short, positive constraints encounter the ‘pile-up’ problem: they favour more structure over less, either individually or through their interaction. In contrast, negative constraints favour less structure over more.

### 3.5.2 Factors that never play a role in stress assignment

The present theory makes restrictive predictions about possible hierarchical relations between vowel categories in sonority-driven stress. Specifically, the constraints cannot produce a system in which stress avoids higher sonority vowels for lower sonority ones – in other words, where the sonority hierarchy is reversed, unless some incidental factor intervenes (e.g. a ban on final stress).

The reason for this restriction relates to how the present theory assigns violations. Every *\(\Delta \alpha/\alpha\) constraint favours higher sonority DTEs over lower sonority ones, so there is no ranking of these constraints that will force stress to avoid high sonority vowels. While [a] attracts stress in several languages (e.g. Abelam, Gujarati, Kara, Kobon, Yimas)\(^{41}\), there is no language in which it repels stress. The same can be said for mid vowels over high vowels (e.g. Abelam, Asheninca, Chukchi, Kobon, Komi, Mordwin), for high vowels over schwa (e.g. Chukchi, Gujarati, Lushootseed, Malay, and many others), and for high vowels over [i] (e.g. Pichis Asheninca).

One issue this typology raises is not why stress is sensitive to sonority, but rather why it is not sensitive to so many other properties. There are no stress systems in which subsegmental features such as Place of Articulation or backness in vowels plays a role in assigning stress. The same goes for features such as [round], [nasal], and secondary articulation. An example of such an unattested system is one in which stress falls on the leftmost round vowel, otherwise on the initial syllable: e.g. [páta], [póto], [póta], [pató].\(^{42}\)

The present theory provides a response to this issue by drawing a fundamental distinction between prosodic and featural scales: the former combine with structural elements to form constraints, while the latter do not. The empirical effect of this division is that only prosodic features (i.e. sonority, tone, structure) may play a role in affecting stress placement.

For stress to be sensitive to a property \(p\), there must be some markedness constraint that distinguishes between a stressed syllable with \(p\) and one without \(p\). Therefore, main

---

\(^{40}\) As a matter of fact, the most harmonic response to the two constraints is to have mid tone on non-DTEs, as attested in a number of languages (e.g. Ayutla Mixtec has epenthetic mid tones – Pankratz & Pike 1969).


\(^{42}\) Stress in the Australian language Madimadi has been claimed to exhibit sensitivity to place of articulation of onset consonants (Hercus 1969, Davis 1985). However, Gahl (1996) has proposed an alternative analysis, where stress is only sensitive to morphological structure. Similarly, Crowhurst & Michael (2002) show that syllables with nuclei of [u] attract stress over those with [i] nuclei in Nanti. It is clear that sonority is not the only relevant factor in this system: it is probably the case that [u] attracts stress because of its greater moraic content.
stress can be sensitive to the presence of [ə] because there is a constraint \( *\Delta_{PrWd} \leq \{ə\} \). However, main stress cannot be sensitive to vowel roundness because there is no constraint \( *\Delta_{PrWd} \leq [+\text{round}] \).

Similarly, constraints such as \( *\Delta_{α}/\text{midV} \) also cannot exist for empirical reasons. This constraint rules out mid vowels in DTEs, predicting a language in which DTEs avoid mid vowels for less sonorous vowels. Tableau (59) illustrates this point for sonority-driven stress. With \( *\Delta_{PrWd}/\text{midV} \) ranked above all other PrWd-DTE markedness constraints and stress locating constraints, stress will avoid a mid vowel for a high vowel – an unattested system.

<table>
<thead>
<tr>
<th>/petito/</th>
<th>( *\Delta_{PrWd}/\text{midV} )</th>
<th>ALL\text{FtL}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (pētīto)</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>(b) pe(tīto)</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

The ban on constraints like \( *\Delta_{α}/\text{midV} \) also follows from the scale combination restriction: ‘mid vowel’ is not the most marked category of any prosodic scale, so it cannot combine with prosodic elements.

**Reduction and Faithfulness**

An opaque type of stress sensitivity to subsegmental features can be caused by constraints that mention prosodic positions. This section discusses the effect of positional markedness constraints; they can be used to force deviation from the default prosodic structure if doing so will preserve some feature value that would otherwise be lost.

For example, suppose there is a language in which all unstressed syllables reduce to [a]. Suppose also that faithfulness to vowel roundness – IDENT[+round] – is ranked above all stress-placement constraints (i.e. ALL\text{FtL}, for argument’s sake). Stress will move to a non-initial position if doing so will prevent a round vowel from reducing. Tableau (60) illustrates this point.

<table>
<thead>
<tr>
<th>/pato/</th>
<th>( *-\Delta_{PrWd}\geq{i,u} )</th>
<th>IDENT[+round]</th>
<th>ALL\text{FtL}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (páto)</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) (páta)</td>
<td></td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>(c) pə(tó)</td>
<td></td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

Candidate (a) is ruled out because the unstressed vowel is not [ə] – \( *-\Delta_{PrWd}\geq\{i,u\} \) assigns a violation to all unstressed (and secondary stressed) syllables that contain a peripheral vowel. Candidate (b) has stress on the leftmost syllable, so satisfying ALL\text{FtL}. However, by doing so, /ə/ is forced to reduce to [ə], losing its roundness. This unfaithfulness to [round] fatally violates IDENT[+round], dooming candidate (b). The only remaining candidate is (c), with stress on the round vowel.
The net result is effectively a system in which stress falls on the leftmost round vowel, and unstressed vowels reduce. Under this ranking, stress seems to be sensitive to subsegmental features, albeit in an opaque way.

On the other hand, the surface form does not violate the generalization that stress falls on the most sonorous element: stress falls on [o], which is more sonorous than [ə]. The question now is whether a system could be set up in which stress is sensitive to a subsegmental feature and the *output* has a stressed vowel that is less sonorous than unstressed ones, due to sensitivity to some subsegmental feature.

**The Wilsonian problem**

The type of concern just outlined comes to the fore in considering observations by Wilson (1999, 2000). Wilson observes that positional faithfulness constraints can be used to force a change in prosodic structure if doing so will help eliminate marked structures.

Imagine a system in which a change in sonority does not take place in unstressed syllables, but rather roundness is neutralized (any other vowel feature – e.g. nasality – could also be used). In other words, round vowels are only contrastive in stressed syllables, and eliminated elsewhere: /poto/ → [póte]. Can the desire to eliminate [+round] force a change in stress with the result that the stressed vowel is less sonorous than the unstressed one? In such a case, /poti/ would emerge as [peti], not as *[póti] with stress on the (default) initial syllable.

The answer is “yes”, but in a rather opaque sense.

To explain, in the present theory [round] is not a prosodic property, so it cannot combine with a (non-)DTE position to form a constraint. To eliminate the [round] contrast in unstressed syllables, then, the only option is a positional faithfulness analysis (Beckman 1998; also see this chapter, §3.5.1.1). Thus, || IDENT[round] » *+round » IDENT[+round] ||. As shown above, ALLFtL must be ranked below IDENT[+round].

The form /poti/ is at issue here.

<table>
<thead>
<tr>
<th>/poti/</th>
<th>IDENT[round]</th>
<th>*+round</th>
<th>IDENT[+round]</th>
<th>ALLFtL</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) póti</td>
<td>* !</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) potí</td>
<td>* !</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) pétí</td>
<td>* !</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(d) petí</td>
<td>* !</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

The tableau shows that stress does end up on the less sonorous vowel [i] from input /poti/; stress does not fall on the default leftmost position. This is due to the effect of *+round. This constraint aims to minimize the number of round vowels in a form, but is blocked in its work by IDENT[round]. The solution is to move stress onto an unround vowel, as in (d), and so neutralize all round vowels in unstressed syllables.

In short, this is a system where stress falls on the leftmost unround vowel, then all unstressed round vowels neutralize.
However, it is not a system in which – on the surface – less sonorous vowels always beat more sonorous vowels. Although /poti/ is realized as [petí], it contrasts with input /petí/, which is realized as [péti] under the ranking above. In /petí/ → [péti], stress clearly does not avoid the more sonorous [e] for [i]. The result is that the system – on the surface – has lexical stress: there are surface forms that contrast only in the position of stress: [péti] (from /petí/) vs [petí] (from /potí/). Roundness, then, acts as little more than a diacritic for stress avoidance in this system. Crucially, it does not create a system where – on the surface – stress always avoids high sonority vowels for lower sonority ones. Similarly, on the surface stress does not avoid round vowels for unround vowels; there certainly is stress-sensitivity to roundness, but in a rather indirect fashion.

- **Summary**

To summarize, stress is never sensitive to subsegmental features. This observation partly follows from the proposal that DTEs may not combine with subsegmental features in constraints.

However, stress sensitivity to subsegmental features can follow as a byproduct of a sonority-based contrast neutralization (i.e. vowel reduction and roundness neutralization), whether by means of positional faithfulness or positional markedness constraints. In other words, stress sensitivity to subsegmental features is possible, but only in an opaque way: stress can avoid vowels based on their roundness, but only if their roundness is neutralized on the surface. The result is a system that – on the surface – apparently has lexical stress, not sonority-sensitive stress. In short, it is always true that in no language stress avoids a high sonority stressed vowel for a lower sonority one in all environments (i.e. putting aside interfering factors like foot form).43

### 3.5.3 Hierarchical form: Subhierarchies and n-ary scales

Part of the present theory’s hierarchy effects derives from the form of the sonority scale.44 The idea that there is a single sonority hierarchy to which scale-constraints refer was adopted in chapter 2. There is a possible alternative though: the sonority hierarchy may in fact be several subhierarchies, each covering part of the sonority scale (e.g. Gnanadesikan 1997). For example, the vowel sonority scale may be considered to be made up of two scales: one for peripherality | central > peripheral |, and one or two for height | high > mid > low | (or even | -low > +low | and | +high > -high |).

- **Scale reversals**

In many cases it is difficult to distinguish the empirical effects of subscales from having a single scale. However, there is a disambiguating phenomenon: when the

---

43 One way around this is if only round vowels reduce to [a]: i.e. /patota/ → [pátota]. The ranking || IDENT{+round} » ALLFTL || could then prevent round vowels from neutralizing, producing [patóta], where stress falls on [o], avoiding the more sonorous [a]. However, vowel reduction never targets round vowels without also targeting unround vowels (Crosswhite 1998), so this situation will never arise for independent reasons.

44 I am grateful to the audience at Haskins Laboratories for comments on a talk that closely relates to this section.
hierarchical relation between two categories can be either way in particular grammars. As an example, the vowel peripherality scale and the vowel height scale mentioned above encode many of the same hierarchical relations between categories as the single sonority scale employed in this chapter. However, schwa outranks high vowels on the Height scale, but the opposite ranking holds on the Peripheral scale. Therefore, languages with both rankings are predicted to appear.

The problem for this particular example is that the vowel sonority scale is remarkably rigid in its hierarchical relations. Sonority-driven stress, for example, always treats [ɔ] as worse than stressed high vowels. The same is true for the relations between low, mid, and high vowels. For consonant sonority, syllabification shows that the |vowel|liquid⟩nasal⟩obstruent hierarchy is also inviolate, suggesting that the Sonority hierarchy consists of a single scale rather than several interacting subscales (see Parker 2002 for a similar conclusion for different reasons).

It is important to note, though, that the present theory does not predict that the Sonority hierarchy must be a single unified scale. As with any scale, such a determination must come about through evidence. Situations of indeterminate ranking are simply a way to determine whether a hierarchy is derived from several subscales or a single scale.

In that regard, an example of a place where subhierarchies may be relevant is with respect to obstruent voicing. In some versions of the sonority hierarchy, voiced obstruents are universally more sonorous than voiceless obstruents: |voiced fricatives⟩voiced stops⟩voiceless fricatives⟩voiceless stops| (e.g. Jespersen 1904, Bolinger 1962, Alderete 1995). Others make the cut between fricatives and stops: |voiced fricatives⟩voiceless fricatives⟩voiced stops⟩voiceless stops| (e.g. Selkirk 1984, Dell & Elmedlaoui 1985, 1988, Ladefoged 1993, Blevins 1995, and many others). Suppose for argument’s sake that there is evidence that both rankings are valid for particular grammars. Such a situation indicates an indeterminate ranking: |voiced stop⟩voiceless fricative| holds in one grammar, while |voiceless fricative⟩voiced stop| in another. Such a situation would indicate that there are two subscales, such as an Obstruent Voicing scale |voiced⟩voiceless| and an Obstruent Continuancy scale |fricative⟩stop|. Since voiced stops are higher on the scale than voiceless fricatives in the former but the opposite relation holds in the latter, such scales would predict variable ranking.

In short, there are reasons of theoretical implementation that some scales cannot be decomposed into several smaller subscales. The reasons relate to natural class behaviour and the formal expression of hierarchy; both of these issues are discussed in turn below.

• Natural classes

Suppose that the vowel sonority scale |œ⟩i,u⟩e,o⟩a| can be decomposed into a series of binary scales: (a) |œ⟩i,u,e,o,a|, (b) |œ,i,u⟩e,o,a| and (c) |œ,i,u,e,o⟩a|. Since these scales are consistent in terms of their hierarchy, they will have an effect similar to that of a single unified scale, as discussed in the preceding section.

However, the present theory draws a direct relation between scales and features. Thus, decomposing a scale in the way just outlined implies that there are three binary features, called f_a, f_b, and f_c, each expressing the scales in (a), (b), and (c) above. For argument’s sake, from scale (a), [œ] is [−f_a] and [i u e o a] are all [+f_a]; from scale (b), [œ i
u] are all \([-f_b]\) while \([e\ o\ a]\) are all \([+f_b]\). Similarly, from (c), \([\partial\ i\ u\ e\ o]\) are all \([-f_c]\) while \([a]\) is \([+f_c]\).

Some of the features have analogues in current feature theories. For example, \([f_c]\) classes sounds in the same way as \([\text{low}]\) does, and \([f_a]\) distinguishes between peripheral and central vowels.

However, proposing such features raises the question of their behaviour in other phonological processes. After all, proposing a new feature is no trivial matter. The feature can be expected to participate in dissimilation, assimilation, harmony, coalescence, and a multiplicity of other phonological processes. For example, \([\text{low}]\) is a reasonable feature because it participates in assimilation and dissimilation (e.g. Kera – Suzuki 1998), and in vowel harmony (van der Hulst & van der Weijer 1995:519ff).

But what of a feature such as \([f_b]\)? There is no vowel harmony whereby every vowel must be either one of \([\partial\ i\ u]\) or one of \([e\ o\ a]\). However, with a feature like \([f_b]\) it would be a simple matter to construct such a case. There is similarly no evidence for assimilation and dissimilation of \([f_b]\).

In general, proposing that multi-valued scales can be decomposed into smaller scales raises the issue of natural classes: if there is a scale \([\partial, i, u \rightarrow e, o, a]\) and a corresponding binary feature, why do \([\partial]\) and \([i\ u]\) not act as a natural class for a variety of other phonological processes?

The same question can be asked for the Place of Articulation scale, which is \([\text{dorsal} \rightarrow \text{labial} \rightarrow \text{coronal} \rightarrow \text{glottal}]\) (ch.5§5.3). If this scale is decomposed into a series of binary scales (a) \([\text{dorsal} \rightarrow \text{labial}, \text{coronal}, \text{glottal}]\), (b) \([\text{dorsal}, \text{labial} \rightarrow \text{coronal}, \text{glottal}]\) and (c) \([\text{dorsal, labial, coronal} \rightarrow \text{glottal}]\) – with corresponding features to boot – this predicts that dorsals and labials will act as a class (after scale (b)) for processes like assimilation and dissimilation. Scale (b) implies that there is a feature \([f]\) and dorsals and labials are \([-f]\) while coronals and glottals are \([+f]\) (or vice-versa – the choice of value is immaterial).

Thus, one could rightly expect a process in which dorsals dissimilate in the presence of labials and vice versa: e.g. /kapa/ → [tapa], cf /tapa/ → [tapa]. I know of no such dissimilation process.

The same is true of assimilation: consonants should be expected to assimilate in \([f]\) value. So, one would expect to find a situation where /anka/ → [amka]. In this case, the \([+f]\) /n/ assimilates to the \([-f]\) value of /k/. Since both labials and dorsals are \([-f]\), the /n/ has a choice of surfacing as [m] or [ŋ]. In this particular grammar, because [ŋ] is more marked than [m], /n/ becomes [m]. Tableau (62) illustrates this situation.

<table>
<thead>
<tr>
<th>/anka/</th>
<th>*ŋ</th>
<th>AGREE[f]</th>
<th>IDENT[f]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) anka</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) amka</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(c) aŋka</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

AGREE[f] requires adjacent consonants to agree in \(f\)-value (Lombardi 1996, 1999). So, because [ŋ] is \([+f]\) and [k] is \([-f]\), candidate (a) falls afoul of AGREE[f]. The two
remaining options are for /n/ to surface as [m] or [ŋ] – both are [–f]. The constraint *[ŋ]
decides the matter – it bans dorsal nasals, so ruling out (b) (see chs.6,7 for more on this
constraint).

The net result is that /n/ turns into [m] before [k]. This type of assimilation does
not take place (see ch.7).

The multi-valued feature approach avoids the issue just described. The processes
identified above – assimilation, dissimilation, and harmony – all require agreement in
terms of a certain feature value. With a multi-valued feature like [Sonority] or [Place],
there is a distinct value for every category. For example, dorsals are [xxxPlace] and labials
are [xxoPlace]. In terms of processes that refer to feature value identity – like assimilation
and dissimilation – labials and dorsals will not act as a class because their feature values
for [Place] are different. This rests on the assumption that all constraints that require
identity are like the IDENT ones proposed here (for discussion see ch.5).

In short, multi-valued features allow classes to be defined without appealing to
some aspect of identity between elements. So, there is no feature value that schwa and
high vowels share that mid and low vowels do not share, yet they can be referred to as a
class for sonority due to the nature of the scale-referring constraints proposed here.

• Maintenance of hierarchies

Suppose there is a single 3-element scale | γ \ β \ α |. This would have three
constraints: *{γ}, *{γ,β}, and *{γ,β,α}. As demonstrated in ch.2 and this chapter, these
constraints formally implement the hierarchy expressed by the scale.

Now suppose that this scale was really three separate scales: (a) | γ \ α |, (b) | β \ α |,
and (c) | γ \ β |. The present theory would generate six constraints: (a) *{γ}, *{γ,α}; (b)
*{β}, *{β,α}, and (c) *{γ}, *{γ,β}.

With free ranking of these constraints, all hierarchical relations in the subscales are
lost. For example, *{β} can outrank *{γ}, so eliminating the hierarchy in the scale | γ \ β |. Similarly,*{γ,α} can outrank *{β}, so reversing the hierarchy | β \ α |; the same is true for
the ranking || *{β,α} » *{γ} ||, which reverses the scale | γ \ α |.

In short, the mechanisms proposed here effectively eliminate the hierarchies
encoded in the subscales given above. The only way to produce the hierarchy | γ \ β \ α | is
to have a single unified scale, and consequently three constraints *{γ}, *{γ,β}, and
*{γ,β,α}.

Of course, one may object to the point made above on the grounds that either (a)
some other constraint-creation algorithm could be used or (b) some meta-condition
prevents certain constraints from being produced. Without a concrete proposal for (a), it is
pointless to pursue this issue further. As for (b), one obvious meta-condition that could be
proposed is that if | x \ y | on any scale, then there can be no constraint that favours y over
x. However, such a condition is much too strong. Different scales can reverse favouring
relations between different types of elements: a segment’s markedness is not an absolute
notion, but only relative to a particular scale. More concretely, chapter 6 argues that
coronals are more marked than glottals on the PoA scale, but the opposite is true in another
scale.
• **Summary**

In summary, it is not a trivial matter to decompose a single multi-member scale into several smaller scales. Doing so has the potential to eliminate hierarchical relations in scales. It also may predict unattested class behaviour.

As a concluding comment, whether sonority or any other property is a single unified scale or is composed of several smaller scales is not a question that can be easily answered outside a particular theory of the formal implementation of scales. The theory presented in this dissertation makes clear predictions about the consequences of having single scales or a multiplicity of smaller scales, as identified above.

### 3.5.4 Typology of conflation

This section identifies the present theory’s predictions for conflation. The theory requires some categories to conflate, allows others to optionally conflate, and prevents other conflations from ever happening. Section 3.5.4.1 deals with required conflations, while §3.5.4.2 examines the other two types.

#### 3.5.4.1 Conflation by constraint form

The present theory requires some ‘universal’ conflations: where two categories are always treated alike. Since two categories $x$ and $y$ are distinct iff some constraint favours one over the other, it follows that two categories are never distinct if there is no such constraint.

An example of a universal conflation is the distinction between [í] and [ú]. No constraint proposed here favours one over the other; therefore, it is trivially true that for every possible ranking, all constraints that distinguish [í] from [ú] are inactive; therefore, [í] and [ú] are conflated. This particular prediction is borne out by the fact that no stress system treats these two categories differently. There is no language, for example, where stress seeks out the leftmost [í], avoiding a [ú] closer to the default stress position (or vice versa). Similarly, no language treats [e] as distinct from [o] for stress purposes, so the same explanation holds: there is no constraint that favours [é] over [ó], or vice versa.

#### 3.5.4.2 Contiguous conflation

As shown in sections 3.3 and 3.4, conflation is not only effected by constraint form, but by ranking as well. Section 3.3 showed that schwa and high vowels could conflate for stress purposes, as could mid and low vowels; §3.4 showed that high and mid vowels could conflate. However, not all imaginable conflations are possible. (63) is an empirical generalization about the conflations observed in sonority-driven stress systems.
The Conflation Generalization

• $x,y,z$ are members of some scale $S$

If $x$ and $y$ are conflated into a single category $C$, and $z$ is between $x$ and $y$ in $S$ (i.e. $|x \succ z \succ y|$ or $|y \succ z \succ x|$), then $z$ is conflated into category $C$.

In other words, a set of categories can only conflate if they form a contiguous part of the scale. Prince (1997 et seq.) shows that fully permutable stringent constraints place no other restrictions on conflation, predicting that any conflation of contiguous categories can happen. Support for this generalization is given in the table below. Building on Prince (1999) and my own work (de Lacy 1997a, 2000a), almost every possible contiguous conflation in stress-sonority interaction is attested.\(^{45}\)

**Table 3.5: Stress conflation typology**\(^{46}\)

<table>
<thead>
<tr>
<th>Categories</th>
<th>Languages</th>
<th>Active Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>/a/</td>
<td>i/u</td>
<td>Kobon (Davies 1981)</td>
</tr>
<tr>
<td>/a/</td>
<td>i/u</td>
<td>Gujarati ($§3.4$)</td>
</tr>
<tr>
<td>/a/</td>
<td>i/u</td>
<td>Asheninca (Payne 1990)</td>
</tr>
<tr>
<td>/a/</td>
<td>i/u</td>
<td>Yil (Martens &amp; Tuominen 1977)</td>
</tr>
<tr>
<td>/a/</td>
<td>i/u</td>
<td>Nganasan ($§3.3$, Helimski 1998)</td>
</tr>
<tr>
<td>/a/</td>
<td>i/u</td>
<td>Kara (Schlie &amp; Schlie 1993)</td>
</tr>
<tr>
<td>/a/</td>
<td>i/u</td>
<td>all vowels are treated the same</td>
</tr>
</tbody>
</table>

(i) ‘a’ stands for any central vowel [æ i u]

The only gap is a language that conflates [ã] and [i ú] but distinguishes mid from low vowels. In such a grammar, stress would be much as in Nganasan, except that it would retract from a mid vowel penult to a low vowel. I assume that this gap is accidental.

- **Non-contiguous conflation**

Missing in the table above – and in the data collected – is a language that conflates non-contiguous categories. For example, there is no language that treats high vowels and low vowels in the same way and distinguishes both types from mid vowels for stress placement. More concretely, there is no language like the one described in (64).

---

\(^{45}\) Categories are marked as conflated if they are grouped inside the same box. For example, the mid and low vowels are conflated in Asheninca, but the central and high vowels are not. Note that ‘a’ stands for any central vowel (e.g. Asheninca has [i], not schwa).

\(^{46}\) The table does not list every sonority distinction. For example, the distinction between tense and lax vowels is not discussed, nor is the distinction between types of central vowels. These omissions are due to lack of data, so I will not comment further on this issue.
Non-Contiguous Conflation
(a) Stress falls on the leftmost high or low vowel [i u a]
   [píta], [píte], [píti]
   [páta], [páte], [páti]
(b) otherwise it falls on a mid vowel:
   [pète]

In this language, stress avoids a mid vowel without also avoiding a low vowel. In effect, [a] and high vowels have been conflated into a single category.

The reason why the present theory prevents such conflation relates to hierarchies and the fact that non-contiguous conflation requires a reversal in hierarchical relations. If stress avoids mid vowels for high vowels, there must be some constraint that favours stressed high vowels over stressed mid vowels. The present theory has no such constraint; the only constraint that bans stressed mid vowels also bans stressed high vowels: i.e. *ΔPrWd≤{e,o}. In short, such a language would require a reversal in the relative ranking of mid and high vowels.

From a conflation perspective, for [a] and high vowels to be conflated no active constraint can assign them violations. However, for mid vowels to be distinct from both [á] and [í ú], some set of constraints must assign mid vowels unique violations. In the present theory, both *ΔPrWd≤e,o and *ΔPrWd≤i,u would have to be active to distinguish mid vowels from the others. However, these constraints also distinguish high vowels from [a], meaning that they cannot be conflated. In other words, the present theory constraints necessitate that for a scale | x > y > z |, if x is distinct from y and z is distinct from y, then x is not conflated with z.

It is important to note that the predictions of the present theory not only rest on its constraints, but on the idea that CON contains no antagonistic constraints – i.e. constraints that impose the opposite harmonic relations between categories. For example, the constraint *σ/ midV cannot exist; this constraint assigns violations to mid vowels in stressed syllables, thereby favouring stressed high and low vowels over stressed mid vowels. Such a constraint allows for a non-contiguous conflation, thereby subverting the present theory’s effects. The fact that such a conflation does not happen indicates that CON does not contain such a constraint.

In summary, the present theory allows for contiguous conflations only, but places no restrictions on which categories conflate or how many separate conflations there may be in a single system.

While this chapter has focused on vowel sonority, there are constraints for every subset of the sonority hierarchy: e.g. *ΔPrWd≤liquid, *ΔPrWd≤nasal, etc. With these constraints, the present theory predicts that stressed liquids and nasals should be even less desirable than schwa. This prediction is borne out in the New Zealand dialect of English (my own). Schwa can be stressed: e.g. [bít] ‘bit’, [práti] ‘pretty’. However, stress never falls on a liquid or nasal, as in many other English dialects. In words like ‘illness’, schwa takes the stress: [šlnás], *[lnás].

The high front lax vowel [i] in other English dialects corresponds to [œ] in New Zealand English.
3.5.5 The conflation-hierarchy implication

The preceding sections have identified the present theory’s predictions for hierarchical relations and possible conflations. This section examines dependencies between the two. The present theory predicts (65).

(65) The Conflation-Hierarchy Implication
• \(x,y,z\) are members of some scale \(S\)
  if \(x\) and \(y\) are conflated
  and \(x\) is more harmonic than \(z\),
  then \(y\) is more harmonic than \(z\).

For example, the categories ‘mid vowel’ and ‘high vowel’ are conflated in Gujarati: neither attracts stress over the other (e.g. \([\text{jur}\hat{\text{op}}ni]\), \([\text{kʰe}d\hat{\text{io}}]\)). Mid vowels attract stress away from schwa (\([\text{kójəldi}]\), *\([\text{kəjəldi}]\)), so the present theory predicts that high vowels will attract stress away from \(\text{[ə]}\) too (as indeed they do: e.g. \([\text{wɪsməɾən}]\), *\([\text{wɪsməɾən}]\)).

A system that is predicted to not exist is one that is similar to Gujarati, with high and mid stressed vowels conflated and where (i) mid vowels attract stress away from schwa but (ii) stress does not avoid schwa for high vowels, producing \([\text{wɪsməɾən}]\) instead of \([\text{wɪsməɾən}]\). In effect, this situation is one of “Avoid \([\text{ə}]\) only if the alternative is significantly better (i.e. a mid vowel).”

I have found no systems like quasi-Gujarati; more generally, there is no language in which the Conflation-Hierarchy Implication does not hold. The reason that the prediction identified above follows from the present proposals is outlined in (66). \(x, y,\) and \(z\) refer to scale categories.

(66) Conflation-Hierarchy Implication; reasoning
• \(x,y,z\) are members of the same scale
  (i) If \(x\) is more harmonic than \(z\) then there is some active constraint \(C_1\) which favours \(x\) over \(z\).
  (ii) If \(x\) is conflated with \(y\) then no active constraint favours \(x\) over \(y\) or \(y\) over \(x\).
  (iii) If no active constraint distinguishes \(x\) over \(y\),
       then \(C_1\) must assign the same violations to \(x\) as it does to \(y\).
  (iv) If \(C_1\) assigns the same violations to \(x\) and to \(y\),
       then \(C_1\) favours \(y\) over \(z\) (because \(C_1\) favours \(x\) over \(z\) – from (i).)
  (v) Therefore, \(y\) is more harmonic than \(z\).

This outline will now be discussed step-by-step.

If \(x\) is more harmonic than \(y\) in a grammar, then some active constraint assigns more violations to \(y\) than to \(x\). For example, \([\text{é}]\) is more harmonic than \([\text{ʃ}]\) in Gujarati because \([\text{ʃ}]\) violates some active constraint while \([\text{é}]\) does not. At this point, it doesn’t matter what the constraint is: the present theory offers both \(\Delta_{PrWd}\leq[i,u]\) and \(\Delta_{PrWd}\leq\) – either will give the right result. Now, when we say that \([\text{é}]\) is conflated with \([i]\) (and \([u]\)),
we mean that there is no active constraint that distinguishes the two. The constraint $\Delta_{Pr,Wd}\leq\{i,u\}$ does distinguish [é] from [i], so it cannot be active. This leaves $\Delta_{Pr,Wd}\leq\emptyset$ as the only possible active constraint. But now [i] must be distinct from [ê]: the latter violates the active constraint $\Delta_{Pr,Wd}\leq\emptyset$ while the former element does not. In this way, it follows purely by the logic of ranking and the form of the constraints that if high and mid vowels are conflated, and mid vowels are actively favoured over schwa, then high vowels are also favoured over schwa.

In a sense, this result reduces to a general property of classical OT: constraints eliminate losers; they do not pick which of the remaining candidates is the winner (McCarthy 2001b:106-7). In other words, if a candidate violates a constraint C, C cannot pick out which of the remaining candidates must be the winner. That job is up to the remaining constraints. For example, if a candidate [apa] violates ONSET, ONSET cannot then designate that [pa] must win; whether [pa] or [?p apa] wins is determined by other constraints (i.e. MAX and DEP). The same is true of the present situation: if a candidate violates $\Delta_{Pr,Wd}\leq\emptyset$, it cannot designate that the winning candidate must contain a stressed [a]. Which non-ê candidate wins is entirely up to the remaining constraints.

In summary, the present theory places a number of restrictions on conflation. Conflation of non-contiguous categories is not possible, and conflation necessitates certain hierarchical relations.

3.6 Conflation and fixed ranking

The aim of this section is to precisely characterize the types of conflation that fixed ranking scale-theories are able and unable to produce, building on work by de Lacy (1999a, 2000a) and Prince (1999).

In §3.6.1, an individual set of constraints in a fixed ranking is shown to allow only ‘high-end conflation’ – conflation with the most unmarked scale categories. Section 3.6.2 considers the conflations produced when several sets of constraints in fixed rankings are intermingled. This section shows that although several sets of constraints with a particular complementarity of form allow for a larger number of conflations, they are still unable to produce systems with two or more separate conflated sets of categories (as in Nganasan). Section 3.6.3 summarizes the results.

3.6.1 High-end and low-end conflation

By way of example, the fixed-ranking constraints in (67) will be employed here:

(67) Fixed Ranking Sonority-Stress Constraints (after Kenstowicz 1996)
$$|| *\sigma/\emptyset \gg *\sigma/\{i,u\} \gg *\sigma/\{e,o\} \gg \sigma/a ||$$

As established in previous sections, two categories $x$ and $y$ are conflated when there is no active constraint that distinguishes between them (see §3.3.2.2 for discussion of ‘active’). An active constraint is one that is crucial in picking a winner from some relevant
candidate competition. For example, since the categories ‘stressed high vowel’ and ‘stressed mid vowel’ are conflated in Gujarati, there can be no constraint that assigns different violations to them, and is active – i.e. outranks ALIGNFtR in this situation.

In contrast, two categories $x,y$ are distinct when some constraint that distinguishes $x$ from $y$ is active. In Gujarati, the categories ‘stressed schwa’ and ‘stressed high vowel’ are distinct, so some active constraint must favour one over the other – i.e. $*\delta/\{\varepsilon\}$.

In Fixed Ranking theories, there are implicational relations between constraint activity: if a constraint $*x$ is active then all constraints that universally outrank it are also active. For example, if the constraint $*\delta/\{e,o\}$ is active, then so are $*\delta/\{i,u\}$, and $*\delta/\varepsilon$. The forced activity of these constraints prevents conflation of the categories to which they refer. For example, since $*\delta/\varepsilon$ is active, the category ‘stressed schwa’ cannot be conflated with any other category. The same goes for $*\delta/\{i,u\}$. An implication of this point is that if a category conflates in a fixed ranking theory, it can only conflate with the unmarked category. For stress, the diagram in (68) graphically illustrates the possible conflations: each oval represents a conflated set. In short, if a category $c$ is conflated at all, it is conflated with the most unmarked scale category – [a] in this case.

(68) Possible conflations under Fixed Ranking

To clarify, the Nganasan low-end conflation case will be reviewed here.

As pointed out above, Fixed Ranking theories can successfully conflate any category with the most unmarked scale element. For example, the categories ‘stressed mid vowel’ and ‘stressed low vowel’ can be conflated, in the Nganasan analysis, and repeated here.

(69)

<table>
<thead>
<tr>
<th></th>
<th>ALIGNFtR</th>
<th>$*\delta/{e,o}$</th>
<th>$*\delta/\varepsilon$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td><em>(jājbom)ti</em></td>
<td>*!</td>
<td>*</td>
</tr>
<tr>
<td>(b)</td>
<td><em>ja(i)bómti</em></td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

Since all constraints that distinguish the two categories are inactive, the distinction between mid- and low-vowels is successfully eliminated in the ranking in (69).

In this same way, high vowels can be conflated with mid and low vowels for stress – achieved by rendering $*\delta/\{i,u\}$, $*\delta/\{e,o\}$, and $*\delta/\varepsilon$ inactive through ranking. Finally, stressed schwa can be conflated with high, mid, and low vowels if all sonority-stress constraints are inactive. In all these conflations, though, the conflated categories form a contiguous range of the scale starting with the least marked [á]. This type of conflation is called ‘high-end conflation’ here.

48 For stress, a “relevant candidate competition” involves candidates that differ in stress placement. Properly speaking, the activity of a constraint is relative to specific processes. For example, a constraint may be inactive for stress purposes, yet active in determining the quality of epenthetic material. The meaning of the term ‘active’ will be self-evident in the following discussion.
However, the Fixed Ranking theory cannot produce ‘low-end’ conflations, illustrated in (70). Each oval represents a low-end conflation – one that cannot be achieved with a single set of constraints in a fixed ranking.

(70) **Low-end conflations**

To illustrate, it is impossible for stressed high vowels and mid vowels to be conflated with the Fixed Ranking constraints unless they are conflated with low vowels. To explain, if central and high peripheral vowels are not conflated with low vowels, then constraints that distinguish between high peripheral and central vowels must be active: i.e. *$\delta$/{i,u}, *$\delta$/{ə}. However, if these constraints are active, they have the unfortunate side effect of producing a distinction between high and central vowels, therefore preventing them from conflating. The relevant tableau from the Nganasan analysis is repeated in (71).

(71)

<table>
<thead>
<tr>
<th>/hursåj/i/</th>
<th>*$\delta$/{ə}</th>
<th>*$\delta$/{i,u}</th>
<th>ALIGNFTR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) hur(såj)i</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) (húrså)jí</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

A summary of the results identified above is given below.

(72) **Fixed Ranking and High-End Conflation**

- For all sets of constraints C with constraints of the form *$\Sigma$/x,
  where $x\in S$, $S$ is a scale,
  $\Sigma$ is some structural element,
  and the members of C are in a fixed ranking
  If $x$ is conflated with $y$,
  then $x$ is also conflated with $u$.
  - $x,y,u$ are members of $S$.
  - $u$ is the unmarked category in $S$, relative to the structural element $\Sigma$.

In other words, a set of constraints in a fixed ranking can only produce ‘high-end’ conflation – it cannot conflate unmarked categories without also conflating them with marked ones.

**3.6.2 Complementary constraints and multiple conflation**

If the Fixed Ranking theory can only produce high-end conflation, it follows that the Fixed Ranking theory can only produce one set of conflated categories per system. In other words, a system like Nganasan’s is impossible to produce: this language has two
different conflations – of central and high peripheral vowels, and of mid peripheral and low vowels.

To illustrate, a constraint type relevant for conflation here in sonority-driven stress is one that mentions the unstressed syllable (closely equivalent to the non-DTE of the PrWd, in the present theory). Unstressed syllable (∅) constraints are provided in (73).\(^\text{49}\)

(73) **Fixed Ranking unstressed syllable-sonority constraints**


Following Prince & Smolensky (1993), Kenstowicz (1996), and the present proposals, the constraints reverse the scale hierarchy, with unstressed low vowels the least favoured type. These constraints are the fixed ranking equivalent of the present theory’s \(*_{-∆\text{PrWd}}\)sonority constraints (cf de Lacy 1999a for non-heads and the tonal scale, Prince & Smolensky 1993 for syllable margins).

The constraints have an effect that is very close to that of the *∅/x constraints: they favour candidates with stressed low vowels over all others, and so on through the hierarchy. This point is illustrated in tableau (74).

\(^{49}\) Crosswhite (1998) presents a series of positively formulated constraints in a fixed ranking that have a similar effect: e.g. ∅→a “Stressed syllables must contain [a]”, and so on. The criticisms applied to the *∅/x constraints apply equally to the positive constraints here – the positive constraints do not allow for conflation of the Nganasan type. For further discussion of positive constraints in general, see de Lacy (1999a, 2000a) and §3.5.1.3.
In the tableau above, stress does not avoid schwa for the high vowel, showing that the two categories are conflated. Even so, the activity of *\(\sigma\)/a and *\(\sigma\)/{e,o} shows that high vowels and schwa are not conflated with any other category.

The reason that the *\(\sigma\)/x constraints can conflate stressed schwa with stressed high vowels again reduces to the fact that Fixed Ranking theories can produce high-end conflation. Since the sonority scale is reversed in combination with \(\sigma\), schwa is the high end of the scale for this particular set of constraints. So, any conflation with schwa is admissible, effectively producing the conflation diagrammed in (76).

\[(76) \quad \text{Diagram showing conflation types.} \]

The net result is that almost any conflation may take place in the Fixed Ranking theory if both *\(\sigma\)/sonority and *\(\sigma\)/sonority constraints exist. To illustrate the empirical effect of this point, a table of conflation types is presented in Table 3.6, with active constraints indicated for each conflation type.

<table>
<thead>
<tr>
<th>Categories</th>
<th>Active Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) i/u  e/o a</td>
<td>*(\sigma)/a (\Rightarrow) *(\sigma)/{i,u} (\Rightarrow) *(\sigma)/{e,o}</td>
</tr>
<tr>
<td>(a) i/u  e/o a</td>
<td>*(\sigma)/a, *(\sigma)/a</td>
</tr>
<tr>
<td>(a) i/u  e/o a</td>
<td>*(\sigma)/a (\Rightarrow) *(\sigma)/{i,u}</td>
</tr>
<tr>
<td>(a) i/u  e/o a</td>
<td>*(\sigma)/a</td>
</tr>
<tr>
<td>(a) i/u  e/o a</td>
<td>*(\sigma)/a (\Rightarrow) *(\sigma)/{e.o}</td>
</tr>
<tr>
<td>(a) i/u  e/o a</td>
<td>Predicted to be impossible</td>
</tr>
<tr>
<td>(a) i/u  e/o a</td>
<td>*(\sigma)/a</td>
</tr>
<tr>
<td>(a) i/u  e/o a</td>
<td>None</td>
</tr>
</tbody>
</table>

As indicated, almost every conflation can be done with the Fixed Ranking constraints. However, there is one type that is still predicted to be impossible: the Nganasan system.

The property that sets the Nganasan system apart from the others is that it has two conflations: [\(\tilde{s}\)]-\([\tilde{u}\tilde{u}]\) and [\(\tilde{\epsilon}\ \tilde{\epsilon}\)\]-\([\tilde{a}\tilde{a}]\); all others have just one (or none). This property points to a general result: even with both the *\(\sigma\)/x and *\(\sigma\)/x constraints, the Fixed Ranking theory cannot produce systems with two or more conflations.

To illustrate this point, in order to conflate [\(\tilde{s}\)] with high vowels, there can be no active constraint that distinguishes the two. This requires *\(\sigma\)/a to be inactive, and hence all the *\(\sigma\)/x constraints to be inactive. Therefore, all the conflations must be due to the *\(\sigma\)/x constraints.

The *\(\sigma\)/x constraint that distinguishes [\(\tilde{s}\)] from [\(\tilde{u}\tilde{u}\)] is *\(\sigma\)/{i,u}, as shown in tableau (75) above. Hence, it must be inactive. However, *\(\sigma\)/{e,o} must be active in order to distinguish high vowels and schwa from mid vowels. This point is made in tableau (77).
However, a problem arises: since \( *\sigma /\{e,o\} \) is active, \( *\sigma /\{a\} \) must also be active. Since these two constraints distinguish stressed mid vowels from low vowels, the ranking requires the categories ‘mid vowel’ and ‘low vowel’ to be distinct. Thus, mid vowels and low vowels cannot be conflated if high vowels and schwa are also conflated, as shown below.

The problem just described results from the general property of constraint activation described above. If a constraint \( C \) is active, then all constraints that are in a fixed ranking above it are also active. If a constraint is active and distinguishes \( x \) from all other categories, then \( x \) cannot be conflated with any other category. Since \( *\sigma /\{e,o\} \) must be active in Nganasan, \( *\sigma /\{a\} \) must also be active. If \( *\sigma /\{a\} \) is active, then \( [\acute{a}] \) cannot be conflated with any other category. To generalize: relative to a set of constraints that mention scale \( S \), if category \( c \) is not conflated with category \( d \) and \( d \) is more marked than \( c \) on \( S \), then \( x \) is not conflated with any category in \( S \). The net result is that there can only be one conflation per system.

Although only the \( *\sigma /\text{sonority} \) and \( *\sigma /\text{sonority} \) constraints have been discussed here, the result generalizes to all sets of structurally complementary scale-referring markedness constraints. So, for any set of fixed-ranking constraints with the form \( *\Sigma /x \) (\( \Sigma \) is a constituent and \( x \) is some scale category), if there is a corresponding set of constraints \( *\Sigma '/x \) (\( \Sigma ' \) is every relevant structural position except for \( \Sigma \)) then the combined effect of the two constraints allows for every system with a single set of conflated categories. However, it still does not allow for systems with two or more separate conflations. This point is summarized in (79).
Structurally Complementary Scale Constraints in a Fixed Ranking: Conflation

For a scale $S$ and two sets of constraints $C_1, C_2$ on $S$,
(a) $C_1$’s members have the form $\Sigma/x$,
   $\Sigma$ is a structural position, $x \in S$.
(b) $C_2$’s members have the form $\Sigma'/x$,
   $\Sigma'$ is every relevant structural position except for $\Sigma$
(c) for all $x, y \in S$, if $|| \Sigma/x \gg \Sigma/y ||$ then $|| \Sigma'/y \gg \Sigma'/x ||$

Then the only restriction in conflation on scale $S$ with respect to $\Sigma$ is that:
(i) if $x$ is conflated with $y$ and
(ii) if $z$ is conflated with some category,
then $z$ is conflated with $x$ and $y$.

In other words, no two-conflation systems are allowed. By generalizing the result this way, it applies not only to sonority-driven stress, but to all sonority-influenced prosodification, including – for example – syllabification. In addition, the generalization extends beyond the sonority scale to tone (de Lacy 1999a).

3.6.3 Summary

To summarize, a set of scale-referring markedness constraints $K$ in a fixed ranking cannot produce low-end conflation: if $c$ is conflated, it must be conflated with the most unmarked category. If there is a set of constraints that is structurally complementary to $K$ in the way described in §3.6.2, then almost all systems with a single conflation can be produced. However, no systems with two or more conflations can be generated with fixed-ranking constraints, regardless of the number of constraints in $\text{CON}$.

These results are summarized in (80).

Fixed Ranking Conflation Implication

For all sets of constraints with the form $\Sigma/s$,
where $s$ is a point on scale $S$,
and $\Sigma$ is some structural element [optional]
(i) If $\Sigma/p$ is active, then
   for all $x \in S$ s.t. $| x \rangle | p |$, $\Sigma/x$ is active.
(ii) For all $y$, if $\Sigma/y$ is active then $y$ is not conflated with any category.
(iii) Therefore, if $p$ is not conflated with any category, then
   for all $z \in S$ s.t. $| z \rangle | p |$, $z$ is not conflated with any category.

In other words, if $x$ and $y$ are distinct categories and $| x \rangle | y |$, then $x$ is distinct from all categories (i.e. $x$ is not conflated with any category), relative to a particular set of constraints.

Importantly, the result above does not apply to sets of constraints $\Sigma/x$ where there is no corresponding set $\Sigma'/x$. With such constraints, it is only possible to produce high-end conflation, as established in §3.6.1. Such a system is provided in chapter 4§4.3.
(Kiriwina). This system is shown to require constraints that refer to the structural category \(-\Delta_{\text{Ft}}\) and that there is no set of constraints that refers to the exact complement – i.e. a combination of foot DTEs and unfooted syllables. Since this system has low-end conflation too, it provides crucial evidence for the stringent formulation of scale-referring markedness constraints, like Nganasan.

This section concludes with the point that the property of the Fixed Ranking theory that prevents low-end conflation is its invariant ranking; the fact that its constraints are not stringently formulated is irrelevant. In other words, a theory with stringent constraints in a fixed ranking would also fail to produce adequate conflation. The reason relates to activation – in any fixed ranking theory, if a constraint C is active, it implies that all other constraints that outrank it are also always active. Since constraint activation implies lack of conflation, any fixed ranking theory will have implicational relations between confluations. The fact that any contiguous conflation is possible – and therefore that there are no implicational relations between confluations – shows that scale-referring markedness constraints are freely rankable, and therefore stringently formulated.

Finally, it should be noted that conflation in prosodification is not the only phonological phenomenon that shows the need for stringent constraints. Other relevant phenomena – neutralization and assimilation – are presented in chapters 5 and 7. Nevertheless, conflation in prosodification provides the most transparent evidence for stringent constraint form.

3.7 Summary

This chapter has shown that the ranking of scale-referring constraints must be freely permutable. This property of the present theory enables it to deal with conflation, while fixed ranking places unattested restrictions on possible confluations. In effect, fixed ranking of scale-based constraints makes certain confluations dependent on others: \(x\) and \(y\) can only conflate if \(y\) and \(z\) have already been conflated.

The dependency relation can be illustrated with the fixed ranking \(\parallel *\Delta_{\text{PrWd}} \leq \{i,u\} \gg *\Delta_{\text{PrWd}} \leq \{e,o\} \parallel\). If stressed mid vowels are distinct from stressed low vowels, as in Gujarati, then \(*\Delta_{\text{PrWd}} \leq \{e,o\}\) must be active. But if it is active, then \(*\Delta_{\text{PrWd}} \leq \{i,u\}\) is also active. If \(*\Delta_{\text{PrWd}} \leq \{i,u\}\) is active, then high vowels and mid vowels cannot be conflated, as shown by \(\text{[t}[\text{j}[\text{okr}\text{ine}]\text{]}\) below:

\[
\begin{array}{|c|c|c|c|}
\hline
\text{}/\text{t}[\text{j}\text{okr}\text{ine}]\text{/} & *\Delta_{\text{PrWd}} \leq \{i,u\} & *\Delta_{\text{PrWd}} \leq \{e,o\} & \text{ALIGNF}\text{T}\text{R} \\
\hline
\text{\textit{\#x}} & \text{(a) (t}[\text{j}[\text{okr}\text{ki}]\text{)ne} & & * \\
\text{\textit{\#x}} & \text{(b) t}[\text{j}\text{ok}(\text{r}\text{in})e] & *! & * \text{\textit{\#x}} \\
\hline
\end{array}
\]

There is no ranking of the constraints above that can produce conflation of high and mid vowels here. Since the two categories can only be conflated if \(*\Delta_{\text{PrWd}} \leq \{i,u\}\) is inactive, \text{ALIGNF}\text{T}\text{R} would have to outrank \(*\Delta_{\text{PrWd}} \leq \{i,u\}\). Such a situation would also render \(*\Delta_{\text{PrWd}} \leq \{e,o\}\) inactive, though, meaning that mid and low vowels should be
conflated too. In short, fixed ranking sets up implicational restrictions between possible conflations, but freely rankable constraints impose no such restrictions.

As demonstrated in §3.6, identifying exactly which conflations are impossible with fixed ranking constraints depends largely on the existence of other related constraints. A valid generalization, though, is that no fixed ranking theory can produce systems with two or more conflations. In addition, on its own, no set of constraints in a fixed ranking can produce low-end conflation – conflation of marked categories alone. However, if there are two sets of constraints that differ only in that they refer to complementary structural elements, any system with a single conflation can be produced.

As discussed in chapter 2, unfettered ranking permutation and the need to effect hierarchical relations between categories necessitates local harmonic bounding. In turn, local harmonic bounding necessitates scales that refer to contiguous parts of a scale. So, the argument presented in this chapter not only advocates free ranking, but that constraints refer to a range of a scale rather than individual points.

The results of this chapter have broad implications for theories of constraints.

• Constraints cannot be in fixed rankings as they would be unable to adequately produce all attested conflations.
• Constraints cannot refer to points on a scale – to do so would prevent hierarchical relations and allow non-contiguous conflations.
• CON cannot contain any constraint that is antagonistic to the constraints of the present theory: if a constraint favours \( x \) over \( y \), there can be no constraint that favours \( y \) over \( x \); such a situation would eliminate hierarchical relations and produce unattested conflations. This restriction clearly places severe restrictions on CON, so not only does the present theory propose a set of constraints, but significantly limits the space of possible additional constraints in CON.
CHAPTER 4

NON-DTEs

4.1 Introduction

The aim of this chapter is to show the need for markedness constraints that refer to non-DTEs. In particular, evidence for the foot non-DTE (-∆_{Ft}) is presented. Foot non-DTEs are all those root nodes that are (i) inside a foot and (ii) not the foot’s DTE; they are circled in Figure 4.1.

Figure 4.1: Foot non-DTEs

50 To be precise, the focus is on -∆_{(P,R)} – i.e. the Root node non-DTEs of a foot.

A point that will prove to be important in the following discussion is that the term ‘foot non-DTE’ is not synonymous with ‘unstressed syllable’. Unstressed syllables that are not parsed into feet are not foot non-DTEs – they have no DTE status at all with respect to feet. This follows from the definition of non-DTE: to be a non-DTE of a foot, a segment must be dominated by a Ft node. For example, in [(páte)ki], [e] is a foot non-DTE, but [i] is not because it is not contained inside a foot. However, both [e] and [i] are non-DTEs of the PrWd; this difference will prove crucial in that following case studies.

Foot non-DTEs are the focus of this chapter because constraints that refer to them have fairly transparent empirical effects. In this chapter, constraints on foot-DTEs will be shown to influence stress, motivate vowel neutralization, and figure in vowel epenthesis.

A secondary aim is to show that DTEs can refer to any prosodic category. Thus, there are constraints that refer to DTEs of feet, as well as those that mention DTEs of syllables, Prosodic Words, Intonational Phrases and so on. Selkirk (1998) and de Lacy (1999a) have argued this point for tone, and Zec (2000) has a similar approach to sonority. This chapter provides further evidence for this point.

Section 4.2 shows that constraints on the sonority of foot non-DTEs can influence the position of feet, and therefore of stress. For example, in the Oceanic language Kiriwina a trochaic foot usually appears at the right edge of the PrWd (1a). However, the foot will appear further towards the left edge if doing so will result in a low-sonority foot non-DTE.
(1b). For example, stress falls on the antepenult in [(míga)la] because penult stress would result in a foot with a high sonority non-head: *[mi(gíla)].

(1) Kiriwina stress in brief

(a) Default penultimate stress

<table>
<thead>
<tr>
<th>Word</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>[am(bái)sa]</td>
<td>‘where?’</td>
</tr>
<tr>
<td>[bó(nára)]</td>
<td>‘shelf (in house)’</td>
</tr>
<tr>
<td>[iko(súvi)]</td>
<td>‘he puts in’</td>
</tr>
<tr>
<td>[imom(kóli)]</td>
<td>‘he tasted (it)’</td>
</tr>
<tr>
<td>[ka(wála)]</td>
<td>‘canoe pole’</td>
</tr>
<tr>
<td>[tau(áu)]</td>
<td>‘hey, men!’</td>
</tr>
</tbody>
</table>

(b) Stress retraction

<table>
<thead>
<tr>
<th>Word</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>[(kúli)a]</td>
<td>‘cooking pot’</td>
</tr>
<tr>
<td>[(lámi)la]</td>
<td>‘outrigger log’</td>
</tr>
<tr>
<td>[la(ódi)la]</td>
<td>‘jungle’</td>
</tr>
<tr>
<td>[(lúgu)ta]</td>
<td>‘yam type’</td>
</tr>
<tr>
<td>[(míga)la]</td>
<td>‘the face’</td>
</tr>
<tr>
<td>[(páku)la]</td>
<td>‘blame’</td>
</tr>
</tbody>
</table>

A markedness constraint that bans high sonority foot non-DTEs – specifically *-ΔFt≥{e,o} – is shown to provide an account for this system. Kiriwina also exhibits conflation that crucially requires stringent constraints, analogous to Nganasan in ch.3§3.3.

A similar argument is made for stress placement in the Ethiopic language Harar Oromo in §4.2.2. Harar Oromo differs from Kiriwina in its response to *-ΔFt≥{e,o}: rather than deviating from the default stress position, feet are reduced in size.

Section 4.3 shows that constraints on foot-DTEs can produce certain patterns of vowel neutralization. To be precise, vowel reduction in the informal register of Dutch only takes place in the foot non-DTE: e.g. [(fóna)loý(i)] ‘phonology’, *[fóna]loý(i)]. This case is argued to require a markedness constraint that refers specifically to foot non-DTEs.

Section 4.4 shows that non-DTE markedness constraints affect the typology of epenthetic vowels. This section shows that any unround vowel can be epenthetic [i a]. This fact is argued to follow from the tension between DTE and non-DTE markedness constraints. Further evidence for non-DTE constraints comes from Shipibo, a language in which the epenthetic vowel is [a] in foot heads and [i] in non-heads.

Section 4.5 summarizes the findings of this chapter.

4.2 Stress and non-DTEs

Some non-DTE constraints have already been discussed in the context of scales. For example, Prince & Smolensky (1993) have a set of constraints that relate sonority and the syllable margin (i.e. -Δσ). Similarly, Kenstowicz (1996) proposes that there are constraints on sonority in the ‘foot margin’ – the foot’s non-head syllable nucleus. I have proposed constraints on tone in foot non-DTEs (de Lacy 1999a, 2002b); also see Zec (1999). In a related vein, Crosswhite (1999) proposes constraints on the sonority of unstressed syllables.

Constraints that mention non-DTEs reverse the scale to which they refer. So, while the DTE constraints militate against low sonority elements, the non-DTE constraints militate against high sonority. This reversal is indicated in the abbreviated constraint form by *-Δσ≥s, where s is some sonority level. The full constraint form refers to the o element
of feature values: i.e. *-\( \Delta_\alpha \)/[oooo]Sonority]; *-\( \Delta_\alpha \geq \{i, u\} \) is violated by any non-DTE of category \( \alpha \) that is more sonorous than a schwa (i.e. [\( i \ u \ e \ o \ e \ a \]). This point is discussed in ch.2§2.4.1.1.

So, the least harmonic non-DTE is a low vowel, then mid peripheral vowels, then high peripheral vowels, and so on through the sonority hierarchy to the least sonorous categories. In terms of foot non-DTE constraints, then, a foot with the form (CV\( ^{\alpha} \)C) is more harmonic than (CVC\( ^{\alpha} \)a) since the latter contains a high sonority foot non-DTE [a], while the former contains the less sonorous [i]. In constraint terms, the latter foot violates *-\( \Delta_\text{Ft} \geq a \), while the former does not.

This section discusses two languages that provide evidence for foot non-DTE constraints. §4.2.1 analyses the stress system of Kiriwina, spoken in the Trobriand Islands, and §4.2.2 deals with Harar Oromo, an Ethiopic language. Both languages seek to form a foot with low sonority non-DTEs, but achieve their aims by somewhat different means: the former retracts stress from the default position, while the latter alters foot size.

### 4.2.1 Kiriwina

Kiriwina – also called Kilivila – is spoken in the Trobriand Islands and the Milne Bay province of Papua New Guinea. The description and data presented here come from Lawton’s (1993) and Senft’s (1986) grammars (hereafter L and S respectively).

Kiriwina has five vowels [i e a o u], and a syllable structure of (C)V(V)(m).\(^{51}\) Bivocalic nuclei are the diphthongs [ai au ei eu oi ou]; bivocalic nuclei never consist of two identical vowels (i.e. a long vowel – S12, 20). Mid vowels almost never occur word-finally (Senft p.24).\(^{52}\)

Stress usually falls on a final bimoraic syllable (i.e. CVV(C), CVC), otherwise on the penult. Increased amplitude and duration are the primary correlates of stress (L43). L also notes some allophonic variation conditioned by stress (p.18).

(2) Default stress in Kiriwina

(a) Final Heavy Syllable (CVV(C), CVC)

[ivabodaním] ‘he came last walking’
[bakám] ‘I will eat’
[íkíúm] ‘he did secretly’
[tauáu] ‘hey, men!’
[lakatupói] ‘I have asked’
[ídói] ‘(a boat) brings something’

---

\(^{51}\) Coda [m] can only appear with monomoraic nuclei and the diphthongs [ai ei] (S 21); no examples of CVVm syllables were provided with stress indicated in the sources. [m] can also appear as the sole nucleus in a word-initial syllable: e.g. [mtona] ‘he 3p.sg.’, [msa] ‘afterbirth’, [mdauvali] ‘fly’. In these cases, stress can fall on [m]: e.g. [mi.wo] {island name}, [mi.na] {particle} (L23).

---

\(^{52}\) Senft (p.24) states that mid vowels “are rarely found in word-final position, except when used in poetic and emphatic forms.” I found no tokens in his data with final mid vowels and stress marked.
(b) Else penult

[idója] ‘it drifts’
[dumdabógi] ‘early dawn’
[péu.la] ‘strong’

[imomkóli] ‘he tasted (it)’
[am.bái.sa] ‘where?’
[náu.?u] ‘nose plug’

However, stress falls on the antepenultimate syllable in one situation: when the penult contains a high vowel and the ultima contains [a] (L45, S25).

(3) [CV{ɪ,u}Ca] in Kiriwina
(a) [CVCiCa]

[mígiila] ‘the face’
[toméikita] ‘selfish person’
[lámila] ‘outrigger log’
[vićim-kóvila] ‘to complete’
[kúlia] ‘cooking pot’

[luko-sísiga] {clan name}
[katusawásila] ‘clear throat’
[laódila] ‘jungle’

(b) CVCuCa

[lásíkula] ‘pull canoe’
[méguva] ‘white magic’
[pákula] ‘blame’
[lůguta] ‘yam type’

[mílila] ‘the face’
[kawála] ‘canoe pole’
[bonára] ‘shelf (in house)’

[múgúvà] ‘a red soil’
[búluva] ‘thong tying door’

In contrast, stress does not retract when the penult contains a non-high vowel (4a), or when the ultima contains a high vowel (4b).

(4) Kiriwina sonority-driven stress

(a) CVC{e,ó,á}Ca

[.tomtomóta] ‘dumb’
[idója] ‘it drifts’
[kawála] ‘canoe pole’
[bonára] ‘shelf (in house)’

[mínbí] ‘dumb’
[kimográf] ‘housefly’
[ivá] ‘he did (it)’
[ikoisúvi] ‘he puts in’

[msimwési] ‘grass type’
[imomkói] ‘he tasted (it)’
[dumdabógi] ‘early dawn’
[mlópu] ‘cave’

[mlom w áluva] ‘a red soil’
[imomkóli] ‘he tasted (it)’
[dumdabógi] ‘early dawn’

[iñógú] ‘cooking pot’

[búluva] ‘thong tying door’

[msim w ési] ‘grass type’
[imomkóli] ‘he tasted (it)’
[dumdabógi] ‘early dawn’
[mlópu] ‘cave’

[mlom w áluva] ‘a red soil’

No forms of the shape [CVCVC{e,o}] are cited because word-final mid vowels are very rare word-finally, and no relevant examples are provided by L and S.\(^54\) Even so, there

\(^{53}\) I was unable to find any […CeCa] words with stress indicated. There are very few such words in L, although they do exist: e.g. beba ‘butterfly’ (303), dodoleta ‘band of carved decoration’.
is evidence that mid vowels are as undesirable as low vowels in foot non-head position, shown in §4.2.1.3.

Alternations support the description of stress above. L99 observes that focus is marked by replacing the final vowel of verbs with a high vowel: e.g. [lumkola] ‘feel’, [lumkoli] ‘feel {with focus}’. In words with otherwise antepenultimate stress, L reports that the vowel change causes stress to appear on the penult, though he does not give any transcriptions of examples.

4.2.1.1 Default footing

The default stress position can be ascribed to a quantity-sensitive trochaic foot, aligned as close to the right PrWd boundary as possible: i.e. [ba(kám)], [tau(áu)], [i(dója)], [imom(kólí)], [am(báí)sa]. Forms like [ba(kám)] show that Kiriwina is quantity-sensitive (i.e. *[bákam]), so feet have the form (CVX) (e.g. [ba(kám)], [tau(áu)]), or (CVCV) (e.g. [i(dója)]). There is no evidence that feet are ever iambic or degenerate. Therefore, the constraints TROCHEE and FTBIN are undominated in this language (see ch.3§3.3.2 for definitions).

Right-edge foot alignment is promoted by the constraint ALIGNFtR. Violations of ALIGNFtR can be forced by FTBIN. This is the case for [(náu)?u]: for this candidate to have a right-aligned foot, the foot would either be degenerate (e.g. *[nau(ʔú)]) or trimoraic (e.g. *[náuʔu]). To avoid this situation and allow for the more harmonic non-right-aligned binary foot, FTBIN must outrank ALIGNFtR.

<table>
<thead>
<tr>
<th></th>
<th>FTBIN</th>
<th>ALIGNFtR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>(c)</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

The only candidate to satisfy both FTBIN and ALIGNFtR is *[na(ʔúu)], a candidate that fatally violates constraints on syllabification.

The following section shows that the *ΔFt≥x constraints account for the cases of antepenultimate stress.

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54 It is not uncommon for word-final position to be a particular locus of neutralization. The constraints that produce neutralization of final /e o/ will not be discussed here since this is tangential to the main point (see Crosswhite 1999 for relevant discussion). The present analysis predicts that words of the shape [(CVC{t,u}C{e,o})] would have antepenult stress.

55 Minimal word restrictions show that FTBIN outranks either DEP or MAX: words must be minimally bimoraic (i.e. a foot – McCarthy & Prince 1986, 1993b).

56 Trimoraic trochees of the form (σµµσµ) are permitted in other languages (Hayes 1995, Kager 1993). However, Hayes argues that they are marginal, so I will assume that they are not permitted in Kiriwina. This ranking also bans trimoraic feet in antepenult-stress words like [(míqiila], *[míqiila].

57 Specifically ONSET, which favours [(náu)?u] over [na.(ʔúʔu)]; see Prince & Smolensky’s (1993:§3.2) analysis of Tongan stress for discussion.
4.2.1.2 Non-DTEs

Constraints on foot non-DTEs are the primary motivation for antepenultimate stress in Kiriwina. Kiriwina aims to avoid a high sonority foot non-DTE, where 'high sonority' refers to both mid and low vowels. In /lamila/, for example, the incorrect output form *[la(míla)] has a foot with a very high sonority non-DTE: *[a]. In contrast, the foot non-DTE [i] in the attested form [(lámi)la] has relatively low sonority. The relevant foot non-DTE constraints are listed in (6).

\begin{align}
\text{(6) Foot non-DTE sonority constraints} \\
\text{*-} & \Delta_F \geq \{i,u\} \quad \text{“Assign a violation for every foot non-DTE that is equally or more} \\
\text{sonorous than high vowels ([i u e o a]).”} \\
\text{*-} & \Delta_F \geq \{e,o\} \quad \text{“Assign a violation for every foot non-DTE that is equally or more} \\
\text{sonorous than mid vowels ([e o a]).”} \\
\text{*-} & \Delta_F \geq a \quad \text{“Assign a violation for every foot non-DTE that is equally or more} \\
\text{sonorous than high vowels ([a]).”} \\
\end{align}

The constraint *-\(\Delta_F \geq \{e,o\}\) is active in Kiriwina: this constraint assigns a violation to a candidate if a foot non-DTE has more sonority than a high vowel. To deal with a form like *[mí/G4A ila]*, *-\(\Delta_F \geq \{e,o\}\) must outrank ALIGNFtR:

\begin{align}
\text{(7)} \\
| /mí qi/la/ & *-\Delta_F \geq \{e,o\} & \text{ALIGNFtR} \\
| a \text{ (míqi)la} & * & *! \\
| b \text{ mi(qíla)} & * & *! \\
\end{align}

An element is a non-DTE of a foot if (i) it is dominated by a foot node and (ii) it is not the foot’s DTE. In candidate (a), only [m], [g], and [i] satisfy these two requirements – [i] is a foot DTE, and [l] and [a] are not dominated by a foot node. Since [m], [g], and [i] are all less sonorous than mid vowels, the constraint *-\(\Delta_F \geq \{e,o\}\) is not violated.

In contrast, candidate (b) has the high sonority [a] as a foot non-DTE, fatally violating *-\(\Delta_F \geq \{e,o\}\).

Note that -\(\Delta_F\) refers not only to the vowel in the unstressed syllable of a foot, but to all segments that are not the foot’s DTE. For candidate (b), this includes the onset of the stressed syllable [g], the onset of the unstressed syllable [l], and the nucleus of the unstressed syllable [a]. In effect, then, the *-\(\Delta_F\) constraint is not only sensitive to the sonority of the non-head syllable’s nucleus, but to the onsets as well. In practice, though, only the non-head syllable’s nucleus will ever be relevant; for the onsets to ever affect the outcome, they would have to be more sonorous than the non-head’s nucleus. This situation only ever comes about in syllables with low sonority syllabic consonants and relatively high sonority onsets (e.g. [ln], [wl]). This situation is not relevant in Kiriwina.

The constraint *-\(\Delta_F \geq \{e,o\}\) must refer specifically to the non-DTE of a foot. The only other potentially viable option is for it to refer to PrWd non-DTEs: *-\(\Delta_{PrWd} \geq \{e,o\}\). However, this will not produce the right result. A non-DTE of a PrWd is effectively every
element except the primary-stressed vowel. So, the -Δ_{PrWd} elements in (a) are [m g l a], and in (b) they are [m i g l a]. Therefore, a constraint like *-Δ_{PrWd} ≥ {e, o} will be equally violated by both candidates since both have [a] as a -Δ_{PrWd}. Since *-Δ_{PrWd} ≥ {e, o} is equally violated, ALIGNFtR would make the crucial decision, incorrectly favouring (b) over (a).

4.2.1.3 Conflation and mid vowels

It is crucial that the constraint *-Δ_{Ft} ≥ {e, o} be active in Kiriwina rather than *-Δ_{Ft} ≥ {a}. *-Δ_{Ft} ≥ {e, o} is violated by both (CVC{e, o}) and (CVCa) feet equally, explaining why words like [i(dója)] have penultimate stress rather than antepenultimate *[i[(ído)ja]]. In the present approach, this is because antepenultimate stress will not improve the non-DTE’s sonority significantly enough: *[i[(ído)ja]] still has a high sonority foot non-DTE, as illustrated in tableau (8).

<table>
<thead>
<tr>
<th>/idoja/</th>
<th>*-Δ_{Ft} ≥ {e, o}</th>
<th>ALIGNFtR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (ídó)ja</td>
<td>*</td>
<td>*!</td>
</tr>
<tr>
<td>(b) i(dó)ja</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

[i(dó)ja] also provides evidence for the ranking of *-Δ_{Ft} ≥ {a}, a constraint that penalizes feet with [a] non-DTEs. The word idója shows that *-Δ_{Ft} ≥ {a} cannot be active. If it were, [i(dó)ja] should be less harmonic than *[i[(ído)ja]].

<table>
<thead>
<tr>
<th>/idoja/</th>
<th>*-Δ_{Ft} ≥ {e, o}</th>
<th>*-Δ_{Ft} ≥ {a}</th>
<th>ALIGNFtR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (ídó)ja</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) i(dó)ja</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

The point made above is that both (CVC{e, o}) and (CVCa) feet are conflated in Kiriwina: they are equally disharmonic. So, any constraint that distinguishes them – such as *-Δ_{Ft} ≥ a – must be ranked below ALIGNFtR, which effectively renders it irrelevant in determining the winner between candidates that differ only in stress placement.

The ranking of the other vowel-non-DTE constraint *-Δ_{Ft} ≥ {i, u} is indeterminable. Since it assigns the same violations to all feet, its ranking cannot be determined by stress placement.

The ranking || *-Δ_{Ft} ≥ {e, o} » ALIGNFtR || also predicts that words ending in mid vowels will undergo stress retraction; however, no words allow final mid vowels, so there is no way to test this prediction.

4.2.1.4 Non-retraction

The ranking above accounts for all the other facts of Kiriwina stress. As noted above, stress does not retract to the antepenult when the final vowel is high: e.g.
The formal expression of markedness – ch.4

The reason for the lack of retraction is that the feet in these words do not have any non-DTEs with unacceptably high sonority – none violate \( ^{-}\Delta F_t \geq \{e,o\} \). Therefore, retraction would be gratuitous, as shown in tableau (10).

(10)

<table>
<thead>
<tr>
<th>(/i\text{gibului}/)</th>
<th>(-\Delta F_t \geq {e,o})</th>
<th>ALIGNFtR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) icibu(lúí)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) icibi(búli)</td>
<td></td>
<td>!</td>
</tr>
</tbody>
</table>

The ranking also accounts for the fact that stress does not retract when the penult contains a non-high vowel and the ultima a low vowel. Both \([(bóna)ra]\) and \([bo(nára)]\) incur the same violations of \(-\Delta F_t \geq \{e,o\}\), so retraction would achieve nothing.

(11)

<table>
<thead>
<tr>
<th>(/\text{bonara}/)</th>
<th>(-\Delta F_t \geq {e,o})</th>
<th>ALIGNFtR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (bóna)ra</td>
<td></td>
<td>!</td>
</tr>
<tr>
<td>(b) bo(nára)</td>
<td></td>
<td>!</td>
</tr>
</tbody>
</table>

The same ranking accounts for the lack of retraction in \([\text{tomt(o)móta})\): the retracted form \([\text{tóm(tóm)ta}\) does not improve DTE sonority; other relevant examples are given in (4a).

- **DTE constraints in Kiriwina**

  The words cited above also show why an approach that entirely relies on DTE constraints will not work. DTE constraints are only useful when competing candidates differ in DTE sonority. However, there are many cases in Kiriwina where candidates do not differ in DTE sonority yet the antepenultimate-stressed form wins.

  For example, the two prime competitors from \(/\text{mígila}/\) are \([\text{(míg)l}a]\) and \([\text{mí(g)l}a]\). Both candidates incur exactly the same DTE violations since both have stressed high vowels. Therefore, since the DTE constraints do not favour one candidate over the other, the choice of winner should fall to ALIGNFtR, incorrectly predicting that the penultimate-stressed candidate should win. Of course, the difference between \([\text{(míg)l}a]\) and \([\text{mí(g)l}a]\) is not in their DTEs, but in the sonority of the foot non-DTE.

  Since DTE sonority does not matter in Kiriwina, all DTE constraints that distinguish \([i u e o a]\) must be inactive. For example, \(\Delta F_{f/p,w,l} \leq \{i,u\}\) would incorrectly favour \([p\text{w}a(jú,ju)] 'sour' over \([p\text{w}a(jú,ju)]\) if active, and \(\Delta F_t \leq \{e,o\}\) would incorrectly favour \([\text{mám}o(\text{va})]\) over \([m\text{má}(\text{mó}v\text{a})]\) 'be alive'.

  The tableau below illustrates the undesirable effect of DTE constraints in Kiriwina.

(12)

<table>
<thead>
<tr>
<th>(/\text{mámo(\text{va})}/)</th>
<th>(-\Delta F_t \geq {e,o})</th>
<th>ALIGNFtR</th>
<th>(-\Delta F_t \leq {e,o})</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) ma(móva)</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(b) (mámo)va</td>
<td></td>
<td>!</td>
<td></td>
</tr>
</tbody>
</table>
If $\Delta_{\text{FT}} \leq \{e,o\}$ (or $\Delta_{\text{P,WD}} \leq \{e,o\}$) outranked $\text{ALIGNFr}R$, (b) would win.

- **FTBIN**
  
  Finally, it is possible to establish a ranking between $\text{FTBIN}$ and $\ast-\Delta_{\text{FT}} \geq \{e,o\}$. One way to avoid violations of the non-DTE constraint is to reduce the size of the foot. For example, [migi(lá)] does not have a highly sonorous foot non-DTE since its only foot non-DTE is [l]. Since this strategy is not employed in Kiriwina, $\text{FTBIN}$ must outrank $\ast-\Delta_{\text{FT}} \geq \{e,o\}$.

<table>
<thead>
<tr>
<th>/migi/la/</th>
<th>FTBIN</th>
<th>$\ast-\Delta_{\text{FT}} \geq {e,o}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (migi)la</td>
<td></td>
<td>* !</td>
</tr>
<tr>
<td>(b) migi(lá)</td>
<td>* !</td>
<td></td>
</tr>
</tbody>
</table>

This ranking will turn out to be of more than passing interest: §4.2.2 shows that Harar Oromo employs the opposite ranking.

As a final note, the constraint $\text{TROCHEE}$ must also outrank $\ast-\Delta_{\text{FT}} \geq \{e,o\}$, otherwise the iambic footed $\ast[mi(gi)lá]$ would win.

### 4.2.1.5 Morpheme boundaries

Retraction only takes place in Kiriwina when there is no morpheme boundary within the last three syllables of the word (L43). When morpheme boundaries intervene, stress falls on the penult regardless of sonority.

The words in the left column of (14) contrast with those in the right column solely in terms of morpheme boundaries. As shown, the presence of a morpheme boundary immediately before either the penult or ultima results in penultimate stress. The bold face morpheme in the right column is the root.\(^{58}\)

(14) Kiriwina Stress and Morpheme Boundaries (Lawton, p.45)

<table>
<thead>
<tr>
<th>låmila</th>
<th>‘outrigger log’</th>
<th>[la-mila]</th>
<th>‘I have become sth’</th>
</tr>
</thead>
<tbody>
<tr>
<td>méguva</td>
<td>‘white magic’</td>
<td>[me-gual]</td>
<td>‘it originated (there)’</td>
</tr>
<tr>
<td>lukuta</td>
<td>‘yam type’</td>
<td>[lu-gu-ta]</td>
<td>‘my sister (male speaking)’</td>
</tr>
<tr>
<td>latu-sawásila</td>
<td>‘clear throat’</td>
<td>[wasí-la]</td>
<td>its obligation</td>
</tr>
<tr>
<td>mgiña</td>
<td>‘the face’</td>
<td>[migí-la]</td>
<td>‘his face’</td>
</tr>
<tr>
<td>to-m-méikita</td>
<td>‘selfish person’</td>
<td>[bob”ailí-la]</td>
<td>‘gift’</td>
</tr>
</tbody>
</table>

Morpheme boundaries before the antepenult are irrelevant: e.g. [i-(búkula)] ‘it bore in clusters’, *[i-**bu(kul)a]**, [luku-(sísi)ga] ‘clan name’.

---

\(^{58}\) Neither S nor L give examples with multiple suffixes.
• **PrWd-Root alignment**

The lack of retraction in morphologically complex forms can be ascribed to two separate restrictions. One is that the left edge of the PrWd must coincide with the left edge of the root by action of the constraint ALIGN-L(Root, PrWd) (McCarthy & Prince 1993a). This will prevent stress from falling on the prefix in words like [me-gúla] ‘it originated (there)’ since it must be prosodified as [me{(gúla)}], where {} mark PrWd boundaries. The word cannot be prosodified as *[{(mé-gú)la}]* because this prevents the root’s and PrWd’s left edges from coinciding.

(15)

<table>
<thead>
<tr>
<th>/me-gúla/</th>
<th>ALIGN-L(Root,PrWd)</th>
<th>*-ΔFt≥{e,o}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) me-((gúla)}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) {(mé-gu)la}</td>
<td>*!</td>
<td></td>
</tr>
</tbody>
</table>

• **PrWd-Suffix alignment**

Alignment of the root’s and PrWd’s left edges will not account for penult stress in [miqu-la], though. In this form, the PrWd boundaries will appear as {{{miqu-la}}} so there is no apparent reason why the foot cannot appear at the left edge: i.e. *[{(míqu)la}]*. One cannot ascribe penult stress in these forms to a peculiarity of the suffix -la, either: the suffixes -ta, -na, and -gwa also cause stress to fall on the penult (L46). Moreover, it is not the shape of suffixes that is relevant – bimoraic suffixes can take the stress: e.g. [i-bukula-váu] ‘it bore in clusters again’ (cf [i-búkula] ‘it bore in clusters’).

I have not been able to devise an OT solution to this issue that I consider entirely satisfactory. One approach is to invoke a constraint that requires the right edge of a foot to align with the right edge of a suffix: ALIGN-R(Ft, suffix). This will favour the morphologically complex [miri-la] over *[{(mígi)-la}]*. Tableau (16a) shows that ALIGN-R(Ft, suffix) ranked above *-ΔFt≥{e,o} will produce the attested result. Tableau (16a) shows the contrasting case with the monomorphemic [miri-la] – since there is no suffix in this form, ALIGN-R(Stem,Ft) is vacuously satisfied, so allowing the effect of the DTE-sonority constraint to emerge.

(16)

<table>
<thead>
<tr>
<th>/miri-la/</th>
<th>ALIGN-R(Ft,suffix)</th>
<th>*-ΔFt≥{e,o}</th>
<th>ALIGNFTR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (mígi)-la</td>
<td>*!</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(b) mi(gi)-la</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>/mirila/</td>
<td>ALIGN-R(Ft,suffix)</td>
<td>*-ΔFt≥{e,o}</td>
<td>ALIGNFTR</td>
</tr>
<tr>
<td>(a) (mígi)la</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(b) mi(gi)la</td>
<td>*!</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

The reason that this account is not entirely satisfactory is because it appeals to alignment of a prosodic constituent with an affix and not a root; contradicting Selkirk’s (1995) and McCarthy & Prince’s (1993a) proposals. Nevertheless, the Kiriwina facts are reminiscent of other stress systems. For example, Latin famously stresses a heavy penult,
else the antepenult. Steriade (1988a) observes that Latin has several clitics, like *que* ‘and’, which force stress to fall on the penult even if it is light (also see Halle 1990:158ff). Analogous to Kiriwina, addition of an enclitic in Latin forces metrical structure to diverge from the default pattern. I leave the discussion of this issue in Kiriwina at this point.

- **Stress Window**
  
  The final property of interest is the issue of the stress window. Lawton says that stress retracts to the antepenultimate syllable, but does not mention that it ever retracts to the pre-antepenult. In the present analysis, a word of the shape [CVGIC(e,o,a)Ca] would be best output with initial stress. I was unable to find any words that would decide this one way or the other and were marked for stress, although such words may exist (e.g. [tolibwala] ‘house owner’ and [toliwaga] ‘name of a chiefly subclan’, although these seem to be morphologically complex). Unfortunately, morphemes that are long enough for a window effect to be seen are rare; it may be the case that the data relevant for determining the presence of a window effect is not available for independent reasons.

4.2.1.6 Summary

Kiriwina shows that the sonority of foot non-DTEs can be decisive in determining stress placement. The rankings established in the preceding sections are summarized in Figure 4.2.

**Figure 4.2: Kiriwina sonority-driven stress ranking summary**

```
FTBIN    TROCHEE  ALIGN-L(Root,PrWd)
*-\Delta_{Ft} \geq \{i,u\}  *-\Delta_{Ft} \geq \{e,o\}
ALIGNFrR
*-\Delta_{Ft} \geq \{a\}   *\Delta_{Ft/PrWd} \leq \{i,u\}  *\Delta_{Ft/PrWd} \leq \{e,o\}
```

The ranking expresses the fact that foot-form is invariant – since FTBIN and TROCHEE outrank all other constraints, no sonority consideration will force feet to be other than well-formed bimoraic trochees.

The crucial ranking is between *-\Delta_{Ft} \geq \{e,o\} and ALIGNFrR. It is this ranking that forces feet to retract if doing so will result in a foot with a low sonority non-head.

It is equally important that ALIGNFrR outrank *-\Delta_{Ft} \geq \{a\}, though. The inactivity of *-\Delta_{Ft} \geq \{a\} is crucial to the conflation of mid and low vowels as equally disharmonic foot non-DTEs. The reverse ranking will be illustrated in the analysis of Harar Oromo. The same is true of DTE constraints – since Kiriwina ignores the sonority of stressed syllables, all relevant foot- and PrWd-DTE constraints must be inactive.

Kiriwina shows that there is no fixed ranking between DTE and non-DTE constraints. If the DTE counterpart of *-\Delta_{Ft} \geq \{e,o\} had to outrank it in every grammar, for example, there should be wholesale avoidance of stressed high vowels, even when the foot
non-DTE’s sonority was not at stake. More concretely, *ΔFt≤{e,o} would require stress to fall on a low vowel even when the foot non-DTE was not at issue: e.g. [ta(búsi)] ‘paddle’ would be *[tábu)si].

Conversely, if the non-DTE constraint *-ΔFt≥{e,o} had to outrank its DTE counterpart *ΔFt≥{e,o} in every grammar, every language with sonority-driven stress would have to be sensitive to the sonority of the foot non-DTE. This is clearly not the case, as shown by the many languages cited in chapter 3 in which only the sonority of the head is significant.

The final point that deserves comment is the position of *-ΔFt≥{i,u}, a constraint that militates against all Kiriwina vowels in foot non-heads. Since all candidates would violate this constraint equally, its ranking with respect to ALIGNFtR is largely irrelevant; it must be dominated by FTBIN, though, otherwise feet would be degenerate – this point is illustrated in Harar Oromo in the next section.

4.2.2 Harar Oromo

The stress system of the Ethiopic language Harar Oromo is also influenced by the sonority of the foot non-DTE. Harar Oromo’s stress system is similar to Kiriwina’s in many ways: it too aims to have a right-aligned trochaic foot and to avoid feet with highly sonorous non-DTEs. However, Harar Oromo differs from Kiriwina in two ways. One is that only forms with [a] as a foot non-DTE are avoided – mid vowel foot non-DTEs are permitted. The other difference is that Harar Oromo reduces the size of the foot, rather than moving it from the right edge.

The data presented here come from Owens (1985). Harar Oromo has five vowels [i e a o u] and their long counterparts [iː eː aː oː uː]. In nouns and adjectives, vowel length is contrastive medially (e.g. [boːru:] ‘dirty’ cf [boru:] ‘tomorrow’), but of the short vowels only [a] is found finally (e.g. [nama] ‘person’). In other words, vowel length in word-final position is only contrastive for the low vowel (see (18)). This restriction accounts for the lack of forms with short non-low final vowels in the data presented below.\(^{59}\) Syllable structure is (C)V(C) (e.g. [bim.be:] ‘mosquito’, [mɔ:r.ma] ‘neck’); an extra consonant is allowed word-finally (e.g. [moːrm] ‘neck’, [sogid:] ‘salt’).

In nominals, stress can only fall on the ultima or penult.\(^{60}\) The default position for stress is the penult, as shown in the following words (Owens 1985: 29):

---

\(^{59}\) The ban on word-final short non-low vowels can be seen as a type of apocope: non-low short vowels are deleted. This can be ascribed to the ranking \[\text{CONTIG} \gg \Delta \mu \leq \{e,o\} \gg \text{MAX}\]. The ranking of \*ΔFt≤{e,o} over MAX results in deletion of non-low vowels in syllable rimes. However, CONTIG prevents medial deletion. From input /nami/, the output would therefore be [nam]. Restriction of apocope to short vowels is common, and can be formally implemented by having a faithfulness constraint that preserves long vowels outrank \*ΔFt≤{e,o} (see Beckman 1998).

\(^{60}\) Tone placement on verbs, an important indicator of stress, is affected by a number of verbal suffixes that obscure the overall pattern. I refer the reader to Owens (1985:28ff), and focus solely on nominal stress here.
(17) Harar Oromo default nominal stress

| [áble:]  | ‘knife’   | [kítli:]  | ‘kettle’ |
| [hant’ábi:] | ‘ice, sleet’ | [kúrsi:]  | ‘chair’  |
| [háre:]   | ‘donkey’  | [okóte:]  | ‘pan’    |
| [hulále:] | ‘door even’| [xále:]   | ‘liver’  |

Stress is realized by increased duration and amplitude (Owens, p.37). In addition, high tone obligatorily associates to the stressed syllable and spreads rightward (tone is therefore entirely predictable in these words). So, words with penult stress have high tone on the penult and ultima, but low tone on preceding syllables (e.g. [hàn’t’ábi:] ‘ice, sleet’) while words with final stress have high tone on the ultima only (e.g. [màk’í:] ‘car’).

The words in (17) show that stress in Harar Oromo is quantity-insensitive: it makes no distinction between bimoraic and monomoraic syllables (e.g. [kítli:] ‘kettle’).

Significantly, stress does not always fall on the penult: it appears on the final syllable if it contains a low vowel ([a] or [aː]). 61

(18) Harar Oromo: Final [a(ː)] attracts stress

| [adːá]    | ‘forehead’ | [lolá]    | ‘battle’ |
| [dümːsá]  | ‘cloud’    | [maɡalá:] | ‘market’ |
| [ɡurbá:]  | ‘boy’      | [makíná:] | ‘car’    |
| [hulá:]   | ‘door’     | [maná]    | ‘house’  |
| [ibidːá]  | ‘fire’     | [mutʃːá:] | ‘child’  |
| [intalá]  | ‘girl’     | [namá]    | ‘person’ |

The words [makiːná:] ‘car’ (18) and [kúrsi:] ‘chair’ (17) are both loanwords, showing that the stress placement rule is productive.

Harar Oromo stress is very similar in kind to Gujarati stress (ch.3§3.4). In both languages, the default position for stress is the penult, and in both languages [a] influences stress. However, there is one important difference between Gujarati and Harar Oromo: when both the penult and ultima contain [a], stress falls on the penult in Gujarati but on the ultima in Harar Oromo. For example, Harar Oromo has [namá], while Gujarati has [sáːdɑ]. This difference will provide evidence for foot non-DTE constraints in Harar Öromo.

4.2.2.1 Default stress and DTEs

The default position for stress in Harar Oromo is the penultimate syllable: e.g. [kúrsi:] ‘chair’, [k’urtúmi:] ‘fish’. To account for this fact, a quantity-insensitive trochaic foot at the right edge of the PrWd is employed here: e.g. [k’ur(túmi:)]. The foot must be

---

61 Owens observes that there are some exceptions to the generalizations made above. In the main these are morphologically conditioned. For example, stress falls on the final syllable in the class of ‘invariable adjectives’ (e.g. [adːi:] ‘white’, *[ádi:] – p.29), and a number of suffixes are pre-stressing, producing penult stress and overriding the sonority conditions on stress: e.g. [gúd-a:] ‘big+masc.’, *[gúd-a:]. There also seem to be a few lexical exceptions: e.g. [mála:] ‘cheek’ (p.29), [saqalé:] ‘sound’, [hóri:] ‘wealth’, [erú:] ‘field, farm’, [aŋɡáfa] ‘eldest sibling’. Since Owens asserts that the exceptions are clearly in the minority, I put them aside and focus on the general pattern.
quantity insensitive because the length of the rime clearly does not affect stress placement, as shown by the examples just given.

As in Gujarati, the constraint TROCHEE requires the head of the foot to be leftmost, while FTBIN-σ requires the foot to be disyllabic. The constraint ALIGNFtR requires all feet to be rightmost.

(19) Default Stress in Harar Oromo

<table>
<thead>
<tr>
<th>/k'urtumi/</th>
<th>FTBIN</th>
<th>TROCHEE</th>
<th>ALIGNFtR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) k’ur(túmi:)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) k’urtu(mí:)</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) k’ur(tumí:)</td>
<td></td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>(d) (k’úrtu)mi:</td>
<td></td>
<td></td>
<td>*!</td>
</tr>
</tbody>
</table>

However, words whose ultima contains an [a(ː)] have final stress (e.g. [dumːesá] ‘cloud’, [namá] ‘person’), indicating that there is some high-ranking constraint that favours candidates with a final [á(ː)]. This is the subject of the following section.

4.2.2.2 Non-DTEs

The non-DTE constraints provide an account for final stress in words like [namá]. In all words with penult stress, the non-head syllable of the foot contains a low sonority vowel [iː oː urː], but never the highest sonority [a] or [aː]. For example, in [(ábleː)] ‘knife’, the non-DTE of the foot contains the nucleus [eː]; the same position in [(kúrsiː)] ‘chair’ has a low-sonority high vowel. In contrast, penult stress in words with a final [a] would create a foot with a very high sonority non-DTE: e.g. *[náma], *[gúrbaː].

Final stress in these words is a solution to this problem: [na(má)], [gur(bá)]. By employing a degenerate foot, highly sonorous foot non-DTEs are avoided. For example, the only foot non-DTE in [gur(bá)] is [b]; the segments [gur] are not inside a foot, and so are not foot non-DTEs.

Avoidance of a high-sonority non-DTE is motivated by the constraint *-ΔFt≥a “Assign a violation for a non-DTE with [a]”. With this constraint outranking FTBIN, stress seeks out a final [a]:

(20)

<table>
<thead>
<tr>
<th>/nama/</th>
<th>ALIGNFtR</th>
<th>*-ΔFt≥a</th>
<th>FTBIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (náma)</td>
<td></td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>(b) na(má)</td>
<td>*!</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>(c) (ná)ma</td>
<td>*!</td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

Candidate (a) violates *-ΔFt/a because one of its foot non-DTEs is [a]. As shown by candidates (b) and (c), the only sort of foot that avoids violating *-ΔFt/a is a degenerate
By having a degenerate foot, foot non-DTEs are eliminated: there is no vocalic \(-\Delta_{Ft}\) in [na(má)] or *[ná]ma]. Of the candidates with degenerate feet, candidate (c) loses to (b) because it does not have a right-aligned foot.

The same ranking produces the correct stress for [a]-final words without penult [a], as illustrated in (21).

(21)

<table>
<thead>
<tr>
<th>/gurba:/</th>
<th>ALIGNFtR</th>
<th>(-\Delta_{Ft}\geq a)</th>
<th>FTBIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (gürba:)</td>
<td></td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>(b) gür(bá:)</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(c) (gür)ba:</td>
<td>*!</td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

In short, Harar Oromo and Kiriwina present different responses to the same problem – i.e. high sonority foot non-DTEs. While Kiriwina retracts stress from the right edge to avoid high sonority non-DTEs, Harar Oromo opts to reduce foot size.

A further ranking that can be established for Harar Oromo is that the non-DTE constraint \(-\Delta_{Ft}\geq\{a\}\) is active in its system while \(-\Delta_{Ft}\geq\{e,o\}\) is not. This latter point is shown by words like [(áble)] ‘knife’, *[ab(lé)]. In contrast, \(-\Delta_{Ft}\geq\{e,o\}\) is active in Kiriwina while \(-\Delta_{Ft}\geq\{a\}\) is not, again illustrating the point that scale-referring constraints’ ranking must be freely permutable.

- The inadequacy of DTE constraints in Harar Oromo

Non-DTE constraints must be used to account for Harar Oromo. DTE-referring ones cannot produce the right results, especially with regard to words like [namá] ‘person’. In such words, stress falls on an ultima [a] even when the penult contains an [a]. The problem is that there is no motivation to deviate from the default stress position (i.e. penult). In constraint terms, ranking any DTE constraint above FTBIN will not cause final stress in this situation. This is illustrated in tableau (22).

(22)

<table>
<thead>
<tr>
<th>/nama/</th>
<th>(-\Delta_{Ft}\leq{e,o})</th>
<th>FTBIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (námá)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) na(má)</td>
<td>*!</td>
<td></td>
</tr>
</tbody>
</table>

The problem illustrated above is that there is no motivation for stress to avoid penult [a]: the constraint \(-\Delta_{Ft}\leq\{e,o\}\) treats a penultimate [á] the same as a final [á], allowing FTBIN to emerge as the crucial constraint. The same result will happen no matter which DTE constraint is used. This follows from the fact that all viable candidates will have a stressed [a], so all will incur equal violations of all DTE constraints.

62 The candidate [(namá)], with an iambic foot, is ruled out by \(-\Delta_{Ft}\geq a\), due to the initial syllable’s [a]. This form shows that FTBIN, and not TROCHEE, is the crucially dominated constraint here.
Analogous to Kiriwina’s stress pattern, the point that the [na(má)]~*[náma)] competition raises is that the sonority of the foot DTE is not at issue; the only difference between the two candidates is in the content of their foot non-DTEs.

In short, the DTE-sonority constraints cannot provide a solution to the Harar Oromo system. As in Kiriwina, it is the sonority of the foot’s non-head syllable that matters.

4.2.2.3 Summary

The ranking established for Harar Oromo is summarized in Figure 4.3.

Figure 4.3: Harar Oromo ranking summary

\[
\begin{align*}
\text{ALIGN FTR} & : \quad \Delta_F \geq \{a\} \\
\text{FTBIN} & : \quad \Delta_F \geq \{e,o\} \\
\text{FTBIN} & : \quad \Delta_F \geq \{i,u\}
\end{align*}
\]

The ranking || \*\-\Delta_F \geq \{a\} » FTBIN || is responsible for sonority-driven stress. ALIGNFTR prevents feet from responding to \*\-\Delta_F \geq \{a\} by movement as in Kiriwina, so they respond by reducing the size of the foot.

The constraints \*\-\Delta_F \geq \{e,o\} and \*\-\Delta_F \geq \{i,u\} do not force feet to reduce in size, so must be inactive in this ranking.

Together, Harar Oromo and Kiriwina illustrate a property of Optimality Theory: “heterogeneity of process and homogeneity of target” (see McCarthy 2001b for discussion). Violations of similar markedness constraints are avoided by different means. Harar Oromo responds to restrictions on the foot non-DTE by reducing foot size; in contrast, feet retract from the right edge in Kiriwina. In constraint terms, the difference is due to the ranking of ALIGNFTR and FTBIN – the former dominates the latter in Harar Oromo while the opposite holds in Kiriwina. Section 4.3 presents yet another option for satisfying non-DTE constraints: vowel reduction.

4.2.3 Alternatives: Sequential theories

The aim in the analyses of Kiriwina and Harar Oromo was to show that constraints must refer to non-DTEs. In the confines of the present theory, there is certainly no other way to produce the Kiriwina system; the DTE constraints are of no use because the sonority of DTEs is often the same in competing candidates (i.e. Kiriwina [mígila] vs *[mígila]).

But what of entirely different constraints? This section examines ‘sequential’ constraints. Such constraints refer to the relation between nearby elements; in this
instance, they would weigh the sonority difference between elements in nearby stressed syllables. The aim is to show that ‘non-sequential’ constraints of the sort proposed here are necessary in any case, and that sequential constraints have undesirable typological consequences.

### 4.2.3.1 Sonority-cline/distance theories

I know of no analysis of sonority-driven stress that has employed a sequential theory. However, one type of sequential theory that may seem like an obvious alternative will be discussed here: that there are sets of constraints that promote a falling sonority cline – or sonority distance – from DTEs to non-DTEs. Such constraints are similar to those proposed for sonority-distance effects (Selkirk 1984, Clements 1990, Baertsch 1998, Gouskova 2002, Parker 2002). The question of interest here is whether a theory with sonority-cline/distance constraints could supplant the present approach. The unifying factor in all such theories is that ‘the steeper the cline (or greater the distance), the better’.

The problem such a theory encounters with Kiriwina is that sonority distance will not distinguish feet of the form (CiCi) and (CáCa) since both nuclei have the same distance between them – i.e. ‘0’. However, the two foot types are treated differently. (CiCi) is highly desirable, motivating stress to retract from the right edge (e.g. [(mí(i)la), *[mi(gíla)]). In contrast, (CáCa) is avoided (e.g. [sa(máni)] ‘admit’, *[sáma(ni)]). The same is true for Harar Oromo: (CáCa(:)) is avoided (e.g. [ma(gálaː)] ‘market’, *[ma(gálaː)]), whereas (CiCi) is not (e.g. [(kíti(li)] ‘kettle’, *[kit(li)]).

In short, sonority distance or cline is not all that matters in Kiriwina and Harar Oromo. Crucially, low sonority foot non-DTEs are favoured more than high sonority ones, regardless of the sonority of foot DTEs.63

Since conditions on non-DTE sonority play an independent role in Kiriwina and Harar Oromo, one may ask whether there is any need for sonority-distance constraints related to footing at all. Constraints that refer to sonority-distance are at least not necessary to account for the cases discussed in this section and chapter 3. Constraints that state independent restrictions on DTEs and non-DTEs adequately account for these patterns of sonority-driven stress, as well as all the others I have examined (see ch.3§2.5.3 for a list). I have argued a similar point for tone-driven stress elsewhere (de Lacy 1999a, 2002b): constraints on the difference between tone levels within a foot are not necessary in tone-driven stress.

Again, the success of the present theory in accounting for Kiriwina and Harar Oromo is that its constraints focus solely on the sonority of a single element; they do not take into account the sonority of adjacent elements.

---

63 A similar problem arises with the OCP, which is another type of sequential constraint. Suzuki (1998§2.4.3.2) uses the constraint OCP(əh) to ban two instances of [ə] within a foot. This constraint – and others like it – cannot be used to deal with Kiriwina stress: OCP(əh) incorrectly favours *[bón(a)ra] over [bo(nára)]. Moreover, OCP(əh) can be rejected on typological grounds: it favours the foot (CiCa) over (CáCa) even though the latter has a higher sonority stressed syllable, so producing a situation of markedness reversal.
In summary, a theory that has sonority-distance constraints alone will face a difficult challenge in Kiriwina and Harar Oromo. The two languages treat (CiCi) and (CaCa) feet differently, even though they do not differ in sonority cline/distance.

This is not to say that sonority-distance constraints do not exist in CON. For example, cooccurrence restrictions on onset segments are often cast in terms of sonority-distance restrictions (Selkirk 1984, Baertsch 1998, Morelli 1998). The same is true for syllable contact effects (Murray and Vennemann 1983, Vennemann 1988, Davis 1998, Gouskova 2002), and for restrictions on possible diphthongs. However, in all these cases, sonority distance is calculated between adjacent elements. In no language are two non-adjacent segments banned because their sonority is too similar. The cases discussed here have an entirely different nature: the sonority of adjacent elements is not at issue; in fact, the sonority of non-adjacent syllable nuclei is evidently never significant either.

In short, there is no evidence that the extra power of a sequential theory is needed. The localistic nature of the (non-)DTE constraints provides an adequate account of the attested languages. On the other hand, it is important to point out that the DTE and non-DTE theory does not preclude sequential constraints. It is possible that sequential constraints coexist with the DTE constraints. However, if they do, the DTE theory places strong restrictions on their form. If sequential constraints exist, none of them may contradict a DTE constraint, favouring a low sonority DTE over a high sonority one, or vice versa for a non-DTE.

4.2.4 Summary

This section has shown that markedness constraints that refer specifically to foot non-DTEs are necessary. If markedness constraints could only refer to DTEs, it would be impossible to produce either the Kiriwina or Harar Oromo systems since stress ignores the sonority of DTEs entirely, relying on the sonority of the foot non-head to determine its position.

This section also showed that it is necessary to refer to the foot’s non-DTE, as opposed to some other category. Reference to the sonority of ‘unstressed syllables’ (or -DéPr,wD) is inadequate, failing to distinguish forms such as Kiriwina’s [(mígi)la] from [mí(gi)la]).

- **Tone and non-DTEs**

  While the sonority scale has been the focus of this section, it is important to point out that the same effects can be seen with other prosodic scales, such as tone. In the present theory, foot non-DTEs can combine with the tonal scale, producing a set of constraints that favour lower-toned foot non-DTEs over higher-toned ones: i.e. *-ΔFt≥L, *-ΔFt≥M, *-ΔFt≥H.

  In de Lacy (1999a, 2002b), I showed that such constraints were instrumental in determining foot placement in several Mixtec languages (for a full analysis, see the cited works). For example, the default position for stress in Ayutla Mixtec is on the initial syllable: e.g. [‘jınúra] ‘his pineapple’. (Pankratz & Pike 1969). However, stress will seek out the leftmost high-toned syllable that is immediately followed by a low-toned syllable:
e.g. [lúˈ(lúrə)], *(lúˈlú)ˈrə] ‘he is small’. The works cited argued that this pattern comes about through the action of a constraint against non-low toned non-DTEs that outranks ALIGNFtL. This is illustrated in tableau (23).

(23)

<table>
<thead>
<tr>
<th>/lulura/</th>
<th>*-$\Delta F_t \geq M$</th>
<th>ALIGNFtL</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) lúˈ(lúrə)</td>
<td>-</td>
<td>*</td>
</tr>
<tr>
<td>(b) lúˈlú)ˈrə</td>
<td>*!</td>
<td></td>
</tr>
</tbody>
</table>

- **Typology and non-DTEs**

This section concludes by discussing the relevance of non-DTE constraints to the typology of sonority-driven stress systems. As established in chapter 3, stress never seeks out a lower sonority vowel, ignoring a higher sonority one in the default stress position. The non-DTE constraints do not subvert this result. In fact, non-DTE constraints have much the same effect as DTE constraints. Non-DTE constraints will also promote stress on sonorous vowels, as shown in tableau (24).

(24)

<table>
<thead>
<tr>
<th>/tika/</th>
<th>*-$\Delta F_t \geq {a}$</th>
<th>ALIGN-$\sigma$-R</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) tika</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>(b) tiká</td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

In short, the non-DTE constraints do not adversely affect the implicational relations for sonority-driven stress, or more generally for prosodification. The hierarchical relations imposed by scales still hold: stress will only ever be attracted to sonorous vowels.

Of course, non-DTE constraints do present a variety of additional predictions for sonority-driven stress. As argued in the previous sections, the sonority of the stressed syllable may not be at issue in a particular language, but rather the sonority of the foot non-DTE (or some other relevant non-DTE). Since the non-DTE constraints only favour low sonority elements, no language will ever seek to make a high sonority element a non-DTE, avoiding lower sonority elements. For example, there is no language that avoids having the non-DTE of a foot contain a high vowel, preferring a low vowel instead. In such a language, stress would retract from a penult low vowel onto the antepenult if the ultima contained a high vowel (e.g. /pakali/ → [(páka)li], *[pa(káli)]; this is the exact opposite situation to Kiriwina (§4.2.1). Again, this sort of system cannot occur because no constraint favours the scenario just sketched out.

In short, the present theory predicts that – when active – the DTE and non-DTE constraints will motivate stressed syllables to seek out highly sonorous vowels, while non-heads will aim to have low sonority elements. These implicational relations ensure that the typological generalizations identified for conflation in chapter 3§3.5 still hold: non-contiguous conflations are not allowed, and the Conflation-Hierarchy Implication still holds. In other words, the non-DTE constraints have no adverse effects on sonority-sensitive prosodification.
To conclude, this section has identified two languages that require constraints that refer to the properties of the non-DTE of a foot.

4.3 Faithfulness and non-DTEs

The previous sections showed that non-DTE constraints could motivate deviation from the default stress position. However, there are a number of other ways to respond to a prohibition on high sonority non-DTEs. One way is to change high sonority non-DTEs into low sonority ones. This is what happens in Dutch: high sonority vowels reduce to [a] in certain unstressed positions (Kager 1989, Oostendorp 1995).


(25) Vowel Reduction in Dutch Registers

| Formal register     | [fɔnoloγi] |
| Semi-formal register| [fɔnalɔyi] |
| Very Informal       | [fɔnəloγi] |
| No register         | *[fɔnolɔγi] |

The Semi-formal register form [fɔnalɔyi] is of particular interest since reduction only takes place in one of the unstressed syllables, not both. Kager (1989:312) shows that the difference in reduction in [fɔnalɔyi] relates to foot structure. In the Semi-formal register, /o/ only reduces in the non-head position of a foot; in other unstressed syllables it remains faithful: i.e. [(fɔn)o(λɔ(γi))].

The primary aim of this section is to show that reduction in the semi-formal register requires markedness constraints that ban high-sonority vowels in foot non-DTEs. In fact, further complexities of reduction in the Semi-formal register show the need for several non-DTE constraints, including constraints on foot non-DTEs (*-\(\Delta_{Ft}\geq\{i,u\}\)) and on non-DTEs of the ProsodicWord (*-\(\Delta_{PrWd}\geq\{e,o\}\)).

Section 4.3.1 discusses the details of reduction in the Semi-formal register. An analysis is presented in §4.3.2.

Reduction in the other registers and the unattested reduction pattern (*[fɔnolɔγi]) is the focus of §4.3.3.

§4.3.4 contains a summary.

4.3.1 Dutch Semi-formal reduction: Description

There is a large literature on vowel reduction in Dutch (Martin 1968, Booij 1977, 1981, van der Hulst 1984, Zonneveld 1985, Kager 1989, Kager, Visch, and Zonneveld 1989). John McCarthy points out that the same pattern is seen in flapping in English. For example, repetitive is acceptable as [rə(pɛtə)nɔv] (formal), [rə(pɛrə)nɔv] (standard), and [rə(pɛrə)nɔv] (very casual), but never *[rə(pɛtə)nɔv]. This pattern can be explained by an account similar to the one below if markedness constraints that promote flapping in non-DTEs are employed. This issue is left for future work.
Within this literature, there is a great deal of agreement about the details of reduction and its relation to register.

Reduction in the semi-formal register is complex. Certain unstressed vowels reduce to schwa, but whether they do so in every unstressed position depends on the type of vowel. While /a/ and /e/ reduce to [a] in all unstressed positions, /o/ and /i/ only reduce in the weak position of a foot (Kager 1989:312, Booij 1981, Oostendorp 1995). For example, /lokomotif/ is realized as [(lòk)mo(tíf)], not *[lòk)ma(tíf)]. The category ‘weak position of a foot’ is effectively equivalent to ‘foot non-DTE’ (−ΔFt), as will be shown below. The round high vowels /y/ and /u/ do not reduce at all.

Figure 4.4 summarizes the generalizations in graphical form.

Figure 4.4: Dutch Semi-Formal reduction summary

- indicates reduction in all unstressed positions
-- indicates reduction in -ΔFt only.

Semi-formal reduction presents several analytical challenges. The one that is of central interest here is the difference between the non-DTE of foot and other unstressed positions for /o/ and /i/. The following sections will argue that this pattern follows from the constraint *-ΔFt≥{i,u}, which bans high sonority elements in foot non-DTEs alone.

As implied above, neither primary nor secondary stressed vowels ever undergo reduction: e.g. [(ála)], *[(ála)]; [(jara)(dis)], *[(jara)(dis)] (Kager 1989:297, Booij 1981).

**Non-metrically conditioned influences**

The focus of this section will be on the patterns of vowel reduction influenced by metrical structure. A number of non-metrically based conditions also trigger and restrict vowel reduction, though.

Vowels in onsetless syllables also do not undergo reduction, nor do prevocalic vowels. Finally, word-final vowels in open syllables do not reduce (e.g. [kóla], *[kóla] ‘cola’ – K304). These restrictions will be discussed in §4.3.3 since they are unrelated to the aspect of vowel reduction that is of immediate interest: i.e. its metrical conditioning.

In short, all post-consonantal non-pre-vocalic vowels in non-final unstressed syllables with onsets are subject to reduction.

**Data**

The words listed below are taken from Kager (1989) (Hereafter K). Footing is my own, based on Kager’s proposals; stress in Dutch is left-to-right trochaic and quantity-sensitive – tense vowels count as bimoraic (Kager 1989:313, Oostendorp 1995§4.2).
The formal expression of markedness – ch. 4

transcriptions are from Cassell’s Dutch Dictionary (van Wely 1977), with vowel reduction marked following K’s indications. Glosses are given where the English translation is not immediately apparent.

(26) /a/ reduces in footed and stray unstressed syllables

\[
\begin{align*}
\text{[kàr]\text{-mél]} & \quad \text{karamel} & \quad \text{[sìr]\text{-tú]} & \quad \text{sigaret} \\
\text{[kòl]\text{-bòr\text{-tòr]} & \quad \text{collaborateur} & \quad \text{[jèr]\text{-lém]} & \quad \text{Jerusalem} \\
\text{[rà\text{-dís]} & \quad \text{radijs ‘radish’} & \quad \text{[ápà\text{-líps]} & \quad \text{apocalyps} \\
\text{[pànà]\text{-mùk]} & \quad \text{panoramiek}
\end{align*}
\]

(27) /e/ reduces in footed and stray unstressed syllables

\[
\begin{align*}
\text{[pròs]\text{-dé]} & \quad \text{procédé ‘process’} & \quad \text{[lit\text{-rýr]} & \quad \text{literatuur} \\
\text{[èk\text{-òmà\text{-tré}]} & \quad \text{economie} & \quad \text{[sà\text{-nát]} & \quad \text{senaat} \\
\text{[ùnt\text{-sà\text{-dènt}]} & \quad \text{antecedent} & \quad \text{[èpí\text{-dà\text{-mí]] & \quad \text{epidemie}
\end{align*}
\]

(28) /o/ reduces in footed unstressed syllables only

\[
\begin{align*}
\text{[fòk]\text{-lá]} & \quad \text{chocola ‘chocola} & \quad \text{[lim\text{-nàdà]} & \quad \text{limonade} \\
\text{[pèl]\text{-tòn]} & \quad \text{peloton ‘platoon’} & \quad \text{[lòk\text{-mò\text{-tíf] & \quad \text{lokomotief} \\
\text{[èk\text{-òmà\text{-mùt] & \quad \text{economie} & \quad \text{[ònà\text{-mà\text{-pè]} & \quad \text{onomatopee} \\
\text{[tò\text{-màt] & \quad \text{tomaat ‘tomato’} & \quad \text{[kàt\text{-go\text{-ríf] & \quad \text{categorie}
\end{align*}
\]

(29) /ü/ reduces in footed unstressed syllables only

\[
\begin{align*}
\text{[rèk]\text{-kwí]} & \quad \text{relikwie ‘relic’} & \quad \text{[dlí\text{-plí\text{-nà]} & \quad \text{discipline} \\
\text{[kùr\text{-kà\text{-rýr)] & \quad \text{karikatuur} & \quad \text{[spèsa\text{-fís\text{-tét]} & \quad \text{specificiteit} \\
\text{[mí\text{-nùt] & \quad \text{minuut} & \quad \text{[indò\text{ví\text{-dù]} & \quad \text{individu} \\
\text{[sèrt\text{-fí\text{-kát}] & \quad \text{certificaat}
\end{align*}
\]

(30) Dutch /y/ and /u/ reduction

(a) /y/ does not reduce

\[
\begin{align*}
\text{[màny]\text{-fàk\text{-týr]} & \quad \text{manufaktuur ‘drapery’} & \quad \text{[prím\text{-là]} & \quad \text{primula} \\
\text{[stìmy]\text{-sà} & \quad \text{stimulus} & \quad \text{[kòm\text{-níst]} & \quad \text{communist}
\end{align*}
\]

(b) /u/ does not reduce

\[
\begin{align*}
\text{[zàlu\text{-zí]} & \quad \text{jalozie} & \quad \text{[kàmu\text{-flà\text{-zà]} & \quad \text{camouflage}
\end{align*}
\]

The following section presents an analysis of this reduction pattern.

4.3.2 Semi-formal reduction: Analysis

Crosswhite (1999) proposes that certain cases of vowel reduction are a response to a ban on high sonority elements in unstressed syllables. The following analysis adopts the
spirit of this approach. The formalism relies on the non-DTE constraints. Semi-formal reduction in Dutch is of particular interest to the present theory because it requires the action of constraints that refer to non-DTEs of different prosodic categories (i.e. \(-\Delta_F\) and \(-\Delta_{PrWd}\)), in some cases crucially ranked with respect to each other.

This analysis starts with reduction of /a/ and /e/ in all unstressed syllables (§4.3.2.1). Section 4.3.2.2 deals with the less general /o/ and /i/ reduction, and §4.3.2.3 concludes by accounting for the lack of reduction of /y/ and /u/.

4.3.2.1 /a/ and /e/ reduction: PrWd non-DTEs

/a/ and /e/ both reduce in unstressed syllables, regardless of whether the syllable is in a foot or not: e.g. /literatyr/ \(\rightarrow\) [(lit\(\alpha\))ra(t\(\ddot{y}\)r)] literatuur. In the present theory, there is no category ‘unstressed syllable’ (cf Crosswhite 1999). Instead, ‘unstressed syllable’ is every PrWd non-DTE that is not a foot DTE.

The non-DTE of a PrWd is every element that is not the primary stressed segment of a PrWd. So, the constraint \(*-\Delta_{PrWd}\geq\{e,o\}\) bans all segments with sonority of more than high vowels that do not bear primary stress. This constraint outranks all faithfulness constraints that preserve the peripherality of /a/ and /e/ – i.e. lowness for /a/ (IDENT[+low]) and frontness for /e/ (IDENT[+back]); these constraints will collectively be called IDENT\(V\) here. With the ranking || \(*-\Delta_{PrWd}\geq\{e,o\} \gg IDENTV \||\), reduction of /a/ and /e/ will take place in all unstressed positions, as shown in tableau (31).

<table>
<thead>
<tr>
<th>/literatyr/</th>
<th>*-(\Delta_{PrWd}\geq{e,o})</th>
<th>IDENT(V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (lit(\dot{e}))ra(t(\ddot{y})r)</td>
<td>* *!</td>
<td></td>
</tr>
<tr>
<td>(b) (lit(\ddot{e}))ra(t(\ddot{y})r)</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>(\rightarrow) (c) (lit(\ddot{e}))ra(t(\ddot{y})r)</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

It is essential to invoke a constraint that refers to the non-DTEs of PrWds rather than non-DTEs of feet here. \(-\Delta_{PrWd}\) refers not only to unstressed syllables within feet, but also ‘stray’ (i.e. unfooted) syllables. In [(lit\(\ddot{e}\))ra(t\(\ddot{y}\)r)], only the first schwa is a \(-\Delta_F\); the second is not a foot non-DTE because it is not dominated by a Ft node. If only \(*-\Delta_F\geq\{e,o\}\) were active, the output would be *[(lit\(\ddot{e}\))ra(t\(\ddot{y}\)r)] without reduction in the stray syllable.

- **Blocking reduction in stressed syllables**

The constraint \(*-\Delta_{PrWd}\geq\{e,o\}\) promotes reduction in both secondary stressed and unstressed positions. It therefore favours *[(\(\ddot{a}\)nt\(\ddot{a}\))sa(d\(\ddot{e}\)nt)] ‘antecedent’, with reduction in the secondary stressed syllable, over the actual winner [(\(\ddot{a}\)nt\(\ddot{a}\))sa(d\(\ddot{e}\)nt)]. This example underscores the point that PrWd non-DTEs are not the same as ‘unstressed syllables’: unstressed syllables are all those PrWd non-DTEs that are not foot DTEs while \(-\Delta_{PrWd}\)

\[\text{Crosswhite’s (1999§2.1) constraints refer to the category ‘unstressed syllable’. The present theory differs in referring to non-DTEs of prosodic units, effectively distinguishing between different types of unstressed syllable; in fact, there is no direct non-DTE equivalent to the category ‘unstressed syllable’, as discussed below.}\]
refers to all syllables that do not bear main stress (i.e. secondary stressed and unstressed syllables).

The DTE constraint \(^*\Delta_{FT} \leq \{\epsilon\}\) blocks reduction in stressed syllables by banning schwa in precisely that position. The constraint also has the incidentally desirable effect of explaining why [\(\epsilon\)] is never permitted in stressed position: with this ranking, underlying /\(\epsilon\)t/ will be forced to peripheralize if it ends up with stress: i.e. /\(p\epsilon\)t/ \(\rightarrow\) [p\(\epsilon\)t] (or some other peripheral vowel), \(^*[p\epsilon\)t].

\(^*\Delta_{FT} \leq \{\epsilon\}\) must outrank \(^*-\Delta_{PrWd} \geq \{e,o\}\), as shown in (32).

\[(32)\]  

<table>
<thead>
<tr>
<th>antecedent</th>
<th>(\epsilon)t</th>
<th>(\epsilon)t</th>
<th>IDENTV</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) ((\epsilon)nt(\epsilon))s(\epsilon)(d(\epsilon)nt)</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(b) ((\epsilon)nt(\epsilon))s(\epsilon)(d(\epsilon)nt)</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

One further ranking is needed to account for lack of reduction in secondary stressed syllables. The ranking given in (32) would not prevent /e/ or /a/ from raising to [i], so satisfying \(^*-\Delta_{PrWd} \geq \{e,o\}\). The constraint IDENT[−high] can be used to avoid this result. If IDENT[−high] outranks \(^*-\Delta_{PrWd} \geq \{e,o\}\), the [−high] /a/ and /e/ will not be able to raise to [+high]/i/; however, they will be able to reduce to the [−high] [\(\epsilon\)].

\[(33)\]  

<table>
<thead>
<tr>
<th>antecedent</th>
<th>IDENT[−high]</th>
<th>(\epsilon)t</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) ((\epsilon)nt(\epsilon))s(\epsilon)(d(\epsilon)nt)</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(b) ((\epsilon)nt(\epsilon))s(\epsilon)(d(\epsilon)nt)</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

The constraint IDENT[−high] will be used as stated here. This constraint is not an ad hoc solution – it turns out that it plays an important role in other reduction patterns, discussed in the context of /o/-reduction below.

The final point of this section is that it is significant the constraint \(^*-\Delta_{PrWd} \geq \{e,o\}\) is used here rather than \(^*-\Delta_{PrWd} \geq \{i,u\}\). This difference accounts for the fact that /i/ does not reduce in unfooted unstressed positions: e.g. [mi(\(n\)\(\epsilon\))t] minuut, *[m\(\epsilon\)(n\(\epsilon\))t] (cf [r\(\epsilon\)(\(d\)\(\epsilon\)\(\epsilon\)is)], *[r\(\epsilon\)(\(d\)\(\epsilon\)\(\epsilon\)is)] ‘radish’). To prevent reduction of /i/ in stray syllables, IDENTV must outrank \(^*-\Delta_{PrWd} \geq \{i,u\}\), as shown in tableau (34).

\[(34)\]  

<table>
<thead>
<tr>
<th>antecedent</th>
<th>(\epsilon)t</th>
<th>IDENTV</th>
<th>(\epsilon)t</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) mi((n)(\epsilon))t</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) m(\epsilon)(n(\epsilon))t</td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Diagram (35) summarizes the rankings established in this section.
As a concluding comment, one of the significant points of this section is that there is no term that corresponds directly to ‘unstressed syllable’ in the (non-)DTE theory. Instead, ‘unstressed syllables’ are those \(-\Delta_{PrWd}\) that are not \(\Delta_F\). This may seem surprising given that processes like vowel reduction generally seem to target ‘unstressed syllables’ as a group (for relevant proposals, see Crosswhite 1999). However, as demonstrated in this section, the fact that there is no 1:1 relation between ‘unstressed syllables’ and non-DTEs does not prevent processes from being limited to unstressed syllables alone. Moreover, the non-DTE theory predicts that there are different types of unstressed syllables – specifically that unstressed syllables in foot non-DTEs are distinct from unfooted syllables; this point is discussed in the following section.

4.3.2.2 /o/ and /i/ reduction: Foot non-DTEs

In contrast to /e/ and /a/, /o/ and /i/ do not reduce in every unstressed syllable. /o/ and /i/ only reduce when they are in the non-DTE position of a foot: e.g. [(lòkə)m(w(tíf)], *[(lòkə)m(a(tíf)] ‘locomotive’; [(ində)v(o(dú)] individu, *[(ində)v(o(dú)]. /i/ reduction will be discussed first, followed by /o/ reduction.

• /i/ reduction

Since /i/ only reduces in the non-DTE position of a foot, the PrWd non-DTE constraint *-\(\Delta_{PrWd}\)\{i,u\} cannot be responsible for /i/-reduction (as established in the preceding section). Instead, the relevant constraint is the foot non-DTE constraint *-\(\Delta_F\)\{i,u\}, which bans peripheral vowels only in the weak member of a foot. Tableau (36) shows that this constraint outranks IDENTV.

(35) Interim ranking summary I: /a/ and /e/ reduction

\[
\begin{align*}
\star \Delta_F & \leq \{\text{a}\} \quad \text{IDENT[- high]} \\
\star -\Delta_{PrWd} & \geq \{\text{e}, \text{o}\} \\
\text{IDENTV} \\
\star -\Delta_{PrWd} & \geq \{\text{i}, \text{u}\}
\end{align*}
\]

As a concluding comment, one of the significant points of this section is that there is no term that corresponds directly to ‘unstressed syllable’ in the (non-)DTE theory. Instead, ‘unstressed syllables’ are those \(-\Delta_{PrWd}\) that are not \(\Delta_F\). This may seem surprising given that processes like vowel reduction generally seem to target ‘unstressed syllables’ as a group (for relevant proposals, see Crosswhite 1999). However, as demonstrated in this section, the fact that there is no 1:1 relation between ‘unstressed syllables’ and non-DTEs does not prevent processes from being limited to unstressed syllables alone. Moreover, the non-DTE theory predicts that there are different types of unstressed syllables – specifically that unstressed syllables in foot non-DTEs are distinct from unfooted syllables; this point is discussed in the following section.

4.3.2.2 /o/ and /i/ reduction: Foot non-DTEs

In contrast to /e/ and /a/, /o/ and /i/ do not reduce in every unstressed syllable. /o/ and /i/ only reduce when they are in the non-DTE position of a foot: e.g. [(lòkə)m(o(tíf)], *[(lòkə)m(a(tíf)] ‘locomotive’; [(ində)v(o(dú)] individu, *[(ində)v(o(dú)]. /i/ reduction will be discussed first, followed by /o/ reduction.

• /i/ reduction

Since /i/ only reduces in the non-DTE position of a foot, the PrWd non-DTE constraint *-\(\Delta_{PrWd}\)\{i,u\} cannot be responsible for /i/-reduction (as established in the preceding section). Instead, the relevant constraint is the foot non-DTE constraint *-\(\Delta_F\)\{i,u\}, which bans peripheral vowels only in the weak member of a foot. Tableau (36) shows that this constraint outranks IDENTV.

(36)

<table>
<thead>
<tr>
<th>/individu/</th>
<th>*-(\Delta_F){i,u}</th>
<th>IDENTV</th>
<th>*-(\Delta_{PrWd}){i,u}</th>
</tr>
</thead>
</table>
| (a) (indsi)v(du) | * | | *
| (b) (indavo)(du) | | | *
| (c) (indavo)(du) | | | *
• **/o/ reduction**

Reduction of /o/ is a slightly more complex matter than /i/-reduction, but shows the interaction of different types of non-DTE constraint in a rather striking way. The constraint \*-\(\Delta_{PrWd} \geq \{e,o\}\) – used in the preceding section – promotes reduction of /o/ in every PrWd non-DTE. However, /o/ is prevented from neutralizing in all such positions because doing so would make it lose its ‘colour’ features – i.e. roundness. In more formal terms, the constraint IDENT[round] prevents /o/ from neutralizing, as shown in tableau (37) with the word [to(mát)] tomaat, \*[^t\(\\alpha\)m\(\\alpha\)t].

(37)

<table>
<thead>
<tr>
<th>/tomat/</th>
<th>IDENT[round]</th>
<th>*-(\Delta_{PrWd} \geq {e,o})</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) to(mát)</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) [^t(\alpha)m(\alpha)t]</td>
<td>*!</td>
<td></td>
</tr>
</tbody>
</table>

IDENT[round] will not block reduction of /a/, /e/, and /i/ because these vowels’ [-round] specification is preserved in [\(\alpha\)].

However, /o/ does reduce to [\(\alpha\)] in foot non-DTE position. As with /i/, there is a stronger pressure to reduce in foot non-DTEs than in unfooted ‘stray’ positions. As with /i/, a foot non-DTE constraint \*-\(\Delta_{Ft} \geq \{e,o\}\) can be used to motivate this change. With \*-\(\Delta_{Ft} \geq \{e,o\}\) outranking IDENT[round], /o/ will reduce to [\(\alpha\)].

(38)

<table>
<thead>
<tr>
<th>/lokomotif/</th>
<th>*-(\Delta_{Ft} \geq {e,o})</th>
<th>IDENT[round]</th>
<th>*-(\Delta_{PrWd} \geq {e,o})</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (l(\sigma)ko)m(\alpha)t</td>
<td>*!</td>
<td>*</td>
<td>***</td>
</tr>
<tr>
<td>(b) (l(\sigma)k(\alpha))m(\alpha)t</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(c) (l(\sigma)k(\alpha))m(\alpha)t</td>
<td>* *!</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

Again, something must be said about why /o/ does not reduce to [u] – \*[(l\(\\sigma\)ku)m\(\alpha\)t] – since this would preserve its [+round] specification. The constraint IDENT[- high] provides the answer: IDENT[- high] outranks IDENT[round]; this ranking prevents /o/ from raising to the [+high] [u], but allows /o/ to reduce to the [-high] mid vowel [\(\alpha\)].

Diagram (39) summarizes the rankings established in this section, and amalgamates them with the ones from the previous section. The rankings on the left side are those from the previous section, and those on the right are from this section.
The discussion has passed by an important aspect of the analysis without comment: /i/ reduction is motivated by the constraint \(\Delta F_t \geq \{i,u\}\), while /o/ reduction is motivated by \(\Delta F_t \geq \{e,o\}\). The next section shows why this must be the case, and therefore why /o/ reduction cannot be forced by \(\Delta F_t \geq \{i,u\}\).

4.3.2.3 /y/ and /u/ preservation

Unlike /o/, the round high vowels /y/ and /u/ do not reduce in any position: e.g. [(kùmy)(nìst)] communist, *[[(kùmø)(nìst)]]; [(zàlu)(zì)] jaloezie, *[[(zàlø)(zì)]]. As with the lack of /o/ reduction in stray syllables, this effect can be ascribed to the constraint IDENT[round]. If IDENT[round] outranks \(\Delta F_t \geq \{i,u\}\), neither /y/ nor /u/ will reduce, as shown in tableau (40).

\[
\begin{array}{|c|c|c|}
\hline
\text{/komynist/} & \text{IDENT[round]} & \text{*-\(\Delta F_t \geq \{i,u\}\)} \\
\hline
\text{(a) (kùmy)(nìst)} & \text{*!} & \text{*} \\
\text{(b) (kùmø)(nìst)} & \text{*!} & \text{*} \\
\hline
\end{array}
\]

/y/ cannot reduce to any other vowel here: reducing to [u] or [o] will still incur violations of \(\Delta F_t \geq \{i,u\}\).

This ranking shows that there is a crucial difference between the foot-level \(\Delta F_t \geq \{e,o\}\) and \(\Delta F_t \geq \{i,u\}\) in Dutch. The former outranks IDENT[round] while the latter does not: \(\Delta F_t \geq \{e,o\} \succ IDENT[round] \succ \Delta F_t \geq \{i,u\}\). \(\Delta F_t \geq \{e,o\}\) must outrank IDENT[round] to allow /o/ to reduce in foot non-DTEs, while IDENT[round] must outrank \(\Delta F_t \geq \{i,u\}\) in order to block reduction of high round vowels. This ranking concludes the analysis of Semi-formal vowel reduction in Dutch.

The complete ranking is presented in Figure 4.5.
Figure 4.5: Dutch Semi-Formal register vowel reduction ranking

\[
\begin{align*}
*\Delta_F \leq &\emptyset \\
*\Delta_{PrWd} \geq &\{e,o\} &\text{IDENT[\text{high}]}
\end{align*}
\]

\[
\begin{align*}
\text{IDENT[round]} \quad &\quad *\Delta_{Pr} \geq \{i,u\} \\
\text{IDENTV} \quad &\quad *\Delta_{PrWd} \geq \{i,u\}
\end{align*}
\]

The fact that the PrWd-level constraint \( *\Delta_{PrWd} \geq \{i,u\} \) is inactive (i.e. ranked below IDENTV) is crucial in preventing /i/ from reducing in all positions. The fact that /i/ (and /o/) only reduce in foot non-DTE positions is evidence that a markedness constraint must promote reduction in this specific position.

### 4.3.3 Informal and unattested reduction

Reduction in the Formal and Informal registers is much less complex than in the Semi-formal register. No reduction takes place in the Formal register, a situation that can be produced by ranking IDENTV above all non-DTE constraints.

Almost every vowel reduces in every unstressed position in the Informal Register. The exceptions are /y/ and /u/, which only reduce in the non-DTEs of feet. The ranking needed for this register differs from the Semi-formal one only in that the non-DTE markedness constraints are higher in the ranking, by precisely two strata.

To force neutralization of /o/ in stray syllables, \( *\Delta_{PrWd} \geq \{e,o\} \) must outrank the faithfulness constraints IDENT[round]. Similarly, to force neutralization of /i/ in all unstressed syllables, \( *\Delta_{PrWd} \geq \{i,u\} \) must outrank IDENTV. However, since reduction of /y/ and /u/ is blocked in stray syllables, IDENT[round] must outrank \( *\Delta_{PrWd} \geq \{i,u\} \). The example in (41) is /lokomotif/, which is realized as [(lòk\mø(tif)) in the informal register, compared with [(lòk\mø(tif))] in the Semi-formal register.

(41) Informal reduction of /o/

<table>
<thead>
<tr>
<th>/lokomotif/</th>
<th>*\Delta_{PrWd} \geq {e,o}</th>
<th>IDENT[round]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (lòk\mø(tif))</td>
<td>*</td>
<td>* *</td>
</tr>
<tr>
<td>(b) (lòk\mø(tif))</td>
<td>* *</td>
<td>*</td>
</tr>
</tbody>
</table>

Reduction of /y/ and /u/ in foot non-DTEs requires the ranking \( \| *\Delta_F \geq \{i,u\} \| \rightarrow \) IDENT[round] \|.
To prevent reduction of /y/ and /u/ in stray syllables, IDENT[round] still must outrank *-\(\Delta_{PrWd} \geq \{i,u\}\); of course, this ranking will not prevent reduction of /i/ to [æ] in unstressed syllables.

The full ranking is summarized in Figure 4.6. In essence, it differs from the Semi-formal register’s ranking only in that the markedness constraints have been moved up two strata in the ranking. The constraints \(*\Delta_{PrWd} \leq \{e,o\} *\) and IDENT[\(-\)high] are omitted here; they occupy a similar position as in the Semi-Formal register – outranking all -\(\Delta_{PrWd}\) constraints.

### Figure 4.6: Dutch Informal register vowel reduction ranking

<table>
<thead>
<tr>
<th>/z̑luzi/</th>
<th>*-(\Delta_{PrWd} \geq {i,u})</th>
<th>IDENT[round]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (z̑lu)(zí)</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(b) (z̑lə)(zí)</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

- **Impossible reduction**

The constraints used here not only account for vowel reduction in the non-formal registers, but also for the unattested reduction pattern \(\exists[(fòno)la(γi)]\).\(^{67}\) I adopt Kager’s proposal in (43) that reduction in stray syllables implies reduction in foot non-DTEs.

### (43) Kager’s Generalization

“For vowels whose reducibility depends on position, reduction is generally easier in adjunct [i.e. foot non-DTE] positions than in stray positions.” (K313)

Kager’s Generalization falls out from the present theory: from input /fonoloγi/, \(\exists[(fòno)la(γi)]\) is harmonically bounded by the candidate with reduction in the foot non-DTE alone [(fòno)lo(γi)]

The relevant constraints here are (i) those that promote reduction in unstressed syllables – i.e. the foot and PrWd non-DTE constraints and (ii) faithfulness constraints.

The major competing candidate is [(fòno)lo(γi)], with reduction in the foot non-DTE only. This candidate fares equally well in terms of faithfulness as \(\exists[(fòno)la(γi)]\) – both are unfaithful to an input /o/\(^{68}\).

---

\(^{67}\) The symbol \(\exists\) indicates a form that is not only unattested in a particular grammar, but also universally impossible.

---

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In terms of markedness constraints, \( [(f\text{òno})l\alpha(y\acute{i})] \) fares no better on any markedness constraint than \( [(f\text{òn}\alpha)lo(y\acute{i})] \). Specifically, for all \( *-\Delta_{PrWd}/x \) constraints, \( [(f\text{òno})l\alpha(y\acute{i})] \) and \( [(f\text{òn}\alpha)lo(y\acute{i})] \) incur the same number of violations. However, \( [(f\text{òn}\alpha)lo(y\acute{i})] \) incurs fewer violations than \( [(f\text{òno})l\alpha(y\acute{i})] \) for several constraints (e.g. \( *-\Delta_{Fr}\geq\{i,u\} \)).

In short, \( [(f\text{òn}\alpha)lo(y\acute{i})] \) is a harmonic bound for \( [(f\text{òno})l\alpha(y\acute{i})] \): the latter incurs a subset of the former’s violations. Tableau (44) illustrates this point.

(44)

<table>
<thead>
<tr>
<th>/fonolo(yi)/</th>
<th>(-\Delta_{Pr}\geq{i,u})</th>
<th>(-\Delta_{PrWd}\geq{i,u})</th>
<th>IDENT\text{V}</th>
</tr>
</thead>
<tbody>
<tr>
<td>#W</td>
<td>(a) (f\text{òn}\alpha)lo(y\acute{i})</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>#E</td>
<td>(b) (f\text{òno})l\alpha(y\acute{i})</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

For \( [(f\text{òno})l\alpha(y\acute{i})] \) to win in some grammar, there would have to be a markedness constraint that promoted reduction in unfooted syllables, thus dooming \( [(f\text{òn}\alpha)lo(y\acute{i})] \). Since ‘stray syllable’ is not definable in non-DTE (or DTE) terms, there is no such markedness constraint in the present theory.

A faithfulness alternative would be to invoke a faithfulness constraint that refers to the foot non-DTE but not to unfooted PrWd non-DTEs. Thus, \( [(f\text{òn}\alpha)lo(y\acute{i})] \) is less faithful than \( [(f\text{òno})l\alpha(y\acute{i})] \) because the former does not retain the underlying /o/’s features in the foot non-DTE position. Such a constraint is not available in the present theory, so the pattern is predicted to be impossible (cf Alderete 1995, Yip 1995).

In short, Kager’s Generalization follows from the fact that candidates with reduction in stray syllables only are harmonically bounded by those with reduction only in foot non-DTEs. This follows from the fact that there is no way to refer to stray syllables without also referring to foot non-DTEs in the present theory.

- Non-metrical restrictions on neutralization

As noted in the description of vowel reduction, vowels in onsetless unstressed syllables in Dutch do not reduce: e.g. *élïte, *élïte; ídïol, *ídïol. K298 notes that lack of reduction is particularly pervasive in word-initial syllables. This statement might be recast as ‘vowels in syllables with [h] and [?] onsets cannot reduce’, since there is an epenthetic [?] at the beginning of all vowel-initial lexical words, and [?] is epenthized in V-initial medial syllables after [a]: e.g. [bá?obab], [má?oist]. Oostendorp (1995) suggests that reduction in these cases is blocked by a constraint that requires syllables to have a specification for Place of Articulation, assuming that [h] and [?] are placeless (cf chs.5, 6, 7). The issue is somewhat complex, though: see Kager (1989:298-9) for a detailed discussion.

---

68 I assume that there is no position-specific faithfulness constraint that favours preservation of /o/ in a stray syllable over preservation of /o/ in a foot non-DTE. This seems reasonable, given theories of positional faithfulness (Beckman 1998, Casali 1997).

69 This does not prevent different reductions from taking place in the foot non-DTE and stray syllables. See Crosswhite (1999) for extensive discussion.
Similarly, prevocalic vowels reduce with difficulty, especially in the initial syllable: e.g. [kairo], *[kaíro] (K299). Similarly, final open syllables are irreducible (Kager 1989: 303-4): e.g. cóla, táugee, köffie, Málmó, hindoe.

It is clear that these restrictions on reduction are not related to DTE or non-DTE status, so – strictly speaking – they are beyond the purview of the present theory. However, they certainly deserve a detailed explanation as similar restrictions occur in other languages (Crosswhite 1999:ch.6). Crosswhite provides reasons for the lack of reduction in all such cases, making use of positional faithfulness constraints and constraints on admissible vowel-vowel sequences. This section will not explore an analysis of these additional restrictions along these lines here; see Crosswhite (1999:ch.6) for a general solution. 70

4.3.4 Summary

This section has shown that vowel reduction in Dutch registers is produced by constraints on non-DTEs, both of the Foot and the PrWd.

Dutch vowel reduction is striking in that it provides evidence for the activity of several non-DTE constraints in the same grammar: *-∆Ft≤{i,u}, *-∆Ft≤{e,o}, *-∆PrWd≤{i,u}, and *-∆PrWd≤{e,o}. These constraints are demonstrably distinct in Dutch, as they interleave with faithfulness constraints. For example, *-∆Ft≤{e,o} outranks IDENT[round] in the Semi-formal register, while *-∆Ft≤{i,u} does not.

The Dutch system shows both the expressiveness and restrictiveness of the (non-)DTE approach. The DTE and non-DTE constraints can be used to refer to a variety of categories of syllables. For example, constraints that refer to DTEs of the PrWd apply only to main-stressed syllables, while those that refer to DTEs of feet apply to both main and secondary stressed syllables. In contrast, there is no DTE category that applies solely to secondary stressed syllables; thus, any constraint that influences secondary stressed syllables also influences main stressed ones (unless it is blocked by some constraint that refers specifically to main-stressed syllables, as in positional faithfulness).

More relevant to Dutch is the distinction between footed unstressed syllables and unfooted (stray) unstressed syllables. The category -∆Ft allows constraints to refer to only those unstressed syllables that are in feet. In contrast, there is no definable non-DTE category that refers solely to stray syllables. The effect is that no markedness constraint can influence the content of stray syllables without also influencing footed unstressed syllables as well.

In short, the DTE/non-DTE approach to constraint form provides adequate expressiveness, but is not unrestricted.

70 One final restriction on vowel reduction deserves some comment in the context of the present theory. Some final vowels in CVC syllables can undergo reduction: múró, proféssor, rødgr. However, reduction is easiest when the final vowel is immediately post-tonic; final reduction in words stressed on the antepenult is more difficult: lúcifer, Júpiter, rábies, Aristóteles. The difference in ease of reduction in CVC syllables again seems to refer to a difference between foot non-DTEs and PrWd non-DTEs: vowels in foot non-DTEs – i.e. immediately post-tonically (mótar) cf (lúcifer) – reduce more easily, showing that foot non-DTE constraints have a greater effect, as they do generally in the language.
As a closing comment, the Dutch system is not unique. Nagy (1998) reports that post-tonic syllables in Faetar obligatorily reduce to [a], while reduction is optional for pre-tonic syllables (also see Nagy & Reynolds 1997). Russian also exhibits differences between immediately pre-tonic (i.e. arguably footed) and other syllables in terms of vowel reduction (see Crosswhite 1999 and references cited therein for discussion and analysis). Similar patterns are found in Saami (Bye 2001) and Lushootseed (Urbanczyk 1996).

4.4 The interaction of DTEs and non-DTEs: Vowel epenthesis

Evidence that markedness constraints refer to non-DTEs is also found in phenomena that are sensitive to the interaction between DTE and non-DTE scale preferences. The existence of both DTE and non-DTE constraints means that the markedness of a vowel depends on its position. In the present theory, high sonority segments are the least marked type in DTEs, but most marked in non-DTEs. In contrast, low sonority segments are least marked in non-DTEs, but most marked in DTEs.

There is a further property of the DTE theory: a segment can be both a DTE and a non-DTE. For example, the [i] in [pá.ti] is the DTE of the syllable and mora, but a non-DTE of the foot and PrWd. Therefore, both DTE and non-DTE constraints can apply to it. The net result can be a tug-of-war between DTE constraints and non-DTE constraints, with the result that the least marked segment is neither high sonority nor low sonority, but has a quality that is a compromise between the two extremes – e.g. [ε].

This section shows how the antagonism between DTE and non-DTE constraints accounts for all the different types of epenthetic vowels, and for the fact that epenthetic vowel features may differ depending on the environment in the same language.

Section 4.4.1 presents a typology of epenthetic elements. It also provides rankings for epenthesis of various types of vowel systems.

Section 4.4.2 discusses Shipibo, a language that has epenthetic [a] in foot heads and epenthetic [i] in foot non-heads (Lauriault 1948, Elías 2000, p.c.). This situation is shown to come about through the action of DTE and non-DTE constraints.

Section 4.4.3 discusses universals of epenthesis. While a vowel of any sonority can be epenthetic, there are restrictions on languages with more than one epenthetic vowel quality, like Shipibo.

4.4.1 The spectrum of epenthesis

Table 4.1 shows that any non-round vowel [i ø i u e a] can be epenthetic.

The table lists cases of ‘default’ epenthesis, where the epenthetic segment is not influenced by the featural content of adjacent elements. ‘Copy’ epenthesis (where the epenthetic element duplicates part or all of a nearby vowel) is discussed only in passing (§4.4.1.2); see Kitto & de Lacy (1999) and references cited therein for discussion of copy vowels. More generally, the cases below do not include those where epenthetic vowel content is influenced by processes such as vowel harmony and assimilation.

The aim in the table is genetic diversity, but for practical (i.e. visual) reasons examples of each type have been limited to a maximum of 10 languages. To give a sense
of the relative frequency of the types, of a total of 105 languages (randomly selected), 22 have [i], 19 [a], 13 [æ], 10 [e], 7 [u], 5 [i], 3 [o], and 26 had copy vowels (see Kitto & de Lacy 1999).

Table 4.1: Typology of epenthetic vowels

<table>
<thead>
<tr>
<th>Vowel</th>
<th>Language</th>
<th>Family</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>Amharic</td>
<td>Semitic</td>
<td>Hayward (1986)</td>
</tr>
<tr>
<td></td>
<td>Karao</td>
<td>N.Phillipine</td>
<td>Brainard (1994)</td>
</tr>
<tr>
<td></td>
<td>Washo</td>
<td>Hakan</td>
<td>Kenstowicz &amp; Kisseberth (1971)</td>
</tr>
<tr>
<td></td>
<td>Chukchi</td>
<td>Chukotko-Kamchatkan</td>
<td>Krause (1980)</td>
</tr>
<tr>
<td></td>
<td>Itelman</td>
<td>Chukotko-Kamchatkan</td>
<td>Bobaljik (1997)</td>
</tr>
<tr>
<td></td>
<td>Karo Batak</td>
<td>Sundic</td>
<td>Woolams (1996)</td>
</tr>
<tr>
<td></td>
<td>Ladahki</td>
<td>Tibetan</td>
<td>Koshal (1979)</td>
</tr>
<tr>
<td></td>
<td>Malay</td>
<td>Sundic</td>
<td>Ahmad (1994)</td>
</tr>
<tr>
<td></td>
<td>Maori</td>
<td>Polynesian</td>
<td>de Lacy (2002a)</td>
</tr>
<tr>
<td></td>
<td>Mongolian</td>
<td>Altaic</td>
<td>Svanesson (1995)</td>
</tr>
<tr>
<td></td>
<td>Palestinian Arabic</td>
<td>Semitic</td>
<td>Abu-Salim (1982:10)</td>
</tr>
<tr>
<td></td>
<td>Sekani</td>
<td>Athapaskan</td>
<td>Hargus (1988)</td>
</tr>
<tr>
<td></td>
<td>Wolof</td>
<td>Senegambian</td>
<td>Ka (1985)</td>
</tr>
<tr>
<td></td>
<td>Alabama</td>
<td>Muskogean</td>
<td>Montler &amp; Hardy (1991)</td>
</tr>
<tr>
<td></td>
<td>Harari</td>
<td>Ethiopian</td>
<td>Rose (1997)</td>
</tr>
<tr>
<td></td>
<td>Maltese</td>
<td>Semitic</td>
<td>Hume (1992)</td>
</tr>
<tr>
<td></td>
<td>Manam</td>
<td>Oceanic</td>
<td>Lichtenberk (1983:32)</td>
</tr>
<tr>
<td></td>
<td>Moañés</td>
<td>Romance</td>
<td>Martínez-Gil (1997)</td>
</tr>
<tr>
<td></td>
<td>Galician</td>
<td>Romance</td>
<td>Martínez-Gil (1997)</td>
</tr>
<tr>
<td></td>
<td>Ojibwa</td>
<td>Algonquian</td>
<td>Piggott (1992)</td>
</tr>
<tr>
<td></td>
<td>Pâli</td>
<td>Indo-European</td>
<td>Fahs (1985)</td>
</tr>
<tr>
<td></td>
<td>Pipil</td>
<td>Aztecan</td>
<td>Campbell (1985)</td>
</tr>
<tr>
<td></td>
<td>Kannada</td>
<td>Dravidian</td>
<td>Sridhar (1990)</td>
</tr>
<tr>
<td></td>
<td>Kodâva</td>
<td>Dravidian</td>
<td>Ebert (1996)</td>
</tr>
<tr>
<td></td>
<td>Tamil</td>
<td>Dravidian</td>
<td>VasanthaKumari (1989)</td>
</tr>
<tr>
<td>e/e</td>
<td>Basque</td>
<td>Indo-Eurpoean</td>
<td>Hualde (1991)</td>
</tr>
<tr>
<td>----------</td>
<td>--------------</td>
<td>--------------</td>
<td>---------------</td>
</tr>
<tr>
<td>e/e</td>
<td>Chipewyan</td>
<td>Athapaskan</td>
<td>Li (1946)</td>
</tr>
<tr>
<td>e/e</td>
<td>Galician</td>
<td>Romance</td>
<td>Colina (1997)</td>
</tr>
<tr>
<td>e/e</td>
<td>Mohawk</td>
<td>Iroquoian</td>
<td>Hopkins (1987)</td>
</tr>
<tr>
<td>e/e</td>
<td>Spanish</td>
<td>Romance</td>
<td>Steriade (1995b)</td>
</tr>
<tr>
<td>e/e</td>
<td>Slave</td>
<td>Athapaskan</td>
<td>Rice (1989:133)</td>
</tr>
<tr>
<td>e/e</td>
<td>Temiar</td>
<td>Mon-Khmer</td>
<td>(closed σs) McCarthy (1980)</td>
</tr>
<tr>
<td>e/e</td>
<td>Tiberian Hebrew</td>
<td>Semitic</td>
<td>(word-final closed σs) Rappaport (1984)</td>
</tr>
<tr>
<td>a</td>
<td>Axininca Campa</td>
<td>Arawakan</td>
<td>Payne (1990), McCarthy &amp; Prince (1993b)</td>
</tr>
<tr>
<td>a</td>
<td>Coos</td>
<td>Penutian</td>
<td>Frachtenberg (1922)</td>
</tr>
<tr>
<td>a</td>
<td>Dakota</td>
<td>Siouan</td>
<td>Shaw (1980:120)</td>
</tr>
<tr>
<td>a</td>
<td>Klamath</td>
<td>Penutian</td>
<td>Kenstowicz &amp; Kisseberth (1971)</td>
</tr>
<tr>
<td>a</td>
<td>Lardil</td>
<td>Pama-Nyungan</td>
<td>Piggott (1993)</td>
</tr>
<tr>
<td>a</td>
<td>Mabalay</td>
<td>Formosan</td>
<td>Lambert (1999§3.2.1)</td>
</tr>
<tr>
<td>a</td>
<td>Atayal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>Marathi</td>
<td>Indo-Aryan</td>
<td>Pandharipande (1997)</td>
</tr>
<tr>
<td>a</td>
<td>Mesola Italian</td>
<td>Romance</td>
<td>Repetti (1996)</td>
</tr>
<tr>
<td>a</td>
<td>Sudanese Arabic</td>
<td>Semitic</td>
<td>Haddad (1983)</td>
</tr>
<tr>
<td>a</td>
<td>Wapishana</td>
<td>Arawakan</td>
<td>Tracy (1972)</td>
</tr>
</tbody>
</table>

The table omits languages with more than one epenthetic vowel. For a relevant case, see §4.4.2.

The epenthetic vowels listed above are inserted to satisfy a variety of requirements, including minimal word restrictions, metrical conditions, and segmental phonotactic restrictions (see Broselow 1982).

The following subsections identify the rankings of the DTE and non-DTE constraints that produce the attested vowel qualities. Section 4.4.1.1 shows how the dominance of DTE over non-DTE constraints can result in the high sonority [a] as the epenthetic vowel, focusing on epenthesis in Coos (Frachtenberg 1922).

Section 4.4.1.2 shows how the dominance of the non-DTE constraints can produce low sonority [i], [a], and (to some extent) [i], with special attention paid to epenthesis in Maga Rukai (Hsin 2000).

Section 4.4.1.3 shows how a mingling of the DTE and non-DTE constraints produces vowels with intermediate sonority – [e], [e], and (to some extent) [i]; [e]-epenthesis in Chipewyan is the main case discussed in this section.

Section 4.4.1.4 discusses vowels that are never, or only ever marginally, epenthetic (e.g. [u o ɔ ø]).
4.4.1.1 Epenthetic [a]

McCarthy & Prince (1994) have shown that the quality of epenthetic elements is due to the emergent effect of markedness constraints. This follows from the fact that epenthetic elements have no underlying correspondents, so faithfulness constraints cannot influence their form. Since faithfulness constraints are irrelevant, the featural content of an epenthetic vowel is the pure expression of markedness constraints. Therefore, default epenthesis provides insight into the DTE and non-DTE constraints.

In terms of the DTE constraints alone, high sonority vowels – i.e. [a] – are the least marked type. The influence of the DTE constraints on epenthetic quality can be seen in a variety of languages. One language of this type that has received a great deal of recent discussion is Axininca Campa (Payne 1990, McCarthy & Prince 1993b), but a number of other languages also have epenthetic [a]. For example, Frachtenberg (1922:309ff) describes [a]-epenthesis in the Penutian language Coos.

Coos has the short vowels [i e a o u] and [a], and the long vowels [iː eː aː oː uː]. Syllable structure is (C)(C)V(X)(C), where X is a sonorant (nasal, liquid, glide, or vowel). Codas are restricted to certain [nasal+obstruent] and [liquid+stop] clusters (i.e. [mt ms mx nt nk nl lt lm l̚l l̚ts]). Nuclei may contain a short vowel, long vowel, or diphthong. Examples of syllables can be seen in [d̚ms.t̚ts] ‘through a prairie’ and [ha.taː.jims] no gloss, [tkem] no gloss (p.307-8).

The restrictions on syllable structure motivate epenthesis in a variety of situations. As Frachtenberg explains, all inadmissible word-final and medial clusters are avoided through the insertion of a vowel (p.309). (45) provides relevant examples.

(45) [a]-epenthesis in Coos

(a) Epenthesis in word-final clusters

[m̚l̚x] cf [m̚l̚x-ánəm] ‘lunch make me’ (315)
[l̚hin̚p] cf [l̚hin̚p-íje] ‘they two came through’ (315)
[ał̯̚q̯̚s] cf [ał̯̚q̯̚s-ája] ‘they two are afraid of it’ (315)
[t̯̚l̯̚l̯̚a̯̚ts] cf [t̯̚l̯̚l̯̚-ts̯̚axəm] ‘he was astonished’ (315)
[kwa̯̚x̯̚a̯̚l] cf [n-kwa̯̚x̯̚a̯̚l-a] ‘they two have bows’ (315)
/w̯̚n̯̚q̯̚-s/ → [w̯̚n̯̚q̯̚ə̯̚s] ‘mat, spider’ (309)
/hel̯̚q/ → [hel̯̝̚a̯̚q] ‘he arrived’ (309)

(b) Epenthesis in word-medial clusters (p.309)

/w̯̚n̯̚q̯̚-x̯̚əm/ → [w̯̚n̯̚q̯̚a̯̚x̯̚ə̯̚m] ‘it is spread out’ (309)
/hel̯̚q-x̯̚əm/ → [hel̯̝̚a̯̚q̯̚ax̯̚ə̯̚m] ‘it is the end’ (309)
/ŋ̯̚q̯̚-a/ → [ŋ̯̚n̯̚a̯̚q̯̚-a] ‘they two went down’ (309)

As an example, /al̯̚q̯̚s/ cannot be faithfully output with an acceptable coda *[a̯̚l̯̚q̯̚s], so [a] is epenthesized to resolve the problem [al̯̚q̯̚as]. In ranking terms, a constraint (or

---

71 It is not clear why /w̯̚n̯̚q̯̚-x̯̚əm/ cannot be repaired by a single epenthetic vowel *[w̯̚n̯̚q̯̚a̯̚x̯̚ə̯̚m], *[w̯̚n̯̚q̯̚a̯̚x̯̚ə̯̚m]. Frachtenberg (1922) provides no relevant comments, so I leave the issue aside here.
The formal expression of markedness – ch.4

constraints) against inadmissible coda clusters must outrank DEP-IO. A detailed account of the constraints against inadmissible codas in Coos will not be given here as this would take the discussion too far from the point here; the constraint – or set of constraints – will simply be called *CODA_CLUSTER here. To prevent deletion, MAX-IO must also outrank DEP. The rankings are illustrated in tableau (46).

<table>
<thead>
<tr>
<th>/alqs/</th>
<th>*CODA_CLUSTER</th>
<th>MAX</th>
<th>DEP-IO</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) alqs</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) al.qas</td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>(c) als</td>
<td></td>
<td>*!</td>
<td></td>
</tr>
</tbody>
</table>

The issue of present interest is not what motivates epenthesis, but rather what determines the quality of the epenthetic vowel. In this regard, there must be some markedness constraint that favours [a] over all other vowels – i.e. [e o i u ø].

A contender for this role is the syllable-level DTE constraint *Δσ≤{e,o}. This constraint militates against all nucleus segments with less sonority than a low vowel. Thus, it will favour [álqas] over all other candidates, including *[álqes], *[álqis], and *[álqas].

The constraint *Δσ≤{e,o} must outrank all markedness constraints that would favour any of the non-low vowels over [a]. This includes all non-DTE constraints that refer to the positions ‘foot non-DTE’ and ‘PrWd non-DTE’. For example, the constraint *-ΔPrWd≥{i,u} favours [a] over [a] in unstressed syllables, so incorrectly favouring *[álqas)] over ((álqas)). Since [a] is the worst type of non-DTE (as it is the most sonorous element), *Δσ≤{e,o} must outrank all relevant non-DTE constraints (i.e. all those that refer to non-DTEs of feet and all higher categories. The following tableau illustrates this ranking.

<table>
<thead>
<tr>
<th>/alqs/</th>
<th>*Δσ≤{e,o}</th>
<th>*-ΔPrWd≥{i,u}</th>
<th>*-ΔPr≥{i,u}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (álqas)</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) (álqas)</td>
<td></td>
<td>*!</td>
<td></td>
</tr>
</tbody>
</table>

To generalize, [a] is epenthesized in the DTE of α when some DTE constraint with the form *Δσ≤{e,o} outranks all non-DTE constraints of the form *-Δβ≥x, where β is a higher prosodic category than α. In Coos, for example, *Δσ≤{e,o} outranks all *-ΔPr≥{i,u}, *-ΔPrWd≥{i,u}, and so on.

• a > i > e

To conclude with an interesting complexity of the Coos system, it seems that [a] is not epenthesized in all environments: after [s], the epenthetic vowel is [i] (e.g. [dɔmsʃít] cf [dɔmsht-éts lhínap] ‘to the prairie he came’, [hætsiʃt] cf [hætsteniʃqəm] ‘a story is being told’). This is due to a constraint requiring agreement in place of articulation between [s]
and a following vowel, which will be referred to as AGREE[coronal] here (after Hume 1992, Clements & Hume 1995). AGREE[coronal] is not otherwise active in Coos, but emerges in epenthesis, just as *Δσ≤{e,o} emerges. AGREE[coronal] must outrank *Δσ≤{e,o} to block epenthesis of the low (non-front) vowel [a].

However, this process raises the question of why [i] is epenthesized rather than [e] since both could satisfy AGREE[coronal]. An answer is provided by lower-ranked DTE markedness constraints. Since the constraint *Δσ≤{e,o} assigns the same violations to [i] and [e], lower-ranked constraints are free to determine which of the two vowels is most harmonic. Since [e] is more sonorous than [i], a non-DTE constraint like *-ΔPrWd≥{e,o} will favour the latter over the former. The result is illustrated in tableau (48).

<table>
<thead>
<tr>
<th>/dəmst/</th>
<th>AGREE[coronal]</th>
<th>*Δσ≤{e,o}</th>
<th>*-ΔPrWd≥{e,o}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) demsît</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(b) demsėt</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(c) demsât</td>
<td>*!</td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

To be more complete, [e] can be prevented from winning by having *-ΔPrWd≥{e,o} outrank all DTE constraints that favour [e] over [i] – i.e. *Δσ≤{i,u}.

Thus, although the non-DTE constraints are dominated, they can have an emergent effect, even in a system where DTE constraints predominate.

4.4.1.2 Epenthetic [i a]

As shown in the preceding section, the dominance of syllable-level DTE constraints over higher-level non-DTE ones results in a high sonority epenthetic vowel. Unsurprisingly, the opposite ranking produces a low sonority epenthetic vowel. Complete dominance of the non-DTE over the DTE constraints will result in a grammar epenthesizing the lowest sonority vowel allowed in its inventory.

Maga Rukai offers an interesting example of low-sonority epenthesis that shows the effect of non-DTE constraints in a rather striking way. Hsin (2000) reports that Maga Rukai has seven contrastive vowels: the peripheral vowels [i e a o u] and the central vowels [i a]. Every word in Maga Rukai must end in a vowel, so epenthesis is used to eliminate consonant-final words. This is a common process in Tsou languages (Tsuchida 1976).

At first, Maga Rukai vowel epenthesis may seem irrelevant to present concerns because the final vowel is generally a copy of the preceding vowel (49a) (cf Selayarese – Basri et al. 1977). However, a key piece of data is that copying does not take place after [a] – [i] is inserted instead (49b).
(49) Maga Rukai epenthesis
(a) [ikivi] ‘tail’ [kpiŋi] ‘clothing’
 [θveke] ‘betel nut’ [rvelə] ‘arrow’
 [tesboko] ‘egret (black)’ [svongvonga] ‘butterfly’
 [uŋulu] ‘drink’ [tkasluu] ‘shrimp’
 [krimi] ‘palate’ [adʒimimi] ‘iron’
 [d̪kaːsa] ‘camphor laurel’ [lc̪̪nə] ‘vegetable’
(b) [cacənali] ‘start’ [tkorpaŋi] ‘frog’

Hsin (2000) provides evidence that the underlying forms listed above lack a final vowel underlyingly. The evidence is rather complex since a number of processes interact to change the underlying form substantially on the surface (including iambic vowel deletion, deletion, and coalescence). The reader is referred to Hsin (2000:95ff) for discussion of the input status of these vowels.72

• Vowel Copy

The most striking aspect of Maga Rukai epenthesis is the fact that the epenthetic vowel – for the most part – is a copy of the preceding one. Since copy epenthesis is not the focus of this section, the constraint that promotes copying is referred to as AGREE V here, requiring harmony between adjacent vowels.

AGREE V outranks markedness constraints that favour a particular vowel over all others, like the DTE constraint *-∆PrWd≥{/pkg/}, which favours [i] over all other vowels. Tableau (50) illustrates this ranking. NOCODA, a constraint that bans coda consonants (Prince & Smolensky 1993), outranks DEP in Maga Rukai, so motivating epenthesis.73

(50)

<table>
<thead>
<tr>
<th>/rvel/</th>
<th>AGREE V</th>
<th>*-∆PrWd≥{/pkg/}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) rvel</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(b) rveli</td>
<td>!</td>
<td></td>
</tr>
</tbody>
</table>

However, *-∆PrWd≥{/pkg/} is not inactive. Its effect emerges in epenthesis after [a], as in [tkorpaŋi] ‘frog’. Epenthesis of [i] in this situation raises two questions: (i) why is the epenthetic vowel not [a]? and (ii) why is the epenthetic vowel [i]? Non-DTE constraints provide an answer to both these questions.

72 To summarize, Hsin (2000) shows that [dmele] derives from a form with underlying /a/ and /i/, which I take to be /damil/ here. Vowels in the weak member of a foot are prohibited, so *[dami] is banned. Instead of deleting, [a] coalesces with the following vowel, forming [(dmeı̯)]. Finally, epenthesis takes place, producing [(dmelo]). This proposal explains why the negative form is [(dam)(li)]; the negative consists of a mora, which forces the underlying [i] to metathelize. The result is that neither vowel is deleted, so showing the true quality of the input vowels. If the input was /damile/ – i.e. the copy vowel was underlying – the negative would be *[damle].

73 NOCODA does not cause word-medial epenthesis (e.g. [tkasluu], *[tkasalu]). There are two possible reasons for this: (1) CONTIGUITY blocks medial epenthesis (McCarthy & Prince 1995, Kenstowicz 1994b), or (2) medial consonant clusters are all complex onsets (cf Kager’s 1997 account of Macushi).
Since [a] is the most marked non-DTE, [a]-copying can be blocked by a constraint such as $^*{-}\Delta_{PrWd}\geq\{a\}$. This situation is illustrated in tableau (51).

\begin{tabular}{|c|c|c|c|}
\hline
| \(/tkorpa\) | $^*{-}\Delta_{PrWd}\geq\{a\}$ | AGREEV | $^*{-}\Delta_{PrWd}\geq\{\alpha\}$ |
\hline
(a) tkòrpáŋə & *! & & |
\hline
(b) tkòrpáŋə & & * & *! |
\hline
(c) tkòrpáŋi & & & * |
\hline
\end{tabular}

The constraint $^*{-}\Delta_{PrWd}\geq\{a\}$ bans high sonority non-DTEs, so eliminating the candidate with epenthetic [a]. This leaves the candidates without copy vowels – (b) and (c).

The tableau also goes some way to accounting for the emergence of [i] in this situation. Since both (b) and (c) do not have copy vowels, they violate AGREEV equally. This allows the lower-ranked constraint $^*{-}\Delta_{PrWd}\geq\{\alpha\}$ to emerge, favouring the lowest sonority vowel available – i.e. [i]. In other words, [i] wins in this situation because it is the most desirable non-DTE.

To ensure that [i] appears in this situation rather than some other vowel, further rankings are crucial. Importantly, $^*{-}\Delta_{PrWd}\geq\{\alpha\}$ must outrank all DTE constraints that promote [a] and more sonorous elements above [i]: i.e. $^*\Delta_{\sigma}\leq\{i\}$ and $^*\Delta_{\mu}\leq\{i\}$.

To generalize, [i] is epenthized in the non-DTE of \(\alpha\) when some non-DTE constraint of the form $^*{-}\Delta_{\sigma}\geq\{\alpha\}$ outranks all DTE constraints of the form $^*\Delta_{\beta}\leq\{\alpha\}$, where \(\beta\) is a lower category than \(\alpha\). In Maga Rukai, $^*{-}\Delta_{PrWd}\geq\{\alpha\}$ outranks $^*\Delta_{\sigma}\leq\{i\}$, $^*\Delta_{\mu}\leq\{i\}$, and so on. In other words, Maga Rukai epenthesis is emergence of the unmarked – the unmarked vowel in terms of the non-DTE constraints emerges when other options – i.e. copying – are blocked.

An analogous ranking can be used to produce [\(\alpha\)] and [i] as epenthetic vowels for languages in which they are the least sonorous vowels available.

4.4.1.3 Epenthetic [e \epsilon]

The cases discussed so far have all relevant DTE constraints outranking all non-DTE ones or vice-versa. However, the DTE and non-DTE constraints can interleave with each other. The net result can be that neither the most nor the least sonorous vowel is ideal for a particular position. In such a case, the epenthetic vowel emerges with ‘medium’ sonority relative to the other vowels – i.e. [e \epsilon] or [i], depending on the other vowels in the language’s inventory.

[\(\epsilon\)]-epenthesis is found in the Athapaskan language Chipewyan (Li 1946). Chipewyan has the vowels [i e \(\epsilon\) a o u] (p.399). Syllables have the shape CVC, where coda consonants must be (i) coronal or glottal and (ii) fricatives or sonorants (i.e. [\(\theta\ \delta\ s\ z\ \j\ h\ n\ ʃ\ ɹ\ r\]) or (iii) [y].

Words are minimally disyllabic in Chipewyan. As in its relative Slave (Rice 1989:133), if a stem is monosyllabic and is not accompanied by a prefix, [\(\epsilon\)] is
epenthesized before the stem. Because of a ban on onsetless syllables, [h] accompanies [ε]-epenthesis, as shown in (52).

(52) Minimal Word epenthesis in Chipewyan
/tsa/ → [hetsa] ‘he sg. was crying’
cf /ywa-tsa/ → [ywatsa] ‘he will cry’
/uht-tsa/ → [huhtsa] ‘you pl. were crying’
/juht-t-ti/ → [juhti] ‘you (dual) were eating’

[ε]-epenthesis appears in a multiplicity of other situations in Chipewyan, illustrated in (53). In all the cases, the epenthetic vowel is inserted to satisfy phonotactic requirements.

(53) [ε]-epenthesis elsewhere in Chipewyan
/n-tsʰa/ → [ngtsʰa] ‘you sg. were crying’
cf /i-t-tsʰa/ → [hitsʰa] ‘we pl. were crying’
/j-n-tʰi/ → [jɛntʰi] ‘you sg. were eating’
/j-n-y-ti/ → [jɛɛntʰi] ‘they (dual) ate’
cf [jɛɛntʰi] ‘you (dual) were eating’
/n-θ-tʰɛs/ → [nɛɛtʰɛz] ‘we lay down’
/h-θ-tʰɛs/ → [ŋɛɛtʰɛz] ‘they lay down’
cf [nɛɛtʰɛz] ‘you sg were lying down’
/tu-n-ti/ → [tunτi] ‘he was drowning’
cf [tu-n-ti] ‘you were drowning’

The issue of present interest is why the epenthetic vowel is [ε], as opposed to the more sonorous [a] or less sonorous [e] or [i]. The combined effect of the DTE and non-DTE constraints provides an answer.

The DTE constraint *Δσ≤{e,o} bans all syllable nuclei with less sonority than low-mid vowels. If this constraint outranks all non-DTE constraints that favour high vowels over mid vowels (e.g. *-ΔPrWd≥{e,o}), the epenthetic vowel will not be [i], as shown in §4.4.1.1.

The non-DTE constraint *-ΔPrWd≥{a} bans all high sonority PrWd non-DTEs. [ε] is only epenthesized in non-main stressed positions, so the epenthetic vowel will always be subject to this constraint.74

The net result is that the DTE constraint *Δσ≤{e,o} rules out high and high-mid vowels and the non-DTE constraint *-ΔPrWd≥{a} rules out [a]. This leaves [ε] as the only viable epenthetic vowel, as illustrated in tableau (54). As in the preceding sections, epenthesis is motivated by a ban on consonant clusters outranking DEP-IO.

74 I assume that the head syllable is always in the stem (following Rice 1987 for Slave). Since alternations only show epenthetic elements outside stems, the effect is that there is only evidence for the quality of non-head epenthetic elements.
The tableau shows how antagonistic conditions on DTE and non-DTE sonority can result in a vowel of medium sonority.

As a final note, [ɛ] is selected over the round vowel [ɔ] because of another scale: round vowels are more marked than unround ones. This point is developed in the next section.

- **Mid vowel epenthesis elsewhere**
  Chipewyan is not unique in having an epenthetic mid vowel. Mohawk’s epenthetic [e] has been the subject of much discussion (Michelson 1988, Hagstrom 1997 and references cited therein). As mentioned above, Slave also has an epenthetic [ɛ], several Romance languages have an epenthetic mid vowel, and Temiar and Tiberian Hebrew have [ɛ]-epenthesis in closed syllables (McCarthy 1980, Rappaport 1981, resp.).

  Moreover, the present ranking is not only needed for epenthetic mid vowels. It is necessary in all situations where neither the least nor the most sonorous vowel in a language is the epenthetic one. For example, a language that has a central vowel but epenthizes [i] will have to employ a ranking analogous to Chipewyan’s: a DTE constraint will have to ban central vowels and a non-DTE constraint will eliminate all non-high peripheral vowels; such a language is discussed in §4.4.2.

### 4.4.1.4 Universals of epenthetic quality

Despite the variation in sonority in epenthetic vowels, they all have features in common: putting aside interference from processes like vowel harmony and dissimilation, all epenthetic vowels are [+round] and almost all are [+back]. This section discusses cases of putative [+round] and/or [+back] epenthetic vowels, concluding that they are extremely marginal, and perhaps unattested. Reasons for their exclusion are also provided.

Convincing cases of round epenthetic vowels are hard to come by. In fact, while cases of [u] or [o] have been reported, it remains uncertain whether there are any round epenthetic vowels. Cases of epenthetic [o] will be discussed first (Hungarian, Pendau, and Seri), followed by cases of epenthetic [u], and finally a case of epenthetic [v].

- **[o] epenthesis**
  Quick (2000:30) shows that Pendau epenthizes [o] between consonant-final roots and clitics: [dʒunduŋ]~[dʒunduŋŋo] ‘his/her house’, cf [babi] ‘pig’~[babi-jo] ‘his/her pig’. However, there is an independent process of vowel harmony: affix vowels agree with root vowels in [round] and [low] (e.g. [me-ide] ‘small’, [me-meŋoŋ] ‘cold’, [ma-paris]
‘difficult’, [mo-doda] ‘red’, [mo-bulu] ‘green’). On top of that, all enclitics contain a round vowel: [ʔu] {1p.sg.gen.}, [mu] {2p.sg.gen.}, [to] {1p.pl.incl.}, [no] {3p.sg.gen.}, [mo] {completive aspect}, [po] {continuative aspect}. Therefore, the appearance of epenthetic [o] instead of [e] or [a] can be ascribed to the influence of nearby vowels. In short, the vowel’s roundness is due to an incidental harmony process, and is not an indication of the form of context-free markedness constraints.

Marlett (1981:55) reports that Seri has epenthetic [o]. However, this vowel seems to appear only before an [m]: e.g. /tm-kap/ → [tomkap] no gloss, /i-t-k-m-pi/ → [itkompi:] ‘didn’t he taste it?’. It also appears in very restricted morphological environments (i.e. between certain prefixes). Moreover, elsewhere [i] is inserted: e.g. /ʔp-mi-panʃ/ → [ʔipimpanʃ] ‘1sg-proximal-run’ (p.54). It is possible that epenthetic [o] is not epenthetic at all, but part of the input.

As in Seri, Hungarian epenthetic [o] only appears in restricted morphological environments, and [a] acts as the epenthetic vowel in other environments (Fowler 1986); it is therefore possible that [o] is a morpheme.

• [u] epenthesis

Epenthetic [u] has been reported by various sources for a number of Dravidian languages (e.g. Sinhala – Keer 1996:10). However, other sources report that the vowel is actually a [ut] or [i] (e.g. Koḍava – Ebert 1999, Bright 1975:13). Even so, Bright claims that the epenthetic vowel is [u] in dialects of Kannada and Telugu, contrasting with epenthetic [i] in other Dravidian languages. In addition, Paradis (1992) reports that the epenthetic vowel is [u] in Fula (also see Causley 1999b:73).

Finally, E. Sapir (1965:17) reports that [u] or [u] (the choice depends on ATR harmony) is used to separate consonants in Diola Fogny: e.g. /amaʃut+ja/ → [amaʃutua] ‘if you don’t want’. Again, it is not clear that [u] is truly epenthetic. Sapir also reports that deletion is used to eliminate underlying clusters: e.g. /let+ku+jaw/ → [lekujaw], *[letukujaw] ‘they won’t go’. There is no immediately apparent reason why deletion should apply in one instance but epenthesis in the other; the morphological and phonological environments seem indistinguishable. It may be the case that deletion is the default case. In fact, this is borne out by the fact that input consonant clusters separated by [u]/[u] undergo deletion in rapid speech: /ujuk+ja/ → slow [ujukuʃa], fast [ujuʃa] ‘if you see’. In short, [u]-epenthesis does not behave like epenthesis in other languages – it applies for no apparent reason to separate clusters that are otherwise resolved by deletion.

Without in-depth examination of each case – something beyond the scope of the present section – no further comment on these cases will be made here. At the very least, [u]-epenthesis is highly marginal.

• [γ] epenthesis

The only other case of a round epenthetic vowel is the front lax round [γ] in Icelandic (Kiparsky 1984, Karvonen & Sherman 1997). [γ] is inserted between a stem-
final consonant and an \[r\]. The only suffixes that produce this environment are the nominative masculine singular \([r]\) and third person singular \([r]\): e.g. \([\text{day}_r] \) ‘day {nom.sg}’, \([\text{tekr}_r] \) ‘take {3sg.pres.}’. Icelandic \([\gamma]\) stands out from the cases in Table 4.1 in terms of the restrictiveness of its environment: it is not epenthesized for word-minima reasons, or to break up any pair of illicit consonants, but only appears in the environment \(C+r\). This – along with its unique quality – may suggest that \([\gamma]\) is not truly epenthetic. Instead, it may be a morpheme, either inserted in just this environment, or as part of the underlying representation of the nom.sg. and 3sg.pres. morphemes. The fact that it does not appear in the environment \(V+r\) may be due to a ban on \(V\gamma\) clusters. Of course, this issue deserves much more serious consideration; nevertheless, it is possible that Icelandic does not present a case of a round epenthetic vowel.

• Theory

The lack of round epenthetic vowels is expected in the present theory. Vowel roundness is a marked value (see ch.8§8.2). Thus, there is no motivation for vowels to be round: to be so would be gratuitously marked. Of course, this leaves aside cases of assimilation and harmony that produce round vowels.

In other words, epenthetic unround vowels are harmonic bounds for epenthetic round vowels in terms of context-free markedness constraints: i.e. \(*[\text{round}]\). Faithfulness constraints cannot be invoked to preserve round vowels since epenthetic vowels have no underlying features (see ch.4§4.4 for discussion).

The only way that an epenthetic vowel could be round is if roundness was an incidental property of some category on a prosodic scale, like sonority. However, there is no evidence that the sonority scale distinguishes round from unround vowels: no stress system is sensitive to roundness. Since no prosodic scale favours round and unround vowels of the same sonority equally, the emergent influence of \(*[+\text{round}]\) will always result in an epenthetic unround vowel.

A similar reason accounts for the fact that almost all epenthetic vowels are non-back. As argued in ch.8§8.3.3, backness in vowels is marked. So, again, an epenthetic vowel with a \([+\text{back}]\) specification would be gratuitously marked. As with roundness, there is no prosodically based (i.e. sonority) motivation to have a back vowel – back vowels are not more sonorous than front vowels of the same height and peripherality. So, sonority cannot subvert the featural influence of the constraint \(*[+\text{back}]\).

The one remaining issue is the set of languages with epenthetic \([\text{tu}]\). It is notable that – except for Japanese – all are Dravidian. Moreover, there seems to be some disagreement – or language-internal variation – as to whether the epenthetic vowel is back \([\text{tu}]\) or central \([i]\). For example, the epenthetic vowel is reported to vary in realization as \([\text{tu}]\) and \([i]\) in Kodava (Ebert 1996:1). Similarly, Bright (1975:13) reports most Dravidian epenthetic vowels to be \([i]\). Therefore, it may be that \([\text{tu}]\) classes as a central vowel in these languages, thus being less sonorous than all other types. Again, this issue requires further investigation and careful phonetic measurement, and is unfortunately beyond the scope of this dissertation.
4.4.2 Contextual epenthesis in Shipibo

The claim that high sonority vowels are preferred in DTEs and low sonority ones are favoured in non-DTEs finds striking support in the Peruvian language Shipibo (Lauriault 1948, Elías 2000, p.c.).

Shipibo has the surface vowels [i u a]. Each syllable contains a single vowel and an optional onset consonant (i.e. (C)V). An epenthetic vowel is inserted to avoid coda consonants, as in the forms /karib-ki/ → [karibäki] ‘went again’, and /honirib-ki/ → [honiribäki] ‘hid again’. From these examples, it is evident that the epenthetic element has two realizations: [a] and [i]. Lauriault observes that the epenthetic vowel is [a] in odd numbered syllables, and [i] in even syllables. The following data illustrates this generalization with a consonant-final stem plus the suffix –[ki] {completed action}:

(55) Shipibo epenthesis

(a) [a]-epenthesis in odd-numbered syllables

[karibäki] ‘went again’
[pirabäki] ‘ate again’
[aribäki] ‘did it again’

(b) [i]-epenthesis in even-numbered syllables

[uūribäki] ‘saw it again’
[unāribäki] ‘knew again’
[buuribäki] ‘healed again’
[honiribäki] ‘hid again’
[junuribäki] ‘commanded again’

Lauriault also shows that the quality of the epenthetic element changes when other affixes are added before the epenthetic element:

(56) /a-rib-ki/ → [aribäki] ‘did it again’
/a-ma-rib-ki/ → [amaribäki] ‘made him do it again’
/a-ma-riś-rib-ki/ → [amarisibäki] ‘merely made him do it again’

In contrast, morphemes added after the epenthetic element have no effect on its form: [aribäki] ‘did it again’ cf [aribāriski] ‘merely did it again’.

• The foot in Shipibo

The variation in epenthetic quality in Shipibo can be related to the foot. Shipibo has left-aligned trochaic feet: e.g. [(jōnu)(riби)ki]. Whenever the epenthetic element...

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76 My thanks to José Elías for providing the underlying forms, narrow transcriptions of output forms, and the description of stress.
77 The only data Lauriault provides consists of the morphemes rib ‘repeated action’ and ki ‘completed action’. However, he asserts that other morpheme combinations exhibit the a/i alternation.
78 For an in-depth discussion of Shipibo stress, see Elías (2000). Elías (p.c.) observes that the initial foot can appear as an iamb under special circumstances: e.g. [(karib)bäki]. For discussion, see Elías (2000). There is little phonetic or phonological evidence for the secondary stresses postulated. It is possible that the foot
appears in the head syllable of a foot, it is realized as the most sonorous vowel \([a]\). In contrast, whenever it appears in the non-head of a foot, it emerges as the low sonority vowel – \([i]\).  

To account for this variation, the foot-referring constraints \(*\Delta_F \leq \{i, u\}\) and \(*_-\Delta_F \geq \{a\}\) are invoked here. The latter constraint bans high sonority vowels in foot non-DTEs, while the former constraint militates against low sonority vowels in foot heads. With these constraints, the variation in epenthetic quality emerges. Epenthesis is motivated by a ban on coda consonants (NOCODA) outranking DEPIO.

\begin{table}
\centering
\begin{tabular}{|l|l|l|}
\hline
 & \(*\Delta_F \leq \{i, u\}\) & \(*_-\Delta_F \geq \{a\}\) \\
\hline
(a) (kári)(bâki) & & \\
(b) (kári)(bîki) & \(*!\) & \\
\hline
\end{tabular}
\caption{Epenthesis of \([a]\) in Foot DTEs in Shipibo}
\end{table}

\begin{table}
\centering
\begin{tabular}{|l|l|l|}
\hline
 & \(*\Delta_F \leq \{i, u\}\) & \(*_-\Delta_F \geq \{a\}\) \\
\hline
(a) (jïnu)(riba)ki & \(*!\) & \\
(b) (jïnu)(ribi)ki & \(*!\) & \\
\hline
\end{tabular}
\caption{Epenthesis of \([i]\) in Foot Non-DTEs in Shipibo}
\end{table}

In both the tableaux above, foot-form constraints dominate the sonority constraints. Higher ranked constraints require left-aligned trochaic feet, effected by PARSE-\(\sigma\), TROCHEE, and ALIGNFTL (McCarthy & Prince 1993b). If this were not so, footing would be sensitive to sonority. In addition, faithfulness constraints outrank the sonority constraints above, so preventing neutralization.

There is one remaining issue, related to the discussion of Chipewyan \([e]\). The non-DTE epenthetic vowel in Shipibo is not the least sonorous one available – i.e. \([i]\). Instead, it is the ‘medial’ sonority \([i]\). With the non-DTE constraints alone, \([i]\) is more harmonic than \([i]\) in non-DTE position since the latter violates \(*_-\Delta_F \geq \{i, u\}\) while the former does not.

As with Chipewyan, the emergence of \([i]\) is due to the intermingling of DTE and non-DTE constraints. Although \([i]\) fares worse than \([i]\) in terms of non-DTE constraints, it is favoured by DTE constraints. Thus, choice of \([i]\) over \([i]\) can be ascribed to a constraint such as \(*\Delta_\sigma \leq \{i\}\), as shown in tableau.

\footnote{The data do not provide evidence for the quality of the epenthetic vowel in an unfooted syllable (in this case, the final syllable of an odd-parity word). If it were found to be \([i]\), the appropriate constraint for Shipibo would be \(*\Delta_{\text{PrWd}} \geq \{e, o\}\), not \(*\Delta_{\text{PrWd}} \geq \{e, o\}\). If it were found to be \([a]\), this could be ascribed to the emergent effect of a constraint such as \(*\Delta_{\sigma} \leq \{e, o\}\). In any case, the behaviour of stray syllable epenthesis does not alter the general point: that DTEs and non-DTEs place different conditions on vowel quality.}

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As discussed in the previous section, the epenthetic vowel cannot be [ø] because of the emergent ban on round vowels (i.e. by *+[+round], outranked by IDENT[+round] to preserve input roundness contrasts).

4.4.3 Universals of epenthesis

To summarize the results of the preceding sections, the DTE and non-DTE constraints together predict that there are no straightforward absolute universals relating to epenthetic quality. A language may take an epenthetic vowel of any sonority in any position.

- Implicational relations within a language

    The DTE constraints do make a somewhat complex prediction, though. The prediction relates to languages like Shipibo, where the quality of the epenthetic vowel differs depending on position. When the quality of the vowel is determined by sonority requirements (as opposed to, e.g., assimilation), the present theory predicts that the more sonorous version of the vowel will appear in a more ‘DTE-like’ position. A position $P_1$ is more ‘DTE-like’ than position $P_2$ if $P_1$ is a DTE of category $\alpha$ while $P_2$ is not.

    For example, Shipibo has two epenthetic vowels – [a] and [i]. Epenthetic vowels end up in two places: $\Delta_{\text{Ft}}$ and $-\Delta_{\text{Ft}}$. The $\Delta_{\text{Ft}}$ position is more DTE-like than $-\Delta_{\text{Ft}}$ because the former is a DTE of a Ft while the latter is not. Therefore [a] will appear in the $\Delta_{\text{Ft}}$ position.

    In contrast, the constraints predict that there is no ‘anti-Shipibo’ language where [i] is epenthesized into the $\Delta_{\text{Ft}}$ position while [a] appears as a $-\Delta_{\text{Ft}}$. This involves the less sonorous [i] ending up in the more DTE-like position $\Delta_{\text{Ft}}$. This prediction follows from the form of the constraints and the nature of the prosodic hierarchy. If a high-sonority vowel $x$ is epenthesized into a DTE of category $K$, this could only have come about through the influence of a DTE-markedness constraint: $*\Delta_{K}/x$. Significantly, this constraint not only puts a restriction on $\Delta$’s of category $K$, but on DTEs of all higher categories. For example, $*\Delta_{\sigma}\leq\{a\}$ not only requires [a] to appear in DTEs of syllables, but also puts the same restriction on DTEs of Ft, PrWds, and so on. This therefore rules out the possibility of epenthesizing a less sonorous vowel into a DTE of a higher category.

    To expand on the last point, the only way that [i] could be epenthesized into a foot DTE in Anti-Shipibo is for some markedness constraint $M$ that favoured [i] over [a] to outrank $*\Delta_{\sigma}\leq\{a\}$. $M$ must not only favour [i] over [a], but must only favour it in foot DTE position, and nowhere else. Thus, $M$ would have a form like $*\Delta_{\text{Ft}}/i$; the problem with such
a constraint is clear – it reverses the scale relation between [a] and [i], and is not allowed in the present theory.

- **Perpetual DTEs and non-DTEs**

  Epenthesis of low sonority vowels depends on the influence of a non-DTE constraint. This raises the issue of positions that are DTEs of every category. If position *p* is not a non-DTE of any category, then anything epenthesized into *p* is subject only to DTE constraints. Since DTE constraints all favour high sonority elements, the epenthetic vowel in *p* must therefore be [a], and can never be anything less sonorous [e i ø i].

  A number of languages provide no insight into this question since epenthetic vowels go out of their way to avoid DTE positions (i.e. most importantly, the main stressed syllables) in many languages (Alderete 1995, Beckman 1998, Broselow 2001). However, cases of epenthesis into $\Delta_{Pr, Wd}$ position are attested.

  A problem is raised by a relevant case in Arabic: [i] is epenthesized into main-stressed position: e.g. [katabtí], *[katabtá] (McCarthy 1979). The problem is that [i] is a low-sonority vowel, yet the position it appears in is the DTE of the highest prosodic level (in some utterances). In short, the DTE-sonority constraints cannot deal with the Arabic system.

  While this presents a problem for the DTE-sonority constraints, it may merely be the case that epenthetic vowel quality is also influenced by other scales. If some other scale favours [i] over [a], [i] will appear in DTE position under an appropriate ranking. Exploration of this issue is left for future work.

  However, it is worth noting that a point similar to the one for DTEs can be made for certain non-DTE positions. Onset position is a non-DTE of all constituents. Since onsets are not DTEs of any category, only non-DTE constraints can apply to them. Therefore, epenthesis into onset position must always produce a low sonority element, as long as other factors do not intervene. Certainly, epenthesis of stops – the lowest sonority category – into onsets is common; a full discussion is provided in ch.5§5.3.

Certainly, epenthetic onset elements can be highly sonorous, but only in response to their environment (e.g. [t] in Boston English – McCarthy 1994, epenthetic glides – Rosenthall 1994).

### 4.5 Summary

The aim of this chapter was to show the need for constraints that refer to non-DTEs. The primary focus was on the foot non-DTE. Evidence for non-DTE constraints was presented from systems with sonority-driven stress, vowel reduction, and epenthesis. Each of these cases is discussed in turn.

- **Sonority-driven stress**

  In Kiriwina and Harar Oromo, stress placement refers to the sonority of the vowel in the foot’s non-head. For example, stress falls on the antepenult in Kiriwina’s [(mí)íla] because the alternative – stress on the default penult position *[mi(gíla)] – results in a foot with a high sonority non-head. Similarly, stress falls on the ultima in Harar Oromo’s
[na(má)] because stress on the penult *[náma)] would create a foot with a high sonority non-head.

In these languages, DTE sonority is irrelevant. This is clearly shown by Kiriwina [(mígi)l] – the competing *[mí(gí)l] does not differ in DTE sonority at all. Since DTE sonority is irrelevant, reference to the foot’s non-DTE is essential.

- **Vowel neutralization**
  Dutch presents a case where the foot non-head places difference conditions on vowel neutralization than in other unstressed positions. While [o] and [i] reduce to [a] in foot non-heads in the informal register, they do not reduce in unfooted syllables: e.g. /lokomotif/ → [(lòkə)mø(tíf)] ‘locomotive’, *[lòkə)mø(tíf)] (Kager 1989 and many others). It is clear that vowel reduction does not simply refer to the category ‘unstressed syllable’ here (cf Crosswhite 1999). Instead, there is a crucial difference between foot non-DTE position and other unstressed syllables, so necessitating markedness constraints that refer to this position.

- **Epenthesis**
  The DTE constraints promote high sonority elements, so a CON without antagonistic constraints would incorrectly predict the epenthetic vowel to be [a] in all languages. The non-DTE constraints provide this antagonism. They provide an account for why [a] is epenthized into foot heads in Shipibo, while [i] appears in foot non-heads. The tension between DTE and non-DTE constraints was used to account for cases with ‘medial sonority’ elements, like Chipewyan’s [e].

- **Other categories**
  While foot non-DTEs have been the focus of this chapter, the theory has non-DTE and DTE constraints that refer to all other elements of the prosodic hierarchy. This point has already been argued for tone by Selkirk (1998) and in my own work (de Lacy 1999a, 2002b). The following paragraphs sketch the evidence for this proposal.

  Prince & Smolensky (1993) show that sonority constraints that refer to syllable DTEs (i.e. nuclei) and syllable non-DTEs (i.e. margins) are necessary in accounting for syllable structure restrictions (also see ch.6§6.5.2.2).

  Evidence that constraints refer to foot DTEs and non-DTEs is provided in this chapter (also ch.1§1.4.1.2), by Kenstowicz (1996) for sonority, and for tone in de Lacy (1999a, 2002b).

  Evidence that constraints refer to PrWd DTEs (as opposed to foot DTEs) is given for Nganasan stress in ch.3§3.2. Evidence for reference to PrWd non-DTEs (as opposed to foot non-DTEs) was provided in §4.3.

  No evidence for reference to categories of higher levels is provided in this dissertation. This is because I know of no evidence that sonority is sensitive to such higher levels. However, this does not mean that constraints cannot refer to higher levels, such as DTEs of Prosodic Phrases, Intonational Phrases, and so on. It is clear that constraints on tone must refer to these levels, so accounting for the fact that heads of these phrases attract high tone, while non-heads attract low tone. For example, Kim (1997) shows that every
Major Phrase in Korean must contain at least one high tone, and that no other high tones are permitted. The constraints $\Delta_{\text{MaP}}/L$ and $-\Delta_{\text{MaP}}/H$ must outrank tone-faithfulness to achieve this result. Similarly, the phonologically assigned (i.e. default) intonational tune in the Polynesian language Maori is $H^*L^*$ on every Major Phrase (Bauer 1993). \(^80\) This can be explained if $\Delta_{\text{MaP}}/L$ and $-\Delta_{\text{MaP}}/H$ are employed in this language. See de Lacy (1999a§5.2) for related discussion.

\(^80\) If declarative intonation is assumed to be the phonological default (phonologically assigned) tonal melody, the tone-prominence constraints explain why the most common pattern is $H^*L^*$, with a high tone on the head of a MajorP/IntonationalP.