THE FORMAL EXPRESSION OF MARKEDNESS

A Dissertation Presented

by

PAUL V. DE LACY

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Department of Linguistics

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DEDICATION

In memory of my brother.
ACKNOWLEDGMENTS

Although this is probably the first part of the dissertation you’ll read, it was the last part I wrote. Now that everything’s (almost) over, I feel like I finally have a moment to contemplate everything that’s happened over the last five years. Looking back, I realize I owe a lot of people a lot of thanks.

- **My parents**
  If it wasn’t for my parents, Reg and Mary, it’s likely I’d still be languishing in New Zealand. While I would be safe from nuclear fallout, I would have missed out on interacting with a truly remarkable group of people and finding my niche in life. My parents’ intellects, encouragement, and support have always been an inspiration to me, and so I thank them.

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  One of the first phonologists I ever met also became my dissertation chairperson, my mentor, and my friend. I cannot hope to adequately express my admiration and respect for John McCarthy. He commented extensively – and mercilessly – on everything I wrote at UMass. More than that, John taught me to think critically and concisely; his influence can be seen in the good parts of this dissertation.

  Alan Prince has a disconcerting ability to immediately see the flaws in any theory, and – equally as quickly – to figure out a solution. Needless to say, I have benefited greatly from Alan’s comments and guidance, not only relating to this dissertation but in a good deal of other work as well.

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  My close friends George Puttner, John Doleman, and Eban de Silva always managed to haul me back down to earth whenever I became too cerebral.

  I owe special thanks to Catherine Kittö for putting up with me while I was working constantly and for listening to me fret endlessly. She’s even more happy that this dissertation’s finished than I am.
ABSTRACT

THE FORMAL EXPRESSION OF MARKEDNESS

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This dissertation presents a formal theory of markedness, set within Optimality Theory. Two of the leading ideas are (a) hierarchical markedness relations may be ignored, but never reversed and (b) the more marked an element is, the greater the pressure to preserve it.

An example of (a) is found in sonority-driven stress systems. In Gujarati, low vowels attract stress away from mid vowels, while Nganasan’s stress system makes no distinction between the two categories. So, while stressed mid vowels are more marked than stressed low vowels (as shown by Gujarati), that distinction can be conflated (as in Nganasan). However, in no language is the markedness relation reversed: stressed mid vowels are never preferred over stressed low vowels.

An example of (b) is found in Yamphu. /t/ is eliminated through a process of debuccalization. In contrast, the more marked segments /h/ and /p/ remain intact; these segments avoid the debuccalization process because they are highly marked and thereby excite greater preservation.

Ideas (a) and (b) are formally expressed as a set of constraint-formation conditions. For constraints on output structures (‘markedness’ constraints), if a constraint assigns a violation to an element p in scale S, then the constraint also assigns a violation to every element that is more marked than p in S. An analogous proposal applies to faithfulness (i.e., preservation) constraints: if a faithfulness constraint bans an unfaithful mapping from element p in scale S, then the constraint also bans unfaithful mappings from all elements that are more marked than p in S. The result is that – regardless of the constraints’ ranking – more marked elements are both subject to more stringent output conditions and preserved more faithfully than lesser-marked ones. The constraints are also shown to allow distinctions between scale categories to be collapsed.

A wide range of phonological phenomena provide evidence for the theoretical proposals, including analyses and typologies of sonority-driven stress (Nganasan, Gujarati, Kirivina, and Harar Oromo), tone-driven stress, vowel and consonant epenthesis, vowel reduction (Dutch), coda neutralization (Malay and Yamphu), Place assimilation (Catalan, Ponapean, Korean, Swedish, and Sri Lankan Portuguese Creole), and coalescence (Attic Greek and Poli).

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LIST OF ABBREVIATIONS

1. Symbols in tableaux
   ✥ The winning form
   ◇ A incorrect/unattested winning form
   ♦ A form that never wins in any grammar

2. Feature classes
   K dorsal (velar, uvular, pharyngeal)
   P labial (bilabial, labio-dental)
   T coronal (dental, alveolar, postalveolar, retroflex, (palatal))
   ? glottal [ʔ h ʔ N]
   [vd] The feature [voice]
   [N] The placeless (glottal) nasal (Trigo 1988, see ch.5§5.3)

3. Prosodic Categories
   μ Mora
   Ft Foot
   σ Syllable
   PrWd Prosodic Word
   MiP Minor Phrase
   MaP Major Phrase
   PPh Phonological Phrase
   IP Intonational Phrase
   UtP Utterance

4. Other symbols
   […] encloses a scale (e.g. [dorsal] coronal)
   […] encloses a ranking (e.g. [ONSET = MAX])
   x → y constraint x outranks constraint y
   x ≥ y the ranking of constraint x and y is indeterminate
   x ≤ y refers to all elements on a scale that are equally or more marked than x
   […] refers to all elements on a scale that are equally or less marked than x
   […] in a constraint, encloses a set of scale elements (e.g. IDENT[KP])
   / / Encloses an input form
   [ ] Encloses an output form
   1 subscript numerals mark correspondence relations: /a1/ → [i1] indicates that input /a/ corresponds to output [i].
   M(x>y) a markedness constraint that favours x over y (i.e. assigns fewer marks to x than y).
   F(x>y) a faithfulness constraint that preserves x without preserving y.
   M(x>k) stands for a markedness constraint that favours [t] over [k].
   M(x<k) a markedness constraint that assigns a violation to [x].
   F(x) a faithfulness constraint that preserves the mapping /d/ → [x].

Δα Designated Terminal Element of α. The terminal element that is associated to α by an unbroken path of prosodic heads.
¬Δα non-Designated Terminal Elements of α. All elements in α that are not α’s DTE.
CHAPTER 1

INTRODUCTION

1.1 Introduction
This dissertation presents a formal theory of markedness, set within Optimality Theory. Two leading ideas behind the theoretical proposals are stated in (1).

1 Leading Ideas
(a) Markedness relations between categories may be ignored, but never reversed.
(b) The more marked an element is, the greater the pressure to preserve it.

The general issues that this dissertation addresses are outlined in §1.1.1. The leading ideas in (1) are discussed in §1.1.2.

Section 1.2 presents a synopsis of the theory, and §1.3 identifies its empirical implications. Section 1.4 contains an outline of this dissertation.

1.1.1 Markedness: Issues
A number of phonological phenomena treat certain classes of segments differently from others. For example, non-assimilated epenthetic consonants are always coronal [t s n l] or glottal [ʔ h]; they are never labial [p m f] or dorsal [k ŋ x] (ch.5§5.3, Lombardi 1998).

Similarly, Place of Articulation is always neutralized to coronal or glottal (ch.6§6.6). For example, all plain stops in Kashaya are converted into [ʔ] in codas (Buckley 1994:99). In contrast, there is no language in which all stops are converted into the dorsal [k] or labial [p] in codas (ch.6§6.6).

In contrast, dorsals can trigger assimilation without coronals doing so. For example, stops and nasals in Korean must assimilate to a following [k] while they retain their underlying place of articulation before [t]. Moreover, there is no language where the opposite occurs: where coronals trigger assimilation but dorsals do not (ch.7§5).

As a final example, stress exhibits a rigid hierarchical preference for certain segment classes: stress will seek out high sonority segments, ignoring lower sonority ones. A relevant case is found in Gujarati, briefly outlined in (2). For further data, see ch.3§3.2.

(2) Gujarati stress in brief (Cardona 1965, my own fieldwork)
(a) Stress a low vowel [a]
   [tʰɛrɛɾ] ‘recently’ [mánˈɛn] ‘respected (masc.)’
   [sɛɾnɛɾ] ‘movie theatre’ [bɛɾlɛɾ] ‘42’
(b) Otherwise stress a non-final non-low peripheral vowel [e ɤ o i u]
   [kʰɒɾdi] ‘little cuckoo’ [tʰɒɾdi] ‘girls’
   [wɪɾɪmɔɾ] ‘forgetfulness’ [kʰɔɾnɪsə] ‘shorts’
(c) Otherwise stress a penult central vowel [ə]
   [ɾɔɾɪ] ‘kite’
   [ɾɔɾɪ] ‘water-dispensing shed’
   [ɾɔɾɪ] ‘toy’
   [ɾɔɾɪ] ‘does, do’

Gujarati stress treats vowels in a hierarchical manner: stress relies on a vowel scale in which [a] is predominant, followed by mid and high peripheral vowels, and finally by [ɛ].

Gujarati stress also raises the issue of universality. Many other processes also refer to the same vowel scale used in Gujarati (i.e. the vocalic part of the sonority hierarchy – ch.3§3.2, Sievers 1881, Jespersen 1904). While some languages make fewer distinctions among the vowels for stress assignment and others make more, all follow the same hierarchy (ch.3§3.5). More importantly, the opposite ‘anti-Gujarati’ situation never occurs: there is no language in which stress ignores [a] and seeks out a non-low vowel instead.

Another issue relates to the versatility and consistency of the scale in different processes. The vowel scale described above is not only used for placing primary stress. Pichis Asheninca refers to it in locating secondary stress (J.Payne 1990), and syllabification in many languages refers to the same scale (e.g. Hooper 1976, Harris 1983, Selkirk 1984, Dell & Elmedlaoui 1985, 1988, Prince & Smolensky 1993:ch.1, Blevins 1995). It is also relevant to processes such as neutralization (ch.6, Crosswhite 1998, 1999, 2000) and coalescence (ch.8).

Even the few examples given above indicate that there is a cross-process and cross-linguistic consistency in terms of the classes of elements that are set in opposition to each other. For Place of Articulation distinctions, dorsals and labials are treated distinctly from coronals and glottal; for vowels, sonority determines hierarchical relations. The recognition of the cross-linguistic consistency of hierarchies has led to theories of ‘markedness’ – attempts to provide a unified explanation of the phenomena discussed above (classically: Jakobson 1941 et seq., Trubetzkoy 1931, 1939, Greenberg 1966; general discussion: Moravec & Wirth 1983, Eckman et al. 1983; for work in generative frameworks: Chomsky & Halle 1968:ch.9, Stampe 1972, Cañas & Feinstein 1982, Prince & Smolensky 1993, Causley 1999b).

The aim of this dissertation is to present a formal theory of markedness relations. In other words, the aim is to provide a formal account of why certain phenomena treat certain segment classes as distinct from others and why there is both cross-phenomena and cross-linguistic consistency in this treatment.

There are a number of challenges to any such theory. Processes can collapse certain markedness distinctions (§1.1.1.1), and even ignore markedness entirely (§1.1.1.2).
In addition, the most marked elements can be retained while less marked ones are eliminated (§1.1.1.3).

1.1.1.1 Conflating markedness distinctions

A complicating factor for markedness is that – on the surface – markedness distinctions are only partially uniform cross-linguistically. Markedness categories that are distinct in some languages may be fused – or ‘conflated’ – in others.

An example of conflation is found in the Gujarati case presented in the preceding section. This system had ‘sonority-driven’ stress – where stress placement is sensitive to vowel quality. Notably, Gujarati treats mid and high peripheral vowels in the same way for stress purposes. Stress does not avoid high vowels for mid peripheral vowels – [tʃiŋˈkriː] ‘girls’, *[tʃiŋˈkrai] nor does stress avoid mid vowels for high vowels: e.g. [tʃiŋˈkɾiɛ] ‘74’, *[tʃiŋˈkɾiɛ]). In other words, the distinction between stressed high and mid peripheral vowels is ignored in this system. This will be called ‘category conflation’ (or just ‘conflation’ for short). The theoretical significance of conflation has been previously recognized in Kenstowicz (1996), Prince (1997a,b,c, 1998, 1999), and in my own work (de Lacy 1997a, 1999a, 2000a, 2002b).

Languages differ as to which categories they conflate. For example, chapter 35.3 discusses stress in the Uralic language Nganasan; this language conflates schwa with high vowels in stress placement, and mid peripheral vowels with low vowels (Helimski 1998). The result is a vowel scale | i, u, e, o, a | for Nganasan stress, compared with Gujarati’s | a, i, u, e, o, a |. Chapter 3 shows that conflation can apply to any contiguous part of the sonority scale, and conflate any number of categories. Conflation also applies to other scales, with a variety of effects. Examples of conflation of the Place of Articulation scale are given in ch.5§5.3.

In short, an adequate theory must not only be able to make category distinctions (e.g. high vs mid peripheral vowels in Nganasan), but also collapse them as well (as in Gujarati). While allowing conflation, though, it is crucial to prevent reversals of the hierarchy: in no language does stress avoid mid peripheral vowels for high peripheral ones. More concretely, an adequate theory must explain why (i) mid vowels are more desirable for stress than high peripheral vowels in Nganasan, (ii) stressed mid and high vowels are equally desirable in Gujarati, and (iii) high vowels are never more desirable than mid vowels in the stress system of any language.

In summary, the present theory aims to explain why hierarchical markedness relations can be ignored, but never reversed. In slightly different terms, the observation arrived at here is that no statement of the form “x is universally more marked than y” is true. Rather, the form of such markedness statements should be “y is never more marked than x”, so allowing for situations where y and x are treated as being equally marked.

1 Category conflation is different from ‘tier conflation’ (Halle & Vergnaud 1987), which is the elimination of a line of marks in a metrical grid.
of a labial and a coronal produces a coronal (e.g. /labh-t/ → [labh-t] 'take (infinitive)'). (ch.8§8.4).

The claim that there are no asymmetries in assimilation and coalescence is controversial (cf Mohanan 1993, Jun 1995, de Haas 1988), so extensive evidence for the empirical claims made above is provided in chapters 6-8.

In summary, unmarked elements may be eliminated, while marked elements are retained (as in Yamphu, Catalan, Attic Greek). However, the opposite situation may also occur: marked elements may be eliminated while unmarked ones remain (as in Malay, Sri Lankan Portuguese Creole, Pāli).

1.1.2 Leading Ideas

This dissertation explores two leading ideas, repeated from (1) for convenience.

(5) (a) Markedness relations between categories may be ignored, but never reversed.
(b) The more marked an element is, the greater the pressure to preserve it.

Of course, (1)/(5) contain informal statements; a formal implementation is outlined in §1.3, set in Optimality Theory. The import of the leading ideas will be discussed informally here, not only for the sake of cross-theoretic applicability, but because it may help clarify the aims and reasons for the theoretical implementation in the next section.

The leading ideas in (5) can be used to account for all of the markedness-related phenomena identified in §1.2.1. (5a) and (b) will be discussed in turn.

- **Leading Idea I:** “x is never less marked than y”

Statement (5a) expresses the notion that categories may be conflated. In previous conceptions of markedness, markedness hierarchies are rigidly hierarchical (e.g. Jakobson 1941, Prince & Smolensky 1993). In the present theory, markedness relations may be collapsed. So, if x is more marked than y in some grammar, x is never less marked than y in any grammar. This collapse allows for grammars in which x and y are conflated in terms of markedness for some process.

This idea aims to account for cases where markedness distinctions can be ignored, as in Gujarati stress placement (§1.1).

- **Leading Idea II:** the more marked, the more preserved

Statement (5b) can be used to account for those processes that exhibit no markedness asymmetries at all, and for those which prevent highly marked elements from undergoing some process.

Phenomena that exhibit no markedness asymmetries follow from both the nature of markedness constraints and from the action of marked-element preservation. As a simple example, §1.1.2 observed that there are no asymmetries relating to the output form of segmental inventories. In other words, any segment may be missing from an inventory.

Inventories that lack a highly marked element exhibit a standard case of markedness reduction: the more marked elements are eliminated while the less marked
ones are retained. In contrast, inventories which lack less marked elements but retain highly marked ones (e.g. \( [k p \tilde{q}] \)) come about through the action of marked-preservation: highly marked elements are preserved while less marked ones are eliminated.

The net surface result of markedness reduction and marked-preservation is that certain phenomena seem to be insensitive to markedness concerns altogether.

The same account can be used to explain why there are no markedness asymmetries for the output of coalescence, and the undergoers of assimilation. Cases where the least marked element emerges in coalescence (e.g. \( [p+d] \rightarrow [t] \)) are due to markedness reduction, while cases where the most marked emerges (e.g. \( [p+d] \rightarrow [b] \)) are due to retention of the marked element.

For assimilation, cases like Catalan where only coronals undergo assimilation follow from marked-preservation: dorsals and labials are exempt from an otherwise general assimilation process. In contrast, assimilation systems like Sri Lankan Portuguese Creole’s – where only marked elements undergo assimilation – are due to markedness reduction. Assimilation is a means of reducing overall markedness, so dorsals and labials assimilate. Coronal do not assimilate because they are already adequately unmarked.

In short, markedness reduction produces systems in which highly marked elements are eliminated, while marked-preservation produces systems in which only the least marked elements are eliminated. The net result is that certain phenomena are apparently insensitive to markedness relations.

This proposal also explains why certain phenomena always exhibit markedness asymmetries. For example, dorsals and labials can never be produced by consonant epenthesis (putting aside incidental processes like assimilation). This follows from (i) markedness reduction: the least marked element will always be inserted (i.e. coronals and glottals), and (ii) marked-preservation: since there is no input element, there is nothing to preserve, so preservation is irrelevant for epenthesis. In short, consonant epenthesis is a ‘pure’ expression of markedness reduction; marked-preservation is irrelevant.

1.1.3 Summary

To summarize, the aim of this dissertation is to present a formal theory of markedness, set within Optimality Theory. Importantly, this dissertation does not aim to deal with issues such as the phonetic basis for sonority and Place of Articulation scale. The scales presented in the following chapters (and above) are constructed from phonological evidence only (see ch.3, ch.5).

Apart from the Sonority Hierarchy, many other scales have been proposed, including scales for place of articulation (ch.5, Jakobson 1941), vowel height (Clements 1991), consonantial stricture (Steriade 1993), inherent voicing (Gnanadesikan 1997), and tone (Ping 1996, 1999, de Lacy 1999a, 2002b)

Scales are by no means a peculiarly phonological phenomenon. McCarthy & Prince’s (1994, 1995) morphological hierarchy of [Root] [Affix] has been shown to have significant consequences for phonological processes. Scales relevant to syntax include the thematic hierarchy (Grimshaw 1980 and others), and scales of person and animacy (Silverstein 1976, Dixon 1979, Aissen 1999).

The influence of scales is pervasive. Apart from syllabification and stress assignment, the sonority scale influences foot structure and segmental cooccurrence (see chapters 3, 4). The tonal scale can affect prosodification (de Lacy 1999a, 2002b), while the Place of Articulation and other subsegmental scales cause many subsegmental changes (see ch.6-8).

The influence of scales is also significant in syntax. The thematic hierarchy determines the initial/base position of arguments, while animacy has a significant role in syntax (Silverstein 1976, Dixon 1979, Aissen 1999, Woolford 1999). Syntactic and morphological scales will not be examined in this dissertation, though the general principles of scale composition proposed here could be extended to them. For relevant comments, see ch.9.

- Where do scales come from?

Before moving on to discuss the theory proposed herein, a comment must be made about the substantive basis of scales. The issues and proposals in this dissertation naturally raise the question “Where do scales come from?” In other words, is there a substantive basis for scales like the sonority hierarchy and Place of Articulation scale? If so, how does a scale come about?

While these questions are significant, they are not addressed in this dissertation. In fact, this dissertation begins where this question ends: the proposals herein are about how scales relate to the formal apparatus of OT, not about the origins of scales. The theory presented below does not assume anything – and does not need to assume anything – about scales except that constraints refer to them. The proposals about the relation of scales to the formal apparatus will hold regardless of where scales come from.

1.2 Theory

This section outlines a formal theory of markedness scale-reference, set within Optimality Theory (Prince & Smolensky 1993). For details, see chapter 2.2 Optimality Theory is admirably suited to formally express the leading ideas in (1). In particular, violability of constraints will play a central role in the following theory – in many cases, the winning form will necessarily violate some markedness- or faithfulness-related constraint.

Underlying the following proposals is the claim that for every scale there is a set of markedness constraints and a set of faithfulness constraints. Both scale-referring markedness and faithfulness constraints have three properties in common, given in (6).

[2] From here on it is assumed that the reader is familiar with Prince & Smolensky (1993), as well as the proposals of McCarthy & Prince (1993a,b, 1995).
(6) Core Properties of Scale-Referring Constraints
For every set of constraints \( C \) that refers to a scale \( S \)
(a) Every constraint in \( C \) refers to a contiguous range of \( S \), and
(b) Every constraint in \( C \) refers to the most marked element of \( S \), and
(c) The constraints in \( C \) can be ranked freely; there are no fixed rankings.

The meaning of the term ‘refers’ differs depending on whether the constraint is a markedness or faithfulness one. Scale-referring markedness constraints are discussed in §1.2.1, and faithfulness constraints in §1.2.2.

A final property adopted here is ‘completeness’: for every distinct set of constraints \( C \) that refers to a scale \( S \), there are as many constraints in \( C \) as there are elements in \( S \) (after Green 1993). Therefore, the markedness constraints that refer to the scale \( |\alpha\beta\gamma| \) are three in number, as are the number of faithfulness constraints.\(^7\)

1.2.1 Markedness
The issue that underlies this section is how to account for category conflation. The proposal that constraints refer to a range of a scale (6a) and that there are no fixed rankings (6c) are significant in this regard.

The idea that scale-referring markedness constraints refer to a range of a scale has been discussed most extensively by Prince (1997 et seq.) (also de Lacy 1997a, 2000a; see ch.2§2.2.3 for further discussion of precursors). In Prince’s terminology, constraints like those in (7) are in a ‘stringency’ relation to each other; accordingly this term will be adopted here.

For purposes of illustration, the Place of Articulation (PoA) scale given in (3) will be used here (i.e. {dorsal} {labial} {coronal} {glottal}). The set of constraints that conforms to the properties listed in (6) is given in (7).

(7) PoA markedness constraints
*{dorsal} For every dorsal segment, assign a violation.
*{dorsal,labial} For every segment that is either dorsal or labial, assign a violation.
*{dorsal,labial,coronal} For every segment that is dorsal, labial, or coronal, assign a violation.
*{dorsal,labial,coronal,glottal} For every segment that is dorsal, labial, coronal, or glottal, assign a violation.

As an example, the constraint *{dorsal, lab} assigns a violation for every segment that has either dorsal or labial Place of Articulation: [kapa] therefore incurs two violations of *{dorsal, lab}.

\(^7\) It is impossible to know whether Completeness is valid at this point. It can only be tested in the context of a full theory of scales (as opposed to the present theory, which is about scale-referring constraints not the form of scales).

### Tableau (8)

<table>
<thead>
<tr>
<th>PoA</th>
<th>*{dorsal}</th>
<th>*{dorsal,lab}</th>
<th>*{dorsal,lab,cor}</th>
<th>*{dorsal,lab,cor,glottal}</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>p</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>k</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

Tableau (8) shows that [i] is the most harmonic consonant in terms of the PoA-referring markedness constraints. The constraints’ ranking makes no difference to this result: if *{dorsal,lab,cor,glottal} outranked all the other constraints, [i] would still be more harmonic than [t], [p], and [k]. Constraint ranking is irrelevant in effecting a hierarchy because glottals incur a proper subset of the violations of all other PoAs. So, after mark cancellation glottals will have no violations of any PoA-markedness constraint while all other PoAs will violate at least one constraint. The same point is true for [t] vs [p] and [k]: no ranking of the constraints will favour [p] or [k] over [t]. A similar situation emerges for [p] and [k]: no ranking will favour dorsals over labials. In this way, the constraints express the hierarchical relations of the PoA scale.

It is important to point out that although ranking between the scale-referring markedness constraints is irrelevant in establishing a hierarchy, the constraints are ranked with respect to each other in individual grammars (just as all OT grammars are total orderings of constraints). Moreover, rankings between scale-referring constraints are crucial in accounting for differences in category conflation, as illustrated in §1.3.1.1 and chapter 3.

If the markedness constraints did not refer to a contiguous range of the scale they could not be freely rankable. For example, if a constraint *{coronal} existed in CON, it could not be ranked just anywhere: if *{coronal} outranked all other PoA markedness constraints, it would reverse the hierarchy | dorsal, labial | coronal |, favouring dorsals and labials over coronals.

The approach to scale-referring markedness constraints just outlined differs from theories that employ a fixed ranking of scale-referring constraints (Prince & Smolensky 1993). Section 1.3 contains a synopsis of the empirical differences between the two approaches.
1.2.2 Faithfulness

Scale-based faithfulness constraints also refer to ranges of scales. Like scale-referring markedness constraints, scale-referring faithfulness constraints can be ranked freely with respect to each other.

For purposes of illustration, the set of Input→Output PoA-referring faithfulness constraints is provided in (9). For similar proposals for Place of Articulation, see Kiparsky (1994) and Jun (1995).

(9) Place of Articulation Faithfulness constraints

\[ \text{IDENT}(\text{dors}) \]
If input \( x \) is dorsal, then \( x \) has the same place of articulation as its output correspondent \( x' \).

\[ \text{IDENT}(\text{dors,lab}) \]
If input \( x \) is dorsal or labial, then \( x \) has the same place of articulation as its correspondent \( x' \).

\[ \text{IDENT}(\text{dors,lab,cor}) \]
If input \( x \) is dorsal, labial, or coronal, then \( x \) has the same place of articulation as its output correspondent \( x' \).

\[ \text{IDENT}(\text{dors,lab,cor,gl}) \]
If input \( x \) is dorsal, labial, coronal, or glottal, then \( x \) has the same place of articulation as its output correspondent \( x' \).

As an example, \( \text{IDENT}(\text{dors,lab}) \) requires input dorsals and labials to remain dorsals and labials respectively in the output. From input /paka/, the outputs [pata] and [taka] both incur one violation of \( \text{IDENT}(\text{dors,lab}) \), while [tata] incurs two. Like the markedness constraints, the faithfulness constraints all preserve a contiguous range of the scale, and all preserve the most marked category – dorsal.

Note that the constraints are ‘asymmetric’ in the sense of Pater (1996, 1999): while IO-IDENT(\text{dors})] bans the mapping /k/\rightarrow/p/, it does not ban /p/\rightarrow/[k] (cf McCarthy & Prince 1995). This point is discussed further in ch.7§7.4.

The constraints in (9) conform to the properties in (6). They all assign violations to a contiguous range of the scale; for example, no constraint assigns a violation to unfaithful mappings from coronals and dorsals without also assigning it to labials (6a). All the constraints militate against the marked endpoint of the scale – i.e. unfaithful mappings from dorsals (6b). Finally, the constraints’ ranking is freely permutable (6c).

The form of the faithfulness constraints effects a hierarchical relation between different PoAs in terms of preservation. Since every faithfulness constraint mentions dorsals, dorsals will be subject to the most preservation. Quasi-tableau (10) underscores this point.

<table>
<thead>
<tr>
<th>Stripped faithfulness</th>
<th>IDENT(dors)</th>
<th>IDENT(dors,lab)</th>
<th>IDENT(dors,lab,cor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>/k/\rightarrow/[p] or [l] or [r]</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>/p/\rightarrow/[k] or [l] or [r]</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>/t/\rightarrow/[k], or [p] or [l]</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/p/\rightarrow/[k], or [l] or [r]</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As shown by the quasi-tableau, glottals are ‘least preserved’ in the sense that all other PoAs may be preserved while glottals are not. Similarly, coronals are ‘less preserved’ than dorsals and labials, and so on up through the scale. The empirical consequence of this property is that marked elements may be exempt from processes that less marked PoAs may undergo, such as assimilation and neutralization. The empirical consequences of this point are discussed in §1.3.

1.2.3 Structure

The final major component of the theory deals with the relation between scales and prosodic positions. For example, the Gujarati case discussed in §1.1 refers to the relation between sonority and the main stressed syllable. In contrast, certain other scales seem to bear quite a different relation to prosodic structure; for example, Place of Articulation never influences stress placement. I propose that these differences reduce to the fact that certain scales combine with prosodic elements to form constraints, while others do not. To be more precise, there is a difference between prosodic and non-prosodic scales in this matter, stated in (11).

(11) The Scale-Structure Combination Restriction

(a) Scales that refer to prosodic properties (e.g. tone, sonority) always combine with prosodic elements in constraints.
(b) Scales that refer to subsegmental properties (e.g. voice, Place of Articulation) never combine with prosodic elements in constraints.

A subsegmental property is any feature that is a dependent of the root node. Thus, [voice], [coronal], and [nasal] are all subsegmental properties. Prosodic properties are all non-subsegmental features – elements that are part of prosodic nodes, or attach to prosodic nodes. For example, tone attaches to syllables or moras, so is a prosodic property; stress (or headedness) is a property of syllables, so is a prosodic property. Sonority is also a prosodic property (ch.3§3.1). Apart from sonority, the term ‘prosodic property’ follows usage established in Trubetzkoy (1939) and Firth (1948).

In short, if a constraint mentions the sonority scale, it must relate the sonority categories to a structural element. For example, there is a constraint \( \text{IDENT}([\gamma]) \), militating against schwas in the prosodic position ‘stressed syllable’. However, there is no constraint \( *([\gamma]) \), militating against segments with the sonority of a schwa without mentioning its relation to structure.
1.2.3.1 Structural elements

Prosodic scales are argued to combine with either of two structural elements – the ‘Designated Terminal Element’ (DTE, or $\Delta$) and non-DTE ($\Delta^-$). The notion of DTE is based on Liberman’s (1975) and Liberman & Prince’s (1977) proposals, but is extended in a number of ways. Related proposals are found in Selkirk (1998, 2000), which served as the starting point for my own work (de Lacy 1999a, 2002b); Zec (2000) contains an analogous proposal. A detailed discussion of DTEs is presented in chapter 2 and exemplified in chapter 4; a synopsis of the core ideas is presented here.

A DTE of a prosodic category $\alpha$ is the terminal element on the prosodic plane that is (i) a head and (ii) associated to $\alpha$ via an unbroken chain of prosodic heads. Since the notion ‘DTE’ crucially relies on the notion ‘prosodic head’ it inherits the main property of heads: for every prosodic node $\alpha$ there is only one DTE of $\alpha$. The structure in Figure 1.1 aims to clarify this definition by identifying the DTEs in a Prosodic Word (PrWd) structure. The symbol + marks heads and – non-heads; $\Delta$ stands for ‘DTE’ and $\Delta^-$ for ‘non-DTE’.

Figure 1.1: DTEs in the Prosodic Word

As indicated, there is only one $\Delta_{\operatorname{PrWd}}$ in this structure – the head of the leftmost syllable [a]; this root node is the DTE of the PrWd since it is a head and is associated to the PrWd node by an unbroken chain of prosodic heads (i.e. the leftmost $\mu$, $\sigma$ and $\operatorname{Ft}$ nodes). In contrast, there are two $\Delta_{\operatorname{PrWd}}$. The leftmost moraic segment [a] is a $\Delta_{\mu}$ since it is a head and is associated to a Ft node by a path of prosodic heads, as is [e]. In this structure the DTEs of moras are the same as the DTEs of syllables.

Selkirk (1998) has argued for tone that constraints may refer to DTEs of any prosodic category; this proposal is adopted here.

A non-DTE of $\alpha$ ($\Delta^-$) is every terminal node in $\alpha$ that is not the DTE of $\alpha$. For example, every root node except [a] is a $\Delta^-$ in $\alpha$. Similarly, every segment except [a] and [e] is foot non-DTEs ($\Delta^-$). Non-DTEs (especially of feet) are discussed in detail in ch.4.

Terminal nodes may be both the DTE of a constituent and the non-DTE of a higher constituent. For example, [e] in $\Delta_{\operatorname{PrWd}}$ the DTE of a syllable and the DTE of a foot, but is also a non-DTE of the PrWd. Similarly, [i] is a DTE of a syllable and a non-DTE of a foot and the PrWd.

In a sense, the notions DTE and non-DTE generalize Prince & Smolensky’s proposal that there are separate sets of sonority constraints for the peak and margin of a DTE and non-DTEs form the structural prominence scale $[\Delta_{\mu}]$–$\Delta_{\sigma}$]. More precisely, there are several DTE scales, one for each possible value of $\alpha$: i.e. $|\Delta_{\mu}|$, $|\Delta_{\sigma}|$, $|\Delta_{\operatorname{Ft}}|$, and so on. Every DTE scale combines with every prosodic scale to form a set of scales, one for each DTE specification.

As an example, the DTE of the foot $\Delta_{\operatorname{PrWd}}$ combines with the vocalic part of the sonority scale; a rather cut-down version is provided in (12) (see ch.3§3.2 for details). The label “$\mu$” refers to all right peripheral vowels: [i y u]; analogously, “$\sigma$” refers to all mid central vowels, “$\mu$” to all mid peripheral vowels, and “$\alpha$” to all low vowels.

(12) The vowel sonority scale (in brief)

$|\mu|$, $|\alpha|$, $|\sigma|$, $|\operatorname{Ft}|$
Constraints that combine the foot DTE and the sonority scale are given in (13).

(13) DTE-sonority constraints

- *Δv/[a]

"Assign a violation for every instance of a stressed vowel with the sonority of schwa"

- *Δv/[a,e/o,i/u]

"Assign a violation for every instance of a stressed vowel with the sonority of schwa or a high peripheral vowel"

- *Δv/[a,i/u,e/o]

"Assign a violation for every instance of a stressed vowel with the sonority of schwa, a high vowel, or a mid vowel"

- *Δv/[a,i/u,e,o,a]

"Assign a violation for every instance of a stressed vowel with the sonority of schwa, a high vowel, a mid vowel, or a low vowel (i.e. all vowels)."

Evidence for the constraints in (13) is provided in ch.3 (also Kenstowicz 1996). As an example, *Δv/[a,i/u] assigns a violation to [p[ð]] and one to [p[ᵻ]], but none to [p[ᵣ] and [p[ᵽ]]. The constraints are freely permutable with respect to each other; more concretely, some grammar may contain the ranking || * Δv/[a] > * Δv/[a,i/u] || while another grammar may have the exact opposite ranking.

Following Prince & Smolensky’s proposal for syllable peaks and margins, prosodic scales are reversed in combination with non-DTEs:

(14) Reversal in non-DTEs

*-Δv/[a], *-Δv/[a,e,o,i/u], *-Δv/[a,e/o,i/u], *-Δv/[a,e/o,a,i,u,ɔ]

Scale reversal in combination with non-DTEs underscores the fact that markedness is relative to position for prosodic scales. This does not contradict the generalization that the most marked scale element is always mentioned in constraints: the most marked sonority category for non-DTEs is “a”, so it is always mentioned in non-DTE constraints.

The theory of structural scales presented above has broad empirical implications; in combination with the sonority scale it predicts that sonority can affect many different constituents, not just the peaks and margins of syllables (see ch.4).

This proposal addresses the issues of versatility and consistency: the fact that the same scale can engage in several different phenomena. With several series of constraints that differ only in the DTE or non-DTE they mention, analogous types of phenomena will occur at every prosodic level. For example, since foot DTEs (stressed syllables) attract high sonority elements, the constraints predict that the same should happen at every other level: there should be languages in which syllable DTEs and PrWd DTEs effect the same sort of attraction. Similarly, since syllable DTEs and non-DTEs can place thresholds on sonority the same should be true for higher level constituents: foot DTEs and non-DTEs should also be able to place thresholds on the sonority of their segments, and so on for all higher levels.

1.2.4 Summary

The theory presented in the previous subsections employs constraints that refer to ranges of scales and have freely permutable ranking. The constraints have been shown to formally implement the hierarchical relations expressed by scales, while allowing categories to be conflated. The theory is universal in that all the constraints exist in all grammars – a basic tenet of Optimality Theory.

The following section provides an overview of the evidence for the major properties of the theory; it summarizes arguments made in details in later chapters.

1.3 Empirical implications

The aim of this section is to provide an overview of how the theoretical proposals in §1.2 account for markedness-referring phenomena. This section is divided into two parts.

Section 1.3.1 discusses the effect of the markedness constraints. This section focuses on providing a formal account of two major markedness issues: (1) category conflation and (2) consistency of scale-reference at different prosodic levels. Issue (1) is discussed with reference to Gujarati’s sonority-driven stress system, introduced in §1.1. The stringent form of the markedness constraints is argued to be crucial in providing an adequate account of this case. Issue (2) focuses on a case where stress is determined by reference to the post-tonic vowel, found in the Trobriand language Kiriwina.

Section 1.3.2 discusses the effect of the faithfulness constraints. This section focuses on providing a formal account of phenomena in which more marked elements are preserved while less marked ones are eliminated. This section mentions neutralization, assimilation, and coalescence.

1.3.1 Markedness

The theoretical proposals outlined in §1.2 aim to account for (1) markedness hierarchies, (2) category conflation, and (3) consistency of scales at various prosodic levels. Section 1.3.1.1 discusses the first two of these issues. It focuses on the stress system of Gujarati, introduced in §1.1. Section 1.3.1.2 deals with the third issue, showing that the same scale can influence elements at the syllable, foot, Prosodic Word, and higher levels.

1.3.1.1 Hierarchies and conflation

One of the leading ideas behind the present theory is that scale distinctions may be collapsed, or conflated. As Prince (1997 et seq.) has shown, constraints that refer to a range of a scale allow conflation. To illustrate this point, an analysis of Gujarati stress will be sketched here; a full analysis is given in chapter §3.4.
Gujarati stress refers to the vowel sonority scale given in (12). The markedness constraints that refer to the vowel sonority scale were provided in (13).

In words with identical vowels, stress falls on the penult in Gujarati: e.g. [aśwāna] ‘coming’, [paścāma] ‘kite’. This can be ascribed to a trochaic foot that appears at the right edge of the PrWd: e.g. [aw(wāna)]. The details of the footing constraints are presented in chapter 3§3.4; the constraint ALIGNFrR, which requires feet to be rightmost, will be used here.

- **Attraction to [a]**
  As shown in (2a), stress seeks out the low vowel [a], even when it is not in the penult: e.g. [[tād̪egr̪a] ‘recently’]. The constraint relevant at this juncture is *Δhv/[a/u/e/o] – it assigns a violation to all main-stressed vowels that are less sonorous than [a]. The candidate *[tadgyla] loses because it violates *Δhv/[a/u/e/o], as shown in tableau (15).

<table>
<thead>
<tr>
<th>/tad̪egr̪a/</th>
<th>*Δhv/[a/u/e/o]</th>
<th>ALIGNFrR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) *tad̪egr̪a</td>
<td><img src="Image" alt="Image" /></td>
<td><img src="Image" alt="Image" /></td>
</tr>
<tr>
<td>(b) *tad̪egr̪a</td>
<td><img src="Image" alt="Image" /></td>
<td><img src="Image" alt="Image" /></td>
</tr>
</tbody>
</table>

Candidate (a) contains mid vowel in the DTE position of a foot – i.e. a stressed syllable, so violating *Δhv/[a/u/e/o]. In contrast, candidate (a) has a low vowel in Δh position, crucially avoiding violations of the Δh constraint.

- **Avoidance of stressed schwa**
  When there are no low vowels, stress generally falls on the penult, as expected: e.g. [kʰe(t̪a)] ‘inkstand’. The exception is when the penult contains schwa – if the initial syllable contains some peripheral vowel, stress falls on it. In the present approach, avoidance of schwa comes about when *Δhv/[a] outranks the stress-placement constraint ALIGNFrR.

<table>
<thead>
<tr>
<th>/pust̪kine/</th>
<th>*Δhv/[a]</th>
<th>*Δhv/[a/u/e/o]</th>
<th>ALIGNFrR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) *pust̪kine</td>
<td><img src="Image" alt="Image" /></td>
<td><img src="Image" alt="Image" /></td>
<td><img src="Image" alt="Image" /></td>
</tr>
<tr>
<td>(b) *pust̪kine</td>
<td><img src="Image" alt="Image" /></td>
<td><img src="Image" alt="Image" /></td>
<td><img src="Image" alt="Image" /></td>
</tr>
</tbody>
</table>

Tableau (16) shows that *Δhv/[a] is crucial in determining stress placement. The constraint *Δhv/[a/u/e/o] is indecisive since it assigns the same violations to both candidates.

- **Conflation**
  The aspect of Gujarati stress that is of present significance is that it makes no distinction between mid and high vowels for stress – i.e. it conflates the two categories.

---

Tableau (17) shows that reference to a range of the sonority hierarchy is essential. Gujarati requires an active constraint that distinguishes [a] from other vowels, but it is essential that no active constraint distinguishes stressed high vowels from stressed mid vowels. The constraint *Δhv/[a/u/e/o] performs both these tasks: (i) it favours [a] over all other stressed vowels and (ii) it assigns the same violations to stressed mid and high vowels. Both properties of the constraints are crucial – if it lacked one or the other, the incorrect candidate (a) would win or the distinction between [a] and other vowels would be lost.

The point that stringently formulated constraints can produce conflation was established by Prince (1997 et seq.); for conflation in sonority-driven stress in particular, see Prince (1997b, 1999). Chapter 3§3.6 discusses the types of conflation that stringent theories can do in more detail.

- **Fixed ranking and conflation**
  Freely rankable stringent constraints differ from those in a fixed ranking in their ability to produce conflation; theories that impose a fixed ranking on constraints prevent certain types of conflation from happening.

  For example, suppose there were a set of constraints || *Δhv/[a] ≈ *Δhv/[i,u] ≈ *Δhv/[e,o] || each constraint refers to a point on the scale rather than a range. All would have to outrank ALIGNFrR in order to ensure that [a] was more harmonic than all other stressed vowels.

<table>
<thead>
<tr>
<th>/pʰisma/</th>
<th>*Δhv/[i,u]</th>
<th>*Δhv/[e,o]</th>
<th>ALIGNFrR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) *pʰisma</td>
<td><img src="Image" alt="Image" /></td>
<td><img src="Image" alt="Image" /></td>
<td><img src="Image" alt="Image" /></td>
</tr>
<tr>
<td>(b) *pʰisma</td>
<td><img src="Image" alt="Image" /></td>
<td><img src="Image" alt="Image" /></td>
<td><img src="Image" alt="Image" /></td>
</tr>
<tr>
<td>(c) *pʰisma</td>
<td><img src="Image" alt="Image" /></td>
<td><img src="Image" alt="Image" /></td>
<td><img src="Image" alt="Image" /></td>
</tr>
</tbody>
</table>
The problem with such a constraint system is that it prevents the conflation of stressed mid and high vowels. The constraints *\( \Delta v / i,u \) and *\( \Delta v / e,o \) both distinguish between the two categories, necessitating that one category will attract stress away from the other.

<table>
<thead>
<tr>
<th>Fixed Ranking Theory II</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>(19) Ft( /e,o,a )</td>
</tr>
<tr>
<td>(a) ( \Gamma ) (t)</td>
</tr>
<tr>
<td>(b) ( \Gamma ) (( \Gamma k ))</td>
</tr>
</tbody>
</table>

No ranking of constraints can produce the right result: if *\( \Delta v /i,u \) were ranked below ALIGNFTR, stress would not avoid high vowels at all. The problem is with the constraints themselves: they incorrectly predict that if a system avoids stressed mid vowels at all (i.e. if *\( \Delta v /e,o \) outranks stress-locating constraints), they cannot be conflated with any other category.

In summary, category conflation necessitates constraints that refer to a range of a scale, starting with the most marked element. This argument is presented in detail in chapter 3§3.6 and is extended by identifying the exact conditions under which fixed ranking theories and stringent constraints differ in terms of conflation.

1.3.1.2 Structure and scales

Chapter 4 contains arguments for the theory of structure-scale constraints proposed here. Arguments for two distinct aspects of the theory are presented: (1) there are constraints that refer to non-DTEs and (2) there are constraints that refer to (non-)DTEs of every prosodic category. The arguments are summarized below.

- **Non-DTEs**
  
  Evidence for non-DTE-referring constraints comes from languages in which the position of stress is not determined by the sonority of the stressed syllable but from the sonority of unstressed syllables. To illustrate, a case where properties of the non-head syllable is relevant to stress is outlined below (see ch.4 for details).

  There is usually a trochaic foot at the right edge of every Prosodic Word in Kiriwina (20a) (Lawton 1993, Senft 1986). However, the foot retracts if doing so will allow it to end up with a non-head vowel of low sonority (i.e. [i u]) (20b):

  \[
  \text{Kiriwina stress in brief} \\
  (a) \text{Stress the penult} \\
  [\text{ka(wa)la}] \text{ 'canoe pole'} \\
  [\text{ba(kam)}] \text{ 'I will eat'} \\
  [\text{ti(doi)}] \text{ 'a boat brings sth.'} \\
  [\text{me(ala)}] \text{ 'late dawn'} \\
  \]

  \[
  (b) \text{Unless antepenult stress will result in a low sonority foot non-head} \\
  [\text{ka(wa)la}] \text{ 'cooking pot'} \\
  [\text{la(mi)la}] \text{ 'outrigger log'} \\
  [\text{me(ala)}] \text{ 'white magic'} \\
  [\text{pa(ku)la}] \text{ 'blame'} \\
  \]

  Importantly, the sonority of the stressed syllable is irrelevant in this language – the foot retracts regardless of the resulting sonority of the stressed syllable: [\text{ka(wa)la}] vs [\text{ma(ala)}]. If the stress system was driven by the need to avoid stressed high vowels, there would be no reason to have antepenult stress in [\text{ka(wa)la}] since it has a stressed high vowel. In other words, its competitor [\text{ka(wia)}] is no improvement over [\text{ka(wa)la}] in terms of the stressed syllable’s sonority alone; all that matters is the sonority of the foot non-head.

  The forms in (20b) show that the aim of foot retraction is to end up with a low sonority non-head – all the non-heads of feet have a high vowel. In contrast, all the feet in (20a)-either already have a high vowel foot non-head (e.g. [\text{ma(mvswa)}]) or foot retraction would not result in a high-vowel non-head (e.g. *[\text{ma(mvswa)}], *[\text{da(mvswa)}]), so such retraction would be gratuitous.

  This system requires a constraint that refers specifically to the non-DTEs of feet (-\( \Delta v \)). Foot non-DTEs are all those elements that are not heads of the nucleus of stressed syllables. By avoiding all such segments with more sonority than a high vowel – i.e. *\( \Delta v /e,o,a \) – stress will only retract onto a high vowel. Tableau (21) illustrates this point.

<table>
<thead>
<tr>
<th>Fixed Ranking Theory II</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>(20) Ft( /i,u )</td>
</tr>
<tr>
<td>(a) Ft( /e,o,a )</td>
</tr>
<tr>
<td>(b) Ft( /i,u,a )</td>
</tr>
</tbody>
</table>

Candidate (21a) is ruled out because it has a highly sonorous foot non-DTE – i.e. [a]. In contrast, the foot non-DTE in candidate (21b) is the relatively low sonority vowel [u].

Kiriwina also shows that non-DTEs reverse the scale in comparison with DTEs. While DTE constraints promote high sonority, the grammar aims to avoid high sonority non-DTEs.

- **DTEs of other categories**
  
  Constraints may refer to DTEs of any prosodic category. Consequently, there are constraints for DTEs of every member of the prosodic hierarchy: e.g. *\( \Delta v /i,u \), *\( \Delta v /i,u \), *\( \Delta v /i,u \), *\( \Delta w /i,u \), *\( \Delta y /i,u \), and so on. Consequently, the theory predicts that DTEs of every level
should show the same predilections for scale elements. For example, since foot DTEs prefer high sonority elements, PrWd DTEs should too, and so on through the prosodic hierarchy. Chapter 4 discusses cases that support this prediction.

- The notion ‘markedness’

Proposing that scales combine with DTEs and non-DTEs in different ways means that the traditional notion of ‘markedness’ does not apply directly to certain scales. For example, there is no real sense in which the sonority category ‘low vowel’ is unmarked. Instead, markedness of prosodic scales depends on the structural element with which they combine. So ‘low vowel’ is the least marked category in terms of DTEs, but the most marked for non-DTEs.

In contrast, markedness is easily applied to featural scales; since featural scales do not combine with DTEs, the least marked element remains consistent across contexts. So, ‘glottal’ is always the least marked PoA element.

1.3.2 Faithfulness

Chapters 6 and 7 deal with scale-referring faithfulness constraints. Scale-referring faithfulness constraints are argued to have two primary properties: (1) they collectively favour preservation of more marked elements over less marked ones and (2) they preserve ranges of a scale. These two proposals are relatively independent. It is possible to have a theory which subscribes to (1) and not (2) (e.g. the fixed ranking $\text{IDENT}^{\text{marked}} \rightarrow \text{IDENT}^{\text{unmarked}}$) – Jun 1995). It is also possible to have faithfulness constraints that refer to ranges of a scale (i.e. property 2) without subscribing to (1) (e.g. $\text{IDENT}^{\text{Place}}$ – Prince 1998, 1999). Accordingly, the two properties are discussed separately below: (1) in §1.3.2.1 and (2) in §1.3.2.2.

1.3.2.1 Preservation of the marked

Chapters 6 and 7 present evidence that faithfulness constraints must refer to the most marked element of a scale. Chapter 6 discusses neutralization, while chapter 7 deals with processes that avoid heterorganic consonant clusters – primarily assimilation. A brief overview of one of the arguments is presented here, using Place assimilation in Catalan.

If there are faithfulness constraints that specifically preserve marked scale elements, it is expected that they could prevent marked elements from taking part in various processes. In Catalan, for example, only coronals undergo assimilation; the more marked labials and dorsals are exempt from this process (Mascaró 1976, and analyses in Kiparsky 1994, Jun 1995).

**Formal expression of markedness – ch.1**

(b) Labial + x (/som/ ‘we are’)
- [som bəus] ‘we are friends’
- [som pks] ‘we are few’
- [som dos] ‘we are two
(c) Dorsal + x
- [tigə] ‘I have bread’

To produce coronal assimilation, a markedness constraint that bans heterorganic consonant clusters must outrank all faithfulness constraints to coronals. This markedness constraint is called ASSIM here for convenience; a full theory of the constraints that trigger assimilation is presented in ch.7§7.4.

<table>
<thead>
<tr>
<th>/son bəus/</th>
<th>ASSIM</th>
<th>IDENT{dors,lab,cor}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) son bəus</td>
<td>*!</td>
<td>*</td>
</tr>
<tr>
<td>(b) som bəus</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

In contrast, it is more harmonic to preserve non-coronals faithfully than to lose their features through assimilation. To exempt non-coronals from undergoing assimilation, a constraint that specifically targets them must outrank ASSIM: i.e. IDENT{dors,lab}.

<table>
<thead>
<tr>
<th>/som dos/</th>
<th>IDENT{dors,lab}</th>
<th>ASSIM</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) som dos</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) son dos</td>
<td>*!</td>
<td></td>
</tr>
</tbody>
</table>

In short, without a constraint that preserves only the most marked members of the PoA scale, the Catalan system could not be produced.

This general approach to PoA faithfulness has also been proposed by Kiparsky (1994) and Jun (1995). In this dissertation, the proposal is extended to all scales, and the present constraints are shown to produce a variety of blocking effects. Full analyses of the Catalan system and a number of other related cases are given in chapter 7§7.2.

Chapter 6 discusses the effect of marked-faithfulness constraints for neutralization. As with assimilation, faithfulness constraints can prevent marked elements from neutralizing, producing segmental inventories that contain highly marked and highly unmarked elements, but no segments of intermediate markedness. This was discussed briefly for the Yamphu coda [k p q] inventory in §1.1.1.3, in which only /l/ debuccalizes. The same general analysis applies here: a faithfulness constraint that preserves the marked dorsals and labials blocks a markedness constraint from debuccalizing /l/.
1.3.2.2 Faithfulness conflation

This section discusses the empirical implications of the proposal that faithfulness constraints refer to ranges of a scale. The empirical effect of this property in markedness constraints is category conflation; there is an analogous effect for faithfulness. Two Input–Output mappings are conflated if they incur the same violations of faithfulness constraints. In chapter 8, this point is illustrated in several case studies involving coalescence. A brief example is provided here, involving Place of Articulation.

In Pali, heterorganic clusters are banned, so underlying consonant clusters are coalesced into a geminate. The manner of articulation of the surface geminate depends on principles discussed in ch.8.4; here the output’s Place of Articulation will be the focus.

In combinations of underlying labials and coronals, the coronal PoA always survives.

(25) Pali coalescence I: Labial + Coronai = [Coronal]

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
<th>Faithfulness</th>
<th>Preservation</th>
</tr>
</thead>
<tbody>
<tr>
<td>/h^ip-ta/</td>
<td>[h^ita]</td>
<td>‘throw (participle)’</td>
<td></td>
</tr>
<tr>
<td>/lab^b-taq/</td>
<td>[lad^cab^a]</td>
<td>‘take (gerund)’</td>
<td></td>
</tr>
<tr>
<td>/lab^b-tum/</td>
<td>[lad^cum]</td>
<td>‘take (infinitive)’</td>
<td></td>
</tr>
<tr>
<td>/lab^b-ta/</td>
<td>[lad^c^a]</td>
<td>‘long for (participle)’</td>
<td></td>
</tr>
<tr>
<td>/lab^r-ta/</td>
<td>[lad^c^a]</td>
<td>‘take (participle)’</td>
<td></td>
</tr>
<tr>
<td>/lab^r-tav/</td>
<td>[lad^c^a]</td>
<td>‘take (absolutive)’</td>
<td></td>
</tr>
</tbody>
</table>

Since labials are more marked than coronals, faithfulness cannot be responsible for the preservation of coronal PoA. More precisely, no faithfulness constraint preserves coronals without also preserving labials, and some faithfulness constraint preserves labials without preserving coronals (i.e. IDENT{dors,lab}). Thus, by faithfulness alone, the marked feature will always be favoured.

However, markedness constraints favour coronals over labials. Thus, the fact that [lad^c^a] and not *[lad^c^a] is output from /lab^b-ta/ is the result of some markedness constraint – i.e. *{dors,lab} – favouring *[lad^c^a] over *[lad^c^a]. Tableau (26) shows the ranking necessary for this result.

(26) Pali coalescence II: Dorsal + Coronai = [Dorsal]

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
<th>Faithfulness</th>
<th>Preservation</th>
</tr>
</thead>
<tbody>
<tr>
<td>/sak^r-ta/</td>
<td>[sak^rati]</td>
<td>‘be able to (future + 3p.sg.)’</td>
<td></td>
</tr>
<tr>
<td>/sak^r-ta/</td>
<td>[sak^r]</td>
<td>‘be able to (aorist+3p.sg.)’</td>
<td></td>
</tr>
<tr>
<td>/lad^b-ta/</td>
<td>[lad^b]</td>
<td>‘write (aorist+3p.sg.)’</td>
<td></td>
</tr>
<tr>
<td>/lad^b-ta/</td>
<td>[lad^b]</td>
<td>‘bore through (aorist+3p.sg.)’</td>
<td></td>
</tr>
<tr>
<td>/lad^b-ta/</td>
<td>[lad^b]</td>
<td>‘bore through (participle)’</td>
<td></td>
</tr>
</tbody>
</table>

The input segments /h^r/ and /t/ coalesce in the output candidates (a) and (b). This means that both /h^r/ and /t/ correspond to a single output segment – [d^r] in (a) and [d] in (b). The markedness constraint *(dors,lab) favours the candidate with the least marked output: i.e. the one with the coronal [d^r]. Crucially, all faithfulness constraints that favour the preservation of labials over coronals – IDENT{dors,lab} – must be outranked by *(dors,lab); as the tableau shows, the opposite ranking would incorrectly result in (a) as the winner.

However, the ranking || *{dors,lab} » IDENT{dors,lab} || is not the whole story. This ranking would eliminate all labials: /lab^b-taq/ would surface as *[lad^c^a]. So, to block wholesale elimination of labials, some labial-preserving faithfulness constraint must outrank *(dors,lab). However, there is a restriction on this constraint: it must also preserve coronals. If it were otherwise, /lab^b-taq/ would surface as *[lad^c^a]. The only solution is to have a faithfulness constraint that preserves labial and coronal PoA equally: i.e. IDENT{dors,lab,cor}. Tableau (27) illustrates this point.

(27)

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
<th>Faithfulness</th>
<th>Preservation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) lad^c^a</td>
<td>* *</td>
<td>IDENT{dors,lab,cor}</td>
<td></td>
</tr>
<tr>
<td>(b) lad^c^a</td>
<td>* *</td>
<td>IDENT{dors,lab}</td>
<td></td>
</tr>
<tr>
<td>(c) lad^c^a</td>
<td>* *</td>
<td>IDENT{dors,lab}</td>
<td></td>
</tr>
</tbody>
</table>

Candidate (a) has eliminated all labials. By doing so, it violates IDENT{dors,lab,cor} twice: once for the fact that /h^r/ has a non-labial correspondent, and once for the fact that /h^r/ has a coronal correspondent [d^r]. In contrast, candidates (b) and (c) only violate the faithfulness constraint once. Candidate (b) violates IDENT{dors,lab,cor} because /h^r/ has a labial output correspondent, and (c) violates it because /h^r/ has a coronal correspondent.

It is crucial that (b) and (c) incur equal violations of IDENT{dors,lab,cor}. If (c) incurred more violations, (b) would incorrectly win. The fact that (b) and (c) incur equal violations allows the markedness constraint *{dors,lab} to emerge, favouring the least marked candidate (c).

In short, Pali shows that a constraint that equally favours preservation of labials and dorsals is necessary.

- Preservation of dorsals
  Interestingly, underlying /dorsal+coronal/ clusters surface as dorsals, not coronals.

(28) Pali coalescence III: Dorsal + Coronai = [Dorsal]

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
<th>Faithfulness</th>
<th>Preservation</th>
</tr>
</thead>
<tbody>
<tr>
<td>/lad^b-ta/</td>
<td>[lad^b]</td>
<td>‘bore through (participle)’</td>
<td></td>
</tr>
</tbody>
</table>

The examples show that the output geminate is a fusion of the output elements – the aspiration in [sak^r] is due to the input /i/ (see ch.8 for details). The proposal that there are faithfulness constraints to marked elements accounts for this result. Since more marked elements are subject to greater preservation, IDENT{dorsal} will favour retaining the dorsal feature rather than the coronal one. In short, the fact that
Paul de Lacy

dorsals win over coronals can be ascribed to the fact that IDENT\{dors\} outranks all markedness constraints that favour coronals over dorsals.

(29)

\[
\begin{array}{|c|c|c|}
\hline
\text{/sak-t\_1}\text{-}\text{t\_3i/} & \text{IDENT\{dors\}} & \text{*\{dors, lab\}} \\
\hline
\text{(a) sak\_t\_1,3i} & \text{*} & \text{*} \\
\hline
\text{(b) sat\_t\_1,3i} & \text{*!} & \text{*} \\
\hline
\end{array}
\]

For a full development of this analysis, see chapter 8§8.4.

1.4  Dissertation outline

The remainder of this dissertation is organized much as in sections 1.2 and 1.3. The theoretical proposals are presented in chapter 2, followed by a discussion of the markedness-related proposals (particularly conflation) in chapters 3 and 4, concluding with an examination of the faithfulness-related proposals (chs.5-9).

•  Part I: Theory
  
  Chapter 2 presents a theory of scale-referring constraints. At the core of this theory is a proposal about feature values and about how constraints refer to those values. The theory consists of three related but relatively independent parts: (1) proposals about scale-referring markedness constraints, (2) proposals about scale-referring faithfulness constraints, and (3) proposals about the relation between structural elements and scales. The following chapters provide evidence for each of these parts of the theory.

•  Part II: Markedness
  
  Chapter 3 contains evidence that scale-referring constraints must refer to ranges of scales and be freely permutable in their ranking. Cases of conflation in sonority-driven stress are examined, focusing on the stress systems of Nganasan and Gujarati.

  Chapter 4 presents evidence that reference to both DTEs and non-DTEs is necessary. This point is illustrated by providing analyses of sonority-driven stress in Kiriwina and Harar Oromo, vowel reduction in Dutch, and in the typology of epenthetic vowels.

•  Part III: Faithfulness
  
  Chapter 5 discusses the main faithfulness-related theoretical proposals in detail. It also contains a discussion of the Place of Articulation scale, which is used extensively in chs.6-8.

•  Chapter 6 contains analyses of neutralization and segmental inventories. This chapter shows that ‘gapped’ inventories exist – inventories that contain highly marked and highly unmarked segments but no segments of intermediate markedness. Faithfulness constraints that specifically preserve marked categories are argued to be necessary for such cases. Languages discussed include Malay and Yamphu.

  Chapter 7 also presents arguments that that there are faithfulness constraints that specifically preserve the most marked scale elements. Processes that avoid heterorganic consonant clusters – assimilation, deletion, and epenthesis – are discussed. Languages analyzed include Catalan, Ponapean, Harar Oromo, Attic Greek, and Korean.

  Chapter 8 presents evidence that the ranking of faithfulness constraints must be freely permutable. The empirical focus is cases of coalescence and bidirectional assimilation. Languages analyzed include Attic Greek, Chipewyan, Harar Oromo, Swedish, and Pilipino.

•  Chapter 9 contains a summary and conclusions.
CHAPTER 2

THEORY

2.1 Introduction

This chapter presents a theory of scale-referring markedness and faithfulness constraints and discusses its relation to previous proposals. Three relatively independent issues provide the organization for the presentation for this theory.

(1) Issues
   (a) Markedness
      (i) In what way do scale-referring markedness constraints assign violations?
      (ii) What are the structural descriptions of scale-referring markedness constraints?
   (b) Faithfulness
      (i) In what way do scale-referring faithfulness constraints assign violations?
      (ii) What are the structural descriptions of scale-referring faithfulness constraints?
   (c) Structure
      (i) Which scales can/cannot combine with structural elements?
      (ii) With which structural elements may scales combine?

Section 2.2 deals with the way in which scale-referring constraints assign violations – their ‘violation profiles’ (1ai, 1bi).

Section 2.3 deals with the structural description of scale-referring constraints – i.e. their symbolic form (1ai, 1bi). This section deals with the representation of scales as multi-valued features.

Section 2.4 deals with constraints that combine scales and structural elements. This section claims that only ‘prosodic’ scales – ones that refer to non-subsegmental properties like tone – may combine with structural elements to form constraints (1ci). A precise characterization of the structural elements with which scales combine is also provided (1cii).

Section 2.5 summarizes the theoretical proposals and outlines how the rest of this dissertation provides evidence for them.
2.2 Violation profiles

The following discussion assumes that for every scale S, there is a set of markedness and a set of faithfulness constraints that refer to S. The aim of this section is to provide a precise characterization of such scale-referring constraints.

The present theory has two goals. One is to correctly translate the hierarchical relations expressed by scales into constraint-violation terms. As discussed in ch.1, this means not only accounting for hierarchical relations, but for category conflation as well. More concretely, the theory aims to explain why for the partial Place of Articulation (PoA) scale | dorsal | coronal | (i) dorsals can be treated as more marked than coronals, (ii) dorsals can be treated as equally marked as coronals (i.e. dorsals and coronals can be conflated), and (iii) dorsals are never treated as less marked than coronals.

The other goal is to have a theory with faithfulness and markedness constraints that can be ranked freely; no constraints are in a universally fixed ranking. As in Prince (1997a,b,c, 1998, 1999), chapter 3 shows that free ranking of markedness constraints is essential in producing certain types of conflation. Chapter 8 shows that free ranking of faithfulness constraints is essential for certain types of coalescence.

The following two sections present a theory that both expresses the hierarchical relations in scales and has fully permutable constraint ranking. Section 2.2.1 is devoted to markedness constraints, and §2.2.2 to faithfulness constraints.

2.2.1 Featural scale-referring markedness constraints

Prince (1997 et seq.) has shown that in order to allow the ranking of scale-referring markedness constraints to be freely permutable while still respecting markedness relations the constraints must refer to ranges of scales in a particular way. To be precise, each constraint must assign a violation to a contiguous range of a scale, always including the most marked element. Prince dubs the relation amongst such scale-referring constraints ‘stringency’; this term will be adopted here.

- Informal schema

There are a number of ways to formally implement stringency. The particular way chosen here is expressed in the schema in (2). Schema (2) applies to ‘featural’ scales – scales that refer to subsegmental features such as Place of Articulation and [voice]; non-featural scales (e.g. sonority, tone) are discussed in §2.4.

(2) Featural scale-referring markedness constraints

(a) For every element p in every scale S, there is a markedness constraint m, assigns a violation for each segment that either

(i) contains p

or (ii) contains anything more marked than p in scale S.

(2a) requires that (i) there is a set of markedness constraints for every scale and (ii) there are as many markedness constraints for a scale S as there are elements in S. For example, for a scale Z={x,y,z} there are three markedness constraints that refer to Z.

By (2b), if a markedness constraint m refers to the element y in scale Z, it will assign a violation to y and all elements that are more marked than y in Z (i.e. x) (2bi); in familiar notation, m can be written as *(x,y). Therefore, m will assign a violation for every segment that is/contains y or x. However, m will not assign violations to any element lower on the scale – z in this case. The ultimate result is a set of markedness constraints with the form *(x), *(x,y), *(x,y,z). In short, if p violates a markedness constraint C, then everything more marked than p will also violate C.

• Formal schema

Schema (2) is expressed in more precise terms in (3). The definition assumes that a constraint is a function from a candidate to a set of violation marks (after Prince & Smolensky 1993). Thus, “m(CAND) → V” is the constraint function m from a candidate CAND to a set of violation marks V. The schema expresses that the number of violation marks in the set V is the same as the number of distinct x’s in the candidate, where x is any element that is equally or more marked than the scale element in question. Conditions (c) and (d) restrict the definition.

(3) Featural Scale-Referring Markedness Constraints (formal)

(a) For every scale S, there is a set of markedness constraints M.

(b) For every element p in S, there is some m ∈ M such that for all x in S such that x is equally or more marked than p, m(CAND) → V

• CAND is a candidate

• V is a set of violation marks.

• the cardinality of V is the same as the number of distinct x’s in CAND.

(c) There are no other members of M.

(d) There are no other sets of markedness constraints for S apart from M.

---

5 One may point out that a set of n violation marks has the same cardinality as a set of n+1 violation marks (if n∈N). To avoid this problem, take a ’violation mark’ to be any element from a denumerably infinite set of discrete elements (e.g. the natural numbers). Thus, a set of three violation marks is {1,2,3}, with a cardinality of 3. For an alternative way of conceiving of constraints, see Samek-Lodovici & Prince (1999) and Prince (2002).
Condition (d) prevents several different sets of markedness constraints from referring to the same scale; it bans another set of markedness constraints apart from M from referring to S in a way that is inconsistent with (3).

On the other hand, (d) does not prevent S from being mentioned in combination with some other scale. For example, chapter 7 presents a set of constraints that combine the Place of Articulation scale with itself; these constraints are distinct from the set that refers only to the PoA elements and to nothing else. Similarly, §2.4 discusses prosodic scales, where a single scale combines with many different structural elements.

The schemas in (2) and (3) encapsulate the proposal that scale-referring markedness constraints are stringently formulated. This point can be illustrated using the Major Place of Articulation scale (dorsal) labial) coronal) glottal (ch. 5 § 5.3.3). By (2)/(3), there are four PoA-referring markedness constraints because the scale has four elements. One assigns violations to dorsals alone; this constraint will be named *{dorsal} here, but – importantly – nothing is implied about its structural description (see § 2.2.3). Of the other three constraints: (i) *{dorsal, labial} assigns a violation to a candidate for every instance of a dorsal or labial, (ii) *{dorsal, labial, coronal} assigns a violation to all segments that are have either dorsal, labial, or coronal Place of Articulation, and (iii) *{dorsal, labial, coronal, glottal} assigns a violation to effectively all segments.

1. Harmonic Bounding

2.2.2 Featural scale-referring faithfulness constraints

I propose that (i) faithfulness constraints refer to ranges of a scale, just like markedness constraints and (ii) that faithfulness constraints all preserve the most marked member of scales. This proposal allows a generalization over both markedness and faithfulness constraints, encapsulated in the following hypothesis:

$$\text{(5) The Marked Reference Hypothesis (MRH)}$$

If a constraint C refers to scale S, C refers to the most marked member of S.

The formal import of the term ‘refer’ differs depending on the type of constraint. (5) requires markedness constraints to assign a violation to the most marked member. In
contrast, (5) requires faithfulness constraints to always preserve the most marked scale member. The MRH is encapsulated in the following informal schema for scale-based faithfulness constraints:

(6) Featural scale-referring faithfulness constraints (informal)
   (a) For every element \( p \) in every scale \( S \), there is a faithfulness constraint \( f \).
   (b) \( f \) preserves \( p \) and all elements in \( S \) that are more marked than \( p \)
      i.e. \( f \) assigns a violation for every element \( x \) that
      (i) is equally or more marked than \( p \) in \( S \)
      and (ii) has a correspondent that is unfaithful to \( x \).

As with the markedness constraints, the schema in (6) requires one faithfulness constraint per scale element. If a faithfulness constraint preserves an element \( p \) in the scale, it also preserves every more marked element. For example, take a scale \( Z=\{ x \}; y \}; z \}\). If a faithfulness constraint preserves the mapping from \( y \) to its correspondent – i.e. it assigns violations to the mappings \( y \rightarrow t[x] \) and \( y \rightarrow z[x] \) – it also preserves the mapping from all more marked elements – i.e. \( \sim y \). The notion ‘mapping’ is expressed in terms of Correspondence Theory (McCarthy & Prince 1995); examples are provided below.

The schema in (6) does not place any restrictions on the dimension of faithfulness: there are separate sets of scale-referring faithfulness constraints for all dimensions (Input → Output, Base → Reduplicant, Output → Output, and so on).

- **Formal schema**

A more precise version of (6) is provided in (7). The ‘dimension’ variable \( D \) refers to Input → Output, Base → Reduplicant, Output → Output, and so on. The aim of (a) is to require a separate set of constraints for every different dimension, but restrict constraints to only one set per dimension.

(7) Featural scale-referring markedness constraints
   (a) For every scale \( S \), for every dimension \( D \) there is a set of faithfulness constraints \( F \).
   (b) For every element \( p \) in \( S \), there is some \( f \in F \) such that
      for all elements \( x \) in \( S \) such that \( x \) is equally or more marked than \( p \),
      \( D(f(CAND)) \rightarrow V \)
      • \( CAND \) is a candidate
      • \( V \) is a set of violation marks,
      • the cardinality of \( V \) is the number of distinct \( x \rightarrow y \) mappings
         along dimension \( D \) such that \( xy \).
   (c) There are no other members of \( F \).
   (d) There are no sets of faithfulness constraints for \( S \) on dimension \( D \) apart from \( F \).

4 See Howe & Pulleyblank (to appear) for a somewhat different approach to scale-referring faithfulness (see ch. 7 for discussion).
2.2.3 Previous theories

A leading idea in the present theory is that scale-referring constraints are freely rankable. As shown above, this requirement necessitates sets of constraints that impose local harmonic bounding relations between candidates. There are a number of precursors to this idea. A few are briefly identified here; more detailed discussion of the proposals is provided in later chapters, when appropriate (see esp. ch.3).

Precursors to the stringent idea can be seen in pre-OT work. For example, Clements (1990) argues that the sonority of a segment is calculated by reference to the features [sonorant], [approximant], [vocalic], and [syllabic]. The features are in subset-superset relation with each other: if a segment is [+vocalic], it is also [+approximant] and [+sonorant], and so on for each feature value. To clarify, Clement’s (1990:292) table is reproduced here (O=obstruent, N=nasal, L=liquid, G=glide).

Figure 2.1: Clements (1990) sonority calculation

<table>
<thead>
<tr>
<th>O</th>
<th>N</th>
<th>L</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

In Clement’s theory there is no need to refer to a hierarchy of features to determine a segment’s sonority – no particular feature has primacy over the others precisely because the features’ values are related to each other in a subset-superset manner. The present approach is loosely related to this idea – there is no fixed ranking because constraints are in a local harmonic bounding relation.

The local harmonic bounding idea can also be found in early OT work, in the context of specific analyses. For example, Kiparsky (1994) uses faithfulness constraints similar to the ones outlined above to deal with PoA assimilation in Catalan (an approach discussed in detail in chapter 7§7.2), while Green (1993) uses sonority constraints analogous to the ones discussed above to deal with syllabification. Finally, Beckman’s (1998) theory of positional faithfulness employs faithfulness constraints that refer to morpheme classes in a special-general relation, rather than in a fixed ranking (cf ch.6). As mentioned above, the most extensive discussion of stringent constraints in previous OT work is in a series of lectures by Alan Prince (Prince 1997a,b,c, 1998, 1999). Prince shows that stringent constraints can express scale hierarchies, just like constraints in a fixed ranking. I have also argued the same point for scales, primarily in the context of prominence-driven stress (de Lacy 1997a, 2000a).

Prince also identifies the crucial empirical difference between the stringent constraints and Fixed Ranking theories – they differ in their ability to produce conflation (also de Lacy 1997a, 2000a). This point is discussed in more detail in chapter 3. In the present work, the aim is to precisely characterize these differences, expanding on Prince’s work and my own.

To summarize, the requirements that scale-referring constraints be freely permutable and effect hierarchical relations can be achieved by invoking harmonic bounded. Harmonic bounding in turn necessitates that scale-referring constraints have particular properties: they must assign violations to a contiguous part of the scale, and always to the same endpoint. In short, the violation profile of scale-based constraints must be such that they produce local harmonic bounding in the way described above. The requirements provide a guide to determining the structural description of constraints, a matter to which we can now turn.

2.3 Structural descriptions

This section contains a proposal about the ‘structural description’ of scale-referring constraints: i.e. how constraints refer to scales, rather than how violations are calculated for each constraint. Section 2.3.1 proposes that the structural description of scale-referring constraints is most easily stated using a multi-valued feature, generalizing proposals by Selkirk (1984), Green (1993), Gnanadesikan (1997), and others. Section 2.3.2 discusses the form of the scale-referring constraints.

To make the aims of this section clearer, the ‘structural description’ of a constraint is distinct from its ‘violation profile’. For example, there is general agreement regarding the violation profile of the well-known constraint ONSET (Prince & Smolensky 1993, McCarthy & Prince 1993): ONSET assigns a violation for each vowel-initial syllable. However, there is controversy regarding the structural description of ONSET: it has been formulated negatively (*[V – McCarthy & Prince 1993a), with the ALIGN schema (i.e. ALIGN-L(\(\sigma,\sigma\)) – McCarthy & Prince’s 1993b), and in other ways as well. However, the controversy over the structural description does not in any way affect the standard view that there is need for a constraint that has the particular violation profile as given above. In other words, the violation profile of a constraint and its structural description may be examined separately. Accordingly, as with ONSET the proposals about scale-referring constraints’ structural descriptions in this section are separate from those about their violation profiles (presented in the preceding section); the validity of the proposals in this section do not depend on the validity of the proposals about violation profiles in the preceding section, and vice-versa.

2.3.1 Multi-valued features

I adopt an approach to feature values that is closely related to Prince’s (1983) grid theory in that feature values are considered to be a string of elements – \(\chi\)’s and \(\sigma\)’s (also see [...])
The formal expression of markedness – ch 2

This point is discussed in §2.3.2; the following section discusses the notion of multi-valued features in comparison to binary ones.

2.3.1.1 Multi-valued and binary features

The proposal that there are multi-valued features is somewhat nonstandard, given the predilection for binary (2-valued) and privative (1-valued) features in previous work (Jakobson, Fant, & Halle 1952, Jakobson & Halle 1956, Chomsky & Halle 1968, Creider 1986, Steriade 1995b:147-157).

However, the proposal that there are multi-valued feature is by no means novel. Chomsky & Halle (1968) employ a multi-valued feature for stress, and a number of researchers have effectively proposed a multi-valued [Sonority] feature (Steriade 1982, Selkirk 1984, van der Hulst 1984, Durand 1990, Green 1993). Ladefoged (1975) and Williamson (1977) propose multi-valued laryngeal features, and Stahlke (1975) and many others have proposed a multi-valued feature for tone (cf Odden 1995). Recently, Gnanadesikan (1997) has argued that several features are ternary-valued and Clements’ (1991) [open] feature can be ‘stacked’, effectively producing multiple distinctions in vowel height (also see Clements & Hume 1995, Lindau 1978). In other words, these theories have expanded the set of feature values to include many more distinct elements (usually represented by the natural numbers \{0,1,2,…\}, for convenience).

The ‘natural number’ approach is only one way to allow multi-valued features. Prince’s (1983) grid theory provides another method (also precursors in Kiparsky 1979, Selkirk 1984). Instead of an n-valued [stress] feature, a string of x’s specifies relative stress among syllables or moras. The grid theory approach to multi-valued features has frequently been extended to other features: for example, it has been used for sonority with gridmarks standing for different sonority levels (van der Hulst 1984, Milliken 1988, Zec 1988, Parker 1989, Clements 1990, 1992, Green 1993).

In the present work, the grid-theory approach to features is adopted, and extended as detailed in the previous section.

• Binary vs Multi-valued features

Surprisingly few works explicitly compare the virtues of binary and multi-valued features. All of the ones that do – Sommerstein (1977), Creider (1986), and McCarthy (1988) – agree with Creider’s statement that “there are surprisingly few phonological arguments [against multi-valued features] in the literature”. In the most recent and detailed account, McCarthy (1988/94) states the following, comparing binary- with multi-valued features:

11 My thanks to the audience at Haskins Laboratories for their comments on a talk closely related to this section.

12 Grid theory is unlike multi-valued features in that gridmarks (and even some multi-valued features) are construed as representing relative values for the feature (stress, sonority) (see esp. Selkirk 1984:112, 121). This conception sets it apart from Gnanadesikan’s feature value theory, in which features can be ternary-valued with each value expressing an absolute, not relative, value (although Gnanadesikan’s constraints have the effect of relative values).
McCarthy observes that arguments presented for one or the other approach are not based on empirically testable issues, but instead rely on appeals to theory-internal simplicity or ease of implementation (e.g. SPE’s evaluation metric). McCarthy points out that objections to multi-valued features often rest on the assumption that multi-valued features automatically introduce the full power of arithmetic to the grammar, allowing features to be incremented or decremented by any number. Of course, the algorithms that manipulate feature values are somewhat independent from the form of the features themselves. The same goes for the objection that there is no obvious limit to the number of distinctions allowed per feature; again the issue of the maximum number of distinctions per feature is entirely separate from the form of the features themselves. In other words, the so proposal does not introduce the full power of arithmetic operations commonly associated with integers.

More concretely, McCarthy compares a theory such as the one presented in the previous section – where there is a single multi-valued [Place] feature – and one that has a non-terminal Place node which dominates several independent features ([coronal], [labial], [dorsal], etc.). McCarthy concludes that “all arguments in favour of the class node Place apply with equal force to the n-ary feature [Place]” (p.94); the reader is referred to this work for further discussion.

However, McCarthy does raise one argument in favour of the privative Place feature approach. Labial cooccurrence restrictions in Arabic apply across intervening segments; thus a stem /btf/ is blocked from appearing faithfully. McCarthy argues that these follows straightforwardly if [labial] and [coronal] are on different tiers, illustrated in Figure 2.2 from McCarthy (1988).

Figure 2.2: Tiers and multi-valued features (McCarthy 1988)

(a) *b i f
[labial] [labial] [xooPlace] [xooPlace] [xooPlace]
(b) b i f
[coronal]

If [labial] and [coronal] are on different autosegmental tiers, it is a straightforward matter to explain why labials cannot appear in the output even when non-adjacent: their [labial] features are adjacent on a tier, and thus are subject to the OCP. In contrast, a theory with a single [Place] feature (Figure 2.2:b) clearly cannot appeal to tier-adjacency.

Within Autosegmental theory, this is clearly a strong argument. However, recent solutions to similar problems have been resolved in non-representational ways (Alderete’s (1997) locally self-conjoined constraint *{labial}2. These constraints do not appeal to tier-adjacency, so they can employ either multi-valued or privative Place features.

In short, there is no compelling phonological reason to reject multi-valued features in favour of binary/privative ones, or indeed to reject binary/privative features in favour of multi-valued ones.13 In the present theory, multi-valued features will be assumed to be possible.

As a final note, the proposal that there are multi-valued features by no means precludes the existence of binary or privative ones. In fact, as shown in ch.3§3.5.3, the cumulative effect of binary features can be indistinguishable from multi-valued ones for scale purposes in certain situations. However, it is not the case that all multi-valued features can be decomposed into several independent binary features. Two arguments for this – (i) natural class behaviour and (ii) conflation – are discussed in ch.3§3.5.3; I leave discussion until that point because it refers to examples discussed in that chapter.

2.3.2 Constraint form

This section incorporates the so theory of feature values into a theory of constraint form. The expression of this theory for markedness constraints is the schema in (12). F is a feature, and v is its value (i.e. a string of x and o’s).

(12) Featural markedness constraint definition

*{xF} Assign a violation for every segment that is [xF]
where v is a substring of v2.

In a constraint like *{xPlace}, x is the value of [Place]. Therefore, *{x[xPlace]} is violated by every segment whose [Place] value contains x: i.e. [xooPlace], [xxoPlace], and [xxoPlace].

There is a restriction on the schema in (12): v may only contain x’s. Certainly, constraints may refer to the o values, but not in context-free markedness constraints (see §2.4). Following Green (1993), constraint instantiation is assumed to be complete; in other words, there is a constraint *[xF] for every possible length of v, implying that there are also *[Place], *[xxPlace] and *[xooPlace] constraints. Completeness is built into the schemas (3b) and (7b).

Together, the *[xF] constraints – with the restrictions stated above – have the desired harmonic bounding effect. Quasi-tableau (13) illustrates this result.

13 Chain shifts have been argued to provide evidence for multi-valued features (e.g. Gnanadesikan 1997 and works cited therein), though Creider (1986) argues to the contrary.
As the quasi-tableau shows, the constraints are in a local harmonic bounding relation with each other. *(Place)* is violated by all segments except [?] while *(xPlace)* is violated by only the marked segments [p] and [k]. Every constraint assigns violations to a contiguous part of the scale, and every element is a harmonic bound for elements higher on the scale in terms of the PoA constraints.

The xo theory of feature values plays an important role in providing a structural description that produces harmonic bounding. To produce harmonic bounding, the structural description of the scale-referring constraints needs to refer to a relation of inclusion between the members of the scale. So, any structural description that includes [p] must also include [k], and so on. The xo theory allows reference to inclusion in a straightforward way via the substring relation.

No covert disjunction

In contrast, theories without the xo representation offer no easy formal way to refer to sets of features. For example, a theory with a set of privative PoA features – [glottal], [coronal], [labial], and [dorsal] – offers no straightforward method of referring to the set {[labial], [dorsal]}. A constraint such as *[labial] & *[dorsal] “Assign a violation to a segment that is either [labial] or [dorsal]” introduces a great deal of formal apparatus to the theory of constraint form. More precisely, a disjunction operation is introduced: a violation is assigned if the segment is [labial] or [dorsal]. Certainly, theories have proposed constraint conjunction operations, as in Local Conjunction (Smolensky 1993); a conjoined constraint such as *[labial] & *[dorsal] is violated only if both *[labial] and *[dorsal] are violated within some domain. However, the constraint *[labial], *[dorsal] is disjunctive, violated if either *[labial] or *[dorsal] are violated within the domain of a single segment: i.e. *[labial] ∨ *[dorsal]. The addition of a disjunction to structural descriptions greatly expands the possible space of constraints and goes no way toward explaining why it is that *[labial] and *[dorsal] form a disjunctive constraint while, for example, *[coronal] and *[dorsal] do not.

The proposal presented above does not covertly implement a disjunction operator in constraint form. Certainly, the interpretation of the constraints does allow for a disjunctive evaluation: *(xPlace)* effectively assigns violations to segments that are {xxxPlace} or {xPlace}. However, this formalism has nothing of the power of a disjunction operator. For example, the present proposal does not allow different features to be disjoined. A constraint that assigns a violation to all segments with either feature f1 or feature f2 is not possible in the present approach – constraints only refer to different values of the same feature. Moreover, the present approach does not allow any arbitrary pair of feature values to be disjoined: only adjacent values are effectively disjoined. For example, there is no constraint that assigns a violation to a segment only if it is {xxxPlace} or {xPlace}, since [xxx] and [xxx] are not contiguous feature values.

In short, while the effect of the present approach has the flavour of disjunction, it has very little of the power of a disjunctive operator. The disjunction approach and its empirical consequences are discussed further in chapter 3 §3.4.2.

Faithfulness

Schema (14) is for scale-referring faithfulness constraints; again F is a feature and v is its value.

(14) Schema for faithfulness to featural scales

\[ \text{IDENT}[F|^v] \]  

If segment \( \alpha \) is \([v,F]\) and \( v \) is a substring of \( v_\alpha \), then \( \alpha \) (the correspondent of \( \alpha \)) is \([v,F]\).

For example, IDENT*[Place] requires every input segment with a Place value that includes x to retain its input specification in the output. More concretely, IDENT*[Place] requires coronals to surface as coronals, labials as labials, and dorsals as dorsals, but is not violated if glottals do not surface faithfully. Similarly, IDENT*[xPlace] is violated only if input labial and dorsal segments do not have output correspondents with the same PoA; it is not violated if glottal or coronal PoA is not preserved. The form of this constraint schema and its empirical effects are discussed in detail in chs.5-8.

Summary

To summarize, ‘scale-referring constraints’ are standard markedness constraints, with the structural description given in (12) above. In this way, the theory of scale-referring constraints is integrated into a general theory of markedness and features.

The proposal that scales are expressed as multi-valued features (almost) reduces the theory of scale-referring constraints to a simple generalization: there is a separate markedness and faithfulness constraint for every value of every feature. For example, the Place of Articulation scale is expressed by a set of constraints that refers to all four values of the [Place] feature. The restriction is that constraints may only refer to x values (except for special circumstances discussed in §2.4), and so in the ‘substring’ manner encoded in the constraint schemas in (12) and (14). Thus, the theory of scales presented here almost reduces to the theory of multi-valued features and how they in turn express scales.

2.4 Scales and structure

Scale-referring constraints often mention a structural position. For example, Prince & Smolensky (1993) propose that the positions ‘syllable peak’ and ‘syllable margin’ are combined with the sonority scale to produce sets of constraints that influence syllabification. Similarly, Kenstowicz (1996) has proposed that the sonority scale can
combine with the structural position `foot head' (i.e. the stressed syllable of a foot) and `foot margin', and I have proposed the same for tone (de Lacy 1999a, 2002b). This section presents proposals about constraints that combine scales with structural elements.

Structure-reference in scale constraints raises two questions: (i) what are the structural elements with which scales may combine? and (ii) which scales may combine with structural elements, and which ones cannot?

Section 2.4.1 presents proposals that the structural elements found in scale-referring constraints are always one of two elements: the Designated Terminal Element (DTE) and non-DTE, adapted from Liberman & Prince (1977). Section 2.4.2 claims that there are general restrictions on which constraints may combine with structural positions in constraints: prosodic scales must combine with structural elements while featural scales must not.

### 2.4.1 DTEs and non-DTEs

I propose that scales can only combine with one of two structural elements: the Designated Terminal Element (DTE) and non-DTE, defined in (15) and (16) respectively. The notion of 'DTE' is taken from Liberman (1975) and Liberman & Prince (1977), but is extended in having `non-DTE's' and reference to two elements in the definition. Related proposals are found in Selkirk (1998, 2000), Zec (2000), and my own work (de Lacy 1999a). Works that specifically discuss the phonological relevance of non-DTEs (especially non-heads of feet) are Kerstowicz (1996), Ping (1999), and de Lacy (2002b).

#### (15) Definition of DTE

\[
\text{DTE}_{\alpha} = \text{a node } n \text{ of type } \beta \text{ is the DTE of prosodic category } \alpha \text{ iff the path from } n \text{ to } \alpha \text{ consists of an unbroken chain of prosodic heads.}
\]

A `path' from } n \text{ to } \alpha \text{ starts with node } n \text{ and goes through all nodes that (i) dominate } n \text{ and (ii) are dominated by } \alpha.

#### (16) Definition of non-DTE

\[
\text{non-DTE}_{\alpha} = \text{a node } n \text{ of type } \beta \text{ is a non-DTE of } \alpha \text{ iff}
\]

(i) \text{ node } n \text{ is (transitively) associated to } \alpha

and

(ii) \text{ node } n \text{ is not a DTE}_{\alpha}.

The definitions presented above differ from Liberman’s (1975) and Liberman & Prince’s (1977) original conception in two ways. One is the notion ‘non-DTE’. The other is that DTEs are 2-place elements: DTE$_{\alpha, \beta}$ refers to the node that is of type $\beta$ and dominated by an unbroken chain of prosodic heads to $\alpha$. For example, DTE$_{\sigma, \mu}$ (read as “the mora-DTE of a foot”) refers to all those head moras that are dominated by head syllables that are dominated by feet; in comparison, DTE$_{\sigma, \nu}$ refers to the head root node dominated by the head mora dominated by the head syllable of a foot.

For discussion of why the $\beta$ argument is necessary, see §2.4.1.1.
is the only element that is not a non-DTE of any category. Some elements are perpetual non-DTEs, though. For example, [k] in Figure 2.3 (i.e. an onset) is not a DTE of any category, since it is a non-head of the lowest prosodic level (i.e. $\mu$).

- **Exemplification II: inside the PrWd**

  The dual DTE-nature of terminal elements is more evident in larger structures, as in the PrWd in Figure 2.4. The figure below identifies the root-node DTEs and non-DTEs; DTEs are shaded.

  ![Figure 2.4: DTEs and non-DTEs in the PrWd](image)

  [a] is the DTE of the Prosodic Word in Figure 2.4, while every other element is a - $\Delta_{Wrd}$. Similarly, [a] and the schwas are DTEs of a foot, while all other root nodes are foot non-DTEs. This table makes it clear that an element may be a DTE for one constituent but not for another.

  Another point that emerges in Figure 2.4 is that it is possible for a root node to have no DTE status with respect to some constituent. The word-final [s] in is neither a $\alpha$, nor a - $\Delta_{s}$ since it is not dominated by a mora.\footnote{The attachment of [s] directly to the $\sigma$ node is meant to show the DTE status of an element that does not obey Strict Layering (Selkirk 1984), but rather is a theory of reference to prosodic structure. Thus, the DTE proposal has no bearing on whether elements may be extraprosodic, or whether feet may be ternary, and the like.}

  In effect, then, no constraint of the form $* \Delta_{s} \leq x$ or $* \Delta_{s} \geq x$ will apply to it. This situation is only possible when strict layering is violated. The empirical effects of this fact are discussed in chapter 4.3.4.

  Traditional notions such as 'syllable peak' and 'margin' can be expressed as DTEs and non-DTEs. For example, the peak (i.e. nucleus) of a syllable is $\Delta_{n,Ro}$ while the margin (onset and coda) is $\Delta_{n,Re}$. Further constituents such as onset, rime, and coda can also be expressed in this system.

  As a final note, the present theory is not a theory of prosodic structure (cf Selkirk 1984), but rather is a theory of reference to prosodic structure. Thus, the DTE proposal has no bearing on whether elements may be extraprosodic, or whether feet may be ternary, and the like.

  2.4.1.1 Constraint form

  DTEs and non-DTEs form the structural prominence scale | $\Delta_{n,Re}$ $\Delta_{n,Ro}$ $\Delta_{s}$ $\alpha$ $\beta$ $\mu$ $\nu$ $\Delta$ |, generalizing P&S's peak-margin structural scale. More precisely, there are several DTE scales, one for each possible specification of $\alpha$: i.e. $\Delta_{n,Re}$ $\Delta_{n,Ro}$ $\Delta_{s}$ $\alpha$ $\beta$ $\mu$ $\nu$ $\Delta$ $\Delta$ |. Depending on the theory of syllable structure adopted, non-strict layering may be banned (cf Selkirk 1995).
The formal expression of markedness – ch.2

- The sonority constraints

As a more extended example, the sonority scale presented in chapter 1, and repeated below, distinguishes 12 steps:

**Figure 2.5: The Sonority Hierarchy**

(a) Consonant sonority

- voiceless stops
- voiceless fricatives
- nasals
- liquids
- glides

(b) Vowel sonority

- high
- mid
- low

Since the scale distinguishes 12 steps, there is a feature [Sonority] with a feature value string of length 11.\(^{20}\) Voiceless stops are \[\ldots\]Sonority\], while [a] is \[\ldots\]Sonority\]. Since this notation is difficult to read, the \(\geq\) and \(\leq\) notation introduced above will be used from now on. Using this notation, the DTE equivalent of P&S’s peak and margin constraints are given below. A capitalized coronal member stands for the entire manner of articulation (e.g. T stands for voiceless stops, from [t]).

**DTE+sonority Constraints**

(a) \(\Delta\leq\) 
- \(\Delta\)s
- \(\Delta\)d
- \(\Delta\)s
- \(\Delta\)n
- \(\Delta\)l

(b) \(\Delta\geq\) 
- \(\Delta\)a
- \(\Delta\)e
- \(\Delta\)o
- \(\Delta\)a

As an example, \(\Delta\leq(a)\) assigns violations to root-DTEs of [\), i.e. syllable nuclei] with sonority of less than or equal to mid central vowels.

The DTE of a syllable (\(\Delta\)) is the element that is the head of the syllable and associated to a \(\Delta\) node by an unbroken chain of heads (see (15)). This concept of \(\Delta\) correlates with the syllable ‘peak’, while \(\Delta\) relates to the syllable margin. As with the Tone constraints, the sonority scale is reversed in combination with non-DTEs: the best peak is the worst margin, and vice-versa.

Of course, the sonority scale does not only combine with syllable DTEs, but with DTEs of every other level. These constraints will be discussed in the following chapters, when they become relevant.

This introduction to DTEs and non-DTEs concludes with the note that all DTE-referencing constraints are freely permutable. There is no fixed ranking between constraints based on the type of DTE element; evidence that constraints that refer to \(\Delta\) do not universally outrank \(\Delta\) constraints or vice-versa is presented in chapter 4. Similarly, \(^{20}\) See Parker (2002) for the same conclusion – that sonority is a single unified multi-valued feature. Chapter 3§3.5.3 discusses proposals in which sonority is constructed from smaller scales.

---

\(19\) For example, the tonal non-DTE constraints for PrWd non-DTEs are

\(\Delta\leq\) 
- \(\Delta\)a
- \(\Delta\)e
- \(\Delta\)o
- \(\Delta\)a
- \(\Delta\)e
- \(\Delta\)o

As an example, \(\Delta\leq(a)\) assigns violations to root-DTEs of [\), i.e. syllable nuclei] with sonority of less than or equal to mid central vowels.

The DTE of a syllable (\(\Delta\)) is the element that is the head of the syllable and associated to a \(\Delta\) node by an unbroken chain of heads (see (15)). This concept of \(\Delta\) correlates with the syllable ‘peak’, while \(\Delta\) relates to the syllable margin. As with the Tone constraints, the sonority scale is reversed in combination with non-DTEs: the best peak is the worst margin, and vice-versa.

Of course, the sonority scale does not only combine with syllable DTEs, but with DTEs of every other level. These constraints will be discussed in the following chapters, when they become relevant.

This introduction to DTEs and non-DTEs concludes with the note that all DTE-referencing constraints are freely permutable. There is no fixed ranking between constraints based on the type of DTE element; evidence that constraints that refer to \(\Delta\) do not universally outrank \(\Delta\) constraints or vice-versa is presented in chapter 4. Similarly, \(^{20}\) See Parker (2002) for the same conclusion – that sonority is a single unified multi-valued feature. Chapter 3§3.5.3 discusses proposals in which sonority is constructed from smaller scales.

---

\(19\) It could be that \(\Delta\) constraints have the form “Incur a violation if \(v\) is not a substring of \(v_2\).”, eliminating the need to refer to \(o\) values. However, this formulation introduces negation – a potentially undesirable operation in constraint form.
there is no need to impose a fixed ranking between constraints that differ in their value for α or β. *Δαβ* constraints do not universally outrank constraints that refer to *Δαβ* or vice-versa.

To repeat a point made in ch.1, the proposal that scales combine with DTEs and non-DTEs in different ways means that the traditional notion of ‘markedness’ does not apply directly to certain scales. For example, there is no real sense in which the sonority category ‘low vowel’ is unmarked. Instead, markedness of prosodic scales depends on the structural element with which they combine. So ‘low vowel’ is the least marked category in terms of DTEs, but the most marked for non-DTEs.

In contrast, markedness is easily applied to featural scales: since featural scales do not combine with DTEs, the least marked element remains consistent across contexts. So, ‘glottal’ is always the least marked PoA element.

### 2.4.2 Featural and prosodic scales

While DTEs combine with some scales (e.g. Tone, Sonority), they do not combine with others. For example, chapter 3§3.5 shows that the PoA scale cannot combine with structural elements. If it could, a constraint such as *θ[dorsal]* would exist in CON, predicting an unattested type of stress system: one where stress is sensitive to Place of Articulation. In contrast, some scales only appear in constraints with DTEs. For example, the sonority scale cannot form a set of context-free constraints of the form *[vSonority]*, where v is some value, since these constraints also produce unattested systems (see chapter 3§3.5.2). Accordingly, a theory of scales must identify the scales that must appear with DTEs and the scales that must not.

I propose the restriction in (22).

(22) **The Scale-Structure Combination Restriction**

(a) Scales that refer to prosodic properties (e.g. tone, sonority) always combine with prosodic elements in constraints.

(b) Scales that refer to subsegmental properties (e.g. voice, Place of Articulation) never combine with prosodic elements in constraints.

A ‘Prosodic’ scale refers to non-segmental features like tone, sonority, and prosodic structure, while featural scales include those features commonly regarded as dependents of the root node (e.g. [voice], Place, [nasal], and so on). So, there are no constraints of the form *τ[Place]*, or *Δτ[vNasal]*, and so on. Similarly, all constraints on sonority or tone must mention a (non-)DTE. This proposal is discussed further in chapters 3 and 4.

As stated above, the ‘prosodic’ scales include the Tonal scale and Sonority scale. Tone has not been considered a subsegmental feature since Leben (1973) and Goldsmith (1976). Sonority is standardly considered a property of entire segments (or root nodes), unlike subsegmental features like place of articulation. This follows the spirit of McCarthy’s (1988) proposals that major class features reside in the root node, and that major class features are essential in defining sonority (Clements 1990, Rice 1992). Thus, sonority is a property of the root node rather than being a dependent feature, unlike [voice] or [nasal]. These scales are dubbed ‘prosodic’ here, with the further claim that only these sorts of scales can combine with structural scales while featural scales cannot.

The generalization made above has broad consequences. It prevents positional markedness constraints to subsegmental features: there are no constraints like *Δνωνευζ[labial]*, or *Δν[¬voice]*. Chapter 3 shows that such a restriction is necessary in relation to subsegmental features and Δν. To summarize the argument, if there were constraints such as *Δνωνευζ[labial]*, stress placement would be potentially sensitive to Place of Articulation – a situation that never happens.

Inside the syllable, a number of researchers have argued that markedness constraints that refer to the relation between constituents and subsegmental features are necessary (e.g. Ito 1986, Zoll 1998).

As a note on Beckman’s (1998) Positional Faithfulness theory, it may seem that (22a) precludes positional faithfulness constraints such as onset-IDENT[voice] since this faithfulness constraint refers to a prosodic position and a subsegmental feature. However, this is outside the scope of (22). (22) prevents the general algorithm that generates constraints from (or relates constraints to) scales from producing full sets of (non-)DTE-referring scale constraints. This explains why there are no faithfulness constraints such as *-Δνωνευζ[labial]*, for example (see ch.9). However, the proposal does not prevent an entirely different algorithm from producing DTE-referring constraints. Beckman’s Positional Faithfulness theory is just such another algorithm – it combines a small set of prosodic positions with scales in a totally independent way from the scale-combination processes proposed here. Note that the set of prosodic elements that Positional Faithfulness allows to combine with scales is a small subset of those of the DTE theory (i.e. onsets, stressed syllables), and even elements that are not definable using DTEs and non-DTEs (e.g. root-initial syllables). In short, the present theory and Positional Faithfulness can potentially coexist.

Of course, empirical restrictiveness will ultimately determine which theories can coexist with the present proposals. The present work aims to argue that all the constraints proposed here are necessary; in some cases it requires that certain types of constraint must not exist – as for combinations of DTEs with featural scales.

For the purposes of this dissertation (22) is taken to be axiomatic; its reduction to other principles is left for future work.

### 2.5 Summary

The contents of the preceding sections can be summarized as a series of proposals about scale-referring constraints:

- **Proposal**: The ranking of scale-referring constraints is freely permutable (§2.3).

  Leads to:

  - Local Harmonic Bounding: Both markedness and faithfulness constraints must refer to a range of a scale.
• Proposal: Prosodic scales must combine with structural elements in constraints; Featural scales cannot do so (§2.4).
  Related Proposal:
  Scale-referring constraints may only refer to the structural elements ‘DTE’ and ‘non-DTE’.

• Proposal: Scale-reference is consistent across constraint types. (§2.5)
  Leads to:
  Faithfulness to the Marked: If a faithfulness constraint preserves a scale element, then it also preserves every more marked scale element.

The following chapters examine the empirical consequences of the proposals presented above:
• Chapter 3 is devoted to showing that the ranking of scale-referring markedness constraints is freely permutable. This result necessitates that they be in a local harmonic bounding relation.
• Chapter 4 aims to show that reference to both DTEs and non-DTEs is necessary.
• Chapter 5 provides an extended discussion of scale-referring faithfulness constraints.
• Chapters 6 and 7 present evidence for the Marked Reference hypothesis, showing that all scale-referring faithfulness constraints preserve the most marked element.
• Chapter 8 provides evidence that faithfulness constraints must be freely rankable.
• Chapter 9 presents a summary of the proposals and their empirical consequences.
CHAPTER 3

MARKEDNESS AND CONFLATION

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§2.1) – 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

\[
\begin{align*}
\text{[aw\dhat]} & \quad \text{'coming'} \\
\text{[p\dhat\dhat]} & \quad \text{'kite'} \\
\text{[\s\dhat\dhat]} & \quad \text{'plus ½'}
\end{align*}
\]

(b) Avoidance of stressed non-low vowels

\[
\begin{align*}
\text{[hr\dhat\dhat]} & \quad \text{'distressed'} \\
\text{[bol\dhat\dhat]} & \quad \text{'is/are spoken'} \\
\text{[\s\dhat\dhat\dhat]} & \quad \text{'shirts'}
\end{align*}
\]

(c) Avoidance of stressed schwa

\[
\begin{align*}
\text{[k\dhat\dhat\dhat]} & \quad \text{'little cuckoo'} \\
\text{[b\dhat\dhat\dhat]} & \quad \text{'a mouthful'} \\
\text{[k\dhat\dhat\dhat]} & \quad \text{'inkstand'}
\end{align*}
\]

(d) No avoidance of stressed high vowels

\[
\begin{align*}
\text{[\dhat\dhat\dhat]} & \quad \text{'girls'} \\
\text{[k\dhat\dhat\dhat]} & \quad \text{'book'}
\end{align*}
\]

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 \( [x \ y] \) 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 \( [c\ o\ a] \) 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, Gnanesekaran 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). Scale (Figure 3.1a) gives the category labels, and (Figure 3.1b) lists the members of the categories.

<table>
<thead>
<tr>
<th>Figure 3.1: Vowel sonority scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) high</td>
</tr>
<tr>
<td>central</td>
</tr>
<tr>
<td>vowels</td>
</tr>
<tr>
<td>(b) u</td>
</tr>
<tr>
<td>y</td>
</tr>
<tr>
<td>ø</td>
</tr>
<tr>
<td>a</td>
</tr>
</tbody>
</table>

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 [æ] is more sonorous than the high central vowel [i].

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 [xxxxxxx0xxxxx0], while [p] is [xxxxxxxxxxxxxxxx] 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: [2X] means “equally or more sonorous than a category of type X”, where X is one of the sonority categories. For example, [2Nasal] refers to all segments that are either nasal or more sonorous than nasals. Conversely, [SNasal] 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. *Δe≤[C] is violated when any segment that is equally or less sonorous than schwa appears inside a syllable DTE (i.e. the head of a syllable). Similarly, *Δe≥[X] 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.

3.7 Summary

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.22

Phonological evidence for the sonority distinctions made above will be presented in the following sections.
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 ([ganasan]). 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 Tenö Senko (1979).

Nganasan has the vowels listed in Table 3.1.

Table 3.1: Nganasan vowels

<table>
<thead>
<tr>
<th>1</th>
<th>y</th>
<th>u</th>
</tr>
</thead>
<tbody>
<tr>
<td>e</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>a</td>
<td></td>
<td></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.

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.

3.3.3 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.

The Nganasan pattern shows that there is a distinction between [a e o] on the one hand and [i y u] 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. *[kóri], *[kúri], *[kúridâ], *[kúridâ], ‘our (dual) skin’.

Similarly, stress does not retract from a central vowel onto a high vowel, as in (4).

Stress does not retract from a high vowel to a central vowel either: e.g. *[kúdâ], *[kúdâ], ‘scoops’, *[bá], ‘there (locative)’.

Evidence for the necessity of reference to non-DTEs is provided in chapter 4.

3.3.5 discusses what it means for two categories to be conflated in Optimality Theoretic terms. Section 3.3.6 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.

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Evidence for the necessity of reference to non-DTEs is provided in chapter 4.
3.3.2 Analysis


While stress retraction to the antepenultimate syllable—and sensitivity to sonority—is optional, Eugene Helmski (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) \[\begin{array}{l}
\text{ALIGNFr} \quad \text{‘The right edge of every foot must be aligned with the right edge of a PrWd.’} \\
\text{FTBIN} \quad \text{‘Every foot is binary at the syllabic or moraic level.’} \\
\text{TROCHEE} \quad \text{‘Every foot is left-headed’} \quad \text{[i.e. ALIGN-L(σ,Ft)]} \\
\end{array}\]

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

(6) Nganasan default stress

<table>
<thead>
<tr>
<th>/kuhúmi/</th>
<th>FTBIN</th>
<th>ALIGNFr</th>
<th>TROCHEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>#(\text{a) kuhúmi})</td>
<td>(_)</td>
<td>(_)</td>
<td>(_)</td>
</tr>
<tr>
<td>(b) kuhúmi</td>
<td>(_)</td>
<td>(_)</td>
<td>*1</td>
</tr>
<tr>
<td>(c) kuhúmi</td>
<td>(_)</td>
<td>*1</td>
<td>(_)</td>
</tr>
<tr>
<td>(d) kuhúmi</td>
<td>*1</td>
<td>(_)</td>
<td>(_)</td>
</tr>
</tbody>
</table>

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 \(*\text{Δ}[i,u]\). 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. [i u]). As a reminder, the notation “≤” refers to all segments with the same sonority or less than peripheral high vowels; this includes the Nganasan vowels [i y u].

The avoidance of stressed high and central vowels forces the foot to retract from the right edge of the PrWd: i.e. [hó[ʊj]v] ‘writes’, [(kórnj]v] ‘carries’. Such a footing violates ALIGNFr, indicating that \(*\text{Δ}[i,u]\) must outrank this constraint.

\(7\)

\[\begin{array}{ccc}
\text{/kontu/} & \text{*\text{Δ}[i,u]} & \text{ALIGNFr} \\
\text{(a) kont[ɨj]a} & * & * \\
\text{(b) kont[ʊj]a} & * & * \\
\end{array}\]

The constraint \(*\text{Δ}[i,u]\) 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] for mid and low vowels, as shown in tableau (8).

(8)

\[\begin{array}{ccc}
\text{/hot[ʊj]v} & \text{*\text{Δ}[i,u]} & \text{ALIGNFr} \\
\text{(a) hot[ʊj]v} & * & * \\
\text{(b) hot[ɪj]v} & * & * \\
\end{array}\]

Analogous to the situation in tableau (7), candidate (b) violates \(*\text{Δ}[i,u]\) 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...
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 $^*\Delta_{\text{PrWd}}{[i,u]}$.

<table>
<thead>
<tr>
<th>/húrsà/</th>
<th>$^*\Delta_{\text{PrWd}}{[i,u]}$</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>
</tbody>
</table>

The tableau above shows that ALIGNFTR can be decisive in choosing the winner when more than one candidate incurs equal violations of the sonority stress constraints. Since $^*\Delta_{\text{PrWd}}{[i,u]}$ assigns the same violations to candidates (a) and (b), the vowels [i] and [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. [húrsjà] ‘returns’. The present ranking accounts for this pattern, as illustrated in tableau (10).

<table>
<thead>
<tr>
<th>/hùrsjà/</th>
<th>$^*\Delta_{\text{PrWd}}{[i,u]}$</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>
</tbody>
</table>

Crucially, both candidates (a) and (b) incur the same violations of $^*\Delta_{\text{PrWd}}{[i,u]}$. Since $^*\Delta_{\text{PrWd}}{[i,u]}$ is not decisive, the violations of ALIGNFTR become relevant, favouring the penult-stressed (b).

By assigning the same violations to stressed central and high vowels, $^*\Delta_{\text{PrWd}}{[i,u]}$ effectively conflates the two categories. Since neither is preferred over the other, the footing constraints take over, preferring the default stress position.
Paninian’ in Prince (1997 et seq.). A constraint C₁ is more general than C₂ if C₁ incurs a superset of C₂’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. [jábomá] ‘seven’, *[ýjábomá]; of course, stress does not avoid a low vowel penult for a mid vowel: e.g. [kónýjá] ‘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 *[AVøypv≤{i,u}] favours [i] over [e] and [u], it must be inactive. In the present case, this means that it is ranked below ALIGNFTR.

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, *[AVøypv≤{i,u}] occupies the same position as *[AVøypv≤{e,o}] in the ranking established so far: || *[AVøypv≤{i,u}] » ALIGNFTR }« *[AVøypv≤{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-antepenult position.

- **Long Vowels**

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

  This follows from foot form considerations. If stress appeared on the ultima in kyý¿ntú the foot would either be degenerate *[kyý¿ntú] or trimoraic *[kyý¿ntú]; 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.
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. **PARSE-σ**  “Every syllable is associated to a foot” (Prince & Smolensky 1993)
   **HDFTr**  “The rightmost foot is the head.” (Tesar 1996)

The constraint **PARSE-σ** requires exhaustive footing. It outranks **ALIGNFTr** in Nganasan, as evinced by the presence of secondary stress in longer words: [[kint\textsuperscript{ny}kt\textsuperscript{un}]] ‘you are smoking’.

16. **/na\textsuperscript{kyn}k\textsuperscript{tun}/**  **PARSE-σ**  **ALIGNFTr**

   (a) [[kint\textsuperscript{ny}kt\textsuperscript{un}]]  **+**  **+**
   (b) [[kint\textsuperscript{ny}kt\textsuperscript{un}]]  **+**  **+**

   The constraint **HDFTr** requires the rightmost foot to be the head. Together, **PARSE-σ** and **HDFTr** ensure that main stress does not retract to the pre-antepenult. This is illustrated with the word /na\textsuperscript{kyn}k\textsuperscript{tun}/ in tableau (17).

17. **/na\textsuperscript{kyn}k\textsuperscript{tun}/**  **HDFTr**  **PARSE-σ**  **\textsuperscript{*}Δ\textsubscript{σ}/\textsuperscript{PrWd}\textsubscript{σ}[1,u]**  **ALIGNFTr**

   (a) [[na\textsuperscript{kyn}k\textsuperscript{tun}]]  **+**  **+**
   (b) [[na\textsuperscript{kyn}k\textsuperscript{tun}]]  **+**  **+**
   (c) [[na\textsuperscript{kyn}k\textsuperscript{tun}]]  **+**  **+**

   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 **PARSE-σ** or **HDFTr** are violated. In (b), **PARSE-σ** is violated because there are unfooted syllables; in (c), **HDFTr** is violated because the head foot is not the rightmost one. With these constraints outranking \textsuperscript{*}Δ\textsubscript{σ}/\textsuperscript{PrWd}\textsubscript{σ}[1,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. \{pam\textsuperscript{acy}m\textsuperscript{q}, \textsuperscript{*}pam\textsuperscript{acy}m\textsuperscript{q}\}). If stress did appear on the antepenult, the output form would have two unfooted syllables: \{pam\textsuperscript{acy}m\textsuperscript{q}\}. In comparison, the penult-stressed form has no unfooted syllables: \{pam\textsuperscript{acy}m\textsuperscript{q}\}. This result is illustrated in tableau (18).

18. **/pam\textsuperscript{acy}m\textsuperscript{q}/**  **PARSE-σ**  **\textsuperscript{*}Δ\textsubscript{σ}/\textsuperscript{PrWd}\textsubscript{σ}[1,u]**

   (a) [[pam\textsuperscript{acy}m\textsuperscript{q}]]  **+**  **+**
   (b) [[pam\textsuperscript{acy}m\textsuperscript{q}]]  **+**  **+**

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 \textsuperscript{*}Δ\textsubscript{σ}/\textsuperscript{PrWd}\textsubscript{σ}[1,u] to emerge. This situation is illustrated in tableau (19).

19. **/nak\textsuperscript{ky}r\textsuperscript{q}/**  **PARSE-σ**  **\textsuperscript{*}Δ\textsubscript{σ}/\textsuperscript{PrWd}\textsubscript{σ}[1,u]**

   (a) [[na\textsuperscript{kyn}r\textsuperscript{q}]]  **+**  **+**
   (b) [[na\textsuperscript{kyn}r\textsuperscript{q}]]  **+**  **+**

   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

- **PARSE-σ**
- **HDFTr**
- **\textsuperscript{*}Δ\textsubscript{σ}/\textsuperscript{PrWd}\textsubscript{σ}[1,u]**
- **\textsuperscript{*}Δ\textsubscript{σ}/\textsuperscript{PrWd}\textsubscript{σ}[1,o]**
- **ALIGNFTr**

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 influence of **HDFTr** required in \*HDFTr “The rightmost foot is the head.” (Tesar 1996) and \*HDFTr “Every syllable is associated to a foot” (Prince & Smolensky 1993) to prevent pre-antepenult stress.

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 §3.5.2.2 for discussion of ‘active’). For example, stressed central and high vowels are conflated in Nganasan because the only relevant active constraint is \( *_{\text{PrWd}} \sqsubset \{i,u\} \) and it assigns the same violations to both types. The relevant tableau is repeated in (20).

\[
\begin{array}{ccc}
\text{hur} & \text{PrWd} & \text{ALIGNFTR} \\
(a) & \text{hur} & * \\
\text{št} & \text{hur} & *
\end{array}
\]

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).

\[
\begin{array}{ccc}
\text{hur} & \text{PrWd} & \text{ALIGNFTR} \\
(a) & \text{hur} & * \\
\text{št} & \text{hur} & *
\end{array}
\]

The activity \( *_{\text{PrWd}} \sqsubset \{i,u\} \) is active, though, then every higher ranked constraint is also active, including \( *_{\text{PrWd}} \sqsubset \{i,u\} \). If either \( *_{\text{PrWd}} \sqsubset \{e,o\} \) or \( *_{\text{PrWd}} \sqsubset \) had to always outrank \( *_{\text{PrWd}} \sqsubset \{i,u\} \), the Nganasan conflations would be impossible.

In fact, §3.4 shows that Gujarati employs the exact opposite to the Nganasan ranking: both \( *_{\text{PrWd}} \sqsubset \{i,u\} \) and \( *_{\text{PrWd}} \sqsubset \{e,o\} \) outrank \( *_{\text{PrWd}} \sqsubset \{i,u\} \). This ranking allows conflation of high and mid peripheral vowels (since \( *_{\text{PrWd}} \sqsubset \{i,u\} \) is inactive). The activity of \( *_{\text{PrWd}} \sqsubset \{i,u\} \) ensures that central vowels are treated distinctly from peripheral vowels, and \( *_{\text{PrWd}} \sqsubset \{e,o\} \) 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 conflation. For example, if the ranking \( \| *_{\text{PrWd}} \sqsubset \{i,u\} \sqsubset *_{\text{PrWd}} \sqsubset \{e,o\} \| \) were universal, no language could both avoid stressed high vowels and conflate them with [5]. If schwa is conflated with high vowels, then no constraint that favours the latter over the former can be active. Therefore \( *_{\text{PrWd}} \sqsubset \{e,o\} \) must be inactive. However, if \( *_{\text{PrWd}} \sqsubset \{i,u\} \) is inactive, then every lower-ranked constraint is also inactive, including \( *_{\text{PrWd}} \sqsubset \{i,u\} \). 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 \( \| *_{\text{PrWd}} \sqsubset \{i,u\} \sqsubset *_{\text{PrWd}} \sqsubset \{e,o\} \| \) incorrectly predicts that if [a] is avoided and not conflated with [i u], then [i u] will also be avoided. If [5] is not conflated with [i u], then some constraint that distinguishes the two categories must be active – i.e. \( *_{\text{PrWd}} \) is active. If *PrWd is active, though, then every lower-ranked constraint is also active. So, \( *_{\text{PrWd}} \sqsubset \{i,u\} \) 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 [a i y u] for [e o 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 [bə] ‘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 [g] 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 CV or CV(C)V: e.g. [tə] ‘fire’, [bə] ‘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 schwa ‘weak’, and consequently unable to bear 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 phonologically distinct from all 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
Gujarati syllables can be described by the template (C₁)(C₂)V((C₃)C₄). Onsets are optional, as shown by [a.po] ‘give’, and [p.ie] ‘he drinks’. C₁ must be one of [j h], while C₃ must be a nasal homorganic with a following stop (e.g. [lùj)e]). Geminate consonants are allowed: e.g. [ch] ‘56’, [gu] ‘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 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] can be seen.

The following table describes the position of primary stress; there is no secondary stress. This data expands on (i).

(25) Gujarati Stress

(a) Stress a syllable with [a]

(i) in the penult

- [aw] ‘coming’
- [utr] ‘passenger’
- [mah] ‘New Year’
- [sám] ‘in front’
- [azá] ‘freedom’
- [fá] ‘go’
- [sá] ‘plus’
- [tá] ‘40’
- [bát] ‘let’s go’
- [sá] ‘plain’
- [betál] ‘42’
- [áp] ‘I give’
- [pát] ‘50th’
- [gá] ‘carrot’

(ii) else in the initial syllable

- [tá] ‘recently’
- [pák] ‘Pakistan’
- [lí] ‘library’
- [ná] ‘swift mare’
- [mán] ‘I want’
- [ják] ‘invasion’

(iii) else in the final syllable

- [sin] ‘movie theatre’
- [hrán] ‘distressed’
- [po] ‘year’
- [bolá] ‘is (are) spoken’
- [fá] ‘office’
- [kár] ‘a hunt’
- [o] ‘gar’s’
- [náš] ‘damage’
- [dekk] ‘can be seen’
- [já] ‘wages, salary’

(b) Else stress a non-final syllable with one of [e o i u]

(i) in the penult

- [fá] ‘girls’
- [ł] ‘instand’
- [mú] ‘74’
- [ká] ‘shirts’
- [ł] ‘office’
- [já] ‘Europe’

(ii) else in the initial syllable

- [p] ‘book’
- [wá] ‘forgetfulness’
- [j] ‘know’
- [k] ‘little cuckoo’
- [b] ‘a mouthful’

(c) Else stress penult [j]

- [d] ‘does, do’
- [n] ‘new (masc.)’
- [l] ‘land’
- [b] ‘beginning’
- [k] ‘kite’
- [s] ‘water-dispensing shed’
- [s] ‘but’
- [j] ‘toy’

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. [tadigəry] ‘recently’, [sinemə] ‘cinema, movie theatre’. Similarly, stress tends to avoid schwa for higher sonority vowels: e.g. [ək′ləsədi] ‘to know’, [ələpoldi] ‘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. [ʃəru] ‘beginning’, [prəsəru] ‘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 [ʃətəfro] ‘girls’, and not on the more sonorous mid vowel: *[ʃətəfo]. In other words, the open mid, close mid, and high vowels are conflated for stress purposes in Gujarati.

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

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. [awənə] ‘coming’, [ekətər] ‘71’, [wəkəspədi] ‘on time’. This fact follows if Gujarati has a trochaic (left-headed) foot aligned with the right edge of the PrWd: i.e. [ekətər]. This is the same pattern as found in Nganasan, so the same constraints and analysis are employed here:

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. [sinəmə]).

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. [tadigər] ‘recently’); high vowel (e.g. [mənətə] ‘respected (masc.)’), or schwa (e.g. [mənətə] ‘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 ALIGNFTR. The latter ranking is crucial since initial stress means that the foot cannot be right aligned: i.e. [tadigər].

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

A further ranking can also be determined. Final [a] also attracts the stress if no other vowel is as sonorous: [ʃəkər] ‘a hunt’, [sinəmə] ‘cinema’, [ʃəpəsədi] ‘office’. In these words, the foot is right-aligned so ALIGNFTR is not violated. Instead, it is FTBIN that is violated since the foot is necessarily monosyllabic: [ʃəkər], [sinəmə]. So, *Δəwəs≤(e,ɔ) must outrank FTBIN.

55 Or the initial syllable – it is impossible to tell given the restrictions on PrWd-length noted above.

56 I assume that TROCHEE is undominated, eliminating candidates with iambic feet (e.g. [ʃəkər]).
3.4.1 Avoidance of stressed schwa

### 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 [a]; e.g. [pātkat] meaning “book”, [wisōrang] meaning “forgetfulness”, [kōjidi] meaning “little cuckoo”.

Schwa is not ‘unstressable’. Stress falls on [a] in two situations: (i) when there are no other non-[a] vowels (e.g. [pātkat] ‘kiti’, [wāwánã] ‘on time’), and (ii) when the only other option is final stress on a non-low vowel (e.g. [kōjidi] ‘do’, [nōwo] ‘new’; [śñr] ‘beginning’, [pātkat] ‘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 [a]. 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 [a] in Gujarati is clearly less harmonic than other stressed vowels. The relevant constraint is *\( \Delta \text{sw} \text{w} \leq \text{FTBIN} \), a constraint that assigns stressed schwa a violation, but no other stressed vowels.

The word [kōjidi] provides a clue to the ranking of *\( \Delta \text{sw} \text{w} \) 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, *\( \Delta \text{sw} \text{w} \) must outrank ALIGNFR. \[28\]

<table>
<thead>
<tr>
<th>Gujarati III: *( \Delta \text{sw} \text{w} \leq \text{FTBIN} )</th>
<th>FTBIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>/pātkat/</td>
<td>*</td>
</tr>
<tr>
<td>(a) [pātkat]</td>
<td>*</td>
</tr>
<tr>
<td>(b) [kōjidi]</td>
<td>*</td>
</tr>
<tr>
<td>(c) pakikastan</td>
<td>*</td>
</tr>
</tbody>
</table>

Even though the stress-sonority constraint *\( \Delta \text{sw} \text{w} \leq \text{FTBIN} \) outranks ALIGNFR 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 *\( \Delta \text{sw} \text{w} \leq \text{FTBIN} \) will not determine the winning form. In this situation, the foot-locating constraints play a decisive role:

### 3.4.1.2.2 Emergence of ALIGNFR and FTBIN

<table>
<thead>
<tr>
<th>Gujarati IV: Emergence of ALIGNFR and FTBIN</th>
<th>FTBIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>/awwa/nã/</td>
<td>ALIGNFR</td>
</tr>
<tr>
<td>(a) [awwa/nã]</td>
<td>ALIGNFR</td>
</tr>
<tr>
<td>(b) [kōjidi]</td>
<td>ALIGNFR</td>
</tr>
<tr>
<td>(c) awwa/nã</td>
<td>ALIGNFR</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: [pātkat], *[pātkat(tán)]. This fact allows us to establish a further ranking: since the final-stressed form violates FTBIN while the initial-stressed form violates ALIGNFR, the former must outrank the latter:

### 3.4.1.2.3 Emergence of \( \Delta \text{sw} \text{w} \leq \text{ALIGNFR} \)

<table>
<thead>
<tr>
<th>Gujarati V: FTBIN = ALIGNFR</th>
<th>ALIGNFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>/awwa/nã/</td>
<td>FTBIN</td>
</tr>
<tr>
<td>(a) [awwa/nã]</td>
<td>ALIGNFR</td>
</tr>
<tr>
<td>(b) [kōjidi]</td>
<td>ALIGNFR</td>
</tr>
<tr>
<td>(c) awwa/nã</td>
<td>ALIGNFR</td>
</tr>
</tbody>
</table>

To summarize, the ranking \( *\( \Delta \text{sw} \text{w} \leq \text{FTBIN} \) = \text{FTBIN} = \text{ALIGNFR} \) 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.

### 3.4.1.2.4 Emergence of \( \Delta \text{sw} \text{w} \leq \text{ALIGNFR} \)

<table>
<thead>
<tr>
<th>Gujarati VI: *( \Delta \text{sw} \text{w} \leq \text{ALIGNFR} )</th>
<th>FTBIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>/kōjidi/</td>
<td>ALIGNFR</td>
</tr>
<tr>
<td>(a) [kōjidi]</td>
<td>ALIGNFR</td>
</tr>
<tr>
<td>(b) kōjidi</td>
<td>ALIGNFR</td>
</tr>
</tbody>
</table>

This leaves the ranking of *\( \Delta \text{sw} \text{w} \) and FTBIN to be determined. In this respect, the form [kōjidi] is illuminating. Its competitor is *[kōjidi], with a higher sonority \( \Delta \text{sw} \text{w} \), but a FTBIN violation. Clearly, the FTBIN violation is not worth avoiding a stressed schwa in Gujarati. Therefore, FTBIN must outrank *\( \Delta \text{sw} \text{w} \).

### 3.4.1.2.5 Emergence of \( \Delta \text{sw} \text{w} \leq \text{ALIGNFR} \)

<table>
<thead>
<tr>
<th>Gujarati VII: *( \Delta \text{sw} \text{w} \leq \text{ALIGNFR} )</th>
<th>FTBIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>/kōjidi/</td>
<td>FTBIN</td>
</tr>
<tr>
<td>(a) [kōjidi]</td>
<td>ALIGNFR</td>
</tr>
<tr>
<td>(b) kōjidi</td>
<td>ALIGNFR</td>
</tr>
</tbody>
</table>

As in Nganasan, the competitor [kōjidi], 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 \( \text{TROCHEE} > \text{FTBIN} = *\( \Delta \text{sw} \text{w} \) = \text{ALIGNFR} \). This ranking is interesting because it shows how the influence of sonority on a stress system may be restricted to specific environments. Unlike *\( \Delta \text{sw} \text{w} \leq \text{FTBIN} \), *\( \Delta \text{sw} \text{w} \) does not outrank every relevant foot-locating constraint; its domination by FTBIN precludes sonority-sensitivity in every environment.

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 \( \text{FTBIN} = \text{ALIGNFR} \) has been proven both directly (in (30)) and by transitivity.

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 \( \Delta_{\text{env}}(i,u) \) – this constraint is violated when the \( \text{env} \) 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 \([e \ o \ i \ u] \) vs \([\{,\}] \). 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. \([\text{máinít}] \) ‘I want’, \([\text{nuksán}] \) ‘damage’, \([\text{ból}] \) ‘is spoken’, \([\text{tíd} \text{gíp}] \) ‘recently’. Similarly, they both attract stress away from \([\{,\}] \): \([\text{pút}] \text{ô} \text{ni}] \) ‘book’, \([\text{wíst} \text{ô} \text{ro}] \) ‘forgotten’, \([\text{kjôdô}] \) ‘little cuckoo’. However, mid and high vowels do not attract stress away from other. Stress does not avoid high vowels for the more sonorous mid vowels: e.g. \([\text{tjô} \text{kí} \text{plïn}] \) ‘boys’, \([k\text{êdô} \text{ï} \text{nkô}] \) ‘inkstand’. Nor does stress avoid mid vowels for high vowels: e.g. \([\text{tjô} \text{mûr} \text{ô} \text{ter}] \) ‘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 \([\{,\}] \) to be distinct from \([\{\}] \), some constraint that favours one over the other must be active. The relevant constraint is \( *\Delta_{\text{env}}(i,a) \); 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 – \( *\Delta_{\text{env}}(i,a) \) must be active. Conversely, if \([\{\}] \) and \([\{\}] \) are conflated, it follows that \( *\Delta_{\text{env}}(i,a) \) must be inactive. In Gujarati, \( *\Delta_{\text{env}}(i,a) \) 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 \( *\Delta_{\text{env}}(i,a) \) inactive, it must be outranked by such conflicting constraints: i.e. \( \text{ALIGNFTR} \) and \( \text{FTBIN} \) 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 \([\text{tjô} \text{kí} \text{plïn}] \).

(33) Ranking of \( *\Delta_{\text{env}}(i,a) \)

<table>
<thead>
<tr>
<th>( \text{tjô} \text{kí} \text{plïn} )</th>
<th>( \text{ALIGNFTR} )</th>
<th>( *\Delta_{\text{env}}(i,a) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) ( \text{tjô} \text{kí} \text{plïn} )</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>(b) ( \text{tjô} \text{kí} \text{plïn} )</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

Importantly, there is no active constraint that distinguishes between \([\{,\}] \) and \([\{\}] \). 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 \( *\Delta_{\text{env}}(i,a) \) and \( *\Delta_{\text{env}}(i,a) \). Tableau (34) aims to clarify this point by showing the full ranking of constraints.

<table>
<thead>
<tr>
<th>(34)</th>
<th>( \text{tjô} \text{kí} \text{plïn} )</th>
<th>( *\Delta_{\text{env}}(i,a) )</th>
<th>( \text{FTBIN} )</th>
<th>( *\Delta_{\text{env}}(i,a) )</th>
<th>( *\Delta_{\text{env}}(i,a) )</th>
<th>( \text{ALIGNFTR} )</th>
<th>( *\Delta_{\text{env}}(i,a) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) ( \text{tjô} \text{kí} \text{plïn} )</td>
<td></td>
<td>*</td>
<td></td>
<td>*</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(b) ( \text{tjô} \text{kí} \text{plïn} )</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Stressed mid and high vowels incur a violation of \( *\Delta_{\text{env}}(i,a) \) because they both have the sonority of mid vowels or less, while both avoid violating \( *\Delta_{\text{env}}(i,a) \) because they are both more sonorous than \([\{,\}] \). 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.

**Figure 3.3: Gujarati sonority-driven stress ranking summary**

- \( *\Delta_{\text{env}}(i,a) \) outranking all other sonority-stress constraints, the opposite is the case in Gujarati. The Gujarati system further underscores the point that the sonority-stress constraints must be freely permutable. With \( *\Delta_{\text{env}}(i,a) = *\Delta_{\text{env}}(i,a) = *\Delta_{\text{env}}(i,a) = *\Delta_{\text{env}}(i,a) \) it is clear that there is no fixed ranking of sonority-stress constraints, at least.

### 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 \([\{,\}] \). 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. \([\text{kô} \text{ô} \text{ê} \text{o}] \) ‘does, do’. However, Cardona reports that if the penult \([\{,\}] \) is in an open syllable, stress may fall on the ultima:
(35) Free Variation: C\text{\textcap CV}\text{\textcap CV} (Cardona 1965:33)

\begin{itemize}
  \item \{\text{sí\textcap mí}\} \quad \text{‘land’}
  \item \{\text{k\textcap e}\} \quad \text{‘beginning’}
  \item \{\text{k\textcap e}\} \quad \text{‘does, do’}
  \item \{\text{\textcap w\textcap o}\} \quad \text{‘new’}
\end{itemize}

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

(36) Penult stress: CV\text{\textcap VC} CV

\begin{itemize}
  \item \{\text{wí\textcap N\textcap i}\} \quad \text{‘personally’,} \quad \{\text{[t\textcap N\textcap i]}\}
  \item \{\text{\textcap w\textcap o}\} \quad \text{‘machine’,} \quad \{\text{[t\textcap N\textcap i]}\}
\end{itemize}

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 \{\text{[k\textcap e\textcap e]}\}, with an iamb; FTBIN – as usual – rules out \{\text{[k\textcap e\textcap e]}\}, so resulting in \{\text{k\textcap e\textcap e}\}. It still will not rule out words like \{\text{[\textcap k\textcap a\textcap \textcap k\textcap a\textcap i]}\} and \{\text{[\textcap \textcap i\textcap a\textcap t\textcap a]}\} – these forms do not violate TROCHEE, having left-headed feet, and \{\text{\textcap w\textcap e\textcap e\textcap e}\} outranks FTBIN.

In the grammar with final stress in \{\text{sí\textcap mí}\}, TROCHEE is outranked by \{\text{\textcap w\textcap e\textcap e\textcap e}\}. With this ranking, stress can fall on a final syllable to avoid a penult \text{\textcap w\textcap e\textcap e} producing an iamb. This is illustrated in tableau (37).

(37) \text{\textcap w\textcap e\textcap e\textcap e}\text{\textcap w\textcap e\textcap e\textcap e}\text{\textcap w\textcap e\textcap e\textcap e}\text{\textcap w\textcap e\textcap e\textcap e}\text{\textcap w\textcap e\textcap e\textcap e}}

The second difference between the grammars is in weight-by-position (Hayes 1989). Codas count as moraic in the grammar with \{\text{\textcap w\textcap e\textcap e}\} but not the grammar with \{\text{\textcap w\textcap e\textcap e}\}. It is significant that FTBIN still outranks \{\text{\textcap w\textcap e\textcap e\textcap e}\}; this ranking explains why stress will not leave a penult closed syllable with \text{\textcap w\textcap e\textcap e\textcap e}. In \{\text{\textcap w\textcap e\textcap e\textcap e}\}, for example, candidates with final stress are either \{\text{\textcap w\textcap e\textcap e\textcap e\textcap w\textcap e\textcap e\textcap e}\} or \{\text{\textcap w\textcap e\textcap e\textcap e}\}. Both violate FTBIN – the former because it has an uneven (\sigma\text{\textcap w\textcap e\textcap e\textcap e}) 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).

(38) \text{\textcap w\textcap e\textcap e\textcap e\textcap w\textcap e\textcap e\textcap e}\text{\textcap w\textcap e\textcap e\textcap e\textcap w\textcap e\textcap e\textcap e}\text{\textcap w\textcap e\textcap e\textcap e\textcap w\textcap e\textcap e\textcap e}\text{\textcap w\textcap e\textcap e\textcap e\textcap w\textcap e\textcap e\textcap e}\text{\textcap w\textcap e\textcap e\textcap e\textcap w\textcap e\textcap e\textcap e}}

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 \text{\textcap w\textcap e\textcap e\textcap e} in open syllables has TROCHEE crucially outranked by \{\text{\textcap w\textcap e\textcap e\textcap e}\}.

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, \{\text{\textcap w\textcap e\textcap e\textcap e}\} is less harmonic than any of \{\text{[\textcap k\textcap e\textcap e]}\}, \{\text{[\textcap k\textcap e\textcap e\textcap e]\textcap w\textcap e\textcap e\textcap e}\}, \{\text{[\textcap k\textcap e\textcap e\textcap e]}\}, which in turn are less harmonic than \{\text{[\textcap w\textcap e\textcap e]}\}. However, in final position, \{\text{[\textcap k\textcap e\textcap e]}\} is conflated with non-low vowels for stress: they are all equally avoided. For example, \{\text{[sí\textcap e\textcap e]}\} shows that final \{\text{\textcap e}\} is not more harmonic than penult \{\text{[\textcap w\textcap e\textcap e]}\}. 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’s (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 \text{\textcap w\textcap e\textcap e\textcap e} renders an otherwise active sonority-stress constraint inactive in a specific competition. In Gujarati, \text{\textcap w\textcap e\textcap e\textcap e} is FTBIN. It renders \{\text{\textcap w\textcap e\textcap e\textcap e}\} inactive when one candidate has final stress and the other does not. Such a situation happens for \{\text{[\textcap k\textcap e\textcap e]}\}, for example. The winner is not \{\text{[\textcap k\textcap e\textcap e]}\} because FTBIN rules out the degenerate foot, rendering \{\text{\textcap w\textcap e\textcap e\textcap e}\} inactive.

(39) \text{\textcap w\textcap e\textcap e\textcap e\textcap w\textcap e\textcap e\textcap e}\text{\textcap w\textcap e\textcap e\textcap e\textcap w\textcap e\textcap e\textcap e}\text{\textcap w\textcap e\textcap e\textcap e\textcap w\textcap e\textcap e\textcap e}\text{\textcap w\textcap e\textcap e\textcap e\textcap w\textcap e\textcap e\textcap e}\text{\textcap w\textcap e\textcap e\textcap e\textcap w\textcap e\textcap e\textcap e}}

FTBIN only renders \{\text{\textcap w\textcap e\textcap e\textcap e}\} inactive in this specific competition. FTBIN is irrelevant in other competitions that do not involve final stress (e.g. \{\text{[\textcap k\textcap e\textcap e\textcap e]}\}). \{\text{\textcap w\textcap e\textcap e\textcap e}\} makes the crucial choice in such situations, as shown in tableau (40).

(40) \text{\textcap w\textcap e\textcap e\textcap e\textcap w\textcap e\textcap e\textcap e}\text{\textcap w\textcap e\textcap e\textcap e\textcap w\textcap e\textcap e\textcap e}\text{\textcap w\textcap e\textcap e\textcap e\textcap w\textcap e\textcap e\textcap e}\text{\textcap w\textcap e\textcap e\textcap e\textcap w\textcap e\textcap e\textcap e}\text{\textcap w\textcap e\textcap e\textcap e\textcap w\textcap e\textcap e\textcap e}}
and similar problems – see de Lacy (1997a) for discussion of this constraint in particular.

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) PRAATMRM has a similar effect, and similar problems – see de Lacy (1997a) for discussion of this constraint in particular.

<table>
<thead>
<tr>
<th>(ko)kálos</th>
<th>FTBIN</th>
<th>*ΔPrWd/∅</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (ko)kálos</td>
<td>*ΔPrWd/∅</td>
<td></td>
</tr>
<tr>
<td>(b) ko(§kálos)</td>
<td>*ΔPrWd/∅</td>
<td></td>
</tr>
</tbody>
</table>

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
\[ [\Delta_{\text{PrWd}} / i] \cup [\Delta_{\text{PrWd}} / 1] = [\Delta_{\text{PrWd}} / i] \]

In Gujarati, FTBIN renders *ΔPrWd/∅ inactive in final syllables: FTBIN outranks *ΔPrWd/∅ to prevent final stress in words like [kájre]. This ranking means that FTBIN also outranks *ΔPrWd/1, 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 [(i)káp], [(i)káp], as shown in tableau (42).

(42) /[(i)káp] FTBIN *ΔPrWd/∅ *ΔPrWd/1,∅
| (a) [(i)káp] | *ΔPrWd/∅ |
| (b) [(i)káp] | *ΔPrWd/1,∅ |

The problem illustrated in (42) follows from transitivity of ranking. FTBIN effectively renders *ΔPrWd/∅ inactive in situations of final stress; in other words, in the competition [(kákär)] vs *[(kákär)], FTBIN alone determines the winner, rendering *ΔPrWd/∅’s violations irrelevant. Since *ΔPrWd/∅ – and by transitivity FTBIN – outranks *ΔPrWd/1, FTBIN also renders *ΔPrWd/1 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 *[(i)káp]/[(i)káp] competition.

Because the ranking of the present theory’s constraints is freely permutable, the same implication does not hold. If [FTBIN = *ΔPrWd/∅], it is not necessarily the case that [FTBIN = *ΔPrWd/1]. As established above, it is necessary that *ΔPrWd/∅ outranks FTBIN in this language; the relevant tableau is repeated in (43).

(43) /[(i)káp] FTBIN *ΔPrWd/∅ *ΔPrWd/1,∅
| (a) [(i)káp] | *ΔPrWd/∅ |
| (b) [(i)káp] | *ΔPrWd/1,∅ |

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 *ΔPrWd/1 and *ΔPrWd/∅ to form a single constraint that assigns a violation to a stressed syllable with either a high vowel or a mid vowel (see e.g. Crowhurst & Hewitt 1997). Such a constraint will be called *ΔPrWd/1 ∨ ΔPrWd/∅ here, and the general type of constraint is ‘encapsulated’.

Certainly, encapsulated constraints can produce conflation. For Gujarati, for example, the ranking would be || *ΔPrWd/∅ ∨ ΔPrWd/1 ∨ ΔPrWd/∅ ∨ ΔPrWd/∅ ||, 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 *ΔPrWd/∅, it also outranks *ΔPrWd/1, and ΔPrWd/∅; the result is that FTBIN renders the latter inactive in the same environments as the former. [(i)káp] is incorrectly predicted to surface as *[(i)káp].

(44) /[(i)káp] FTBIN *ΔPrWd/∅ *ΔPrWd/1,∅ *ΔPrWd/∅,∅
| (a) [(i)káp] | *ΔPrWd/∅ |
| (b) [(i)káp] | *ΔPrWd/1,∅ |

Again, there is no ranking that will produce the attested [(i)káp]. 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.

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) PRMRM 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.4.3).

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 ALIGN-σ. 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, *ΔΛw=0 Σo outranks ALIGN-σ-L to produce avoidance of a stressed schwa; the opposite ranking would render *ΔΛw=0 Σo inactive, and therefore stress would ignore sonority.

(45)

<table>
<thead>
<tr>
<th></th>
<th>/pāti/</th>
<th>*ΔΛw=0 Σo</th>
<th>IDENTV</th>
<th>ALIGN-σ-L</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>(a) p̃</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>(b) p̃</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>(c) p̃ti</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 [pāti], where the /t/ has changed to [a]; this change effectively avoids violating *ΔΛw=0 Σo 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).

(46)

<table>
<thead>
<tr>
<th></th>
<th>/pāti/</th>
<th>*ΔΛw=0 Σo</th>
<th>IDENTV</th>
<th>ALIGN-σ-L</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>(a) p̃</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>(b) p̃ti</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>(c) p̃ti</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 former outranks the latter, 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 [p̃ti]—stress cannot help but fall on a schwa. With *ΔΛw=0 Σo outranking IDENTV, though, whichever vowel receives stress changes.

(47)

<table>
<thead>
<tr>
<th></th>
<th>/p̃ti/</th>
<th>*ΔΛw=0 Σo</th>
<th>IDENTV</th>
<th>ALIGN-σ-L</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>(a) p̃</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>(b) p̃ti</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>(c) p̃ti</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.
Positional markedness constraints that are relevant mention at least two distinct {i,u} IDENTV ≥ σ. This section aims to identify the general properties where positional markedness and positional faithfulness differ.

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). The ‘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.

3.5.1 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 *-ΔHV[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.

<table>
<thead>
<tr>
<th>/pita/</th>
<th>*-ΔHV[i,u]</th>
<th>IDENTV</th>
<th>ALIGN-σ-L</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) pita</td>
<td>#1</td>
<td>#1</td>
<td>*</td>
</tr>
<tr>
<td>(b) pita</td>
<td>#1</td>
<td>#1</td>
<td>*</td>
</tr>
<tr>
<td>(c) páti</td>
<td>#1</td>
<td>#1</td>
<td>*</td>
</tr>
</tbody>
</table>

The faithful candidate (a) has a high-sonority unstressed vowel [a], so fatally violates *-ΔHV[i,u]. This leaves candidates (b) and (c). Candidate (b) avoids violating *-ΔHV[i,u] by shifting stress onto the [a]. Candidate (c) also avoids *-ΔHV[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 [a] 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 [a] can be stressed (e.g. [bɛ̃a] ‘batter’).

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 || σ-IDENTV = *2[i,u] || (where *2[i,u] bans all vowels with equal or more sonority than high vowels) can produce vowel reduction in unstressed syllables, after Beckman (1998).
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 [h䦫pافظ] has output candidates [*[h䦫pافظ] and [*[h applyMiddleware]]. These candidates do not differ in terms of faithfulness, so no faithfulness constraint can distinguish them – the entire responsibility falls on markedness constraints.37 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 pIDENT[fr], 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).

3.3.1.2 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 *Δ₀≤[i/u] and *Δ₀≤[a]. As shown in tableau (52), the constraints are in conflict in competition between two candidates from the input /pɨti(ki)t/.38

If *Δ₀≤[a] outranked *Δ₀≤[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, [(pɨti(ki)t) and (pɨti(ki)t)] 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 *Δ₀≤[i/u]). A constraint like LAPSE will do the job (Prince 1983; Selkirk 1984; Green & 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: *Δ₀≤[i,u] ≥ *Δ₀≤[a]. Under this ranking, it seems that stress avoids high vowels (as in [(pɨti(ki)t)]) for schwa (as in [pɨti(ki)t]). 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. *Δ₀/[(a) ≥ *Δ₀/[(e,o) ≥ *Δ₀/[(a)].

Because *Δ₀/[(a] always outranks *Δ₀/[(i,u)], a candidate with stressed [a] will always incur 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 *Δ₀≤[a] universally outranked *Δ₀≤[i,u], the candidate (pɨti(ki) t) would never win.

• Potential solutions and conflation

Prince (1999) identifies four potential solutions to this problem, one of which will be discussed here.39 This solution retains the stringent form of constraints, but keeps a fixed ranking between them. If *Δ₀≤[a] universally outranks *Δ₀≤[i,u], then [pɨti(ki)t] will never beat [(pɨti(ki)t)] 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 || *Δ₀/[(a) ≥ *Δ₀/[(e,o) ≥ *Δ₀/[(a)] is needed in Nganasan to conflate high vowels and schwa. If *Δ₀≤[a] universally outranks *Δ₀≤[i,u], schwa cannot be conflated 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 [pɨti(ki)t] to be favoured over [(pɨti(ki)t)] inevitable if the theory is to deal with conflation.

• Reconsidering the effect

The particular problem of [pɨti(ki)t] vs [(pɨti(ki)t)] will be the focus here since the sonority scale is the focus of this dissertation. To recap, the fear is that *Δ₀≤[i,u] causes a reversal of the sonority hierarchy: stress seemingly avoids high vowels for schwa. However, this is only superficially so.

*Δ₀≤[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.

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.

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 (1999:44f) for discussion.
To illustrate *Δσ≤(i,u)’s structure-minimizing effects, compare two candidates from input [piːkiːtʰ]: (a) [piːkiːtʰi] vs (b) [piːkiːtʰi]. Candidate (a) violates *Δσ≤(i,u) twice, while (b) violates it only once. Sonority clearly plays no crucial role here; the winner is solely determined because *Δσ≤(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 *Δσ≤(i,u) prefers [piːti(k)kiːtʰ] over [(piːt)kik(ʰ)] for two reasons: (i) [piːti(k)kiːtʰ] has less structure than [(piːt)kik(ʰ)] and (ii) *Δσ≤(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 *Δσ≤(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 *Δσ≤(i,u).

So, *Δσ≤(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 [(kìt)kiːtʰ] vs *[(kìt)kìk(ʰ)], 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 *Δσ≤(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. *Δσ≤(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\|C\{i,u\}C\{i,u\} – like all negative markedness constraints through the association relation); every candidate if it contains some structure Σ. In contrast, positive constraints require certain structures: they assign violations to a candidate if it does not contain some structure Σ. For example, the constraint Δσ→[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 *Σ where Σ 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 Σ. In contrast, positive constraints with the form x→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.

\[(53) \quad \begin{align*}
& (a) \quad *\Delta_L \leq \Delta_M \leq *\Delta_H \\
& (b) \quad \Delta_M \rightarrow \Delta_L = \Delta_H \rightarrow \Delta_M = \Delta_H \rightarrow \Delta_L
\end{align*} \]

As an example, the constraint \(\Delta_M \rightarrow \Delta_H\) 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 simplexes. This is because a contour tone as in [pa] satisfies both \(\Delta_M \rightarrow \Delta_H\) and \(\Delta_H \rightarrow \Delta_L\) (i.e. it violates \(\Delta_M \rightarrow \Delta_L\) only), while [pa] violates both \(\Delta_H \rightarrow \Delta_M\) and \(\Delta_H \rightarrow \Delta_L\).

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 \(\Delta_M \rightarrow \Delta_L\), 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 *Δσ→{L} and *Δσ→{L,M}, while (56b) does not (the structural assumptions for rising diphthongs follow McCarthy 1995). This predicts – among other things – that rising diphthongs could be epenthetic.

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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 [l].

- **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).

The 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 [(\textipa{\textipa{pátí}})], [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, *Δσ→{H} requires [i] to bear a high tone, but the non-DTE constraint - *ΔFt→{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 [(\textipa{\textipa{pátî}})].

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)).

In contrast, negative constraints cannot produce such a pattern. Consider the constraints *Δσ/{L} and *-Δσ/{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 \(\ast \Delta \alpha /\Delta \alpha\) 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. Abalum, 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. Abalum, Asheninca, Chukchi, Kobon, Komu, Mordvin), 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. [pátá], [póto], [pótá], [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 – Pantrutz & Pike 1969).


\(^42\) Stress in the Australian language Madimadi has been claimed to exhibit sensitivity to place of articulation of onset consonants (Hercus 1969, Davies 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 [tm] attract stress over those with [l] nuclei in Nanti. It is clear that sonority is not the only relevant factor in this system: it is probably the case that [tm] attracts stress because of its greater moraic content.

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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 [g]. 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: /poti/ → [póti]. 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 [p[ëti]], not as [p[òti]] 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, || X-IDENT[round] ≻ [+round] » IDENT[+round] ||. As shown above, ALLFLNL must be ranked below IDENT[+round].

The form /poti/ is at issue here.

(61) /poti/    IDENT[round]    +[+round] IDENT[+round] ALLFLNL
           (a) pòti      X    X      X
           (b) poti      X    X      *  
           (c) pèti      X    X      *  
           (d) pòti      X    X      *  

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 [pòti] is realized as [p[ëti]], it contrasts with input /peti/, which is realized as [pèti] under the ranking above. In /peti/ → [pèti], 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: [pèti] (from /peti/) vs [p[èti]] (from /poti/). 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).

### 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. 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 peripheral [mid] low (or even -low) +[low] and one or two for height [high] mid low. 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.

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).

- **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

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43 One way around this is if only round vowels reduce to [g]; i.e. /patot/ → [patot]. The ranking || IDENT[round] ≻ IDENT[+round] AllFLNL || could then prevent round vowels from neutralizing, producing [patot], 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.
The 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 Peripherality 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 [a] as more sonorous 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) voiceless stops [e.g. Selkirk 1984, Dell & Elmeslaou 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] or an Obstruent Continuant Feature [voiceless] fricative) stop. Since voiced stops are high on the scale, whereas voiceless fricatives in the former but the opposite ranking 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 smaller scales raises the issue of natural classes: if there is a scale [a i u e o] and a corresponding binary feature, why do [a] and [i u] not act as a natural class for a variety of other phonological processes?

Some of the features have analogues in current feature theories. For example, [i] classes sounds in the same way as [low] does, and [i] 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, [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]? There is no vowel harmony whereby every vowel must be either one of [a i u] or one of [e o a]. However, with a feature like [f] it would be a simple matter to construct such a case. There is similarly no evidence for assimilation and dissimilation of [f].

In general, proposing that multi-valued scales can be decomposed into smaller scales raises the issue of natural classes: if there is a scale [a i u e o] and a corresponding binary feature, why do [a] 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 [dorsal] labial coronal glottal (ch.5§5.3). If this scale is decomposed into a series of binary scales (a) dorsal | labial, coronal, glottal, (b) | dorsal, labial, coronal, glottal | and (c) | dorsal, labial, coronal) glottal | with corresponding features to boot – this predicts that dorsal and labial 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 dissipate in the presence of labials and vice versa: e.g. [kapal] [tapal], cf [tapal] [tapal]. I know of no such dissimilatory 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 [n]. In this particular grammar, because [g] is more marked than [m], /n/ becomes [m]. Tableau (62) illustrates this situation.

\[
\begin{array}{ccc}
\text{anka} & \ast & \text{AGREE}[f] \\
\text{(a) anka} & \ast & \ast \\
\text{(b) amka} & \ast & \\
\text{(c) apma} & \ast & \\
\end{array}
\]

AGREE[f] requires adjacent consonants to agree in f-value (Lombardi 1996, 1999). So, because [n] is [+f] and [k] is [−f], candidate (a) falls afloat of AGREE[f]. The two
remaining options are for /h/ to surface as [m] or [n] – both are [f]. The constraint *γ| 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 /h/ 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 [xoxPlace]. 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, *γ|β, and *γ|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, *γ|α, (b) *β|β, *β|α, and (c) *γ|γ, *γ|β.

  With free ranking of these constraints, all hierarchical relations in the subscales are lost. For example, *β|β can outrank *γ|γ, so eliminating the hierarchy in the scale |γ \ β |.

  Similarly, *γ|α can outrank *γ|β, so reversing the hierarchy |β \ α |; the same is true for the ranking |β \ α | = *γ|β \ γ|α, 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, *γ|β, and *γ|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 | γ \ x | or | x \ γ | on any scale, then there can be no constraint that favours γ 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’ conflation: 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 [e] over [o], 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

- If x and y are members of some scale S and they are conflated into a single category C, then z is between x and y in S (i.e. |x z y| or |y z x|).

(63)

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

<table>
<thead>
<tr>
<th>Categories</th>
<th>Languages</th>
<th>Active Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 i/u</td>
<td>e/o</td>
<td>a</td>
</tr>
<tr>
<td>2 i/u</td>
<td>e/o</td>
<td>a</td>
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</tr>
<tr>
<td>2 i/u</td>
<td>e/o</td>
<td>a</td>
</tr>
</tbody>
</table>

(64) Non-Contiguous Conflation

(a) Stress falls on the leftmost high or low vowel [i u a] [piá], [pié], [pií] [pá], [pá], [pá]
(b) otherwise it falls on a mid vowel: [pá]

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. *Δ(e), *Δ(e/o).

The formal expression of markedness – ch.3

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 [i] stands for any central vowel (e.g. Asheninca hai [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.
47 The high front lax vowel [i] in other English dialects corresponds to [ç] 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. [puʃpi], [kʰɛʃjo]). Mid vowels attract stress away from schwa ([koʃdi], *[koʃdi]), so the present theory predicts that high vowels will attract stress away from [a] too (as indeed they do: e.g. [wisməna], *[wisməna]).

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 [wisməna] instead of [wisməna]. In effect, this situation is one of “Avoid $[s]$ 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 differentiates $x$ from $y$, 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 $x$. For example, [e] is more harmonic than [i] in Gujarati because [i] violates some active constraint while [e] does not. At this point, it doesn’t matter what the constraint is: the present theory offers both $\Delta w_{i} o_{[i]}$ and $\Delta w_{i} o_{[e]}$—either will give the right result. Now, when we say that [e] is conflated with [i] (and [i]), we mean that there is no active constraint that distinguishes the two. The constraint $\Delta w_{i} o_{[i]}$ does distinguish [e] from [i], so it cannot be active. This leaves $\Delta w_{i} o_{[e]}$ as the only possible active constraint. But now [i] must be distinct from [j]: the latter violates the active constraint $\Delta w_{i} o_{[e]}$ 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 [ʔapa] wins is determined by other constraints (i.e. MAX and DEP). The same is true of the present situation: if a candidate violates $\Delta w_{i} o_{[e]}$, it cannot designate that the winning candidate must contain a stressed [a]. Which non-$S$ 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 conflation 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 confluences, 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)

$\mathcal{C}_0 = \{ \mathcal{C}_{i}[i], \mathcal{C}_{e}[e], \mathcal{C}_{o} \mathcal{C}_a \}$

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  and  are distinct when some constraint that distinguishes  from  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. *[a].

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 *[e,o] is active, then so are *[i,u], and *[i,u]. The forced activity of these constraints prevents conflation of the categories to which they refer. For example, since *[i,u] is active, the category ‘stressed schwa’ cannot be conflated with any other category. The same goes for *[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  is conflated at all, it is conflated with the most unmarked scale category – [a] in this case.

(68) Possible conflations under Fixed Ranking

\[
\begin{array}{c|c|c|c}
\text{stress} & \text{vowel} & \text{alignment} \\
\hline
\text{low} & [a] & * \text{align} \\
\text{high} & [a] & *
\end{array}
\]

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) Low-end conflations

\[
\begin{array}{c|c|c|c}
\text{stress} & \text{vowel} & \text{alignment} \\
\hline
\text{low} & [a] & * \text{align} \\
\text{high} & [a] & *
\end{array}
\]

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 *[i,u], *[e,o], and *[i,u] 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 [a]. This type of conflation is called ‘high-end conflation’ here.

**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 (Ø) constraints are provided in (73).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 *\( \text{Ø} /{e,o} \)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 *\( /a \) constraints: they favour candidates with stressed low vowels over all others, and so on through the hierarchy. This point is illustrated in tableau (74).

<table>
<thead>
<tr>
<th>( /\text{tike} / )</th>
<th>*( /a )</th>
<th>*( /{e,o} )</th>
<th>*( /\text{Lu} )</th>
<th>ALIGN-Ø-L</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) ( /\text{tike} / )</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(b) ( /\text{tike} / )</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(c) ( /\text{tike} / )</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(d) ( /\text{tike} / )</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

The tableau shows that the winning form is the one with the stressed low vowel. In a form without low vowels, candidate (c) – with a stressed mid-vowel – would win, and so on through the hierarchy.

As observed in Prince (1999) and my previous work (de Lacy 1999a), the *\( /a \) constraints have the same hierarchical effect as the *\( /a \) constraints, they differ in conflation. While the *\( /a \) constraints cannot conflate [\( /\text{tike} / \) and [\( /\text{i} / \), for example, the *\( /a \) constraints can do so.

(75) Fixed Ranking unstressed syllable-sonority constraints

The net result is that almost any conflation may take place in the Fixed Ranking theory if both *\( /a \)sonority and *\( /a \)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>1</td>
<td>*( /u ) *( /e/o ) *( /{e,o} ) *( /\text{Lu} ) *( /a )</td>
</tr>
<tr>
<td>2</td>
<td>*( /u ) *( /e/o ) *( /{e,o} ) *( /\text{Lu} ) *( /a )</td>
</tr>
<tr>
<td>3</td>
<td>*( /u ) *( /e/o ) *( /{e,o} ) *( /\text{Lu} ) *( /a )</td>
</tr>
<tr>
<td>4</td>
<td>*( /u ) *( /e/o ) *( /{e,o} ) *( /\text{Lu} ) *( /a )</td>
</tr>
<tr>
<td>5</td>
<td>*( /u ) *( /e/o ) *( /{e,o} ) *( /\text{Lu} ) *( /a )</td>
</tr>
<tr>
<td>6</td>
<td>*( /u ) *( /e/o ) *( /{e,o} ) *( /\text{Lu} ) *( /a )</td>
</tr>
<tr>
<td>7</td>
<td>*( /u ) *( /e/o ) *( /{e,o} ) *( /\text{Lu} ) *( /a )</td>
</tr>
<tr>
<td>8</td>
<td>*( /u ) *( /e/o ) *( /{e,o} ) *( /\text{Lu} ) *( /a )</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: [\( /\text{tike} / \)–[\( /\text{i} / \) and [\( /\text{i} / \)–[\( /\text{u} / \); all others have just one (or none). This property points to a general result: even with both the *\( /a \) and *\( /a \) constraints, the Fixed Ranking theory cannot produce systems with two or more conflations.

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

The *\( /a \) constraint that distinguishes [\( /\text{tike} / \) from [\( /\text{i} / \) is *\( /\text{Lu} / \), as shown in tableau (75) above. Hence, it must be inactive. However, *\( /{e,o} \) 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 \( *\text{\textbeta} / \{\text{\textsl{e}}, \text{\textsl{o}}\} \) is active, \( *\text{\textbeta} / \{\text{\textsl{a}}\} \) 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.

(78)

<table>
<thead>
<tr>
<th>(/\text{\textalpha} \text{\textbeta})</th>
<th>( *\text{\textbeta} / {\text{\textsl{a}}} )</th>
<th>( *\text{\textbeta} / {\text{\textsl{e}}, \text{\textsl{o}}} )</th>
<th>ALIGNFTR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) ( *\text{\textalpha} \text{\textbeta}\text{\textalpha})</td>
<td>( * )</td>
<td>( \text{\textsl{a}} )</td>
<td>( * )</td>
</tr>
<tr>
<td>(b) ( *\text{\textalpha} \text{\textbeta}\text{\textalpha})</td>
<td>( * )</td>
<td>( \text{\textsl{a}} )</td>
<td>( * )</td>
</tr>
</tbody>
</table>

The problem just described results from the general property of constraint activation described above. If a constraint \( \text{\textc} \) 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 \( *\text{\textbeta} / \{\text{\textsl{e}}, \text{\textsl{o}}\} \) must be active in Nganasan, \( *\text{\textbeta} / \{\text{\textsl{a}}\} \) must also be active. If \( *\text{\textbeta} / \{\text{\textsl{a}}\} \) is active, then \( \{\text{\textsl{a}}\} \) 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 \( *\text{\textsl{d}} \text{\textsl{sonority}} \) and \( *\text{\textsl{d}} / \text{\textsl{sonority}} \) 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 \( *\Sigma / \Sigma (\Sigma \text{ is a constituent and } x \text{ is some scale category}) \), if there is a corresponding set of constraints \( *\Sigma / \Sigma (\Sigma \text{ is every relevant structural position except for } \Sigma) \) 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).

(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 \( x \in S \), if \( *\Sigma / x + *\Sigma / y \) then \( *\Sigma / x \leq *\Sigma / y \)

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 \( x \) 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).

(80) Fixed Ranking Conflation Implication

For all sets of constraints with the form \( *\Sigma / x \),

where \( x \) is a point on scale \( S \),

and \( \Sigma \) is some structural element [optional]

(i) If \( *\Sigma / x \) is active, then

for all \( x \in S \) s.t. \( x \) \( p \), \( *\Sigma / x \) 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 \( x \in S \) s.t. \( x \) \( p \), \( \Sigma \) is not conflated with any category.

In other words, if \( x \) and \( y \) are distinct categories and \( \{x \} \{y\} \), 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.
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 conflations. In effect, fixed ranking of scale-based constraints makes certain conflations 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 $\Delta_{\text{low}} \leq \Delta_{\text{e.o.}} \rightarrow \Delta_{\text{low}} \not\leq \Delta_{\text{e.o.}}$. When stressed mid vowels are distinct from stressed low vowels, as in Gujarati, then $\Delta_{\text{low}} \leq \Delta_{\text{e.o.}}$ must be active. If it is active, then $\Delta_{\text{low}} \leq \Delta_{\text{e.o.}}$ is also active. If $\Delta_{\text{low}} \not\leq \Delta_{\text{e.o.}}$ is active, then high vowels and mid vowels cannot be conflated, as shown by (81) below:

<table>
<thead>
<tr>
<th>Case</th>
<th>Foot</th>
<th>$\Delta_{\text{low}} \leq \Delta_{\text{e.o.}}$</th>
<th>$\Delta_{\text{e.o.}} \not\leq \Delta_{\text{low}}$</th>
<th>ALIGNFTR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Ft</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b)</td>
<td>Unft</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

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 $\Delta_{\text{low}} \not\leq \Delta_{\text{e.o.}}$ is inactive, ALIGNFTR would have to outrank $\Delta_{\text{low}} \leq \Delta_{\text{e.o.}}$. Such a situation would also render $\Delta_{\text{low}} \not\leq \Delta_{\text{e.o.}}$ 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 section concludes with the point that the property of the Fixed Ranking 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 (∆s) 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

\[
\text{DTE} \quad \text{Ft} \quad \text{ NON-DTEs}
\]

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 [patekili], [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 prosodie 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.

To be precise, the focus is on ∆s,Ft,P – i.e. the Root node non-DTEs of a foot.

(1b). For example, stress falls on the antepenult in [(migilà] because penult stress would result in a foot with a high sonority non-head: *[mi[tgilà]).
of feature values: i.e. \*-$\lambda_\alpha$[ooooSonority]; \*-$\lambda_\alpha$[i,a] is violated by any non-DTE of category $\alpha$ that is more sonorous than a schwa (i.e. [i u 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 non-DTE constraints, then, a foot with the form (CVC) is more harmonic than (CVCa) 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 \*-$\lambda_\alpha$[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 Coda [m] can only appear with monomoraic nuclei and the diphthongs [ai ei] (S 21); no examples of CVM 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] (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.

The formal expression of markedness – ch.4

(b) Else penult

[ idôja ] ‘it drifts’  [ imomkôli ] ‘he tasted (it)’
[ dumdadôgi ] ‘early dawn’  [ am.báisá ] ‘where?’
[ péu.la ] ‘strong’  [ ná.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) \[CVC(\{a\})Ca\] in Kiriwina

(a) \[CVC(\{a\})CiCa\]

[mílula] ‘the face’  [luko-sísi] {clan name}
[ tomčékita ] ‘selfish person’
[ lámlíla] ‘outrigger log’  [ katusawásíla ] ‘clear throat’
[ vijim-kôvilia] ‘to complete’  [ lóádíla ] ‘jungle’
[ kúlia] ‘cooking pot’

(b) \[CV(\{a\})CuCa\]

[lasíkula] ‘pull canoe’  [mélíva] ‘white magic’
[pákula] ‘blame’  [mlom Paísíla ] ‘a red soil’
[lútuga] ‘yam type’  [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).

4.2.1 Kiriwina sonority-driven stress

(a) \[CVC(\{e,o\})Ca\]

[ tomomotúa ] ‘dumb’  [ idôja ] ‘it drifts’
[ káwála ] ‘canoe pole’
[ bonárá] ‘shelf (in house)’

(b) \[CVCV(\{e,o\})C{i,u}Ca\]

[ gíbulúla ] ‘he is angry at’  [ msínsí] ‘grass type’
[ mntum’(a)tu ] ‘shaggy’  [ imomkôli ] ‘he tasted (it)’
[ mdowálí] ‘housefly’  [ dumdadôgi ] ‘early dawn’
[ ívági] ‘he did (it)’
[ ikósiwívi] ‘he puts in’  [ mlópu ] ‘cave’
[ giugulomb”aíígu ] ‘the meeting I love’

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

51 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. beha ‘butterfly’ (303), didoláta ‘hand 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. [lumkoli] ‘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(dój)a], [i(móm(kóli)], [ám(bájí)a].

Forms like [ba(kám)] show that Kiriwina is quantity-sensitive (i.e. [b(ákám)]), so feel have the form (CVX) (e.g. [ba(kám)]), [tau(áu)], or (CVVC) (e.g. [i(dój)a]).

There is no evidence that feet are ever iambic or degenerate. Therefore, the constraints trochee and fnhin are undominated in this language (see ch.3§3.3.2 for definitions).

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

\[
\begin{array}{ccc}
\text{candidate} & \text{fnhin} & \text{alignFTRN} \\
(a) (náu) & * & 1 \\
(b) nau & 1 & * \\
\hline
\text{candidate} & \text{fnhin} & \text{alignFTRN} \\
(a) (náu) & * & 1 \\
(b) nau & 1 & * \\
\end{array}
\]

The only candidate to satisfy both fnhin and alignFTRN is *[náu(ú)ú], a candidate that fatally violates constraints on syllabification.57

The following section shows that the *Δmax constraints account for the cases of antepenultimate stress.

54 It is not uncommon for word-final position to be a particular focus of neutralization. The constraints that produce neutralization of final e or o will not be discussed here since this is tangential to the main point (see Crosswhite 1999 for relevant discussion).

55 The present analysis predicts that words of the shape [CV] have a right-aligned foot, the foot would either be degenerate (e.g. *[nau(ú)ú]) or trimoraic (e.g. *[náu(ú)]). To avoid this situation and allow for the more harmonic non-right-aligned binary foot, fnhin must outrank alignFTRN.

56 Minimal word restrictions show that fnhin outranks either def or max: words must be minimally trimoraic (i.e. a foot – McCarthy & Prince 1986, 1993b).

57 Specifically onset, which favours [náu] over [na(ú)ú]: 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 [lámila], for example, the incorrect output form *[lám(í)la] has a foot with a very high sonority non-DTE: [a]. In contrast, the foot non-DTE [i] in the attested form [(lám)íla] has relatively low sonority. The relevant foot non-DTE constraints are listed in (6).

(6) Foot non-DTE sonority constraints

*Δv ≥ [i,u] “Assign a violation for every foot non-DTE that is equally or more sonorous than high vowels (i u e o a)."

*Δv ≥ [e,o] “Assign a violation for every foot non-DTE that is equally or more sonorous than mid vowels (e o a)."

*Δv ≥ [a] “Assign a violation for every foot non-DTE that is equally or more sonorous than high vowels (a)."

The constraint *Δv ≥ [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 [migila], *Δv ≥ [e,o] must outrank alignFR:

\[
\begin{array}{ccc}
\text{candidate} & \text{fnhin} & \text{alignFTRN} \\
(5) migila & * & 1 \\
(a) (migila) & * & 1 \\
(b) migila & 1 & * \\
\end{array}
\]

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 *Δv ≥ [e,o] is not violated.

In contrast, candidate (b) has the high sonority [a] as a foot non-DTE, fatally violating *Δv ≥ [e,o].

Note that *Δv 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 [i], and the nucleus of the unstressed syllable [a]. In effect, then, the *Δv 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. [l], [w]). This situation is not relevant in Kiriwina.

The constraint *Δv ≥ [e,o] must outrank specifically to the non-DTE of a foot. The only other potentially viable option is for it to refer to PrWd non-DTEs: *Δv ≥ [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 \( -\Delta_{p} \) elements in (a) are \([m\ q\ i\ a]\),
and in (b) they are \([m\ i\ q\ a]\). Therefore, a constraint like \( ^*\Delta_{p} \) will be equally
violated by both candidates since both have \([a]\) as a \( -\Delta_{p} \). Since \( ^*\Delta_{p} \) 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 \( ^*\Delta_{p} \) be active in Kiriwina rather than
\( ^*\Delta_{p} \). \( ^*\Delta_{p} \) is violated by both (CV\{e,o\}) and (CV\{a\}) feet equally,
explaining why words like \([i(d)j]\) have penultimate stress rather than antepenultimate
\( *[i(d)j]. \) In the present approach, this is because antepenultimate stress will not improve
the non-DTE’s sonority significantly enough. \( *[i(d)j] \) still has a high sonority foot non-
DTE, as illustrated in tableau (8).

<table>
<thead>
<tr>
<th>(8)</th>
<th>/idoja/</th>
<th>( ^*\Delta_{p} )</th>
<th>ALIGNFTR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (idoja)</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(b) (idoja)</td>
<td></td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

\( *[i(d)j] \) also provides evidence for the ranking of \( ^*\Delta_{p} \), a constraint that
penalizes feet with \([a]\) non-DTEs. The word \( *\) shows that \( ^*\Delta_{p} \) cannot be active.

If it were, \( *[i(d)j] \) should be less harmonic than \( *[i(d)j]. \)

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penalizes feet with \([a]\) non-DTEs. The word \( *\) shows that \( ^*\Delta_{p} \) cannot be active.

If it were, \( *[i(d)j] \) should be less harmonic than \( *[i(d)j]. \)

<table>
<thead>
<tr>
<th>(9)</th>
<th>/i/idoja/</th>
<th>( ^*\Delta_{p} )</th>
<th>ALIGNFTR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (i/idoja)</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(b) (i/idoja)</td>
<td></td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

The point made above is that both (CV\{e,o\}) and (CV\{a\}) feet are conflated in
Kiriwina: they are equally disharmonic. So, any constraint that distinguishes them – such as \( ^*\Delta_{p} \) – 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 \( ^*\Delta_{p} \) is indeterminable.
Since it assigns the same violations to all feet, its ranking cannot be determined by stress
placement.

The ranking \( ^*\Delta_{p} \) » 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.

\[ (a) \text{mámo)va} \]

\[ (b) \text{bo(nára)} \]

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 \( *[\text{bóna}ra] \) and \( *[\text{bo(nára)}] \)
incur the same violations of \( ^*\Delta_{p} \), so retraction would achieve nothing.

<table>
<thead>
<tr>
<th>(10)</th>
<th>/i/ghibuhá/</th>
<th>( ^*\Delta_{p} )</th>
<th>ALIGNFTR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (ghibuhú)</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(b) (ghibuhú)</td>
<td></td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

The same ranking accounts for the lack of retraction in \( *[\text{tomtómo}ta] \): the retracted
form \( *[\text{tomtómo}ta] \) 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 \( /\text{mi lá}/ \) are \( /\text{mi lá}/ \) and \( /\text{mi lá}/ \), the latter is more harmonic.

The same ranking accounts for the lack of retraction in \( /\text{tomtólópa}/ \): the retracted
form \( *\) does not improve DTE sonority; other relevant examples are given in
(4a).

- **DTE constraints in Kiriwina**

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For example, the two prime competitors from \( /\text{mi lá}/ \) are \( /\text{mi lá}/ \) and \( /\text{mi lá}/ \), both of which are equally
harmonic. Therefore, retraction would be gratuitous, as shown in tableau (10).

\[ (11) \]

\[ /\text{bonára}/ \]

\[ /\text{bo(nára)} \]

Since \( *\) incur the same violations of \( ^*\Delta_{p} \), so retraction would achieve nothing.

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 \( *\) and \( *\) incur the same violations of \( ^*\Delta_{p} \), so retraction would achieve nothing.
If *\( \Delta_l \leq [e,o] \) (or *\( \Delta_{sy} \leq [e,o] \)) outranked ALIGNFT, (b) would win.

- **FTBIN**
  Finally, it is possible to establish a ranking between FTBIN and *\( \Delta_l \geq [e,o] \). One way to avoid violations of the non-DTE constraint is to reduce the size of the foot. For example, [mi(gi)la] 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, FTBIN must outrank *\( \Delta_l \geq [e,o] \).

\[
\begin{array}{c|c|c}
\text{PrWd-Root alignment} & \text{PrWd-Suffix alignment}\\
\end{array}
\]

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-gula] ‘it originated (there)’ since it must be prosodified as *[mi(gi)la]*, where {} mark PrWd boundaries. The word cannot be prosodised as *[(mi-gi)la]* because this prevents the root’s and PrWd’s left edges from coinciding.

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.\(^{56}\)

(13)

<table>
<thead>
<tr>
<th>/migi/</th>
<th>FTBIN</th>
<th>*( \Delta_l \geq [e,o] )</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) migila</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) migila</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 TROCHEE must also outrank *\( \Delta_l \geq [e,o] \), otherwise the iambic footed *[mi(gi)la]* would win.

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

| [lami] | ‘outrigger log’ |
| [mequa] | ‘white magic’ |
| [lagata] | ‘yarn type’ |
| [latu-sawala] | ‘clear throat’ |
| [migi] | ‘the face’ |
| [tom-mekita] | ‘selfish person’ |

Morpheme boundaries before the antepenult are irrelevant: e.g. [i–(buku)la] ‘it bore in clusters’, *[i–buku(la)], [luku–(s)iga] ‘clan name’.

\(^{56}\) Neither S nor L give examples with multiple suffixes.
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 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 [CVVC/C(e,o,a)C] 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 rolwaga ‘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)

*-$\Delta_{v2}$[i,u] *-$\Delta_{v2}$[e,o]

ALIGN-FTR

*-$\Delta_{v2}$[a] *-$\Delta_{v1}$r[\{i,u\} \{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 *-$\Delta_{v2}$[e,o] and ALIGN-FTR. 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 ALIGN-FTR outranks *-$\Delta_{v2}$[\{i,u\}] or ALIGN-FTR. This is the ranking that forces DTE to retract if doing so will result in a foot with a low sonority non-head.

It is equally important that ALIGN-FTR outranks *-$\Delta_{v2}$[\{a\}] or ALIGN-FTR. This 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 *-$\Delta_{v2}$[\{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, *-$\Delta_{v2}$[\{e,o\}] would require stress to fall on a low vowel even when the foot non-DTE was not at issue: e.g. [tabüsũ] ‘paddle’ would be *[tabüsũ].

Conversely, if the non-DTE constraint *-$\Delta_{v2}$[\{e,o\}] had to outrank its DTE counterpart *-$\Delta_{v2}$[\{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 section 3 in which only the sonority of the head is significant.

The final point that deserves comment is the position of *-$\Delta_{v2}$[\{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 ALIGN-FTR 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 [\{i,u\}] [\{e,o,a\}] and [\{a\}], though. The inactivity of long vowels is contrastive medially (e.g. [bo\{ru\}] ‘dirty’ cf. [bo\{ru\}] ‘tomorrow’), but of the short vowels only [a] is found finally (e.g. [\{na\}ma\}] ‘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.

Syllable structure is (C)V(C) (e.g. [bim.be\{ru\}] ‘mosquito’, [mo\{ru\}] ‘dirty’), but of the short vowels only [\{a\}] is found finally (e.g. [\{na\}ma\}] ‘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.

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 \[ contamination \times \time
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. [hunˈtʃəˈbɪː] ‘ice, sleet’) while words with final stress have high tone on the ultima only (e.g. [ˈmækiˈnæː] ‘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. [ˈkɪtɪː] ‘kettle’).

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

The words [makinˈnæː] ‘car’ (18) and [ˈkʊrˈtʊm̩i] ‘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 [námæ], while Gujarati has [sáː]. This difference will provide evidence for foot non-DTE constraints in Harar Oromo.

4.2.2.2 Non-DTEs

The non-DTE constraints provide an account for final stress in words like [námæ].

In all words with penult stress, the non-head syllable of the foot contains a low sonority vowel [ɛ: ɪ ʊ ʊː], but never the highest sonority [a] or [aː]. For example, in [ˈtʃəlɛː] ‘knife’, the non-DTE of the foot contains the nucleus [ɛː]; the same position in [ˈkʊrˈtʊm̩i] ‘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. [*([námæ]), [*([ɡɚˈbæː])].

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

Avoidance of a high-sonority non-DTE is motivated by the constraint *-Δɛːa.

Candidate (a) violates *-Δɛːa because one of its foot non-DTEs is [a]. As shown by candidates (b) and (c), the only sort of foot that avoids violating *-Δɛːa is a degenerate
one. By having a degenerate foot, foot non-DTEs are eliminated: there is no vocalic $\Delta_1$ in [na(má)] or *[ná]ma].62 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).

$$
\begin{array}{|c|c|c|}
\hline
\text{candidate} & \text{ALIGNFTR} & \text{FTBIN} \\
\hline
(a) (gárbac) & & \\
(b) gárbac & & \\
(c) (qúrbac) & & *!
\hline
\end{array}
$$

In short, Harar Oromo and Kirivina present different responses to the same problem – i.e. high sonority foot non-DTEs. While Kirivina 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 *-$\Delta_1 \geq [a]$ is active in its system while *-$\Delta_1 \geq [e,o]$ is not. This latter point is shown by words like [áble] ‘knife’, *[áble] vs [úrba(j)] ‘knife’, *[ab(lé)] vs [ur(bá)] ‘knife’. In contrast, *-$\Delta_1 \geq [e,o]$ is active in Kirivina while *-$\Delta_1 \geq [a]$ 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).

$$
\begin{array}{|c|c|c|}
\hline
\text{candidate} & \text{ALIGNFTR} & \text{FTBIN} \\
\hline
\text{namá} & *-$\Delta_1 \leq [e,o]$ & \\
\text{na(má)} & & *
\hline
\end{array}
$$

The problem illustrated above is that there is no motivation for stress to avoid penult [a]: the constraint *-$\Delta_1 \leq [e,o]$ treats a penultimtate [a] the same as a final [a], 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 *-$\Delta_1 \geq [a]$, due to the initial syllable’s [a]. This form shows that FTBIN, and not TROCHEE, is the crucially dominated constraint here.
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, Baetsch 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 (CiCa) 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. ([mi]gila], *[mi(gila)]). In contrast, (CiCa) is avoided (e.g. [sa(ma)ni] ‘admit’, *[si(ma)ni]). The same is true for Harar Oromo: (CiCa(i)) is avoided (e.g. [ma(ka)ki] ‘market’, *[ma(ga)la]), whereas (CiCi) is not (e.g. [ki(la)] ‘kettle’, *[ki(la)l]).

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.55

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.

---

55 A similar problem arises with the OCP, which is another type of sequential constraint. Suzuki (1998:2.4.3.2) uses the constraint OCP[αβ] to ban two instances of [α] within a foot. This constraint – and others like it – cannot be used to deal with Kiriwina stress: OCP[αβ], incorrectly favours *[sō(na)ra] over [boo(na)ra]. Moreover, OCP[αβ] can be rejected on typological grounds: it favours the foot (CiCa) over (CiCa) even though the latter has a higher sonority stressed syllable, so producing a situation of markedness reversal.

---

The formal expression of markedness – ch.4

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 (CiCa) feet differently, even though they do not differ in sonority clining. 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, Baetsch 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 -αειωθ) is inadequate, failing to distinguish forms such as Kiriwina’s [(mi)gila] from [mi(gila)].

- **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. *-ειωθM, *-ειωθH.

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. *[ˈʃinara] ‘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. [lù'Ìrà], *(lùlùrà) ‘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 ALIGN-FtL. This is illustrated in tableau (23).

(23)

<table>
<thead>
<tr>
<th></th>
<th>*-À[0]=M</th>
<th>ALIGN-FtL</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>(b)</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></th>
<th>*-À[0]=a</th>
<th>ALIGN-Φ-R</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>(b)</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 retraction from a penult low vowel onto the antepenult if the ultima contained a high vowel (e.g. /pakali/ → [(päkälì]), *[pat(kälì)]; this is the exact opposite situation to Kisirima (§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.

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 sonority-driven 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 | /fûnoloyi/ |
| Semi-formal register | /fûnoloyi/ |
| Very Informal | /fûnoloyi/ |
| No register | * /fûnoloyi/ |

The Semi-formal register form [fûnoloyi] 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 [fûnoloyi] 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. [(fûnol)]oyi].

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, the difference in reduction in [fûnoloyi] 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. [(fûnol)]oyi].

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 (*-À[0]=[a,u]) and on non-DTEs of the ProsodicWord (*-À[0]=a=[c,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 (* /fûnoloyi/) is the focus of §4.3.3. §4.3.4 contains a summary.

4.3.1 Dutch Semi-formal reduction: Description


---

John McCarthy points out that the same pattern is seen in flapping in English. For example, repetitive is acceptable as [r[ep]t[ep]] (formal), [r[ep]t[ep]] (standard), and [r[ep]t[ep]] (very casual), but never *[r[ep]t[ep]]. 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.
1987, Oostendorp 1995). 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 [ə] 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 [(lōkə)mət(ə)f], not *[l(lōkə)mət(ə)f)]. The category ‘weak position of a foot’ is effectively equivalent to ‘foot non-DTE’ (-Δt), 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 -Δt 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 *-Δt≠{:ja}, which bans high sonority elements in foot non-DTEs alone.

As implied above, neither primary nor secondary stressed vowels ever undergo reduction: e.g. [gālba], *[g(š)la]; [(pərə)]diss), *[p(ə)rə]diss)] (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. [kɔlə], *[kโльa] ‘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 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

  ![Graphical representation](image-url)

  - [k(ka)m(ə)] karamel
  - [s(ɪ)yə]r(ə)t(ɪ)] sigaret
  - [k(ʃ)ɔ]b(ə)r(ə)t(ə)r] collaborateur
  - [j(ɛ)r(y)z(ə)]l(ə)m(ə)] Jerusalem
  - [r(æ)ð(ə)s)] radj(ɪ) ‘radjis’
  - [ʃ(ə)p(ə)k(ə)l(ə)ps)] apocalypsis
  - [p(ə)nt(ə)]p(ə)n(ə)m(ə)] panoramaick

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

  - [p(ə)ʊ(ə)z(ə)]d(ə)] procé(ˈ)dɛs ‘process’
  - [s(ɒ)n(ə)]t(ə)r(ə)t(ɪ)] literatuur
  - [ɛn(ə)m(ə)]economie
  - [s(ə)n(ə)]t(ə)r(ə)sent(ə)] antecedent
  - [s(ɪ)n(ə)]t(ə)r(ə)m(ə)] epidemic

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

  - [k(ə)p(ə)l(ə)]s(ə)l(ə)] chocola ‘chocolate’
  - [s(ɪ)m(ə)]t(ə)r(ə)limonade
  - [k(ə)p(ə)l(ə)]s(ə)l(ə)] pelot(ə)n ‘platoon’
  - [k(ə)p(ə)l(ə)]s(ə)l(ə)] lokomotief
  - [e(κ)ɔ]n(ə)m(ə)] economie
  - [t(ə)p(ə)l(ə)]t(ə)m(ə)] tomaat ‘tomaato’
  - [k(ə)p(ə)l(ə)]s(ə)l(ə)] tomaat ‘tomaato’

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

  - [k(ə)p(ə)l(ə)]s(ə)l(ə)] karikatuur
  - [m(ə)n(ə)]n(ə)] minnaat
  - [k(ə)p(ə)l(ə)]s(ə)l(ə)] s(ə)n(ə)]t(ə)certificaat

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

  (a) /y/ does not reduce

  - [m(ə)n(ə)]f(ə)(k(ə)t(ə)r] manuf(ə)kt(ə)r ‘draper(ə)’
  - [s(ɪ)m(ə)]t(ə)l(ə)] stimulus
  - [k(ə)m(ə)]m(ə)] communist

  (b) /u/ does not reduce

  - [k(ə)p(ə)l(ə)]s(ə)l(ə)] j(ə)l(ə)oezi

  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.66 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. \( \Lambda \), and \( \Delta \text{prWd} \)), in some cases crucially ranked with respect to each other.

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

### 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/ \( \rightarrow \) [(litàr)atyr]literatyr. 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 \( \sim \Delta \text{prWd} \geq [e,o] \) 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 || \( \sim \Delta \text{prWd} \geq [e,o] \times \text{IDENT\[V\]} \) reduction of /a/ and /e/ will take place in all unstressed positions, as shown in tableau (31).

<table>
<thead>
<tr>
<th>antecedent</th>
<th>( \Lambda )</th>
<th>( \sim \Delta \text{prWd} \geq [e,o] )</th>
<th>IDENT[V]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (lit)(erat)(yr)</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) (lit)(e)(rat)(yr)</td>
<td>*</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. \( \sim \Delta \text{prWd} \) refers not only to unstressed syllables within feet, but also ‘stray’ (i.e. unfooted) syllables. In [(litàr)atyr], only the first schwa is a \( \sim \Delta \text{prWd} \), the second is not a foot non-DTE because it is not dominated by a Ft node. If only \( \sim \Delta \text{prWd} \geq [e,o] \) were active, the output would be *[lit(à)rat(yr)] without reduction in the stray syllable.

#### Blocking reduction in stressed syllables

The constraint \( \sim \Delta \text{prWd} \geq [e,o] \) promotes reduction in both secondary stressed and unstressed positions. It therefore favours \(*[[\text{ont}]\text{at}(d\text{int})] \sim \text{antenct}], \) with reduction in the secondary stressed syllable, over the actual winner \([\text{ont}]\text{at}(d\text{int})\]. 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 \( \sim \Delta \text{prWd} \) refers to all syllables that do not bear main stress (i.e. secondary stressed and unstressed syllables).

The DTE constraint \( \Lambda \) blocks reduction in stressed syllables by banning schwa in precisely that position. The constraint also has the incidentally desirable effect of explaining why [a] is never permitted in stressed position: with this ranking, underling /y/ will be forced to peripheralize if it ends up with stress: i.e. /pét/ \( \rightarrow \) [pêt] (or some other peripheral vowel), *[pät]*. \( \Lambda \) must outrank \( \sim \Delta \text{prWd} \geq [e,o] \), as shown in (32).

<table>
<thead>
<tr>
<th>antecedent</th>
<th>( \Lambda )</th>
<th>( \sim \Delta \text{prWd} \geq [e,o] )</th>
<th>IDENT[V]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (ont)a(ot(dint))</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) (int)a(ot(dint))</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 \( \sim \Delta \text{prWd} \geq [e,o] \). The constraint IDENT\[high\] can be used to avoid this result. If IDENT\[high\] outranks \( \sim \Delta \text{prWd} \geq [e,o] \), the [-high] /a/ and /e/ will not be able to raise to [+high] /i/; however, they will be able to reduce to the [-high] [a].

<table>
<thead>
<tr>
<th>antecedent</th>
<th>IDENT[high]</th>
<th>( \sim \Delta \text{prWd} \geq [e,o] )</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (ont)a(ot(dint))</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) (int)a(ot(dint))</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 /i/-reduction below.

The final point of this section is that it is significant the constraint \( \sim \Delta \text{prWd} \geq [1,1] \) is used here rather than \( \sim \Delta \text{prWd} \geq [1,1] \). This difference accounts for the fact that /i/ does not reduce in unfooted unstressed positions: e.g. [mi(mnùt)] minuat, *[mm(mnùt)] (cf [rr(dés)s]), *[rd(és)] ‘radish’). To prevent reduction of /i/ in stray syllables, IDENT\[V\] must outrank \( \sim \Delta \text{prWd} \times \text{IDENT\[V\]} \), as shown in tableau (34).

<table>
<thead>
<tr>
<th>antecedent</th>
<th>( \sim \Delta \text{prWd} \geq [1,1] )</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (mi(mnùt))</td>
<td>*</td>
</tr>
<tr>
<td>(b) (m(mnùt))</td>
<td>*</td>
</tr>
</tbody>
</table>
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 \*-PrWd that are not \*Ft. 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 \(\text{o}/\) and \(\text{i}/\) reduction: Foot non-DTEs

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

- \(\text{i}/\) reduction

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

(36)\
<table>
<thead>
<tr>
<th>(\text{individu})</th>
<th>*-Ft(\text{t}{\text{e},\text{o}})</th>
<th>IDENT(\text{V})</th>
<th>*-PrWd(\text{t}{\text{e},\text{o}})</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) ((\text{ind\ ŋ})v(ð dú))</td>
<td>*</td>
<td></td>
<td>**</td>
</tr>
<tr>
<td>(b) ((\text{ind\ ŋ})v(ð dú))</td>
<td></td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>
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. [(kömy)(nist)] communist, *[(köma)(nist)] jaloezie, *[(gola)(zi)] jaloëzie. As with the lack of /o/ reduction in stray syllables, this effect can be ascribed to the constraint IDENT[round]. If IDENT[round] outranks neither /y/ nor /u/ will reduce, as shown in tableau (40).

(40) /komynist/ IDENT[round] *-Δu≥[1,u]   
   ** (a) (kömy)(nist)   IDENT[round] *   *   *   *   *   *
   (b) (kömš)(nist)  IDENT[round]  *!

/y/ cannot reduce to any other vowel here: reducing to [u] or [o] will still incur violations of *-Δu≥[1,u].

This ranking shows that there is a crucial difference between the foot-level *-Δu≥[e,o] and *-Δu≥[1,u] in Dutch. The former outranks IDENT[round] while the latter does not: || *-Δu≥[e,o] = IDENT[round] || *-Δu≥[1,u] ||. *-Δu≥[e,o] must outrank IDENT[round] to allow /o/ to reduce in foot non-DTEs, while IDENT[round] must outrank *-Δu≥[1,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.

The fact that the PrWd-level constraint *-Δuvw≥[1,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, *-Δu≥[e,o] must outrank the faithfulness constraints IDENT[round]. Similarly, to force neutralization of /i/ in all unstressed syllables, *-Δuvw≥[1,u] must outrank IDENTV. However, since reduction of /y/ and /u/ is blocked in stray syllables, IDENT[round] must outrank *-Δuvw≥[1,u]. The example in (41) is /lokømot(tif)/, which is realized as [(loko)(mo(tif))] in the informal register, compared with [(lökø)(mo(tif))] in the Semi-formal register.

(41) Informal reduction of /o/ /lokømot(tif)/ IDENT[round] * * *   
   ** (a) (lökø)(mot(tif))   IDENT[round]  *   *   *
   (b) (lökø)(mo(tif))  IDENT[round]  *!

Reduction of /y/ and /u/ in foot non-DTEs requires the ranking || *-Δu≥[1,u] » IDENT[round] ||.
Crosswhite (1999) for extensive discussion. Impossible reductions from taking place in the foot non-DTE and stray syllables. See different faithfulness (Beckman 1998, Casali 1997).

This does not prevent faithfulness (Beckman 1998, Casali 1997).

It seems reasonable, given theories of positional faithfulness (Beckman 1998, Casali 1997).

See Kager (1989:298-9) for a detailed proposal in (43) that reduction in stray syllables implies reduction in foot non-DTEs.

Kager’s Generalization falls out from the present theory: from input /fônol oyv]/, /fônol oyv]/ is harmonically bounded by the candidate with reduction in the foot non-DTE alone /fônol oyv]/.

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 constraints used here not only account for vowel reduction in the non-formal registers, but also for the unattested reduction pattern /fônol oyv]/. I adopt Kager’s proposal in (43) that reduction in stray syllables implies reduction in foot non-DTEs.

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, /fônol oyv]/ is less faithful than /fônol oyv]/ 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. /aélle; idóləl/. 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 [θ] onsets cannot reduce’, since there is an epenthetic [θ] at the beginning of all vowel-initial lexical words, and [θ] is epenthized in V-initial medial syllables after [a]; e.g. /bakθobab/, /málθi/nt. 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 [θ] are placeless (cf chs.5, 6, 7). The issue is somewhat complex, though: see Kager (1989:298-9) for a detailed discussion.

The formal expression of markedness – ch 4

In terms of markedness constraints, /fônol oyv]/ fares no better on any markedness constraint than /fônol oyv]/. Specifically, for all *-ΔWw's constraints, /fônol oyv]/ and /fônol oyv]/ incur the same number of violations. However, /fônol oyv]/ incurs fewer violations than /fônol oyv]/ for several constraints (e.g. *-ΔWw[1,u]).

In short, /fônol oyv]/ is a harmonic bound for /fônol oyv]/; the latter incurs a subset of the former’s violations. Tableau (44) illustrates this point.

---

67 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).

68 This does not prevent different reductions from taking place in the foot non-DTE and stray syllables. See Crosswhite (1999) for extensive discussion.

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The formal expression of markedness – ch 4

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68 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. [kairô], *[kairoj] (K299). Similarly, final open syllables are irreducible (Kager 1989: 303-4): e.g. cola, tångere, köfie, Malmö, 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 scope 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.50

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: *-\(\Delta_0\subseteq\{i,u\}\), \(-\Delta_0\subseteq\{e,o\}\), \(-\Delta_0\subseteq\{i\}\), and \(-\Delta_0\subseteq\{e,o\}\). These constraints are demonstrably distinct in Dutch, as they interleave with faithfulness constraints. For example, \(-\Delta_e\subseteq\{e,o\}\) outranks IDENT[round] in the Semi-formal register, while \(-\Delta_e\subseteq\{i\}\) 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 \(-\Delta_i\) 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.

50 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: möer, profésseur, rüder. However, reduction is easiest when the final vowel is immediately post-tonic: final reduction in words suffixed on the antepenult is more difficult: lucifer, Jupiter, rubies, Aristoteles. 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 (möer) – reduce more easily, showing that foot non-DTE constraints have a greater effect, as they do generally in the language.

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 Dutch theory: a segment can be both a DTE and a non-DTE. For example, the [i] in [pá.či] 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. [e].

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, Elias 2000). 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 o 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 \([\text{a}]\), 13 \([\text{e}]\), 10 \([\text{u}]\), 7 \([\text{i}]\), 5 \([\text{o}]\), 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>Hohan</td>
<td>Koenstowicz &amp; Kisseberth (1971)</td>
</tr>
<tr>
<td></td>
<td>Chukchi</td>
<td>Chukotko-Kamchatkan</td>
<td>Krause (1980)</td>
</tr>
<tr>
<td></td>
<td>Itelmen</td>
<td>Chukotko-Kamchatkan</td>
<td>Bobaljik (1997)</td>
</tr>
<tr>
<td></td>
<td>Karo Batak</td>
<td>Sandic</td>
<td>Woolams (1996)</td>
</tr>
<tr>
<td></td>
<td>Ladakhi</td>
<td>Tibetan</td>
<td>Koskal (1939)</td>
</tr>
<tr>
<td></td>
<td>Malay</td>
<td>Sandic</td>
<td>Ahmad (1994)</td>
</tr>
<tr>
<td></td>
<td>Mongolian</td>
<td>Altaic</td>
<td>Svan (1995)</td>
</tr>
<tr>
<td></td>
<td>Palestinian Arabic</td>
<td>Semitic</td>
<td>Abu-Salam (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>Muskokean</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>Malay</td>
<td>Sandic</td>
<td>Ahmad (1994)</td>
</tr>
<tr>
<td></td>
<td>Telugu</td>
<td>Dravidian</td>
<td>Hame (1992)</td>
</tr>
<tr>
<td></td>
<td>Manam</td>
<td>Oceanic</td>
<td>Lichtenberk (1983:32)</td>
</tr>
<tr>
<td></td>
<td>Mâori</td>
<td>Polynesian</td>
<td>de Lacy (2002a)</td>
</tr>
<tr>
<td></td>
<td>Moatânes 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>Fäh (1985)</td>
</tr>
<tr>
<td></td>
<td>Pápia</td>
<td>Aztecian</td>
<td>Campbell (1985)</td>
</tr>
<tr>
<td></td>
<td>Kannada</td>
<td>Dravidian</td>
<td>Sridhar (1990)</td>
</tr>
<tr>
<td></td>
<td>Kodava</td>
<td>Dravidian</td>
<td>Ebert (1996)</td>
</tr>
<tr>
<td></td>
<td>Tamil</td>
<td>Dravidian</td>
<td>Vasanthakumari (1989)</td>
</tr>
</tbody>
</table>

The table omits languages with more than one epenthetic vowel. See §4.4.2 for discussion.

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 \([\text{a}]\) 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 \([i]\), \([\text{a}]\), and (to some extent) \([\text{i}]\), 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 – \([\text{e}], [\text{e}'], \text{and (to some extent) } [\text{e}]\) – 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. \([u, o, ə, e]\)).
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-IO</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) al.s</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 a].

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

The constraint *Δa≤[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 *-[a], favours [a] over [a] in unstressed syllables, so incorrectly favouring *[ålq] over [(ålq)]. Since [a] is the worst type of non-DTE (as it is the most sonorous element), *Δa≤[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>/ålqs/</th>
<th>*Δa≤[e,o]</th>
<th>*-[a],</th>
<th>*-[a]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) álq</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 epenthized in the DTE of α when some DTE constraint with the form *Δa≤[e,o] outranks all non-DTE constraints of the form *Δα≤[e,α], where β is a higher prosodic category than α. In Coos, for example, *Δa≤[e,o] outranks all *-Δα≤[e,α] and so on.

- a > i > e

To conclude with an interesting complexity of the Coos system, it seems that [a] is not epenthized in all environments: after [s], the epenthetic vowel is [i] (e.g. [đensći] cf [đensćići] ‘the prairie he came’, [haršigi] cf [haršenjiqpm] ‘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 AGREEMENT[coronal] here (after Hume

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4.4.1 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 [s], and the long vowels [i: e: a: o: u:]. 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 ft hs]). Nuclei may contain a short vowel, long vowel, or diphthong. Examples of syllables can be seen in [dmsn.ts], ‘through a prairie’ and [ha.ta:ji.me] 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

/śmชำระx/ → [śmชำระ] ‘lunch with me’ (315)
/ślินখx/ → [ślินখ] ‘they two came through’ (315)
/śqাx/ → [śqাx] ‘two are afraid of it’ (315)
/ślিনখx/ → [ślিনখ] ‘he was astonished’ (315)
/শেখালx/ → [শেখাল] ‘they two have bows’ (315)

/b) Epenthesis in word-medial clusters (p.309)³³

/śqাx/ → [śqাx] ‘it is spread out’ (309)
/শেখালx/ → [শেখাল] ‘he arrived’ (309)

As an example, /alqs/ cannot be faithfully output with an acceptable coda *[ålq], so [a] is epenthized to resolve the problem *[ålq]. In ranking terms, a constraint (or constraints) against inadmissible coda clusters must outrank DEP-IO. A detailed account

³³ It is not clear why /śqাx/ cannot be repaired by a single epenthetic vowel *[śqাx]. Frachtenberg (1922) provides no relevant comments, so I leave the issue aside here. 


4.4.1.2 Epenthetic [i ə]

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 \{a ə\}. 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 1992), where verbs and nouns end in a vowel (Paul de Lacy 1992, Clements & Hume 1995). \textsc{agree}*[coronal] is not otherwise active in Coos, but emerges in epenthesis, just as *\(\Delta R_{\text{V}}\{e, o\}\) emerges. \textsc{agree}[coronal] must outrank *\(\Delta R_{\text{V}}\{e, o\}\) to block epenthesis of the low (non-front) vowel [a].

However, this process raises the question of why [i] is epenthized rather than [e] since both could satisfy \textsc{agree}[coronal]. An answer is provided by lower-ranked DTE markedness constraints. Since the constraint *\(\Delta R_{\text{V}}\{e, o\}\) 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 *\(\Delta R_{\text{V}}\{e, o\}\) will favour the latter over the former. The result is illustrated in tableau (48).

<table>
<thead>
<tr>
<th></th>
<th>\textsc{agree}[coronal]</th>
<th>*(\Delta R_{\text{V}}{e, o})</th>
<th>*(\Delta R_{\text{V}}{e, o})</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b)</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(c)</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

To be more complete, [e] can be prevented from winning by having *\(\Delta R_{\text{V}}\{e, o\}\) outrank all DTE constraints that favour [e] over [i] – i.e. *\(\Delta R_{\text{V}}\{i, a\}\).

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

4.4.1.3 Epenthetic [e]

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.

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.

\textbf{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 \textsc{agree}*[Vd] here, requiring harmony between adjacent vowels.

\sc{agree}*[Vd] outranks markedness constraints that favour a particular vowel over all others, like the DTE constraint *\(\Delta R_{\text{V}}\{i, e\}\), which favours [i] over all other vowels. Tableau (50) illustrates this ranking. \textsc{nocoda}, a constraint that bans coda consonants (Prince & Smolensky 1993), outranks DTE constraints in Maga Rukai, so motivating epenthesis.

<table>
<thead>
<tr>
<th></th>
<th>\textsc{agree}[Vd]</th>
<th>*(\Delta R_{\text{V}}{i, e})</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>(b)</td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

However, *\(\Delta R_{\text{V}}\{i, e\}\) is not inactive. Its effect emerges in epenthesis after [a], as in /tkorpa/ ‘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.

\textsuperscript{72} To summarize, Hsin (2000) shows that [dmeIg] derives from a form with underlying /a/ and /i/, which I take to be /damIli/ here. Vowels in the weak member of a foot are prohibited, so *[damIli] is banned. Instead of deleting, [a] coalesces with the following vowel, forming [dmeIg]. Finally, epenthesis takes place, producing [dmeIg]. This proposal explains why the negative form is [dimmIli]: the negative consists of a mora, which forces the underlying [i] to metathesize. The result is that neither vowel is deleted, so showing the true quality of the input vowels. If the input was /damIli/ – i.e. the copy vowel was underlying – the negative would be *[damI];

\textsuperscript{73} \textsc{nocoda} does not cause word-medial epenthesis (e.g. [tkaslu][d], *[tkaslu][d]). There are two possible reasons for this: (1) \textsc{continuity} 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 $\neg \text{AGREEV}[a]$. This situation is illustrated in tableau (51).

(51)

<table>
<thead>
<tr>
<th>(/to)kpàŋa/</th>
<th>$\neg \text{AGREEV}[a]$</th>
<th>$\neg \text{AGREEV}[a]$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) tokpàŋa</td>
<td>$\text{AGREEV}[a]$</td>
<td>$\text{AGREEV}[a]$</td>
</tr>
<tr>
<td>(b) tokpàŋa</td>
<td>$\neg \text{AGREEV}[a]$</td>
<td>$\text{AGREEV}[a]$</td>
</tr>
<tr>
<td>(c) tokpàŋa</td>
<td>$\neg \text{AGREEV}[a]$</td>
<td>$\neg \text{AGREEV}[a]$</td>
</tr>
</tbody>
</table>

The constraint $\neg \text{AGREEV}[a]$ 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 $\neg \text{AGREEV}[a]$ 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, $\neg \text{AGREEV}[a]$ must outrank all DTE constraints that promote [a] and more sonorous elements above [i]; i.e. $\text{AGREEV}[i]$ and $\text{AGREEV}[e]$. To generalize, [i] is epenthized in the non-DTE of $\alpha$ when some non-DTE constraint of the form $\neg \text{AGREEV}[\alpha]$ outranks all DTE constraints of the form $\text{AGREEV}[\beta]$, where $\beta$ is a lower category than $\alpha$. In Maga Rukai, $\text{AGREEV}[a]$ outranks $\text{AGREEV}[e]$, 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 [a] and [i] as epenthetic vowels for languages in which they are the least sonorous vowels available.

4.4.1.3 Epenthetic [e i]

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 i] or [i], depending on the other vowels in the language’s inventory.

[e]-epenthesis is found in the Athapaskan language Chipewyan (Li 1946). Chipewyan has the vowels [i e e a o u] (p.399). Syllables have the shape CVC, where codas can consist of [t] coronal or glottal and (ii) fricatives or sonorants (i.e. $\{\theta \delta s z \ h n l \ r \}$) or (iii) [i].

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, [e] is epenthized before the stem. Because of a ban on onsetless syllables, [h] accompanies [e]-epenthesis, as shown in (52).

(52) Minimal Word epenthesis in Chipewyan

```
/taksa/ → [hnts'ax] 'he sg. was crying'
cf. /gwa-тsa/ → [hnts'ax] 'he will cry'
/uh-тsa/ → [hnts'ax] 'you pl. were crying'
/juh-t-t/ → [hnts'ax] 'you (dual) were eating'
```

[e]-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) [e]-epenthesis elsewhere in Chipewyan

```
/n-t'sa/ → [nts'ax] 'you sg. were crying'
cf /n-t's/ → [nts'ax] 'you pl. were crying'
/j-n-t's/ → [nt's'ax] 'you sg. were eating'
/j-n-t's/ → [nt's'ax] 'you (dual) were eating'
/n-0-t's/ → [nt's'ax] 'you lay down'
/h-n-0-t's/ → [nt's'ax] 'they lay down'
/tu-n-t's/ → [nt's'ax] 'you sg. were lying down'
/cf /tu-n-t's/ 'you (dual) were lying down'
```

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

The DTE constraint $\Lambda_{\text{e,i}}$ 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. $\neg \text{AGREEV}[\text{e,i}]$), the epenthetic vowel will not be [i], as shown in §4.4.1.1.

The non-DTE constraint $\text{AGREEV}[\text{e,i}]$ bans all high sonority PrWd non-DTEs. [i] is only epenthized in non-main stressed positions, so the epenthetic vowel will always be subject to this constraint.\(^{51}\)

The net result is that the DTE constraint $\Lambda_{\text{e,i}}$ rules out high and high-mid vowels and the non-DTE constraint $\neg \text{AGREEV}[\text{e,i}]$ rules out [a]. This leaves [e] 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.

\(^{51}\) 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.
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The tableau shows how antagonistic conditions on DTE and non-DTE sonority can result in a vowel of medium sonority.

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

• **Mid vowel epenthesis elsewhere**

Chippewyan 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 [e], as does Czech (Ketter 2003), several Romance languages have an epenthetic mid vowel, and Terniari and Tiberian Hebrew have [e]—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 Chippewyan’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 untested. 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 [e] between consonant-final roots and clitics: [djuŋəŋ]—[djuŋəŋ-wh] ‘his/her house’, cf [bab] ‘pig’—[bab-wh] ‘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-i-de] ‘small’, [me-mənŋ] ‘cold’, [ma-paris] ‘difficult’, [mo-doda] ‘red’, [mo-bulaŋ] ‘green’). On top of that, all enclitics contain a round vowel: [tu] [1p.sg.gen.], [mu] [2p.sg.gen.], [to] [1p.pl.incl.], [to] [3p.sg.gen.], [me] {complete aspect}, [po] {continuative aspect}. Therefore, the appearance of epenthetic [e] 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.

Marlet (1981:55) reports that Seri has epenthetic [e]. However, this vowel seems to appear only before an [m]: e.g. /tm-kap/ → /tomkap/ no gloss, /t-k-m-pit/ → /rikompit/ ‘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-panʃy/ → /ʔ[ɲipmɔŋʃy]/ ‘1sg-proximal-run’ (p.54). It is possible that epenthetic [e] 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 [a] is a morpheme while [e] is the true default.

• **[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 [u] or [i] (e.g. Kođava – 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 Cauley 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. /manʃutʃəj/ → /maʃutʃəj/ ‘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. /tʃtʃuʃuʃəj/ → /tʃuʃuʃəj/, *[tʃtʃuʃuʃəj] ‘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: /tʃuʃuʃəj/ → /ʃuʃuʃəj/, fast [ʃuʃəj] ‘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.

---

55 [e] is used to separate consonants in the formation of distributives: /kəd=fuləŋ/ → /fuləŋfuləŋ/. However, [e] does not appear in other forms, with no apparent regularity.
[v] epenthesis

The only other case of a round epenthetic vowel is the front lax round [v] in Icelandic (Kiparsky 1984, Karvonen & Sherman 1997). [v] is inserted between a stems-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. [dayvr] 'day {nom.sg}’, [tekvr] ‘take {3sg.pres}.’. Icelandic [v] 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+V. This – along with its rare featural content – may suggest that [v] 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+V may be due to a ban on [Vv] clusters. 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. *[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 *[+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, backness in vowels is marked. So, again, an epenthetic vowel with a [+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 *[+back].

The major exception to the [+back] generalization is the low vowel [ə], which is often classed as [+back] in many languages, and can be epenthetic. This is an exception because it often has no front counterpart, so *[+back] is necessarily violated, as shown above epenthetic [a] comes about through imposition of sonority requirements.

The one remaining issue is the set of languages with epenthetic [ut]. 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 [ut] or central [i]. For example, the epenthetic vowel is reported to vary in realization as [ut] and [i] in Kodaqa (Ebert 1996:1). Similarly, Bright (1975:13) reports most Dravidian epenthetic vowels to be [i]. Therefore, it may be that [ut] 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 DTÉs and low sonority ones are favoured in non-DTÉs finds striking support in the Peruvian language Shipibo (Lauriault 1948, Elias 2000, p.c.).

Shipibo has the surface vowels [i 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/ → [karibə] ‘went again’, and /honari-ki/ → [honariə] ‘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

\[
\begin{align*}
\text{karibə} & \quad \text{‘went again’} \\
\text{buribə} & \quad \text{‘ate again’} \\
\text{aribə} & \quad \text{‘did it again’} \\
\end{align*}
\]

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

\[
\begin{align*}
\text{ulribə} & \quad \text{‘saw it again’} \\
\text{urribə} & \quad \text{‘knew again’} \\
\text{buriə} & \quad \text{‘healed again’} \\
\text{hiəribi} & \quad \text{‘hid again’} \\
\text{junuribə} & \quad \text{‘commanded again’} \\
\end{align*}
\]

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

\[(56)\] epenthesis

\[
\begin{align*}
\text{a-rib-ki} & \quad \rightarrow [aribə] \quad \text{‘did it again’} \\
\text{a-ma-rib-ki} & \quad \rightarrow [amariə] \quad \text{‘made him do it again’} \\
\text{a-ma-ri-rib-ki} & \quad \rightarrow [amariə] \quad \text{‘merely did it again’} \\
\end{align*}
\]

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

\[\text{My thanks to José Elias for providing the underlying forms, narrow transcriptions of output forms, and the description of stress.}\]

\[\text{The only data Lauriault provides consists of the morphemes rib ‘repeated action’ and ki ‘completed action’. However, he asserts that other morpheme combinations exhibit the a/i alternation.}\]
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. [[j̃i(k̃a)rib(̃k̃i)]. Whenever the epenthetic element 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 *\(\Delta_{0}\leq\{i,u\}\) and *\(\Delta_{0}\geq\{a\}\) 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.

(57) Epenthesis of [a] in Foot DTEs in Shipibo

<table>
<thead>
<tr>
<th></th>
<th>(\Delta_{0}\leq{i,u})</th>
<th>(\Delta_{0}\geq{a})</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (k̃a)(b̃k̃i)</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) (k̃a)(b̃k̃i)</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

(58) Epenthesis of [i] in Foot Non-DTEs in Shipibo

<table>
<thead>
<tr>
<th></th>
<th>(\Delta_{0}\leq{i,u})</th>
<th>(\Delta_{0}\geq{a})</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (j̃i(k̃a)rib(̃k̃i)</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) (j̃i(k̃a)rib(̃k̃i)</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</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 ALIGNFVX (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 *\(\Delta_{0}\geq\{i,u\}\) 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 [a] in terms of non-DTE constraints, it is favoured by DTE constraints. Thus, choice of [i] over [a] can be ascribed to a constraint such as *\(\Delta_{0}\leq\{i\}\), as shown in tableau (59).

(59) Example tableau

<table>
<thead>
<tr>
<th></th>
<th>(\Delta_{0}\leq{i,u})</th>
<th>(\Delta_{0}\geq{a})</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (ña(̃a)rib(̃k̃i)</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) (ña(̃a)rib(̃k̃i)</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(c) (ña(̃a)rib(̃k̃i)</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

As discussed in the previous section, the epenthetic vowel cannot be [a] 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 P2 is more ‘DTE-like’ than position P1 if P1 is a DTE of category \(\alpha\) while P2 is not.

For example, Shipibo has two epenthetic vowels – [a] and [i]. Epenthetic vowels end up in two places: \(\Delta_{0}\) and \(-\Delta_{0}\). The \(\Delta_{0}\) position is more DTE-like than \(-\Delta_{0}\), because the former is a DTE of a Ft while the latter is not. Therefore [a] will appear in the \(\Delta_{0}\) position.

In contrast, the constraints predict that there is no ‘anti-Shipibo’ language where [i] is epenthesized into the \(\Delta_{0}\) position while [a] appears as a \(-\Delta_{0}\). This involves the less sonorous [i] ending up in the more DTE-like Ft position.

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 \(\alpha\), this could only have come about through the influence of a DTE-markedness constraint: *\(\Delta_{0}=\alpha\). Significantly, this constraint not only puts a restriction on \(\alpha\)'s of category \(\alpha\), but on DTEs of all higher categories. For example, *\(\Delta_{0}=\{a\}\) not only requires [a] to appear in DTEs of syllables, but also puts the same restriction on DTEs of Ft, PrWd's, and so on. This therefore rules out the possibility of epenthesisizing 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 *\( \Lambda \xi \geq \{a\} \). 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 *\( \Lambda \xi \xi /i\); 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 \([e, i, o, a]\).

  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 \(\Delta F_{pWd}\) position are attested.

  A problem is raised by a relevant case in Arabic: \([i]\) is epenthesized into main-stressed position: e.g. \([k\alpha\beta\theta\xi\xi]\), *\([\kappa\alpha\beta\theta\xi\xi]\) (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. Epenthetic onset elements can be highly sonorous, but only in response to their environment (e.g. \([a]\) in Boston English – McCarthy 1994, epenthetic glides – Rosenthal 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 Kiriwin 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 Kiriwin’s ([mɪjɪl̩a] because the alternative – stress on the default penult position *[mɪjɪl̩a]* – 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 *[(ná)ma]* would create a foot with a high sonority non-head.

  In these languages, DTE sonority is irrelevant. This is clearly shown by Kiriwinina ([mɪjɪl̩a] – the competing *[mɪgɪl̩a]* 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. /lɑkɔmɔtɪf/ → [(lɑkɔ)mɔtɪf] ‘locomotive’, *[[(lɑkɔ)mɔtɪf]] (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 epenthesized 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§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 *Λ\textsubscript{ML}/L and *-Λ\textsubscript{MHL}/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^{*}\textsubscript{L}' on every Major Phrase (Bauer 1993).\textsuperscript{80} This can be explained if *Λ\textsubscript{ML}/L and *-Λ\textsubscript{MHL}/H are employed in this language. See de Lacy (1999a§5.2, 2003) for related discussion.

\textsuperscript{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^{*}\textsubscript{L}'%, with a high tone on the head of a Major\textsubscript{P}/Intonational\textsubscript{P}. 
5.1 Introduction

The aim of Part III, including chapters 5 to 8, is to present a theory of scale-referring faithfulness constraints and provide evidence for it.

There are two leading ideas behind the theory. One is that more marked elements excite greater preservation than less marked ones. The other is that categories can be conflated for faithfulness purposes.

To expand on the first of these proposals, degree of markedness will be argued to correlate with degree of preservation (also see Kiparsky 1994, Jun 1995, and chs.6,7). For example, in the Place of Articulation scale (dorsal) labial (coronal) glottal (discussed in detail in §5.3), the most marked element is ‘dorsal’. Therefore, pressure to preserve dorsals is paramount; no other element is subject to the same degree of preservation. Least of all are glottals – since they are least marked, they are also the (relatively) least preserved.

This is not to say that dorsals will always be preserved in preference to less marked categories. Categories can be conflated for faithfulness: labials can be accorded the same degree of preservation as dorsals in some grammars; in others dorsals, labials, and coronals can be conflated for faithfulness purposes.

• Constraints

The ‘marked preservation’ proposal – that marked elements excite greater preservation than less marked ones – is formally expressed by (i) having constraints that preserve marked elements but not less marked ones and (ii) not having any constraints that preserve unmarked elements but not marked ones.

The faithfulness conflation proposal is formally expressed in a way analogous to the proposal for markedness conflation (ch.3) – faithfulness constraints are formulated stringently.

To schematize the combined effect of these proposals, for a scale \([\gamma F \rightarrow \beta F \rightarrow \alpha F]\), where \(\gamma\) is the most marked value of feature \(F\), there is a set of faithfulness constraints, listed in (1). Since all the constraints preserve the marked element, constraints of this type will be called ‘marked-faithfulness’ constraints.

(1) Marked-faithfulness constraints

<table>
<thead>
<tr>
<th>(\text{IDENT}([\gamma F]))</th>
<th>(\text{IDENT}([\gamma F, \beta F]))</th>
<th>(\text{IDENT}([\gamma F, \beta F, \alpha F]))</th>
</tr>
</thead>
<tbody>
<tr>
<td>If (x) is ([\gamma F]), then its correspondent (x’) has the same value for (F) as (x) (i.e. (x’ = [\gamma F])).</td>
<td>(\ast)</td>
<td>(\ast)</td>
</tr>
<tr>
<td>If (x) is ([\gamma F, \beta F]), then its correspondent (x’) has the same value as (x) for feature (F) (i.e. ([\gamma F) or ([\beta F) respectively).</td>
<td>(\ast)</td>
<td>(\ast)</td>
</tr>
<tr>
<td>If (x) is ([\gamma F) or ([\beta F) or ([\alpha F), then its correspondent (x’) has the same value as (x) for feature (F).</td>
<td>(\ast)</td>
<td>(\ast)</td>
</tr>
</tbody>
</table>

The formal expression of markedness – ch.5

The constraints in (1) are the ‘skeleta’ for scale-referring constraints. They may be elaborated by mentioning dimension of application (e.g. Input–Output, Output–Output, Base–Reduplicant), or certain prosodic positions (Casali 1997a,b, Beckman 1998); examples of each of these dimensions are provided in chapter 6. They may also be elaborated by restriction to a prominent position (Beckman 1998); examples will be provided when relevant.

The constraint IO-IDENT\([\gamma F, \beta F]\) demands that input segments specified as \([\gamma F\) or \([\beta F\) remain faithful in the output. So, IO-IDENT\([\gamma F, \beta F]\) assigns a violation to (i) all mappings from \([\gamma F]\) that result in \([\beta F]\) or \([\alpha F]\) and (ii) all mappings from \([\beta F]\) that result in \([\gamma F]\) or \([\alpha F]\).

The constraints are ‘asymmetric’ in the sense of Pater (1996, 1999). For example, while IDENT\([\gamma F]\) bans \([\gamma F]\) \(\rightarrow [\beta F]\), it does not militate against \([\beta F]\) \(\rightarrow [\gamma F]\). For further discussion of this point, see ch.7 §7.7.4.

Unless otherwise stated, all IDENT constraints will refer to the Input–Output dimension in this and the following chapters. For discussion of IDENT and its effect on dimension, see ch.7 §7.7.4.

Finally, there are no MAX or DEP equivalents of the IDENT constraints. For discussion, see ch.6 §6.4.2.

The form of stringent faithfulness constraints is discussed further in §5.2; an implementation of the Place of Articulation scale is provided in §5.3.

The constraints in (1) are stringent in that an unfaithful mapping from a less marked element incurs a proper subset of the violations of all unfaithful mappings from a more marked element. Quasi-tableau (2) illustrates this point: an unfaithful mapping from the most marked element \([\gamma F]\) incurs a superset of violations of all unfaithful mappings from less marked elements.

(2) Stringent form of faithfulness constraints

<table>
<thead>
<tr>
<th>(\text{IDENT}([\gamma F]))</th>
<th>(\text{IDENT}([\gamma F, \beta F]))</th>
<th>(\text{IDENT}([\gamma F, \beta F, \alpha F]))</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\gamma F) (\rightarrow [\beta F]) or ([\alpha F])</td>
<td>(\ast)</td>
<td>(\ast)</td>
</tr>
<tr>
<td>(\beta F) (\rightarrow [\gamma F]) or ([\alpha F])</td>
<td>(\ast)</td>
<td>(\ast)</td>
</tr>
<tr>
<td>(\alpha F) (\rightarrow [\gamma F]) or ([\beta F])</td>
<td>(\ast)</td>
<td>(\ast)</td>
</tr>
</tbody>
</table>

The tableau shows that the constraints have the cumulative effect that more marked elements are subject to more preservation than less marked ones. For example, since \([\gamma F]\)
is the most marked element, all faithfulness constraints preserve it. Since $\beta F$ is more marked than $\alpha F$, more faithfulness constraints preserve $\beta F$ than $\alpha F$.

The faithfulness constraints also allow conflation. As determined in ch.3, two categories are conflated when they incur the same violations of active constraints. Since $\gamma F$ and $\beta F$ both violate $\text{IDENT}(\gamma F, \beta F)$ equally, the categories $\gamma F$ and $\beta F$ will be conflated in a grammar where $\text{IDENT}(\gamma F, \beta F)$ is the only active faithfulness constraint. Similarly, all the categories will be conflated in a grammar in which $\text{IDENT}(\gamma F, \beta F, \alpha F)$ is the only active faithfulness constraint.

- **Separability of proposals**

It is important to point out from the outset that the ‘marked preservation’ aspect of the faithfulness constraints in (1) is quite separate from the fact that they are stringently formulated. To underscore this point, there are many alternative theories with stringent constraints that do not have the ‘marked preservation’ property. For example, the ‘unmarked-faithfulness’ constraints $\text{IDENT}(\alpha F)$, $\text{IDENT}(\alpha F, \beta F)$, and $\text{IDENT}(\alpha F, \beta F, \gamma F)$ – based on the scale $\gamma F > \beta F > \alpha F$ – are stringently formulated but cannot preserve marked elements without also preserving unmarked ones.

Moreover, there are non-stringent theories that effectively express the marked-preservation property. For example, the set of non-stringent constraints in a fixed ranking $\| \text{IDENT}(\gamma) \rightarrow \text{IDENT}(\beta) \rightarrow \text{IDENT}(\alpha) \|$ encodes the ‘marked preservation’ property by virtue of having faithfulness constraints to marked elements universally outrank all faithfulness constraints to less marked elements (Jun 1995, Kiparsky 1994).

In contrast, chapter 8 argues solely for the point that faithfulness constraints must have the ‘marked preservation’ property; they do not present arguments that faithfulness constraints must be stringently formulated. Accordingly, the arguments presented in those chapters support all theories with the ‘marked preservation’ property, including the stringent approach in (1) and the fixed ranking theory outlined in the preceding paragraph.

In short, the ‘marked preservation’ and stringency proposals are separable – neither depends on the validity of the other. Similarly, the empirical phenomena that support the proposals are also quite separate, as summarized briefly below.

### 5.1.1 Empirical implications

The proposed form of the scale-referring faithfulness constraints has a number of empirical effects.

Since marked elements can excite greater preservation than less marked ones, marked values may be exempt from processes that less marked values undergo. For example, with only the constraint $\text{IDENT}(\gamma F)$ outranking all markedness constraints, input segments specified as $\{\gamma F\}$ will surface faithfully, but the less marked values $\{\beta F, \alpha F\}$ will undergo changes triggered by the markedness constraints. Thus, only the marked value may escape processes such as neutralization (chs.6,9) and assimilation (ch.7).

The other major empirical effect has to do with ‘faithfulness conflation’. As shown in ch.3§3.6, stringent markedness constraints allow category distinctions to be collapsed for certain processes; the same is true of stringent faithfulness constraints. Since an unfaithful $\gamma F/ \rightarrow \beta F$ mapping and an unfaithful $\beta F/ \rightarrow \gamma F$ mapping incur the same violation of $\text{IDENT}(\gamma F, \beta F)$, if $\text{IDENT}(\gamma F, \beta F)$ is the only active faithfulness constraint, the two mappings would be effectively conflated in terms of faithfulness.

Such conflation has visible effects in certain types of coalescence (ch.8).

Some concrete examples are given below to illustrate the points made above.

### Neutralization: marked-faithfulness & Gapped Inventories

Chapter 6 discusses the effect of the proposal that marked elements are more faithfully preserved than less marked elements. The phenomena discussed relate to neutralization of Major Place of Articulation distinctions: i.e. | dorsal | labial | (tongue location). Neutralization produces an ‘inventory’, a term that refers to the surface segments that can appear in a particular position.

Two kinds of inventories are identified, following Prince & Smolensky (1993) and Prince (1997c). One type produces a ‘harmonically complete’ inventory of segments, consisting of a contiguous set of the scale starting with the least marked element. For example, the Polynesian language Tahitian has the voiceless stops $\{p t k\}$ – in terms of PoA the glottal |. Neutralization of this type often involves the ‘harmonically gapped’ type (a term from Prince 1997c): it consists of the least marked element and a highly marked element, but crucially lacks elements of intermediate markedness. The Polynesian language Hawaiian provides a relevant case: it has the stop inventory $\{k p t\}$ (Churchward 1953).

The other type of inventory is of more immediate interest. This is the ‘harmonically gapped’ type (a term from Prince 1997c): it consists of the least marked element and a highly marked element, but crucially lacks elements of intermediate markedness. The Polynesian language Hawaiian provides a relevant case: it has the stop inventory $\{k p t\}$ (Churchward 1953).

Gapped segmental inventories require faithfulness constraints that exclusively refer to marked categories. To show this, relevant PoA-referring constraints are given in (3); further discussion of their form is given in §5.3.
(3) Place of Articulation constraints

(a) Markedness

*{dors} For every dorsal segment, assign a violation.

*{dors,lab} For every segment that is either dorsal or labial, assign a violation.

*{dors,lab,cor} For every segment that is dorsal, labial, or coronal, assign a violation.

*{dors,lab,cor,glottal} For every segment that is dorsal, labial, coronal, or glottal, assign a violation.

(b) Faithfulness

IDENT{dors} If $x$ is dorsal, then $x$ has the same place of articulation as its correspondent $x'$.

IDENT{dors,lab} If $x$ is dorsal or labial, then $x$ has the same place of articulation as its correspondent $x'$.

IDENT{dors,lab,cor} If $x$ is dorsal, labial, or coronal, then $x$ has the same place of articulation as its correspondent $x'$.

IDENT{dors,lab,cor,glottal} If $x$ is dorsal, labial, coronal, or glottal, then $x$ has the same place of articulation as its correspondent $x'$.

For coronals to be eliminated, some markedness constraint that bans coronals must outrank all faithfulness constraints that preserve it: i.e. $|| *{dors,lab,cor} \gg \text{IDENT{dors,lab,cor}} \gg \text{IDENT{dors,lab,cor,glottal}} ||$.

(4) Neutralization Ranking: $\exists \text{Mk}(x) \gg \forall \text{Faith}(x) ||$

\[
\begin{array}{c|c|c|c}
\text{PoA} & *{dors,lab,cor} & \text{IDENT{dors,lab,cor}} & \text{IDENT{dors,lab,cor,glottal}} \\
\hline
\text{\textskew{-10}a} & 1 & * & * \\
\text{\textskew{-10}a} & 2 & * & * \\
\end{array}
\]

However, the more marked elements /p/ and /k/ surface faithfully. Prince (1997c, 1999) has shown that some faithfulness constraint that preserves dorsals and labials must outrank all markedness constraints that ban them in such a system. So IDENT{dors,lab} must outrank all markedness constraints, including *{dors,lab,cor}.

(5) Preservation Ranking: $\exists \text{Faith}(x) \gg \forall \text{Mk}(x) ||$

\[
\begin{array}{c|c|c}
\text{PoA} & *{dors,lab} & \text{IDENT{dors,lab}} \\
\hline
\text{\textskew{-10}a} & 1 & * \\
\text{\textskew{-10}a} & 2 & * \\
\end{array}
\]

It is crucial that the faithfulness constraint preserve only labials and dorsals. If it preserved coronals as well, coronals would not neutralize at all. In short, the ranking identified above allows only /k p t/ to surface faithfully; /t/ is debuccalized to /θ/.

Chapter 6 shows how the theory deals with both gapped and harmonically contiguous inventories. The theory is also shown to be restrictive: it cannot produce ‘disharmonic’ inventories, in which only marked elements exist (e.g. [k p], with no [t] or [θ]).

- Assimilation: Marked Faithfulness & Blocking

Further evidence that marked elements are subject to more faithfulness than less marked ones is presented in chapter 7. With Kiparsky (1994) and Jun (1995), this chapter will argue that systems in which only unmarked PoAs require faithfulness constraints that exclusively preserve marked categories.

For example, only coronals undergo assimilation in Catalan: /son brus/ $\rightarrow$ [som brus] ‘they are voices’, cf /som dos/ $\rightarrow$ [som dos], *[son dos] ‘we are two’; /tín presa/ $\rightarrow$ [tín presa], *[tín presa] ‘I have bread’ (Mascaró 1976, 1986, Hualde 1992). As proposed by Kiparsky (1994), this system can be produced by ranking a faithfulness constraint that preserves dorsals and labials only above all assimilation-triggering constraints (called ASSIM here).

Tableau (6) shows the ranking needed for coronal assimilation: ASSIM must outrank all constraints that preserve coronals – i.e. IDENT{dors,lab,cor}.

(6) Coronals undergo assimilation

\[
\begin{array}{c|c|c|c}
/\text{son brus}/ & \text{ASSIM} & \text{IDENT{dors,lab,cor}} \\
\hline
(a) son brus & * & * \\
(b) som brus & * & * \\
\end{array}
\]

In contrast, since dorsals and labials do not undergo assimilation, some faithfulness constraint that preserves them – and only them – must outrank ASSIM.

(7) Dorsals and labials do not undergo assimilation

\[
\begin{array}{c|c|c|c}
/tín presa/ & \text{IDENT{dors,lab}} & \text{ASSIM} & \text{IDENT{dors,lab,cor}} \\
\hline
(a) tín presa & * & * \\
(b) tam presa & * & * \\
\end{array}
\]

The ranking $|| \text{IDENT{dors,lab}} \gg \text{ASSIM} ||$ does not effect the outcome of tableau (6): since IDENT{dors,lab} does not evaluate mappings from a coronal, all candidates in (6) will vacuously satisfy it.

This chapter shows that Catalan-type systems can be produced using the marked-faithfulness constraints, and that – under certain assumptions – that marked-faithfulness constraints are an indispensable part of any analysis of such systems.

The remainder of the chapter deals with further predictions of the marked faithfulness constraints and their interaction with markedness.
Coalescence: Stringent faithfulness

Chapter 8 provides evidence that faithfulness constraints are formulated stringently. For Place of Articulation, this means that there are constraints IDENT{dors,lab} and IDENT{dors,lab,cor} which preserve several different PoA specifications equally, as opposed to a set of faithfulness constraints for each PoA individually: e.g. IDENT{dors} \Rightarrow IDENT{lab} \Rightarrow IDENT{cor} ||.

Evidence for this proposal comes from a type of coalescence in which the output retains unmarked values. For example, adjacent consonants in Pali coalesce to satisfy certain syllable-based restrictions (ch.8§8.4). If the two input consonants differ in their PoA specification, the output retains the least marked value. For example, the /b \textsuperscript{5}-t/ in /lab\textsuperscript{3}-taba/ coalesce to form a [d\textsuperscript{2}] (i.e. [lad\textsuperscript{2}aba] ‘take {gerund}’). The coalesced output [d\textsuperscript{2}] retains the less marked PoA – i.e. coronal.

The reason that coronals survive is due to markedness: *{KP} favours [d\textsuperscript{2}] over *[bh\textsuperscript{1}]. Thus, *(dors,lab) outranks all faithfulness constraints that favour preservation of labials over coronals – i.e. IDENT{dors,lab}.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|}
\hline
/\textsuperscript{lab\textsuperscript{3}}-t\textsuperscript{2}-aba/ & IDENT{dors,lab,cor} & IDENT{dors,lab} \\
\hline
(a) lad\textsuperscript{3}_{1}\textsuperscript{2}aba & * & * \\
\hline
(b) lad\textsuperscript{3}_{1}\textsuperscript{2}ada & * & * \\
\hline
\end{tabular}
\caption{Table (9) summarizes the structure of Part III. Chapters 6 and 7 argue the point that all faithfulness constraints preserve the most marked element. Chapter 8 deals with the proposal that faithfulness constraints are stringently formulated.}
\end{table}

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While IDENT{dors,lab,cor} eliminates candidate (c) (the candidate with across-the-board labial neutralization), it assigns equal violations to (a) and (b). These equal violations allow the markedness constraint *(dors,lab) to determine the outcome, favouring candidate (a). In other words, in order for *(dors,lab) to have an influence on the outcome, the unfaithful mappings /b \textsuperscript{5}-t/ \rightarrow [d\textsuperscript{2}] and /b \textsuperscript{5}-t/ \rightarrow [h\textsuperscript{1}] must be treated as equally unfaithful.

In short, a faithfulness constraint that assigns equal violations to unfaithfulness of dorsals, labials, and coronals – i.e. IDENT{dors,lab,cor} – is essential in accounting for this type of coalescence, hence the need for stringent faithfulness constraints. The remainder of chapter 8 provides a survey of coalescence cases, and documents the implications of the theory in other related areas.

Structure of Part III in Brief

Table (11) summarizes the structure of Part III. Chapters 6 and 7 argue the point that all faithfulness constraints preserve the most marked element. Chapter 8 deals with the proposal that faithfulness constraints are stringently formulated.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|}
\hline
Chapter & Theoretical issue & Phenomenon \\
\hline
6 & Marked preservation & PoA Neutralization \\
7 & Marked preservation & Assimilation (PoA and voice) \\
8 & Faithfulness conflation – stringency & Coalescence \\
\hline
\end{tabular}
\caption{Outline of Part III}
\end{table}

The rest of this chapter

There are two parts to the rest of this chapter. §5.2 discusses the formal implementation of the present theory in more detail. §5.3 is an extended discussion of the Place of Articulation faithfulness constraints and the Place of Articulation scale itself.

The aim of these sections is to (i) clarify the preceding discussion and (ii) provide evidence for some basic assumptions made in the following chapters.

5.2 Scale-referring faithfulness constraints: Theory

The aim of this section is to provide a more formal discussion of the proposals summarized in §5.1.

The theory of scale-referring faithfulness constraints presented here derives from two separate hypotheses. One is that faithfulness constraints are stringently formulated.
The other is that more marked elements can be preserved while less marked elements are not.

These two leading ideas have obvious parallels to the form of markedness constraints: markedness constraints are also stringently formulated (ch.3), and they assign violations to more marked elements without assigning violations to less marked ones.

Since degree of markedness correlates with degree of faithfulness in such a direct way, markedness and faithfulness constraints have a very similar form. In effect, for every set of elements that markedness constraints refer to, there is a faithfulness constraint that refers to the same set. So, one can generalize over the form of both markedness and faithfulness scale-referring constraints as in (12).

(12) Marked Reference Hypothesis (MRH)
If a constraint C that refers to scale S mentions category c in S, then C also mentions all categories k where k is more marked than c in S.

The meaning of ‘mentions’ depends on whether the constraint is a markedness or faithfulness one. If the constraint is a markedness constraint M, M ‘mentions’ category c if it assigns a violation for every instance of c in a candidate. If the constraint is a faithfulness constraint F, F ‘mentions’ c if F assigns a violation for the mapping \( \langle c \rightarrow \{d\} \rangle \), where \([d][\neq c]\).

Section 5.2.1 shows how the hypothesis is formally implemented in the present theory. Section 5.2.2 discusses alternative formulations of the faithfulness constraints.

5.2.1 Scale faithfulness
The MRH in (12) provides a strong condition on scale-referring faithfulness constraints. The other condition adopted here is completeness: for every scale element \( x \) there is some faithfulness constraint that mentions \( x \). Thus, there is no element in a scale that is neglected by faithfulness entirely.

To restate the example from the introduction, for a scale \( \langle /\gamma \rangle \langle /\beta \rangle \langle /\alpha \rangle \delta \), there are three scale-referring faithfulness constraints. The faithfulness constraints can be informally defined as in (13).

(13) Marked-faithfulness constraint skeleton
\[
\begin{align*}
\text{IDENT}[\gamma F] & \quad \text{If } x = \gamma F, \text{then its correspondent } x' \text{ has the same value for } F \text{ as } x \text{ (i.e. } x' = \gamma F). \\
\text{IDENT}[\gamma F, \beta F] & \quad \text{If } x = \gamma F \text{ or } \beta F, \text{then its correspondent } x' \text{ has the same value as } x \text{ for feature } F. \\
\text{IDENT}[\gamma F, \beta F, \alpha F] & \quad \text{If } x = \gamma F \text{ or } \beta F \text{ or } \alpha F, \text{then its correspondent } x' \text{ has the same value as } x \text{ for feature } F. 
\end{align*}
\]

For every scale element, there is some faithfulness constraint in (13) that preserves it. In addition, (13) lists the only faithfulness constraints that refer to \( \langle /\gamma \rangle \langle /\beta \rangle \langle /\alpha \rangle \delta \). The
empirical argument against MAX-feature constraints is presented in ch.6§4.2.1. In other words, IDENT constraints are the only ones that can refer to scale elements.

Another point relates to the form of the IDENT constraints. The IDENT constraints require identity rather than inclusion in terms of the feature value \( v \). For example, IDENT\( [xx] \) does not require every input segment with \( xx \) in its Place value to simply contain \( xx \) in its Place value in the output. Such a requirement would allow less marked elements to become more marked with impunity: for example, the mapping \( /m/ \rightarrow *[\eta] \) would be admissible since \( /m/ \) is \([xx] \), \([\eta] \) is \([xx] \), and both values contain \( xx \). While in most cases such a mapping would not take place because \( /m/ \rightarrow *[m] \) incurs fewer markedness violations than \( /m/ \rightarrow *[\eta] \), it does become an issue in assimilation. If IDENT\( [xx] \) does not block the mapping \( /m/ \rightarrow *[\eta] \), then labials should always assimilate to dorsals. This incorrect version of IDENT is called ‘IDENT’ in the tableau below:

\[
\begin{array}{|c|c|c|}
\hline
/\text{amka}/ & \text{IDENT}[\text{xxPlace}] & \text{ASSIM} \\
(a) \text{ amka} & \vdash & \star \text{I} \\
(b) \text{ anyka} & \vdash & \vdash \\
\hline
\end{array}
\]

In short, IDENT constraints require feature values to be identical, not freely chosen from a set of possible values.

It is also important to point out that the elements mentioned in the antecedent are the same as those in the consequent. For example, IDENT\([dors]\) can be cast as “If an input segment \( S \) is dorsal, then \( S \)’s correspondent must be dorsal.” The antecedent and consequent cannot refer to different elements: e.g. “If an input segment \( S \) is dorsal, then \( S \)’s output correspondent must be labial” (i.e. an ‘unfaithfulness’ constraint), or “If an input segment is dorsal, then its output correspondent must be \(+\text{voice}\)” (cf Orgun 1994).

5.3 Major Place of Articulation: Form and constraints

Since the Major Place of Articulation (PoA) scale figures prominently in several of the following chapters, it will be used here to exemplify the structure of the marked faithfulness constraints.

The form of the PoA scale used here is given in (16), closely following Lombardi (1995, 1998b). The scale in (16) has precursors in a great deal of previous work, including Jakobson (1941), Paradis & Prunet (1991) and references cited therein, and within Optimality Theory Prince & Smolensky (1993:ch.9§1.2,§2), Smolensky (1993), Gnanadesikan (1995), Prince (1997c, 1999), and Pater & Werle (2001), to name but a few.

(16) The Major Place of Articulation (PoA) Scale

\[
\text{[dorsal] \text{ labial} \text{ coronal} \text{ glottal]}
\]

‘Labial’ refers to both bilabial and labiodental (e.g. \( [\beta], [v] \)). ‘Coronal’ covers interdental, dental, alveolar, and palato-alveolar places of articulation. ‘Dorsal’ is used primarily to refer to velars; for discussion of the classification of uvulars and pharyngeals see McCarthy (1994). ‘Glottal’ refers solely to the glottals \([\text{7 h f}]\) and to anusvara \([N]\), discussed in Trigo (1988) and §5.3.3. The scale does not deal with secondary place articulations (i.e. labialization, palatalization, velarization); these will be discussed where appropriate.

The PoA scale is well suited to illustrating the points in this section and the following chapters. Since it is a featural scale (cf sonority), it cannot combine with DTEs in markedness constraints; there are no constraints of the form \(*_{\text{dors}}/(\text{dorsal})\), for example (for strong typological reasons – see ch.3§3.5). Therefore, there is no ambiguity about the markedness of PoA in a particular position: dorsal segments are highly marked for PoA regardless of whether they are in an onset, coda, stressed syllable, or any other prosodic constituent. This consistency makes featural scales ideal for approaching questions about neutralization. In contrast, prosodic scales are ambiguous when it comes to neutralization and markedness. For example, \( [a] \) is unmarked as a DTE, but highly marked as a non-DTE; this markedness ambiguity has significant empirical effects (see ch.4§4.4), but is too complex to use as an exemplar of a theory of neutralization.

Moreover, the PoA scale already has a significant amount of theoretical support (see references above).

The primary aim of this section is to exemplify the form of scale-referring constraints. So, §5.3.1 discusses the form of the PoA-markedness constraints. This section also provides arguments that they must be stringently formulated.

Section 5.3.2 presents the PoA-faithfulness constraints. The form of the PoA scale is discussed in §5.3.3. The scale does not deal with secondary place articulations (i.e. labialization, palatalization, velarization); these will be discussed where appropriate.

5.3.1 The PoA markedness constraints

There are four PoA markedness constraints in the present theory, given in (17) (also see Prince 1999). Their extended form is given in the left column. The right column gives their abbreviated form, used from now on.

(17) PoA Markedness Constraints

\[
\begin{array}{|c|c|}
\hline
\text{Long Form} & \text{Short Form} \\
\hline
*\text{(dorsal)} & *[K] \\
*\{dorsal,labial\} & *[KP] \\
*\{dorsal,labial,coronal\} & *[KPT] \\
*\{dorsal,labial,coronal,glottal\} & *[KPT?] \\
\hline
\end{array}
\]
The constraint \( *{\text{KPT}} \) is violated by a segment that is either dorsal, labial, or coronal. For example, the form [kapata?] will incur three violations of \( *{\text{KPT}} \) – one for [k], one for [p], and one for [t]. In contrast, [t] does not violate \( *{\text{KPT}} \).

As dictated by the MRH in (12), every constraint bans the most marked element – dorsals. Just as with the sonority constraints, the markedness constraints are in a stringency relation, as shown in quasi-tableau (18).

\[
\begin{array}{cccc}
\text{MoA1} & \text{MoA2} & \text{MoA3} & \text{MoA4} \\
\text{[k]} & * & * & * \\
\text{[p]} & * & * & * \\
\text{[t]} & * & * & * \\
\text{[?] & * & * & * \\
\end{array}
\]

As with the sonority constraints in chapter 3, there is no need to invoke a fixed ranking to ensure that glottal will always be the least marked PoA. Since no constraint favours non-glottals over glottals and some constraint favours glottals over every other PoA, glottals will always be most harmonic in terms of the markedness constraints. In short, glottals are a local harmonic bound for all other PoAs.

5.3.1.1 Manner and PoA

The constraints in (17) are intended to be the skeleton for all PoA-referring markedness constraints. In other words, there may be elaborations on the constraints in (17) as long as their favouring relationships – i.e. which PoAs are treated as more harmonic than others – are kept the same.

- **No implicational relations between different manners of articulation**

One elaboration relates to manner of articulation. A survey of inventories reported in Appendix A shows that there is no relation between different manners of articulation for PoA. To be precise, no implicational statements of the form “If there is a segment with PoA x in MoA1 then there is a segment with PoA x for MoA2 (MoA1≠MoA2)”, where MoA is ‘Manner of Articulation’, were found to hold.

The lack of implicational relations between PoAs of different manners can be seen in Polynesian languages. For example, Māori has the voiceless stops [p t k] and the voiceless fricatives [f h] (Bauer 1993); clearly there is no implicational relationship between the existence of dorsal and coronal voiceless stops and the existence of those same PoAs for voiceless fricatives. Colloquial Samoan shows that the opposite also does not hold: this language has [s] and [k p t], showing that the existence of a coronal voiceless fricative does not imply the presence of a coronal voiceless stop (Clark 1976, Mosel & Hovhdaugen 1992).

Similarly, Hawaiian has the voiceless stops [k p t], nasals [m n], and fricative [h] – the existence of a coronal nasal does not imply the presence of a coronal voiceless stop or voiceless fricative in any of the other manners of articulation (Pukui & Elbert 1979). Conversely, Colloquial Samoan has the voiceless fricatives [f s] and nasals [m n] – again the presence of a coronal voiceless fricative does not imply the presence of a coronal nasal.

Table 5.1 underscores this point. It lists languages in which the PoA contrasts for a particular manner of articulation are a proper subset of those found in another manner of articulation. For example, PoA contrasts in Murut voiceless fricatives are a proper subset of the voiced stop contrasts: the former has just the coronal [s], while the latter has [b d g]. Conversely, voiced stop contrasts are a proper subset of voiceless fricative contrasts in Wintu. The gaps for voiced fricatives are probably accidental – due to the relative rarity of voiced fricatives cross-linguistically. The table below is based on the survey reported in Appendix B.

**Table 5.1: PoA proper subset relations among different manners of articulation**

<table>
<thead>
<tr>
<th>PoA</th>
<th>-vd stops</th>
<th>+vd stops</th>
<th>-vd fricatives</th>
<th>+vd fricatives</th>
<th>nasals</th>
</tr>
</thead>
<tbody>
<tr>
<td>[s]</td>
<td>Nganasan</td>
<td>Wintu</td>
<td>Tongan</td>
<td>Boazi</td>
<td>Komit</td>
</tr>
<tr>
<td>[b d g]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[f s]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[m n]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As Table 5.1 shows, there are no implicational relations between different manners of articulation for PoA contrasts.

- **Theoretical implications**

The theoretical implication of the observation just made is that there may well be manner-specific PoA constraints. Markedness constraints of this type could have the form \( *{\text{KPT}} \) nasal (i.e. \( *{\text{KPT}} \) nasal [m n]), \( *{\text{KPT}} \) [t] and \( *{\text{KPT}} \) [k], and so on. For example, to account for the fact that there is a velar [k] in Mordva but no velar nasal [m n], \( *{\text{KPT}} \) nasal [m n] and \( *{\text{KPT}} \) velar [k] hold: this language has [kh] and [fs] and [ptck].

Similarly, Colloquial Samoan has the voiceless fricatives [f s] and nasals [m n] – again the presence of a coronal voiceless fricative does not imply the presence of a coronal nasal. Conversely, Colloquial Samoan has the voiceless fricatives [f s] and nasals [m n] – again the presence of a coronal voiceless fricative does not imply the presence of a coronal nasal.

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<th>+vd fricatives</th>
<th>nasals</th>
</tr>
</thead>
<tbody>
<tr>
<td>[s]</td>
<td>Nganasan</td>
<td>Wintu</td>
<td>Tongan</td>
<td>Boazi</td>
<td>Komit</td>
</tr>
<tr>
<td>[b d g]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[f s]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[m n]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
would outrank all velar-preserving faithfulness constraints while *{K}//-vd stop] would not.

A separate issue is whether there are manner-specific faithfulness constraints to complement the markedness constraints (e.g. IDENT[KPT]/nasal vs IDENT[KPT]/stop). As it turns out, the cases discussed in chs.6-8 do not provide much insight into this issue. If the constraints did exist, they would not affect the results of the following chapters. Since this is tangential to the main point of this Part, the issue is left for future research.33

For the sake of brevity, the PoA markedness constraints will be mentioned without manner specifications in the following chapters; the manner of articulation will be mentioned only when it is directly relevant.

5.3.1.2 Stringent form

Since chapter 3 showed in detail why markedness constraints must be stringently formulated, this section will briefly and schematically identify a phenomenon that provides evidence for stringent PoA-markedness constraints.

Take a hypothetical system where stops are neutralized to [?] in codas: e.g. /ak/ → [aʔ], /atma/ → [aʔma]. As discussed in detail in ch.6, this type of neutralization involves the constraint *{KPT}, which outranks all faithfulness constraints that preserve dorsal, labial, and coronal PoA (i.e. all faithfulness constraints).

\[
\begin{array}{ccc}
\text{/ak/} & *{KPT} & \text{IDENT[KPT]} \\
\text{(a) ak} & *! & * \\
\text{(b) aʔ} & * & *
\end{array}
\]

However, suppose that [?]’s are banned before other glottals, so that *[aʔha] is unacceptable.34 This ban will prevent coda stops from debuccalizing in this environment too, so that /akha/ → *[aʔha]. Importantly, though, /akha/ is not realized as *[aʔha] – in other words, /k/ does not neutralize to the next least marked element [?] when it cannot neutralize to [?]. So, unless /k/ can neutralize to [?] in this language, it does not neutralize at all.

With stringent markedness constraints, this blocking effect is easy to achieve. The constraint against glottal+glottal clusters – OCP(glottal) – must outrank *{KPT}, as shown in tableau (20).

\[
\begin{array}{ccc}
\text{/akha/} & \text{OCP(glottal)} & \text{*{KPT} IDENT[KPT]} \\
\text{(a) akha} & *! & *! * \\
\text{(b) akha} & *! & * \\
\text{(c) aʔha} & * & *
\end{array}
\]

Candidate (a) has neutralized /k/ to [?], but in doing so fatally violates OCP(glottal). This leaves candidates (b) and (c). Candidate (c) is important: instead of neutralizing /k/ to [?], it changes /k/ to the next least-marked element [t]. However, the next least marked element is not good enough in this system: unless /k/ can neutralize to [?], it will not neutralize at all. This property is formally achieved by the stringent form of the constraint *{KPT}: *{KPT} assigns the same violations to both [k] and [t], so it does not favour (c) over (b). The crucial constraint is then IDENT[KPT], which prefers the faithful (b) over (c). Crucially, no constraint that favours [t] over [k] (e.g. *{K}/{-vd stop}) can outrank IDENT[KPT]; otherwise (c) would beat (b).

To show why the stringent *{KPT} is necessary for this case, consider a fixed ranking theory with || *K » *P » *T ||. To get neutralization of /k/ to [?], *K would have to outrank all faithfulness constraints that preserved it (i.e. all faithfulness constraints in the present theory). The same is true for *P and all labial-preserving faithfulness constraints, and *T and all coronal-preserving faithfulness constraints.

To block neutralization to [?] before other glottals, OCP(glottal) would have to outrank *K. That way, from input /akha/, *[aʔha] would be eliminated. However, there is now no way to prevent /k/ from neutralizing to [t], producing *[aʔha] from /akha/. This is illustrated in tableau (21).

\[
\begin{array}{ccc}
\text{/akha/} & \text{OCP(glottal)} & *K *T IDENT[KPT] \\
\text{(a) akha} & *! & * \\
\text{(b) akha} & *! & * \\
\text{(c) aʔha} & * & *
\end{array}
\]

The tableau above shows that the form with debuccalization (a) is correctly eliminated, thanks to OCP(glottal). However, problems arise in the competition between (b) and (c). Because *K favours [t] over [k], it incorrectly eliminates the faithful form, with the result that the form with neutralization to [t] wins.

There is no way to avoid this problem. No markedness constraints can be invoked: such a constraint would have to favour [k] over [t] and outrank *K, incorrectly reversing the markedness relation between dorsal and coronal, thereby predicting unattested phenomena such as epenthetic dorsals (cf §5.3.3.3). No faithfulness constraint can be employed either: if a dorsal-preserving faithfulness constraint like IDENT[K] outranked *{K}/, /k/ would never neutralize to [?], even in environments where it should.

34 It is difficult to separate the effects of manner-specific markedness and faithfulness constraints. If there were manner-specific faithfulness constraints, one could expect them to block a process for a particular manner of articulation while allowing others to undergo it. For example, nasals assimilate in PoA in English while fricatives and stops do not. This may indicate that IDENT[KPT]/stop,fricative] outranks all assimilation-triggering constraints while IDENT[KPT]/nasal is ranked lower. On the other hand, it may indicate that there are nasal-specific PoA constraints: *{KPT}/nasal may outrank IDENT[KPT], while assimilation-inducing constraints for stops and fricatives are ranked below the faithfulness constraint.35 For such a constraint, see the discussion of Yamphu in ch.7.5.4. Also see McCarthy (1994) for discussion of OCP constraints on glottals. In any case, any constraint that blocks the usual output of neutralization in a specific environment could be used here.
The problem is that the markedness constraint *K favours coronals over dorsals. So, if [?] is not available, /k/ will inevitably seek out the next least marked element – coronals – in the Fixed Ranking theory.

As shown in (20), the solution to this problem is to conflate candidates (a) and (b) – if both incur the same violations of active markedness constraints, faithfulness will emerge to preserve the most faithful candidate.

To generalize from this case, stringent markedness constraints allow neutralization to be blocked when it will not yield the least marked element in a specific environment. In contrast, non-stringent constraints predict that “the next best is good enough” – that for a scale (z y x), if z generally neutralizes to x but y is blocked in some z-neutralizing environment, z will always neutralize to the next least marked element y.

5.3.2 The PoA faithfulness constraints
The PoA faithfulness constraints are given in (22).

(22) PoA Faithfulness
IDENT{K} If x is dorsal, then x’ has the same PoA as x.
IDENT{KP} If x is dorsal or labial, then x’ has the same PoA as x.
IDENT{KPT} If x is dorsal, labial, or coronal, then x’ has the same PoA as x.
IDENT{KPT2} If x has any PoA, then x’ has the same PoA as x.

As an example, IDENT{KP} requires input dorsals and labials to surface faithfully. So, IDENT{KP} is violated by any unfaithful mapping from /k/ or /p/: i.e. /k/ → /g/ or [?] or [?] and /p/ → /p/ or [k] or [t] or [t]. It is not violated by the mappings /k/ → /k/ and /p/ → /p/, nor by any unfaithful mapping from a coronal or glottal (i.e. /t/ → [k,p,t], /l/ → [k,p,t]).

Table (23) shows the effect of the faithfulness constraints.

(23) Violations

<table>
<thead>
<tr>
<th>IDENT{K}</th>
<th>IDENT{KP}</th>
<th>IDENT{KPT}</th>
<th>IDENT{KPT2}</th>
</tr>
</thead>
<tbody>
<tr>
<td>/K/ → /[P] or [?] or [?]</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>/P/ → /[K] or [?] or [?]</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>/L/ → /[K] or [?] or [?]</td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>/I/ → /[K] or [?] or [?]</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Chapter 6§6.4.2 will argue that IDENT constraints are the only type of faithfulness constraint that refers to scales; there are no MAX or DEP constraints that refer to features: i.e. no MAX{K}.

To provide a more formal statement of the PoA-faithfulness constraints, Place of Articulation is taken to be the feature [Place], with the possible values of this feature as in (24).

(24) [Place] values
[xxx Place] = dorsal
[xoo Place] = labial
[xxo Place] = coronal
[ooo Place] = glottal

The Marked Reference Hypothesis is implemented in the present theory as the requirement that every constraint must refer to the same value element – i.e. x, in this case. For the Place of Articulation scale, this requirement allows the following markedness and faithfulness constraints:

(25) (i) PoA Markedness Constraints
* [xxx Place], *[xxPlace], *[xPlace], *[Place]
(ii) PoA Faithfulness Constraints
IDENT[xxxPlace], IDENT[xxPlace], IDENT[xPlace], IDENT[Place]85

As discussed in chapter 2 and illustrated in chapter 3, the markedness constraints are evaluated as such: *{xPlace} is violated for every instance of a Place feature f if f’s value contains x. So, *[xPlace] is violated by *[xxxPlace], *[xxPlace], and *[xx[Place]] features.

Faithfulness constraints require identity between correspondents. A constraint like IDENT[xxxPlace], for example, requires an input segment that is [xxxPlace] to be [xxxPlace] in the output. The constraint IDENT[xxPlace], on the other hand, requires input dorsals to be dorsals in the output, and input labials to be labials in the output. Extensive support for the form of the faithfulness constraints will be provided in later chapters.

5.3.3 The form of the PoA scale
The aim of this section is to justify the distinctions and ranking given in the PoA scale proposed here, repeated in (26).

(26) The Major Place of Articulation (PoA) Scale
| dorsal | labial | coronal | glottal |

The form of the scale most closely agrees with Lombardi’s (1998) proposals.86

Other precursors (of which there are many) were mentioned in the introduction to §5.3.

The idea that there is a markedness hierarchy involving different places of articulation has had much support. However, there is a great deal of disagreement over the details.

85 The value of [Place] in IDENT[Place] is e (the empty string), which all values of [Place] contain. Therefore, IDENT[Place] preserves all PoA values.
86 Lombardi (1995) groups pharyngeals [f] with glottals as the least marked PoA. No evidence relevant to the markedness status of pharyngeals is presented in the following chapters, so determination of its status will be left for future research.
Section 5.3.3.1 discusses the category distinctions made in (26), focusing especially on the ‘glottal’ class. This class includes [ʔ], [ŋ], and Trigo’s (1988) [N] – a nasal glide. Recognition of a nasal equivalent to [ʔ] and [ŋ] will prove to be important in explaining patterns of nasal neutralization and epenthesis.

Evidence for the rankings of the PoA scale is discussed in sections 5.3.3.2-5.3.3.4. Section 5.3.3.2 identifies diagnostics used to determine relative markedness.

The proposal that glottals and coronals are the least marked PoAs is discussed in §5.3.3.3. This section presents evidence from consonant epenthesis and neutralization to support this proposal. The proposal that velars can be the least marked PoA is also considered (Trigo 1988, Rice & Causley 1998, Rice 2000a,b).

Section 5.3.3.4 deals with the ranking between labials and dorsals.

### 5.3.3.1 Glottals

The PoA scale in (26) distinguishes four main classes of PoA. As the coronal, labial, and dorsal classes are generally accepted in a great deal of previous work, the ‘glottal’, or ‘laryngeal’, class is the focus of this section. The class of glottals includes the glottal stop [ʔ], the fricatives/approximants [h n], and Trigo’s (1988) [N]. The least well known of these – [N] – will be discussed first, followed by a discussion of glottals as a class.

The following discussion builds on Trigo’s (1988) proposal that there are nasal counterparts of [ʔ] and [h]. I will argue that there are two separate nasal glottals. One is a nasalized approximant [R]. The other is a nasal stop, symbolized as [N] (not to be confused with uvular [ŋ]). Although [N] is phonologically glottal, I propose it is phonetically realized with an oral constriction in the velar-uvular region.

- **The Nasal Glide (Anusvara) [R]**
  
  [R] is the Sanskrit anusvara, also found in Japanese word-final codas (McCawley 1968, Trigo 1988). Trigo describes it as a ‘glide-like transitional element’. In Gujarati it is said without (complete) occlusion in the oral cavity, thus sounding like a nasalized [h] (or – rather – a nasalized [R] since it is voiced).
  
  [R] is reported to occur in a number of Peruvian languages. For example, Rich (1963) reports its existence in Arabela onsets, which also can contain [m] and [n]. The Arabela [R] is clearly nasal: it motivates nasal harmony, just as [m] and [n] do (e.g. [Ramú] ‘to fly’, cf. [mũwär] ‘partridge’, [mũnũ] ‘kill’).
  
  [R] is also reported to alternate with [ŋ] in some languages. Payne (1990:162) reports that it appears in Aguaruna onsets, but is realized as [ŋ] in codas: [sunkũ] ‘influenza’ cf. [sunkũ-ᵣũ] ‘influenza+accusative’ (p.162).

  Just like [h], [R] continues the articulations of preceding vowels. For example, McCawley (1968:84) describes the Japanese [R] as “a nasalized prolongation of the preceding vowel”.

I suggest that the implementation of the ‘placeless’ [N] effectively calls for the most direct route from the glottis to the nostrils (via the pharyngeal and nasal airways). Any oral cavity would subvert this aim; therefore the size of oral cavity must be restricted. As shown in the diagrams above, a constriction in the velar region is the best that can be done in this regard.

This implementation can be compared with another ‘placeless’ consonant [ŋ]: like the proposal for [N], [ŋ] is produced by creating the most direct route from the glottis to the sound radiation point (the mouth); the nasal cavity is closed off in this case.

The net result is that two different phonological segments – /ŋ/ and /N/ – have the same phonetic realization, but for quite different reasons. The phonological specifications of /ŋ/ issue a directive for velar constriction; in contrast, the phonological specifications of /N/ merely require a direct route from source to radiation point, and velar constriction happens to be necessary to achieve this goal.
Phonological Evidence for [N]

The reason so much time has been spent in discussing [N] is that it appears prominently in the analysis of neutralization in chapter 6. For example, a number of languages neutralize all nasal PoA contrasts to [N] in coda position (e.g. Hullaga Quechua, Seri\(^{37}\), Yampu (Rutgers 1998), Makassarese (Aronoff et al. 1987), and Misantla Totonac (San Marcos dialect) (Mackay 1994:380); others are provided in ch.6§6.1.1. Since [N] is realized with velar constriction, the result is a coda nasal inventory of just [ŋ], or [n ŋ] if only coronals neutralize.

One may wonder why this velar nasal should be considered to be [N] at all. A variety of evidence is presented in ch.6§6, so I will only summarize it here.

One reason relates to parallelism of neutralization. Most of the languages with neutralization to [N] also have neutralization of oral stops to [?] and/or fricatives to [h]. In contrast, no language has neutralization of oral stops to [k] and fricatives to [x] (see ch.6§6.3.1).)

Another reason relates to epenthesis. The oral stops [?] and [t] are commonly produced by epenthesis, as is the glottal [h]; in contrast, [k] and [x] are never epenthetic. As shown in §5.3.2.2, Uradhi provides an example of epenthesis that produces [ŋ], supporting the proposal that this is phonologically [N].

Another reason relates to the behaviour of nasals in assimilation to glottals. For example, the coronal nasal /n/ assimilates to a following glottal’s PoA in Yampu (Rutgers 1988): [pẽni] → [pẽnŋi] ‘he’s sitting’; [hẽn-hec-nd-um-de-] → [hẽnŋecondwende] ‘can you open it?’ (p.44) (for further discussion see ch.6§6.6). This is easily explained if the nasal realized here is [N]: i.e. [penŋi], [heNheondwende]. Otherwise, it is difficult to see why a glottal would cause a preceding nasal to turn into a velar. Certainly, assimilation of stops to glottals results in a glottal, not a velar: e.g. /me-dok-ha/ → [modɔʔa] ‘like those’ (p.48).

Further evidence for the phonological status of [N] will be presented in ch.6§6.6.

Comparison with Trigo (1988)

In summary, I have proposed that there are two nasal glottals: the approximant [h] and the stop [N]. The latter is realized with constriction in the velar–uvular region, making it indistinguishable from [ŋ].

Although this proposal is based on Trigo’s (1988) work, it is important to point out that it differs from Trigo’s (1988:45ff) proposals. For Trigo, there is no glottal nasal stop; there is only a nasal glide, equivalent to [ʔ] here. To account for the fact that this sound is realized with velar constriction in some languages, Trigo proposes that “the dorsal articulation of place-less consonants is acquired to implement the [+consonantal] feature” (p.49). In other words, glottal nasals always start off as [ʔ] and are converted to velar nasal stops at some point in the derivation (p.55).

37 To be precise, /m/→[ŋ] before pause (e.g. /kõt̪paŋ/→ [kõt̪pɑŋ] ‘sardine’), but not in an unstressed syllable (e.g. [sãt̪am] ‘he will beg’ Marlett 1981:20). Faithfulness to the stressed syllable blocks neutralization in this case (Beckman 1998).

The formal expression of markedness – ch.5

I do not adopt Trigo’s view for two reasons. One is theory-internal: /N/→[ŋ] conversion is necessarily opaque. /N/ must first trigger all processes that rely on its glottal PoA, then at the last it is converted into a velar. Since the output is phonologically velar ([ŋ]), this is necessarily a two-step process in Trigo’s theory: first /N/-assimilation produces [N], which is then followed by velarization to [ŋ]. In the present view, the assimilated nasal is the glottal [N] in the output: i.e. [penŋi]. There is no ‘velarization’ step – realization of the stop with velar constriction is not due to a phonological process, but a matter of phonetic implementation. I reject the opaque approach because it does not sit well with classic Optimality Theory as presented by Prince & Smolensky (1993).

Certainly, opacity does exist, and theories for dealing with it have been proposed (McCarthy 1999, 2002a, Goldrick & Smolensky 1999, Goldrick 2000, Bye 2001). However, /N/-velarization is quite a different type of opaque process: it is obligatory, occurring every time /N/ appears.

The other reason is more concrete, relating to the markedness of velars. Trigo (1988:ch.2) argues that the phonological rule that inserts dorsals applies to placeless consonants generally, not just /N/. With an opaque derivation, this implies that placeless oral stops and oral fricatives could also be given a [dorsal] feature. As Trigo shows, the result of this prediction is that [k] can be epenthetic and a target of neutralization. For epenthesis, a placeless consonant is inserted, then assigned a [dorsal] feature to produce [k]. For neutralization, stop consonants first debuccalize, then the output is assigned a dorsal feature, predicting that [k] and [x] can be the output of place neutralization.

Although Trigo argues that cases supporting these predictions exist, I will argue that none withstand scrutiny – there is never epenthesis of [k] or [x], and these segments are never the output of neutralization (see also Paradis & Prunet 1990a,b, 1994). Since the arguments are best set in a theory of neutralization, I leave discussion of this point until ch.6§6.6. For a discussion of epenthesis, see 5.3.3.3.

Glottals are not placeless

The final issue to be discussed here is the phonological representation of the class of glottals ([2 h fi N]). I will argue that these elements bear a PoA feature, following McCarthy (1994) (cf. Clements 1985, Sagey 1986, Hayes 1986, Avery & Rice 1989, Rice & Avery 1993). McCarthy (1994) presents evidence that the place feature of glottals is phonologically active in a number of phonological processes (also see Rose 1996). Ch.6§5.2.1 adds to this evidence.

McCarthy’s (1994) proposal that these elements have the feature [+glottal] will be adopted. Following a suggestion by John Kingston, the [+glottal] feature can be interpreted as requiring an absence of consonantal constriction downstream from the sound source that divides the oral cavity into separate resonating chambers.\(^{38}\) This is the case for [N]: the nasal passage provides the only resonating chamber; there is no oral resonating chamber due to velar constriction.

For phonological interests, the crucial point is that glottals have a PoA feature.

38 The ban on a consonantal constriction – a constriction related to the production of a consonant – allows for coarticulation of glottals with vowels (as typically happens). My thanks to John Kingston for discussion of this point.
5.3.3.2 Markedness diagnostics

The rankings proposed in the scale (dorsal | labial | coronal | glottal) are motivated by a particular conception of markedness diagnostics – phenomena that show asymmetries in the treatment of different PoAs. The aim of this section is to first identify the diagnostics considered valid in this work. The section concludes by identifying other previously proposed diagnostics, and outlining why they are not considered relevant.

Many diagnostics for determining markedness relations have been proposed (Greenberg 1966, Brown & Witkowski 1980, Moravcsik & Wirth 1983:6, Paradis & Prunet 1991, Cauley 1999b§2.3, Rice 2000a,b). Of these, the ones in Table 5.2 are argued to be valid.

Table 5.2: Markedness diagnostics considered valid

<table>
<thead>
<tr>
<th>Diagnostic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Neutralization: outputs</td>
<td>If /x/ and /y/ neutralize to produce [x], then y is more marked than x. (Jakobson 1941, Trubetzkoy 1939; ch.6§6, Cairns 1969)</td>
</tr>
<tr>
<td>(b) Deletion</td>
<td>If y undergoes structurally conditioned deletion and x does not, then y is more marked than x. (Rice 2000a,b, ch.6§6.4.2)</td>
</tr>
<tr>
<td>(c) Epenthesis (Consonant)</td>
<td>If consonant x is epenthesized and y is not, then y is more marked than x. (Archangeli 1984, 1988, McCarthy &amp; Prince 1994, §3.3.3)</td>
</tr>
<tr>
<td>(d) Assimilation: triggers</td>
<td>If y triggers assimilation and x does not, then y is more marked than x. (Mohanan 1993:75,76, Jun 1995:78; ch.7§7.7)</td>
</tr>
<tr>
<td>(e) Prosodification: mutual influence</td>
<td>If some prosodic constituent x is attracted to or attracts y and ignores y, then y is more marked than x in terms of α. (tone &amp; stress: Goldsmith 1987, de Lacy 1999a, 2002b; sonority &amp; stress: chs.3,4, Kenstowich 1996; sonority and syllable structure: Prince &amp; Smolensky 1993 and references cited therein).</td>
</tr>
<tr>
<td>(f) Inventory structure (to a very limited extent)</td>
<td>If the presence of x in a segmental surface inventory implies the presence of y but not vice versa, then y is more marked than x. (Jakobson 1941, Trubetzkoy 1939, Greenberg 1966; cf ch.6)</td>
</tr>
</tbody>
</table>

* The term ‘structurally-conditioned’ is from Trubetzkoy (1939:235ff). A process is structurally conditioned if (i) it takes place in some prosodic position (e.g. coda, onset, stressed syllable) and (ii) no surrounding elements are involved in triggering the process. For example, /k/ is deleted in Lardi codas (Hale 1973) – this is structurally conditioned deletion. In contrast, deletion of [k] before another dorsal is not structurally conditioned since a non-structural element – i.e. the other dorsal – is crucial to triggering the process.

For example, [a] attracts stress over [i] in Gujarati, so [i] is more marked than [a] in terms of stress.
performance mechanisms, while those in the Tables above relate to competence. The following chapters focus on competence diagnostics only.

5.3.3.3 Coronals and glottals: Consonant epenthesis

The idea that coronals are less marked than both labials and dorsals is popular (see Paradis & Prunet 1991, McCarthy & Taub 1992 and references cited in these works for discussion). This section identifies some markedness diagnostics that support this claim. The relative ranking of coronals and glottals is also discussed, as is the proposal the velars are less marked than coronals.

• Epenthesis: Data

Epenthetic segments can be divided into two types for PoA. One is where the PoA is copied from a nearby segment. This is the case in glide epenthesis, for example, where the glide is palatal [j] if an adjacent vowel is front, but labial [w] if the vowel is back (e.g. Dakota – Shaw 1980:90). Such cases are treated as arising from PoA assimilation in ch.7.

The other type is where the PoA is not influenced by surrounding segments – ‘default’ epenthesis. Such cases show the emergence of context-free markedness constraints. For example, the epenthetic consonant in Hare and Bearlake Slave is [h], regardless of the environment (Rice 1989:133). /h/-epenthesis is used to eliminate onsetless syllables: e.g. /icé/ → [hicé] ‘we start to sing’ (cf /i-icé/ → [iicé] ‘we start to sing’); /le-i- wee/ → [lehiwee] ‘we eat in two’.

As Table 5.4 shows, epenthetic consonants may take on glottal [ʔ h N] or coronal [t s n l] PoA. The list builds on Lombardi (1998, p.c.), and on my previous work on epenthesis (Kitto & de Lacy 1999).91

Table 5.4: Typology of consonant epenthesis92

<table>
<thead>
<tr>
<th>Language</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chadic</td>
<td>Frazyngier &amp; Kope (1989)</td>
</tr>
<tr>
<td>Cupeño</td>
<td>Crowhurst (1994)</td>
</tr>
<tr>
<td>Larike</td>
<td>Laidig (1992)</td>
</tr>
<tr>
<td>Mohawk</td>
<td>Hale &amp; White Eagle (1980)</td>
</tr>
<tr>
<td>Tigré</td>
<td>Raz (1983)</td>
</tr>
<tr>
<td>Tsxshaath Nootka</td>
<td>Stonham (1999)</td>
</tr>
</tbody>
</table>

91 I am grateful to Linda Lombardi for discussing PoA in consonant epenthesis with me. For discussion and theoretical proposals relating to PoA markedness and epenthesis, see Lombardi (1995, in prep.).
92 Epenthetic [ʔ] has been reported for British English (Wells 1982, Gick 1999). However, Bermudez-Otero (2003) shows that this is not truly epenthetic.
Aximina Campa: Payne (1981)
Korean: Kim-Renaud (1986:19)
Maori: de Lacy (2002a) & references cited therein
Ayutla Mixtec: Pankratz & Pike (1967)
Chippewyan: Li (1946)
Fox: Bloomfield (1924:220)
Slave (Bear Lake, Hare): Rice (1989:133)
Tigre: Rose (1996)
Tucanoan (utterance-final C-epenthesis): Welch & Welch (1967:18)
Yucatec: Mayan (utterance-final C-epenthesis)

Uradhi

Fula language game
Bugembi: Lombardi (1998)
Korean: Hong (1997)
Murut: Prentice (1971:113)
Tunica: Haas (1946), Lombardi (1998)

Ameojth: Lynch (2000:29)
Southern Tati: Yar Shater (1969)

Not on glides
Glides present a rather special case in relation to epenthesis. The ‘commonly accepted’ glides are [j w y] and [probably] [ŋ] (Chomsky & Halle 1968); [ŋ] might also be considered a glide, but more controversially. The interesting fact about the set [ŋ j w y] is that there is no ‘pure’ coronal glide; the closest is the palatal [j]. Chapters 7 and 8 will show that palatality is marked, with the effect that an epenthetic [j] may be ruled out by means of a ban on palatal segments. If the constraint against palatals is ranked high enough and the glottal [ŋ] is also avoided, the most unmarked PoA left is labial.

In short, the present system predicts that there could be languages with an epenthetic [w], if that language avoids palatals and glottals. Parker (1989) shows that this is precisely the case for Chamicuro. However, it is important to emphasize that glides are a special case – they are special because they essentially lack an dental/alveolar element; in essence, this means that the labial [w] can be ‘promoted’ in unmarkedness. The existence of dental/alveolars of all other manners of articulation means that the same thing cannot happen for other manners of articulation – [p], [t], and [m] can never be epenthetic.

[?] is the most common epenthetic category; only a few representative cases are listed above.

The most common site of epenthesis is in onsets. Fox provides an example of onset [h]-epenthesis: /mana icawiwa/ → /mana ihchawiwa/ (Bloomfield 1937:220); Slave presents a further case (Rice 1989:130ff).

Epenthetic consonants can also appear in codas. For example, Ayutla Mixtec requires the PrWd-initial syllable to be bimoraic (i.e. CVC) (Pankratz & Pike 1967). Usually this is achieved by geminating the following consonant: [tos.so] ‘a floral arch’, [tim.ma] ‘candle’, [cel.le] ‘scissors’, [naj.ja] ‘a dog’. However, coda stops are banned, so /h/ is inserted into stressed syllable codas instead of geminating them: [tuh] ‘a few’, [kah.t] ‘a dog’.

A few languages do assign epenthetic consonants their PoA through assimilation in some environments, and a default PoA in others. For example, a number of languages epenthesize glides next to high vowels, but [?] elsewhere: Dutch (Boooij 1995:191), Tamil (Wiltshire 1988), Kalinya (Rosenthal 1994:180), Malay (Cohn 1989, Cohn & McCarthy 1994).

In contrast, no language inserts an epenthetic labial [p m f] or dorsal [k x j] (for discussion, see ch.6§6.6) (unless some independent process – like assimilation – interferes).

[24] Paradis & Prunet (1990a:12) propose that the epenthetic segment is simply a floating [+nasal] feature that acquires dorsality from the preceding vowel. More recent views of vowel features do not consider all vowels to be [dorsal], so this approach is put aside here. Having said this, Uradhi offers some interesting further complexities. Final nasals – both underlying and epenthetic – can be optionally denasalized if the preceding consonant is oral. The result is [?] or [ŋ], depending on the dialect. This complication is left for future research.

Trigo (1988:57ff) argues that Uradhi has epenthetic [N], not [ŋ], though the phonetic realization is the same.
• Epenthesis: theoretical implications
This asymmetry in epenthesis shows that coronals and glottals are less marked than dorsals and labials. In more technical terms, this asymmetry shows that (i) there is a markedness constraint or constraints that favour coronals and glottals over dorsals and labials, and (ii) that there is no markedness constraint that favours dorsals and/or labials over glottals and/or coronals. If a constraint ‘favours x over y’, it assigns fewer violations to x than to y.

To explain this point, faithfulness constraints do not apply to epenthetic segments. Therefore, the featural content of epenthetic segments is entirely determined by markedness constraints (Smolensky 1993:5). Since epenthetic elements emerge as coronals and glottals and not labials or dorsals, there must therefore be markedness constraints that favour the former pair over the latter pair (i.e. *{K} and *{KP} in the present theory). Moreover, since epenthetic elements are never labials or dorsals, it must be the case that no markedness constraint favours them over glottals and coronals. If there were a constraint *{T}, for example, and it outranked all anti-{KP} constraints, epenthetic elements could be dorsal or labial.

Lombardi (1998) observes that inventories without glottals show that there cannot be a markedness constraint that favours dorsals and labials above coronals (i.e. *{T}). In all such cases, the epenthetic consonant is coronal: e.g. Maori (Bauer 1993, de Lacy 2002a), Axininca Campa (Payne 1981). For example, Axininca Campa inserts [t] to eliminate onsetsyllables; it has the stops [k p t] (Payne 1981:59)

(27) Axininca Campa [t]-epenthesis (Payne 1981:108ff)

\[
\begin{align*}
\text{[t]} & \rightarrow \text{[t]\text{[t]}}, \text{he will paddle} \\
\text{[t]} & \rightarrow \text{[t]\text{[t]}}, \text{he will paddle again} \\
\text{[t]} & \rightarrow \text{[t]\text{[t]}}, \text{he will paddle for} \\
\text{[t]} & \rightarrow \text{[t]\text{[t]}}, \text{he will paddle for it again} \\
\text{[t]} & \rightarrow \text{[t]\text{[t]}}, \text{he will cut}, \text{[t]\text{[t]}} \\
\end{align*}
\]

If there were a constraint *{T}, a system could easily be constructed whereby labials or dorsals would be epenthetic. For example, if glottals were eliminated and *{T} outranked all other markedness constraints, a system with [k p t] would have epenthetic [t]:

(28) No *{T},

<table>
<thead>
<tr>
<th></th>
<th>*{T}</th>
<th>*{K}</th>
<th>*{KP}</th>
</tr>
</thead>
<tbody>
<tr>
<td>a/</td>
<td><img src="image1.png" alt="image" /></td>
<td><img src="image2.png" alt="image" /></td>
<td><img src="image3.png" alt="image" /></td>
</tr>
<tr>
<td>(a) la</td>
<td><img src="image4.png" alt="image" /></td>
<td><img src="image5.png" alt="image" /></td>
<td><img src="image6.png" alt="image" /></td>
</tr>
<tr>
<td>(b) pa</td>
<td><img src="image7.png" alt="image" /></td>
<td><img src="image8.png" alt="image" /></td>
<td><img src="image9.png" alt="image" /></td>
</tr>
</tbody>
</table>

Howe & Pulleyblank (2001) propose that faithfulness constraints are responsible for the quality of epenthetic segments (focusing on vowels). Their proposal uses DISP-F constraints to ban the insertion of marked features. Arguments against MAX-F constraints are given in ch.6§6.4, so this theory will be discussed further.

In short, epenthesis shows that there can be no constraint that favours dorsals and labials over coronals.72

• Coronal vs Glottals
The epenthetic element can be (and usually is) glottal even when a coronal is available (Lombardi 1998). Therefore, some markedness constraint must favour glottals over coronals. On the other hand, the markedness constraint cannot favour dorsals and labials over coronals, as established above. The present theory’s *{KP} satisfies both these requirements. The existence of this constraint relies on the proposal that coronals are more marked than glottals.

Certainly, glottals may be banned from inventories, indicating that some markedness constraint favours coronals over glottals; ch.6§5.2 discusses this issue in detail.

• Other diagnostics
Other diagnostics apart from epenthesis support the proposal that glottals and coronals are less marked than dorsals and labials.

In ch.6§6.6, the output of neutralization is shown to always be glottals or coronals, never labials or dorsals. It is also shown that the featural content of the output of neutralization is determined (almost) solely by markedness constraints. Hence, direction of neutralization shows the structure of markedness constraints (just like epenthesis).

Ch.6§6.4.2 discusses asymmetries in deletion. Cases where only dorsals and labials are deleted (e.g. Lardil, Nunggubuyu) are argued to show the need for markedness constraints that favour coronals and glottals over the other PoAs. The lack of cases where coronals delete but labials and dorsals survive is argued to show that there are no constraints that ban coronals without also banning labials and dorsals.

As a final note, since subsegmental scales (i.e. not sonority or tone) do not affect prosodic structure (ch.3§3.5.2.2), prosodification provides no evidence for featural scales.

• Velar unmarkedness
This discussion concludes with a brief consideration of two counter-proposals for markedness, both involving velar as less marked than coronals.

Trigo (1988) proposes that coronals are least marked in onset position, but dorsals are least marked in coda position.

Rice & Causley (1998) and Rice (2000a,b) propose that – in effect – there are two scales relevant to PoA. One relates to structural complexity: on this scale, velars are less marked than coronals, labials, and other dorsals.68 However, PoAs can also be evaluated

67 This discount fixed rankings. If fixed ranking was allowed, *{T} would have to be universally outranked by constraints that favoured coronals over dorsals and glottals. Some languages epenthize [t] even when it is otherwise banned in the language (e.g. German, English). The present constraints provide no particular insight into these cases, so they will not be discussed further here.

68 Rice & Causley (1998) propose that glottals consist of a bare root node while velars consist of a root node and a Place node, but no place features. In contrast, coronals, labials, and non-velar dorsals have more complex structure: root nodes, Place nodes, and place features.
in terms of structural completeness, in which case coronals, labials, and non-velar dorsals are less marked than both velars and glottals. In effect, then, there are two scales, one in which coronals are less marked than velars, and another in which velars are less marked than coronals.

Both proposals make predictions about the output of epenthesis and neutralization. For epenthesis, they predict that [k] could be an epenthetic consonant, as could [x]. Cases that seem to have epenthetic velars are discussed in ch.6§6.6.2; for all of these (very few) cases, the ‘epenthetic’ velar is argued to really be a morpheme.

Ch.6§6.1 shows that there are no cases where segments neutralize to velars. Thus, there is no case where stops neutralize to [k], or fricatives to [x]; languages with nasal neutralization to [n] are argued to instead involve neutralization to [N]. In contrast, a number of languages neutralize stop PoA distinctions to coronals.

Other arguments for velar unmarkedness will be shown to rely on unreliable diagnostics. For example, Trigo (1988:84f) argues that assimilation provides evidence for velar unmarkedness: in some languages, only velars undergo assimilation, while in others only velars trigger it. Chapter 7 shows that the typology of undergoers in assimilation provides no support for relative markedness.

Trigo (1988:90f) also cites evidence from transparency to vowel feature spreading. In Chinook, only the velars [k k’ g x], uvulars [q q’ ñ ñ’] and glottal [ʔ] are transparent to rounding harmony: e.g. [u-k’ask’s] ‘girl’ (cf [i-k’ask] ‘boy’), [u-qañak] ‘large boulder’ (cf [i-qañak] ‘stone’); cf [t-pawilʔ-ma] ‘bunches of grass’, [u-lata-ịs] ‘flounder’. Trigo proposes that the ability of dorsals to allow spreading indicates that they lack any place features. Paradis & Prunet (1994) provide an alternative account, based on the proposal that feature spreading is strictly local (also see Gafos 1996). Consequently, [t-round] can only spread through consonants that can bear a [t-round] feature. It just so happens that only velars and uvulars can bear such a secondary articulation: [p’ t’] are not allowed in the language.

Paradis & Prunet provide an interesting array of cross-linguistic support for their proposal. They adduce a minimally contrasting case from Inor: this language allows labialized labials and velars, and consequently allows rounding support to spread through both types, but not coronals. Given the Inor facts, if transparency truly indicated lack of PoA features, one would have to argue that both labials and velars are featureless in Inor.

In short, there is no solid evidence that velars can be less marked than coronals in any grammar. Further discussion of this point is provided in ch.6§6.3.1.

5.3.3.4 Dorsals vs labials

This section discusses evidence for the relative markedness of dorsals and labials. There is very little agreement over the relative markedness of dorsals and labials; some authors have labials as the more marked of the pair (e.g. Prince 1997, Hamilton 1997), others have dorsals as more marked than labials (Mohanan 1993, Lombardi 1998, Bernhardt & Stemmerger 1998:172), and yet others have no ranking between the two (e.g. Jun 1995). Few of the authors offer diagnostics for the rankings (cf Hamilton 1997 – inventories in Australian languages; Mohanan 1993:75-6 – assimilation triggers).

Very few of the markedness diagnostics are applicable to the ranking between labials and dorsals. For example, since either a coronal or glottal is always available in an inventory, neutralization will never reduce PoA contrasts to labials or dorsals. Likewise, epenthesis will never produce a labial or dorsal since coronals and glottals are universally less marked.

Of all the diagnostics, only two remain: deletion and direction of neutralization. In Siuslawan codas, [k] deletes but [p] does not (Frachtenberg 1922: ch.6§4.2.2). This indicates that some markedness constraint that bans [k] but not [p] outranks MAX, the anti-deletion constraint (McCarthy & Prince 1995). Moreover, no markedness constraint that assigns a violation to [p] can outrank MAX in this grammar. The existence of a markedness constraint that targets dorsals alone – i.e. *[K] – indicates that dorsals and labials are distinct on some scale.

Siuslawan does not show that dorsals are necessarily more marked than labials. It could be that dorsals and labials are not ranked with respect to each other (e.g. Smolensky 1993, Rice 2000a, Jun 1995, Cho 1999).

However, there is an absence of typological evidence that labials are ever deleted while dorsals remain. Therefore, I have as yet found no need for a markedness constraint that bans labials without banning dorsals. If it is always true that labials cannot delete without dorsals also deleting, then all markedness constraints that assign a violation to labials must also assign one to dorsals, just as *[KP] does.

Evidence for the (dorsal) labial | ranking also comes from triggers of assimilation. Chapter 7§6 discusses this issue, showing that dorsals can trigger place assimilation while velars do not (also Mohanan 1993:75-6). For example, labials assimilate to a following dorsal in Korean, but dorsals do not assimilate to a following labial (see ch.7§6.2.2 for other examples). Chapter 7 provides arguments that this asymmetry follows from the greater markedness of dorsals: more marked elements may force assimilation while less marked elements do not. In contrast, I found no cases where labials forced assimilation while dorsals did not. This indicates that labials are never more marked than dorsals under any ranking. This fact can only follow if there is no markedness constraint *[P], banning labials but not dorsals.

The lack of *[P] can be explained if dorsals are universally more marked than labials. Since markedness constraints must mention the most marked member of a scale, any constraint that mentions labials must therefore also mention dorsals: i.e. *[KP].

To conclude, although there is evidence that dorsals are more marked than labials, it is less robust than evidence that coronals and glottals are less marked than labials and dorsals. Accordingly, the theoretical proposals presented in the following chapters never rely on the relative markedness of dorsals and labials. In almost all cases, the argument would follow if labials were more marked than dorsals, or they had the same ranking on the PoA scale. The few cases where the ranking is relevant will be identified when they arise.

57 There are languages with dorsals but no labials. However, this does not indicate that input labials delete in such cases – they may neutralize, as shown in chapter 6.
58 The case of Received Pronunciation English with assimilation of /n/ to labials but not dorsals is discussed in ch.7§5.3.4.
5.4 Summary
The aim of this chapter was to introduce the scale-referring faithfulness constraints used in the following chapters. The constraints have two important properties: (i) they preserve more marked elements over less marked ones, and (ii) they are stringently formulated. Arguments for the necessity of these two properties are presented in the following chapters.
A secondary aim of this chapter was to provide an implementation of the PoA scale in terms of constraints. Evidence for the form | dorsal (K) > labial (P) > coronal (T) > glottal (G12) | was provided; further evidence is supplied in the following chapters where relevant.

CHAPTER 6
FAITHFULNESS TO THE MARKED I:
NEUTRALIZATION

6.1 Introduction
This chapter is the first of two to argue for the proposal that marked elements are subject to greater preservation than less marked ones. This informal statement is formally expressed for the Major Place of Articulation scale | dorsal (K) > labial (P) > coronal (T) > glottal (G12) | by the marked-faithfulness constraints in (1).

(1) Major Place of Articulation marked-faithfulness constraints
* x corresponds to x’
  IDENT{K}  If x is dorsal, then x’ has the same PoA as x.
  IDENT{KP}  If x is dorsal or labial, then x’ has the same PoA as x.
  IDENT{KPT}  If x is dorsal, labial, or coronal, then x’ has the same PoA as x.
  IDENT{KPTG12}  If x has any PoA, then x’ has the same PoA as x.

For the remainder of this chapter, all IDENT constraints will refer to the Input→Output dimension unless otherwise stated. So, IO-IDENT will be abbreviated to IDENT. For discussion of the relevance of dimension to IDENT constraints, see ch.7§7.7.4.
As explained in chapter 5, the form of the constraints ensures that faithfulness to unmarked elements never overrides faithfulness of marked elements. For example, every faithfulness constraint that preserves coronals also preserves the more marked labial and dorsal elements (i.e. IDENT{KPT}, IDENT{KPTG12}). The result is that there is no way to single out unmarked elements for special faithfulness; in contrast it is possible for marked elements to be preserved faithfully while less marked elements are not.
As an example, IDENT{KP} requires both dorsals and labials to be faithfully preserved. So, any unfaithful mapping from /k/ will incur a violation, as will any unfaithful mapping from /p/. However, IDENT{KP} incurs no violations for unfaithful mappings from /t/ or /G12/.
As a reminder, the ‘marked preservation’ aspect of the faithfulness constraints in (1) is quite separate from the fact that they are stringently formulated (i.e. refer to ranges of a scale). As discussed in ch.5§5.1, the ‘unmarked-faithfulness’ constraints IDENT{T}, IDENT{TP}, and IDENT{TPK} are also stringently formulated but cannot preserve marked elements without also preserving unmarked ones. In contrast, the set of non-stringent constraints in a fixed ranking || IDENT{K} > IDENT{P} > IDENT{T} > IDENT{G12} || encodes the ‘marked preservation’ property by having faithfulness constraints to marked elements.
The empirical focus of this chapter is neutralization. The term ‘neutralization’ is used here to refer only to structurally conditioned non-assimilative and non-dissimilative neutralization, to use Trubetzkoy’s (1939:233ff) terminology. This includes processes that change the featural content of a segment in a certain structural position (or in all structural positions), but do not refer to adjacent segments. For example, in Slave all stops and fricatives are neutralized to [h] in coda position regardless of which segments precede or follow (Rice 1989) – this counts as neutralization here. In contrast, /p/ changes to [m] in Chukchi codas, but only before a labial consonant (ch.7§4.5.1, Bogoras 1922, Krause 1980); although this is a type of neutralization, it is assimilative and therefore not the focus of this chapter (see ch.7). As a note on terminology, the phrase ‘/t/ neutralizes to /β/’ will be used to mean that /t/ and /β/ neutralize, producing [β]. Thus, Slave’s coda /β/ neutralizes to [h].

This chapter will discuss (i) neutralization of PoA distinctions in syllable codas and (ii) absolute PoA neutralization. The latter refers to the situation where certain segments are banned in all environments.

- **Neutralization**
  - Evidence for marked-faithfulness constraints comes from languages that have inventories that contain highly marked elements but lack less marked ones. The term ‘inventory’ is used here to refer to the surface segments found in a language; it may be further modified by a prosodic position, such as ‘coda inventory’, being those segments that can appear in syllable codas in a language. The particular type of inventory of interest here is exemplified by Yamphu (Rutgers 1998). This Nepalese language has the stops /k p t/ in onset position. In codas, though, only /k p t/ appear; /t/ is neutralized to [ʔ].
  - A selection of relevant data is provided in (2); this case is discussed in more detail in §6.3. Yamphu has intervocalic voicing of singleton stops (e.g. [hard-u-ŋ], [ʰhar-u-ŋ]).

In the Prague School conception of markedness (Jakobson 1941, Trubetzkoy 1939), Yamphu coda neutralization is surprising, to say the least. Yamphu eliminates a very unmarked element in codas – the coronal /t/ – but leaves the highly marked elements /k/ and /p/ untouched. On the surface, this seems to be directly contrary to the spirit of markedness theory.

The proposal that marked elements may excite great preservation provides an explanation for Yamphu. /k/ and /p/ escape the PoA neutralization process because they are highly marked, and so are the subject of greater preservation than the less marked element /t/.

In formal terms, the key constraint is IDENT[KP], which preserves input dorsals and labials in the output but not coronals. IDENT[KP] outranks all constraints that promote elimination of dorsals and labials: i.e. *{KP} and *{KPT}.

### Tableau (3)

<table>
<thead>
<tr>
<th></th>
<th>IDENT[KP]</th>
<th>*{KP}</th>
<th>*{KPT}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>ap</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td>a⁴</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

Tableau (3) shows how IDENT[KP] blocks neutralization of /p/ to [ʔ]. In contrast, IDENT[KP] does not prevent /t/ from neutralizing.

If all faithfulness constraints that preserve coronals IDENT[KPT], IDENT[KPT] are ranked below the constraints that ban coronals (*{KPT}) the result will be that /t/ is debuccalized, as shown in tableau (4).
Tableau (5) puts the two rankings together (ignoring IDENT{KPT}) and *{KP} for brevity. The input to tableau (5) is /sok+sæt/ ‘squeeze+pull’, producing [sok-sæt].

(5) Marked preservation and unmarked neutralization

<table>
<thead>
<tr>
<th></th>
<th>IDENT{KP}</th>
<th>*{KPT}</th>
<th>IDENT{KPT}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) sok+sæt</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) sok+sæt</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(c) so+sæt</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(d) so+sæt</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

As a side note, debuccalization is blocked in onsets by positional faithfulness constraints (Beckman 1998, Lombardi 1995, 1999).

The inventory of coda consonants in Yamphu is ‘gapped’, a term from Prince (1997c, 1998). While Yamphu has the marked elements [k p] and the highly unmarked [?] in codas, its inventory lacks the ‘intermediately’ marked [t]; in other words, [t] is a gap in an otherwise contiguous range of the PoA scale. This chapter shows that faithfulness constraints that preserve only marked elements are essential in accounting for gapped inventories.100 Prince (1998) has also shown that this type of constraint can produce gapped inventories.

This chapter also shows that – contrary to previous claims – every type of gapped inventory exists for every manner of articulation. As a brief example, Table 6.1 lists coda inventories of voiceless stops. As shown, every type of gapped inventory – one that lacks a less marked element but contains a more marked one – is attested. A ✓ indicates that the stop is present in the coda of the language cited, while a blank square means that the stop is banned.

Table 6.1: Gapped voiceless stop inventories

<table>
<thead>
<tr>
<th></th>
<th>Coda Inventory</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ ✓</td>
<td>Cockney English, Yamphu</td>
</tr>
<tr>
<td>✓ ✓</td>
<td>Nambiquara</td>
</tr>
<tr>
<td>✓ ✓</td>
<td>Nganasan</td>
</tr>
<tr>
<td>✓ ✓</td>
<td>Fuzhou</td>
</tr>
<tr>
<td>✓ ✓</td>
<td>Mordvin</td>
</tr>
</tbody>
</table>

100 To underscore the point that gapped inventories support the ‘marked preservation’ proposal and not the proposal that faithfulness constraints are stingently formulated, the ranking || IDENT{K} > IDENT{P} > *{KP}, *{KPT} > IDENT{T} || with non-stringent faithfulness constraints can also produce the Yamphu system (also see Prince 1999).
The final issue discussed in this chapter relates to the marked-faithfulness constraints’ influence on the output target of neutralization: e.g. whether /k/ neutralizes to [p], [t], or [ʔ]. This section shows that it is crucial that the faithfulness constraints have no influence on the output target. For example, no marked-faithfulness constraints favour neutralization to [p] over neutralization to [ʔ] and [t]; if it did the unattested /k/ → [p] neutralization could take place. This result follows from the fact that the faithfulness constraints assign equal violations to all unfaithful mappings. Its empirical effect is that a segment will always neutralize to the least marked PoA available.

The form of the marked-faithfulness constraints means that markedness constraints are forced to make the crucial determination as to the target of neutralization: they force neutralization to the least marked PoA available. Neutralization targets are discussed in §6.6.

Implications for markedness

This chapter has implications for the concept of ‘markedness’. As observed by Prince (1998), previous theories of markedness have “programmatically assumed that something like harmonic completeness is true of every language.” Given the existence of gapping, inventories can no longer be seen to provide clear evidence about markedness relations in scales. To be more concrete, the fact that [k] exists in Hawaiian but not [t] does not imply that [k] is less marked than [t] in any grammar. In short, this chapter all but eliminates inventory structure as a diagnostic for markedness.

The one exception relates to the least marked element. The present theory predicts that the least marked element of scale S can never be eliminated by S-referring constraints. This point is discussed in detail in §6.4.

In contrast, this chapter affirms direction of neutralization and epenthesis as reliable diagnostics for markedness (§6.6). Both direction of neutralization and epenthesis are free from the influence of faithfulness constraints, so they provide insight into the form of markedness constraints.

Organization

The organization of the rest of this chapter is as follows.

Section 2 discusses harmonically complete inventories – those that contain a contiguous section of the PoA scale, starting with the least marked element. The ranking needed to produce such theories is identified, along with typological evidence for the existence of the full range of such inventories.

Section 3 deals with gapped inventories – those that contain highly marked elements and the least marked element, but lack segments of intermediate markedness. This section identifies a number of gapped inventories, and identifies the ranking responsible for producing them.

Neutralization Target

This section identifies a number of gapped inventories, and identifies the ranking needed to ensure neutralization of /G12/. Section 6.2.3 summarizes the results of this section. It also identifies the general ranking needed to ensure neutralization of /t/G12 to /β/.
6.2.1 Description

This section presents evidence that harmonically complete inventories exist for all places of articulation, for both coda inventories and onset inventories. Moreover, two types of harmonically complete inventory are identified. One type is purely the product of the PoA markedness constraints; the other type takes into account the influence of an independent process – Glottal Elimination.

- Standard harmonically complete Inventories

With the PoA scale | dorsal | labial | coronal | glottal |, and no other interfering factors, there are four harmonically complete inventories. Table 6.2 lists examples of each type of harmonically complete voiceless stop inventory; table 6.3 does the same for voiceless fricatives. For the sake of brevity, only one language is cited for each system (see Appendix A for other manners of articulation and further examples).

The languages listed under 'coda inventory' have the contrasts indicated in codas; in onsets they have a fuller range of contrasts (see Appendix A for details). The languages listed under 'onset inventory' have the range of contrasts indicated in onsets in all positions. References for languages cited are given in Appendix B.

Table 6.2: Harmonically complete inventories I: Voiceless stops

<table>
<thead>
<tr>
<th>k</th>
<th>p</th>
<th>t</th>
<th>?</th>
<th>Coda Inventory</th>
<th>Onset Inventory</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Kashaya</td>
<td>Nancowry and Tubatulabal reduplicants</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Chickasaw</td>
<td>Harar Oromo (plain stops)</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Standard Malay</td>
<td>Tahitian</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Pendau</td>
<td>Tongan</td>
</tr>
</tbody>
</table>

Table 6.3: Harmonically complete inventories II: Voiceless fricatives

<table>
<thead>
<tr>
<th>x</th>
<th>f</th>
<th>s</th>
<th>h</th>
<th>Coda Inventory</th>
<th>Onset Inventory</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Fox</td>
<td>Rapanui</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Chipewyan</td>
<td>Sokaiana</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Maltese</td>
<td>Yanomann</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Egyptian Arabic</td>
<td>Harar Oromo</td>
</tr>
</tbody>
</table>

As an example, Kashaya has the inventory of plain voiceless stops [k p t ?] in onsets, but neutralizes this to just [?] in codas (Buckley 1994:99). Almost at the other end of the harmonically complete inventory type, Tahitian has an onset inventory of [p t ?], lacking [k].

I have been unable to find a language that has [?] as the only voiceless stop in onsets. I suggest this typological gap exists for functional reasons: voiceless stops tend to be used a great deal in lexical items, so several contrasts are called for; therefore the lack of an onset inventory with only a [?] is not a concern from a competence point of view. However, onset inventories can be reduced to just [?] in certain environments, such as in reduplicants (see §6.2.2.2, Alderete et al. 1999).

In contrast, there is no such restriction on voiceless fricatives: a number of Polynesian languages only allow [h] in onsets (e.g. Rapanui (Easter Island); see Clark 1976 for a survey).

- Glottal Elimination

The systems just mentioned do not exhaust the list of harmonically complete PoA inventories. Several independent processes can interfere with the output of neutralization, one of the most significant being ‘Glottal Elimination’: the fact that glottals [?] are banned from onset and/or coda inventories in some languages. For example, onsets in Maori can contain the voiceless stops [k p t], but no [?] (Bauer 1993); for voiceless fricatives, Apatani codas allow [s] but no [h] (onsets allow [x s h]).

Section 6.5.2 argues that Glottal Elimination has nothing to do with place neutralization: it is driven by entirely different markedness constraints. In that section, glottals are argued to be more sonorous than segments with different PoA, so a ban on highly sonorous syllable margins (see ch.3) can effectively eliminate glottals from an inventory. For a discussion of the full typological effects of Glottal Elimination, see §6.5.2. For the moment, the notion of Glottal Elimination will be adopted without further comment.

The effect of Glottal Elimination is to promote coronals to least marked status: if there is no glottal, then there is no lesser-marked PoA than coronal. So, languages with Glottal Elimination provide a further three types of harmonically complete inventory, listed in tables 6.4 and 6.5. The tables again list voiceless stop and voiceless fricative inventories.

Table 6.4: Voiceless stop inventories with Glottal Elimination

<table>
<thead>
<tr>
<th>k</th>
<th>p</th>
<th>t</th>
<th>?</th>
<th>Coda Inventory</th>
<th>Onset Inventory</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Uradhi</td>
<td>-</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Formal Kiowa</td>
<td>Vanimo</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>New Zealand English</td>
<td>Maori</td>
</tr>
</tbody>
</table>

101 Harar Oromo has three series of stops: plain voiceless, voiced, and voiceless glottalized (Owens 1985:10). Of the plain voiceless stops, there are only the coronals [t] and [?] [k]. [h] only appears as a geminate. The other stop series have more PoAs: [b d ʈ y, p ʈ ʂ k].
The formal expression of markedness – ch.6

<table>
<thead>
<tr>
<th>Voiced Fricatives and Voiced Stops</th>
</tr>
</thead>
</table>
| Voiced Fricatives and Voiced Stops are distinct from voiceless stops, voiceless fricatives, and nasals in that they have no glottal counterpart. Because of this, coronal is predicted to be the least marked PoA for voiced stops and fricatives. The harmonically complete inventory types for voiced stops and fricatives are therefore just three: (i) [d], [b d], [g b d] for voiced stops and (ii) [z], [v z], [y v z] for voiced fricatives. Neutralizations involving voiced stops and voiced fricatives will not be discussed in any detail in the following sections because overt PoA neutralizations involving them (i.e. those with alternations) are so few: usually coda voiced stops and voiced fricatives are eliminated by voice neutralization. See Appendix A for typological generalizations.

### 6.2.2 Ranking

The aim of this section is to identify the ranking needed to produce harmonically complete inventories. Prince & Smolensky (1993) and Prince (1998) have discussed harmonically complete systems in detail. The present work builds on their proposals, with the difference that the following discussion employs stringent marked-faithfulness constraints instead of non-stringent non-marked faithfulness ones (see §6.2.3 for discussion).

This section focuses on the inventories found in Standard Malay (Lapoliwa 1981). Malay offers an excellent case study for such inventories: it has different harmonically complete voiceless stop inventories in different environments.

#### 6.2.2.1 Malay codas: [p t ʔ]

<table>
<thead>
<tr>
<th>Voiced Fricatives and Voiced Stops</th>
</tr>
</thead>
</table>
| Voiced Fricatives and Voiced Stops (and voiced fricatives) are distinct from voiceless stops, voiceless fricatives, and nasals in that they have no glottal counterpart. Because of this, coronal is predicted to be the least marked PoA for voiced stops and fricatives. The harmonically complete inventory types for voiced stops and fricatives are therefore just three: (i) [d], [b d], [g b d] for voiced stops and (ii) [z], [v z], [y v z] for voiced fricatives. Neutralizations involving voiced stops and voiced fricatives will not be discussed in any detail in the following sections because overt PoA neutralizations involving them (i.e. those with alternations) are so few: usually coda voiced stops and voiced fricatives are eliminated by voice neutralization. See Appendix A for typological generalizations.

### 6.2.2.2 Malay onsets: [k p t]

<table>
<thead>
<tr>
<th>Voiced Fricatives and Voiced Stops</th>
</tr>
</thead>
</table>
| Voiced Fricatives and Voiced Stops (and voiced fricatives) are distinct from voiceless stops, voiceless fricatives, and nasals in that they have no glottal counterpart. Because of this, coronal is predicted to be the least marked PoA for voiced stops and fricatives. The harmonically complete inventory types for voiced stops and fricatives are therefore just three: (i) [d], [b d], [g b d] for voiced stops and (ii) [z], [v z], [y v z] for voiced fricatives. Neutralizations involving voiced stops and voiced fricatives will not be discussed in any detail in the following sections because overt PoA neutralizations involving them (i.e. those with alternations) are so few: usually coda voiced stops and voiced fricatives are eliminated by voice neutralization. See Appendix A for typological generalizations.

### 6.2.2.3 Malay onsets: [k p t v z]

<table>
<thead>
<tr>
<th>Voiced Fricatives and Voiced Stops</th>
</tr>
</thead>
</table>
| Voiced Fricatives and Voiced Stops (and voiced fricatives) are distinct from voiceless stops, voiceless fricatives, and nasals in that they have no glottal counterpart. Because of this, coronal is predicted to be the least marked PoA for voiced stops and fricatives. The harmonically complete inventory types for voiced stops and fricatives are therefore just three: (i) [d], [b d], [g b d] for voiced stops and (ii) [z], [v z], [y v z] for voiced fricatives. Neutralizations involving voiced stops and voiced fricatives will not be discussed in any detail in the following sections because overt PoA neutralizations involving them (i.e. those with alternations) are so few: usually coda voiced stops and voiced fricatives are eliminated by voice neutralization. See Appendix A for typological generalizations.

### 6.2.2.4 Malay onsets: [k p t v z]

<table>
<thead>
<tr>
<th>Voiced Fricatives and Voiced Stops</th>
</tr>
</thead>
</table>
| Voiced Fricatives and Voiced Stops (and voiced fricatives) are distinct from voiceless stops, voiceless fricatives, and nasals in that they have no glottal counterpart. Because of this, coronal is predicted to be the least marked PoA for voiced stops and fricatives. The harmonically complete inventory types for voiced stops and fricatives are therefore just three: (i) [d], [b d], [g b d] for voiced stops and (ii) [z], [v z], [y v z] for voiced fricatives. Neutralizations involving voiced stops and voiced fricatives will not be discussed in any detail in the following sections because overt PoA neutralizations involving them (i.e. those with alternations) are so few: usually coda voiced stops and voiced fricatives are eliminated by voice neutralization. See Appendix A for typological generalizations.

---

103 This is not entirely true since fricatives have a voiced glottal [f]. However, [f] never seems to contrast with [h], so it cannot be said that an inventory has an [f] with the same status as other fricatives. Thus, [f] is put aside here. Recall from ch.5 that nasals have a glottal member - [N].
The formal expression of markedness – ch.6

Malay codas [p t ʔ] (Lapoliwa 1981:88-9)\(^{104}\)

\[(a) /k\rightarrow[ʔ]\]

<table>
<thead>
<tr>
<th>Root</th>
<th>#</th>
<th>+C</th>
<th>+V</th>
<th>(\rightarrow)</th>
</tr>
</thead>
<tbody>
<tr>
<td>/baik| bai\ ‘good’</td>
<td>bai-la ‘all right’</td>
<td>k+baik-an</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/didik| didi\ ‘educate’</td>
<td></td>
<td>didik-an</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/duduk| dudu\ ‘sit’</td>
<td>dudu-la ‘to seat’</td>
<td>duduk-i</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/gara| gara\ ‘move’</td>
<td>gara-la ‘move it’</td>
<td>gara-an</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/pendek| pendek ‘short’</td>
<td>pendek-pa ‘in short’</td>
<td>k+pendek-an</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/sorak| sorak ‘shout’</td>
<td>sorak-pa ‘he shouted’</td>
<td>sorak-i</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(b) /p t ʔ stay faithful

[atap] ‘roof’
[ikat] ‘to tie’
[lstup] ‘to explode’
[sakat] ‘parasitic plant’
[surpur] ‘grumble’

In short, the result of /k/-debulicalization is the harmonically complete coda inventory [p t ʔ].

Malay is not unique in having this particular pattern: a case just like it is found in Arekuna Carib: [k p t] appear in onsets, but /k/ neutralizes to [ʔ] in codas: /mak-na ‘→ maʔni ‘aunt’, cf [makai] ‘sin’ (Edwards 1978). The same pattern is also found in Makassarese (Aronoff et al. 1987). An analogous case for onset inventories is found in Tahitian (Coppennath & Prevost 1974); the Tahitian ranking is mentioned in the analysis below.

• Neutralization

To neutralize /tə/ to [β] in Optimality Theory, a markedness constraint that favours [β] over [tə] must outrank all faithfulness constraints that preserve /tə/ (at the very least – see §6.2.2.4 for details). Therefore, to neutralize /k/ to [ʔ] some markedness constraint that assigns violations to [k] but not [ʔ] must outrank all faithfulness constraints that preserve /k/.

Since almost all PoA-markedness constraints favour [k] over [ʔ], any would do at this point. *{K} will be used here – the reason for this choice will become evident below. Since all faithfulness constraints preserve /k/, *{K} must outrank them all.

---

\(^{104}\) Lapoliwa also cites the free variants [gaak-la}, [sorak-pa], [baik-la}, (but not *[p]pendek-pa]). The variable appearance of [k] rather than [ʔ] in these forms may relate to the development of onset clusters, so that /baik-la} can be syllabified as [bai-la} or [ba]Dah]. Such clusters are found only in loans and as the result of certain syncope processes (Hendon 1966:32-3). In any case, the appearance of [ʔ] word-finally – unambiguously a coda – shows that /k/ neutralizes to [ʔ].

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Paul de Lacy

Neutralization of coda /k/, step 1

<table>
<thead>
<tr>
<th>/baik\</th>
<th>*{K}</th>
<th>{IDENT[K]}</th>
<th>{IDENT[KP]}</th>
<th>{IDENT[KPT]}</th>
<th>{IDENT[KPT]}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) baik</td>
<td>*(!)</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) baik</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

As the tableau shows, candidate (a) is eliminated because it contains a dorsal, so violating *{K}. All the dorsal-preserving faithfulness constraints are ranked lower, so the input dorsal cannot survive. As a reminder, a constraint like IDENT[ KP] is violated by unfaithful mappings from either dorsals or labials. So, the fact that /k\rightarrow[ʔ] in candidate (b) results in a violation of IDENT[ KP].

A point that will turn out to be significant relates to the form of the markedness constraint that triggers neutralization. If /k/ neutralizes to [ʔ], /k/-neutralization must be motivated by a markedness constraint that favours [ʔ] over [k]. It is not simply enough that the markedness constraint assigns a violation to [k]. So, the constraint *{KPT}\(\) cannot be used to force /k/-neutralization. This constraint assigns the same violations to all PoAs, so it does not favour any segment over [k]. Since all segments violate *{KPT}\(\), it will not assign any crucial violations. Since *{KPT}\(\) is not decisive, the decision will be passed to lower ranked constraints. Tableau (9) underscores this point.

With [k] and [baik] violating *{KPT}\(\) equally, the constraint is irrelevant in picking a winner. The lower-ranked constraint IDENT[K] then emerges to favour the faithful form.

The ranking identified above does not guarantee that /k/ will neutralize; it could assign violations to /k/ but not *[k]. Therefore, to neutralize /k/ to *[k], any would do at this point. *{KPT}\(\) will be used here – the reason for this choice will become evident below. Since all faithfulness constraints preserve /k/, *{KPT}\(\) must outrank them all.

---

\(^{105}\) The primary ranking arguments in this section stands regardless of whether positional markedness or positional faithfulness motivates coda place neutralization (Beckman 1998 cf Zoll 1996). If a set of coda-specific PoA constraints (e.g. *{coda}{k}, etc.) were used to motivate neutralization, the ranking needed would be the same.
Tahitian (Coppenrath & Prevost 1974). In tableau (10), the onset-faithfulness constraint onset-IDENT[\textit{K}] is used, but it could well be any other onset-IDENT constraint.

(10) Neutralization of coda /k/, step 2: Preserving the onset

<table>
<thead>
<tr>
<th>/kaat/</th>
<th>onset-IDENT[\textit{K}]</th>
<th>*\textit{K}</th>
<th>IDENT[\textit{K}]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) kaat</td>
<td>*\textit{K}</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) kaat</td>
<td>*\textit{K}</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

- **Neutralization target**

The final important issue relates to why /k/ turns into [ʔ] rather than [t] or [p]. The reason follows from the form of both the faithfulness and markedness constraints. The outputs [p], [t], and [ʔ] are equally unfaithful to /k/ – they all incur the same violations of the PoA-faithfulness constraints (see §6.6 for further discussion). Therefore, the choice of output falls to the PoA-markedness constraints. Since [ʔ] is a local harmonic bound for all other segment types in terms of the PoA-markedness constraints, it will emerge triumphant regardless of ranking. This result is illustrated in tableau (11).

(11) Neutralization of coda /k/, step 3: Getting the right target

<table>
<thead>
<tr>
<th>/baat/</th>
<th>*\textit{K}</th>
<th>*\textit{KP}</th>
<th>*\textit{KPT}</th>
<th>*\textit{KPT?}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) baat</td>
<td>*\textit{K}</td>
<td>*\textit{KP}</td>
<td>*\textit{KPT}</td>
<td>*\textit{KPT?}</td>
</tr>
<tr>
<td>(b) batb</td>
<td>*\textit{K}</td>
<td>*\textit{KP}</td>
<td>*\textit{KPT}</td>
<td>*\textit{KPT?}</td>
</tr>
<tr>
<td>(c) batb</td>
<td>*\textit{K}</td>
<td>*\textit{KP}</td>
<td>*\textit{KPT}</td>
<td>*\textit{KPT?}</td>
</tr>
<tr>
<td>#* (d) batb</td>
<td>*\textit{K}</td>
<td>*\textit{KP}</td>
<td>*\textit{KPT}</td>
<td>*\textit{KPT?}</td>
</tr>
</tbody>
</table>

Note that [ʔ] is a harmonic bound for all the other PoAs in terms of the PoA-markedness constraints alone. Other constraints may interfere with this result, producing neutralization to coronals instead. Section 6.6 provides a detailed discussion of this point.

- **Preservation**

All stops apart from /k/ are faithfully preserved in Malay codas. So, the type of ranking used to eliminate /k/ in (8) must be reversed for all other PoAs. For example, since /p/ is preserved, some faithfulness constraint that preserves /p/ (IDENT[\textit{KP}], IDENT[\textit{KPT}], or IDENT[\textit{KPT?}]) must outrank all markedness constraints that favour some other segment over /p/ (i.e. *\textit{KP} and *\textit{KPT}, but not necessarily *\textit{KPT?}) as explained above. The same is true for the coronal /t/: at least one of IDENT[\textit{KPT}] and IDENT[\textit{KPT?}] must outrank /k/ to be eliminated.

Neutralization target

The final important issue relates to why /k/ turns into [ʔ] rather than [t] or [p]. The reason follows from the form of both the faithfulness and markedness constraints. The outputs [p], [t], and [ʔ] are equally unfaithful to /k/ – they all incur the same violations of the PoA-faithfulness constraints (see §6.6 for further discussion). Therefore, the choice of output falls to the PoA-markedness constraints. Since [ʔ] is a local harmonic bound for all other segment types in terms of the PoA-markedness constraints, it will emerge triumphant regardless of ranking. This result is illustrated in tableau (11).

(11) Neutralization of coda /k/, step 3: Getting the right target

<table>
<thead>
<tr>
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<th>*\textit{K}</th>
<th>*\textit{KP}</th>
<th>*\textit{KPT}</th>
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</tr>
</thead>
<tbody>
<tr>
<td>(a) baat</td>
<td>*\textit{K}</td>
<td>*\textit{KP}</td>
<td>*\textit{KPT}</td>
<td>*\textit{KPT?}</td>
</tr>
<tr>
<td>(b) batb</td>
<td>*\textit{K}</td>
<td>*\textit{KP}</td>
<td>*\textit{KPT}</td>
<td>*\textit{KPT?}</td>
</tr>
<tr>
<td>(c) batb</td>
<td>*\textit{K}</td>
<td>*\textit{KP}</td>
<td>*\textit{KPT}</td>
<td>*\textit{KPT?}</td>
</tr>
<tr>
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<td>*\textit{K}</td>
<td>*\textit{KP}</td>
<td>*\textit{KPT}</td>
<td>*\textit{KPT?}</td>
</tr>
</tbody>
</table>

Note that [ʔ] is a harmonic bound for all the other PoAs in terms of the PoA-markedness constraints alone. Other constraints may interfere with this result, producing neutralization to coronals instead. Section 6.6 provides a detailed discussion of this point.

(12)

<table>
<thead>
<tr>
<th>/atap/</th>
<th>IDENT[\textit{KPT}]</th>
<th>#\textit{KP}</th>
<th>#\textit{KPT}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) atap</td>
<td>IDENT[\textit{KPT}]</td>
<td>#\textit{KP}</td>
<td>#\textit{KPT}</td>
</tr>
<tr>
<td>(b) atap?</td>
<td>#\textit{KP}</td>
<td>#\textit{KPT}</td>
<td></td>
</tr>
</tbody>
</table>

The only other segment not discussed here is /l/. Underlying /l/ will clearly stay faithful in Malay codas, appearing as [ʔ]. Interestingly enough, nothing has to be said about the ranking of the PoA constraints to ensure that /l/ survives faithfully. The reason relates to the ranking needed to neutralize a segment: /l/ can only be eliminated through the action of a markedness constraint that favours some other segment over /l/. However, none of the PoA-markedness constraints have this property; *\textit{KPT?} is the only one that assigns a violation to [ʔ], and it also assigns a violation to every other PoA. Thus, /l/ can never be eliminated in terms of the PoA constraints. For further discussion, see §6.2.2.3 and §6.4.

(12)

<table>
<thead>
<tr>
<th>/atap/</th>
<th>IDENT[\textit{KPT}]</th>
<th>#\textit{KP}</th>
<th>#\textit{KPT}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) atap</td>
<td>IDENT[\textit{KPT}]</td>
<td>#\textit{KP}</td>
<td>#\textit{KPT}</td>
</tr>
<tr>
<td>(b) atap?</td>
<td>#\textit{KP}</td>
<td>#\textit{KPT}</td>
<td></td>
</tr>
</tbody>
</table>

- **Ranking summary**

The resulting ranking for Malay codas is summarized in Figure 6.1. The solid lines indicate that the higher constraint outranks the lower one. The dotted lines indicate that at least one of the rankings must hold: so either IDENT[\textit{KPT}] or IDENT[\textit{KPT?}] (or both) must outrank *\textit{KP}; either IDENT[\textit{KP}], IDENT[\textit{KPT}], or IDENT[\textit{KPT?}] must outrank *\textit{KPT}.

Figure 6.1: Malay coda neutralization ranking

As discussed above, the position of the markedness constraint *\textit{KPT?} is irrelevant because it does not favour any segment over any other type. The topmost faithfulness constraint could be any onset-IDENT constraint, since all preserve /k/.

The diagram gives a sense of the ranking needed to neutralize and preserve. To neutralize /k/ to [ʔ], some constraint that favours [ʔ] over /k/ must outrank all /k/-preserving faithfulness constraints: this is shown in the diagram, where *\textit{K} outranks all the faithfulness constraints above. The diagram shows that the other PoAs survive because some relevant faithfulness constraint outranking all relevant markedness constraints. A precise version of the ranking needed for neutralization will be provided in §6.2.2.4.

\footnote{This does not mean that *\textit{KPT} (or its faithfulness counterpart IDENT[\textit{KPT}]) is always inconsequential – see ch.7 for discussion.}

\footnote{As a matter of interest, all words that have a cognate form with [k] in other languages have [ʔ] in Tahitian e.g. Maori [kai] 'food, eat' cf Tahitian [ʔa].}
The diagram also gives a sense of the ranking needed for a harmonically complete inventory. A harmonically complete inventory is one in which the more marked elements are banned. In ranking terms, this involves a markedness constraint that bans marked values alone (*{mf}) outranking all faithfulness constraints that preserve those values (IDENT{mf}, IDENT{mf,ut}). It also involves some faithfulness constraint that preserves unmarked values (IDENT{mf,ut}) outranking all markedness constraints that ban those values (i.e. *{mf,ut}) (for discussion on whether this ranking is necessary, see §6.4). The result is the ranking || {*{mf} » IDENT{mf}, IDENT{mf, ut} » *{mf,ut} || , with certain assumptions about the ranking of other constraints (see §6.2.2.4). In the ranking above, the marked value of the [Place] feature is ‘dorsal’, and the relatively unmarked values are ‘labial’ and ‘coronal’, hence the ranking || {*{K} » IDENT{KPT} » *{KP}, *{KPT} || . A precise account of the ranking needed for harmonically complete inventories will be provided in §6.2.2.4.

Other manners of articulation

The ranking for Malay can also be used to account for the same type of neutralization in other manners of articulation. For example, an interesting case is found in Florentine Italian spirantization (Giannelli & Savoia 1979, Kirchner 1998). Between a vowel and sonorant, labial and coronal stops spirantize to fricatives. In the speech of younger speakers, /p/ spirantizes to [φ], and /k/ to [θ], but velar /k/ debuccalizes to [h] (/k/ spirantizes to [x] in the formal speech of older speakers). The net result is a spirantized harmonically complete inventory of [φ θ h], lacking [x]. Again, the dorsal PoA is neutralized while the others are preserved.

6.2.2.2 [7] in Ulu Muar Malay reduplicant codas

The Ulu Muar Malay language shares the restriction on [k] in codas with Standard Malay, but also exhibits another harmonically complete coda inventory – only [7] is allowed in reduplicant codas (Hendon 1966).

Hendon (1966:58-9) reports that the coda stops [k p t] in two reduplicants neutralize to [7] in Ulu Muar Malay. The full reduplicant (13a) reduplicates the entire stem and replaces stem-final stops with [7]. The partial reduplicant (13b) reduplicates the first CV of the stem and the stem-final consonant. If the stem-final consonant is a stop, it reduplicates it as a [7].


(a) Full reduplicant

[mat-kan] ‘is kept alive’ (65), [atap-rumãh] ‘thatch of a house’ (9), [sakit-mato] ‘have eye trouble’ (9).

(b) Partial (CVC) reduplicant

[ta-keh] ‘feels stiff all over’, [ija-ke] ‘to their h

The account given here parallels the account given by Alderete et al. (1999) for Tubatulabal and Nancowry in some respects – in these languages, all reduplicant onsets are neutralized to [7]. As discussed in the previous section, neutralization of /ta/ to [θ] only comes about when some markedness constraint that favours [θ] over [t] outranks all faithfulness constraints that preserve /t/. In the case of Malay reduplicants, since /t/ neutralizes to [θ], all markedness constraint that favours [θ] over [t] (i.e. *{KPT}) must outrank all faithfulness constraints that preserve /t/ in reduplicants. In the latter case, the relevant PoA faithfulness constraint refers to the Base-Reduplicant dimension, as given in (14).

Other manners of articulation

The ranking for Malay can also be used to account for the same type of neutralization in other manners of articulation. For example, an interesting case is found in Florentine Italian spirantization (Giannelli & Savoia 1979, Kirchner 1998). Between a vowel and sonorant, labial and coronal stops spirantize to fricatives. In the speech of younger speakers, /p/ spirantizes to [φ], and /k/ to [θ], but velar /k/ debuccalizes to [h] (/k/ spirantizes to [x] in the formal speech of older speakers). The net result is a spirantized harmonically complete inventory of [φ θ h], lacking [x]. Again, the dorsal PoA is neutralized while the others are preserved.

Eliminating all but [7]

The issue of immediate interest is the neutralization of reduplicant coda stops to [7] does not appear in the full reduplicant: [mat-αmat-] ‘various kinds’, [lajag-lajan] ‘kite’, [patu-patu] ‘are severed’, [janke-janke] ‘feels stiff all over’, [liq-iq] ‘are green’, [pan-api] ‘fire’, [mato-mato] ‘police’ (p.59). The CVC reduplicant is only found with stems that end in a stop, /h/, or a nasal. If the stem ends in a nasal, the reduplicant’s final consonant is a nasal homorganic with the following stop: [kan-kawan] ‘friend’, [sin-sian] ‘during the daytime on various days’ (p.59). If the stem ends in /h/, the reduplicant’s consonant is [h]: [souh-pueh] ‘to their complete satisfaction’.

Debuccalization of stops is clearly an emergent process because stop-C clusters are permitted in non-reduplicative morpheme-juncture environments: e.g. [nilt-kan] ‘is prayed for’ (64), [sdup-kan] ‘is kept alive’ (65), [atap-rumãh] ‘thatch of a house’ (9), [sakit-mato] ‘have eye trouble’ (9).

What makes reduplicant codas interesting is that they go further in debuccalization than non-reduplicant codas: while only /h/ debuccalizes in base codas, all stops debuccalize in reduplicant codas. The result is that the stop inventory of codas reduplicants is the minimal harmonically complete inventory: [7].

The diagram also gives a sense of the ranking needed for a harmonically complete inventory. A harmonically complete inventory is one in which the more marked elements are banned. In ranking terms, this involves a markedness constraint that bans marked values alone (*{mf}) outranking all faithfulness constraints that preserve those values (IDENT{mf}, IDENT{mf,ut}). It also involves some faithfulness constraint that preserves unmarked values (IDENT{mf,ut}) outranking all markedness constraints that ban those values (i.e. *{mf,ut}) (for discussion on whether this ranking is necessary, see §6.4).

The account given here parallels the account given by Alderete et al. (1999) for Tubatulabal and Nancowry in some respects – in these languages, all reduplicant onsets are neutralized to [7]. As discussed in the previous section, neutralization of /ta/ to [θ] only comes about when some markedness constraint that favours [θ] over [t] outranks all faithfulness constraints that preserve /t/. In the case of Malay reduplicants, since /t/ neutralizes to [θ], some markedness constraint that favours [θ] over [t] (i.e. *{KPT}) must outrank all faithfulness constraints that preserve /t/ in reduplicants. In the latter case, the relevant PoA faithfulness constraint refers to the Base-Reduplicant dimension, as given in (14).

This reduplicaton pattern is reminiscent of the one found in Makassarese (Anroff et al. 1987, McCarthy & Prince 1994:sec.5). In Makassarese a [ʔ] also appears in reduplication: [budu] ‘to braid’. However, McCarthy & Prince argue that the global stop is epenthetic, forced by a constraint requiring PrW-final consonants. Alderete et al. (1999) use the same solution to account for the fact that all reduplicant onsets are [ʔ] in Nancowry and Tubatulabal reduplicants. The epenthesis solution is not available for the present data: [ʔ] only appears when the stem has a final stop (pupatutu, *[pupa]pata, cf. [pa]pata[ʔ]). If [ʔ] were an epenthetic consonant, its appearance would be driven by purely prosodic factors, and not contingent on the presence of a stem-final stop.
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(14)  BR-IDENT[KPT]  If x is K or P or T, then x has the same PoA as x.
    • x is in the base
    • x is in the reduplicant
    • x and y are correspondents

The relevant ranking is provided in tableau (15). As for faithfulness in bases, IO-
IDENT[KPT] – the input-output version of IDENT[KPT] – outranks *[KPT] to prevent
neutralization of coda /t/. Only violations by stops of the constraint *[KPT] are shown below.

A similar ranking must hold for /p/: some markedness constraint that favours [?] over [p] (i.e. *[K], *[KPT]) must outrank all BR-IDENT constraints that preserve it (i.e.
BR-IDENT[KP], BR-IDENT[KPT], BR-IDENT[KPT]). This type of ranking has been
invoked for similar PoA neutralizations in reduplication by Alderete et al. (1999).

As pointed out in the preceding section, no special ranking needs to be invoked for
base [?]. Since no PoA-markedness constraint favours any other segment over [?], base
[?] will be faithfully copied regardless of the ranking.

To prevent reduplicant onsets from neutralizing to [?], an onset-specific version of
BR-IDENT[KPT] must outrank *[K], *[KP], and *[KPT]. The opposite ranking would
produce a system in which all onsets neutralize to [?]. This is found in Nancowry and
Tubatulabul reduplicants (see Alderete et al. 1999 for references and an analysis).

Figure 6.2 summarizes the ranking needed for coda neutralization.

(15)  

<table>
<thead>
<tr>
<th>/RED-lakit/</th>
<th>*(KP)</th>
<th>BR-IDENT[KP]</th>
<th>BR-IDENT[KPT]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) lakit/lakit</td>
<td>* * *</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) laki/lakit</td>
<td>* *</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

Moreover, reduplication of the stem-final consonant – consequently violating BR-
ANCHOR-R – is blocked when the coda is not a nasal or a stop. This can be ascribed to
an emergent ban on continuity in codas, called *CODA+CONT here (also see Zec 1988). With
*CODA+CONT outranking BR-MAX, the reduplicant will copy only part of the base
rather than having a continuant coda. Both BR-IDENT[cont] and *CODA+CONT must
outrank BR-ANCHOR-R, otherwise the full reduplicant would reduplicate all consonants,
regardless of their manner of articulation.

This ranking only does part of the job, though: *mutu/putus satisfies both
*CODA+CONT and BR-MAX. To ban this candidate, the constraint BR-IDENT[cont] –
requiring corresponding segments to agree in continuity – must outrank BR-MAX.

109 *CODA+CONT can be reduced to the ranking || onset-IDENT[cont] » *continuant »
IDENT[continuant] ||, given in §6.5.1.
In the survey (Appendix B) does this for voiceless stops in all environments (no doubt for functional reasons). However, it is attested with fricatives: a number of languages have onsets – i.e. neutralizes PoAs in all positions. As mentioned above, none of the languages

Neutralization of all PoA distinctions to [ʔ] in codas is extremely common – perhaps even the commonest type of PoA neutralization. Kashaya (Buckley 1994) presents an example: all plain stops debuccalize in coda position. Debuccalization does not apply to stops with a secondary articulation (i.e. glottalization, aspiration). The debuccalization examples are from Buckley (1994:99); page numbers for the contrasting non-debuccalized cases are given in brackets.

Kashaya stop debuccalization (Buckley 1994)

(a) /ʔ/ → [ʔ]
   /qahmaʔ/ → [qahmaʔ] ‘angry’ cf [qamaf:ʔ] ‘he’s angry’ (68)
   /jɛʔeʔ/ → [jeʔeʔ] ‘basket’ cf [jeʔeʔ-emu] ‘that’s a basket’ (72)
   /mahsiʔ/ → [masiʔ] ‘embers’ cf [masi:ʔ] ‘it’s embers’ (68)

(b) /h/ → [ʔ]
   /q’ʔamʔoʔ/ → [q’ʔaboʔ] ‘garter snake’ [q’ʔabot:ʔ] ‘it’s a garter snake’ (68)
   /sulemaʔ/ → [sulemaʔ] ‘rope’ cf [sulemat-ʔ] ‘it’s a rope’ (68)

(c) /t/ → [ʔ]
   /wataʔaʔ/ → [wataʔaʔ] ‘frog’ cf [watat-ʔu] ‘it must be a frog’ (73)
   /maʔjaʔ/ → [maʔaʔ] ‘they’ cf [maʔjaʔ-emu] ‘that’s them’ (72)

(d) /qʔ/ → [ʔ]
   /mihjoqʔ/ → [mihjoqʔ] ‘woodrat’ cf [mihoqʔ] ‘it’s a woodrat’ (69)
   /muʔaʔ/ → [muʔaʔ] ‘sweat’ cf [muaʔ] ‘it’s sweat’ (69)

In contrast to Malay, *(KPT)* outranks both IO-IDENT[KPT] and IO-IDENT[KPT7] in Kashaya, rather than BR-IDENT constraints. As in Malay, though, onset-specific IDENT constraints must outrank *(KPT)*.

Even more extreme than Kashaya is a language in which allows only glottals in onsets – i.e. neutralizes PoAs in all positions. As mentioned above, none of the languages in the survey (Appendix B) does this for voiceless stops in all environments (no doubt for functional reasons). However, it is attested with fricatives: a number of languages have

Glottals elsewhere

As a final comment, while neutralization to glottals in codas only occurs in reduplicants in Malay, the present theory predicts that it could occur in any position – i.e. (i) codas of bases and (ii) in both onsets and codas.

Neutralization of all PoA distinctions to [ʔ] in codas is extremely common – perhaps even the commonest type of PoA neutralization. Kashaya (Buckley 1994) presents an example: all plain stops debuccalize in coda position. Debuccalization does not apply to stops with a secondary articulation (i.e. glottalization, aspiration). The debuccalization examples are from Buckley (1994:99); page numbers for the contrasting non-debuccalized cases are given in brackets.

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(c) /t/ → [ʔ]
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Even more extreme than Kashaya is a language in which allows only glottals in onsets – i.e. neutralizes PoAs in all positions. As mentioned above, none of the languages in the survey (Appendix B) does this for voiceless stops in all environments (no doubt for functional reasons). However, it is attested with fricatives: a number of languages have

Glottal Elimination in Malay onsets

Malay onsets contain yet another type of voiceless stop inventory: [k p t]. Notably, Malay onsets cannot contain [ʔ] (Hendon 1966:31, Lapoliwa 1981:85f). In the present theory, such a situation cannot come about through the action of PoA constraints (see §6.4). Instead, this section shows that an independent process – ‘Glottal Elimination’ – is responsible for the lack of [ʔ].

In §6.5, glottals are argued to be more sonorous than segments with other PoAs. Accordingly, the constraint *(Δμ>0)glottal* bans glottals onsets, leaving [k p t] p. To recall from ch.2-4, *(Δμ>0)refers to the non-DTE of a mora – i.e. onset consonants. As in ch.2-4.1, moraic non-DTEs are onset consonants, assuming that onset consonants are the dependent of a η node while coda consonants are either moraic or dependents of the η node (Hyman 1985, Zec 1988:7).

DTEs below the syllable

Ranking

The ranking needed for Glottal Elimination depends on the means used to eliminate the glottals. This section starts by identifying the neutralization ranking.

At least two rankings must hold for glottals to be eliminated. One involves a markedness constraint that favours some other segment over glottals – i.e. *(Δμ>0)glottal* – outranking all glottal-preserving faithfulness constraints (i.e. IDENT[KPT7]).

The other crucial ranking is that *(Δμ>0)glottal* must outrank *(KPT)*. Since *(KPT)* favours glottals over all other segments, it would render *(Δμ>0)glottal* inactive in any other ranking. This ranking will prove to have significant consequences for the typology of eponyms and direction of neutralization (§6.6).

Tableau (20) illustrates the two rankings needed for Glottal Elimination.
Glottal Elimination

The formal expression of markedness – ch.6

(20) Glottal Elimination

<table>
<thead>
<tr>
<th>/t/</th>
<th>*-Δg-glottal</th>
<th>IDENT[KPT]</th>
<th>*{KPT}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) /t/</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) /t/</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The table shows that both the rankings identified above are crucial. If IDENT[KPT] outranked *-Δg-glottal, [ta] would be blocked for its unfaithfulness. If *{KPT} dominated *-Δg-glottal, [ta] would also be eliminated because it contains a coronal (as would [pa] and [ka]). If glottals were eliminated through deletion rather than neutralization, *-Δg-glottal would outrank MAX. Again, *-Δg-glottal will outrank *{KPT}, but by transitivity in this ranking: if *{KPT} outranked MAX all PoAs would be banned in the inventory.\footnote{It is not clear whether [ʔ] is eliminated through deletion or neutralization in Malay. One strategy suggests that it is neutralized. Suppose there were an underlying stem-final [ʔ] – it would emerge faithfully as [ʔ]; \&A[ʔ]→h3A[ʔ]; it could not delete because there is no ban on coda [ʔ]. Addition of a vowel-initial affix would make the \& appear in an onset: [baʔi]. If glottals deleted in this position (i.e. [ba]-), one would expect to find sets of words that have a stem-final [ʔ] in citation form but no consonant before vowels. Neither Lapoliwa nor Hendon report such words; the only ones with surface final-[ʔ] appear with a [k] preceding a vowel. Therefore, it is possible that \& neutralizes to [k]. For an analysis, see §6.6.}

- Promotion of coronal

Glottal Elimination effectively gives coronals ‘least marked’ status. This means that the glottal-less inventories [k p t], [p t], and [t] are – in effect – harmonically complete.

For example, Vanimo’s [p t] inventory and Tahitian’s [p t] inventory differ only in that the former has no glottal stop. In terms of the PoA constraints, then, Vanimo and Tahitian are not significantly different; the difference relates solely to the ranking of *-Δg-glottal. Apart from that, the languages’ rankings are almost identical.

Since glottals are eliminated in Vanimo, coronals graduate to ‘least marked’ status in terms of PoA. This follows because \( x \) is less marked than \( y \) in a grammar if all markedness constraints that favour \( y \) over \( x \) are inactive. Since *-Δg-glottal favours coronals over glottals, no active markedness constraint favours anything over coronals. Since coronals are the least marked remaining element, it makes no difference how coronal-referring faithfulness and markedness constraints are ranked; any ranking will produce the same result (see §3.3). The fact that coronals become least marked is attested by the fact that languages without glottals neutralize to coronal. Examples are provided in §6.

In short, the only difference between inventories with glottals and those without them is that constraints from another scale interfere with the workings of the PoA scale in the latter type.

Further discussion of the rankings needed to account for the typology of Glottal Elimination is given in §6.5.2.2.

6.2.2.4 Harmonic completeness

This section identifies the ranking needed to produce harmonically complete inventories. As a first step, the ranking needed to neutralize /t/ to [β] is discussed.

- Neutralizing /t/ to [β]

It is not a simple matter to ensure neutralization of /t/ to [β]. The following paragraphs step through the necessary and sufficient conditions, summarized (26) (also see McCarthy 2001b:67ff).

To neutralize /t/ to [β], some markedness constraint \( M \) that favours [β] over [α] must outrank all faithfulness constraints that ban the \( /t\rightarrowβ \) mapping, and importantly, \( M \) must favour [β] over [α] – it cannot assign equal violations to both elements (like the constraint *{αβ}).

<table>
<thead>
<tr>
<th>/t/</th>
<th>*{α}</th>
<th>IDENT{α}</th>
</tr>
</thead>
<tbody>
<tr>
<td>α</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>β</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The part that makes the neutralization ranking complex is ensuring that no higher-ranked constraints prevent /t/ from neutralizing or being realized as [β]. For a start, no markedness constraint that favours [α] over [β] (e.g. *{β}) can outrank the neutralization-triggering constraint *{α} here). Otherwise, [β] would be eliminated.

<table>
<thead>
<tr>
<th>/t/</th>
<th>*{α}</th>
<th>*{β}</th>
<th>IDENT{α}</th>
</tr>
</thead>
<tbody>
<tr>
<td>α</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>β</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ensuring that /t/ neutralizes to [β] rather than some other segment requires a similar ranking. For every markedness constraint \( m \) that favours some other segment [γ] over [β], \( m \) must outrank all constraints that favour [β] over that [γ]. For example, the constraint *{β} bans [β] but not some other segment [γ], so a constraint that favours [β] over [γ] – i.e. *{γ} – must outrank *{β}.

<table>
<thead>
<tr>
<th>/t/</th>
<th>*{α}</th>
<th>*{β}</th>
<th>IDENT{α}</th>
</tr>
</thead>
<tbody>
<tr>
<td>α</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>β</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The final step is to ensure that faithfulness constraints do not prevent /t/ from neutralizing to [β]. For example, suppose [α] and [β] shared some feature value [γ] that [β] does not have. If IDENT{γ} outranked *{β}, /t/ would map to [β], not [β], because...
doing so would be more faithful. Thus, \( *\{\delta\} \) must outrank \( \text{IDENT}\{\gamma\} \). More generally for every segment \( \gamma \), some markedness constraint that favours \( \beta \) over \( \gamma \) must outrank every faithfulness constraint that prefers the \( /\alpha/\rightarrow/\beta/ \) mapping over the \( /\alpha/\rightarrow/\delta/ \) map.

(24) **Neutralization, step 4a**

<table>
<thead>
<tr>
<th>( /\alpha/ )</th>
<th>( *{\alpha} )</th>
<th>( *{\delta} )</th>
<th>( \text{IDENT}{\gamma} )</th>
<th>( *{\beta} )</th>
<th>( \text{IDENT}{\alpha} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \alpha )</td>
<td>( *! )</td>
<td>( *! )</td>
<td>( ! )</td>
<td>( ! )</td>
<td>( ! )</td>
</tr>
<tr>
<td>( \delta )</td>
<td>( \beta )</td>
<td>( \gamma )</td>
<td>( \beta )</td>
<td>( \gamma )</td>
<td>( \beta )</td>
</tr>
<tr>
<td>( x \rightarrow \delta )</td>
<td>( x \rightarrow \beta )</td>
<td>( x \rightarrow \gamma )</td>
<td>( x \rightarrow \beta )</td>
<td>( x \rightarrow \gamma )</td>
<td>( x \rightarrow \beta )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>( /\alpha/ )</th>
<th>( *{\alpha} )</th>
<th>( \text{IDENT}{\gamma} )</th>
<th>( *{\beta} )</th>
<th>( \text{IDENT}{\alpha} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \alpha )</td>
<td>( *! )</td>
<td>( ! )</td>
<td>( ! )</td>
<td>( ! )</td>
</tr>
<tr>
<td>( \delta )</td>
<td>( \beta )</td>
<td>( \gamma )</td>
<td>( \beta )</td>
<td>( \gamma )</td>
</tr>
<tr>
<td>( x \rightarrow \delta )</td>
<td>( x \rightarrow \beta )</td>
<td>( x \rightarrow \gamma )</td>
<td>( x \rightarrow \beta )</td>
<td>( x \rightarrow \gamma )</td>
</tr>
</tbody>
</table>

There is an alternative to the ranking \( \| *\{\delta\} \| = \text{IDENT}\{\gamma\} \). Suppose \( \{\alpha\} \) and \( \{\beta\} \) share some feature value \( +z \) that \( \{\alpha\} \) and \( \{\beta\} \) do not share. Then \( \text{IDENT}\{+z\} \) would favour the mapping \( /\alpha/\rightarrow/\beta/ \) over \( /\alpha/\rightarrow/\delta/ \). So, if \( \text{IDENT}[^{+z}] \) (i) outranked all markedness constraint that favoured \( \delta \) over \( \beta \) (i.e. \( *\{\beta\} \)) and (ii) outranked all faithfulness constraints that favoured the mapping \( /\alpha/\rightarrow/\delta/ \) over \( /\alpha/\rightarrow/\beta/ \) (i.e. \( \text{IDENT}\{\gamma\} \)), then the same result would follow.

(25) **Neutralization, step 4b**

<table>
<thead>
<tr>
<th>( /\alpha/ )</th>
<th>( *{\alpha} )</th>
<th>( \text{IDENT}{+z} )</th>
<th>( \text{IDENT}{\gamma} )</th>
<th>( *{\beta} )</th>
<th>( \text{IDENT}{\alpha} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \alpha )</td>
<td>( *! )</td>
<td>( ! )</td>
<td>( ! )</td>
<td>( ! )</td>
<td>( ! )</td>
</tr>
<tr>
<td>( \delta )</td>
<td>( \beta )</td>
<td>( \gamma )</td>
<td>( \beta )</td>
<td>( \gamma )</td>
<td>( \beta )</td>
</tr>
<tr>
<td>( x \rightarrow \delta )</td>
<td>( x \rightarrow \beta )</td>
<td>( x \rightarrow \gamma )</td>
<td>( x \rightarrow \beta )</td>
<td>( x \rightarrow \gamma )</td>
<td>( x \rightarrow \beta )</td>
</tr>
</tbody>
</table>

In short, it is no easy matter to ensure that \( /\alpha/ \) neutralizes to \( \beta \). Apart from the basic \( \| *\{\delta\} \| = \text{faithfulness} \) ranking to ensure neutralization in the first place (26a), the influence of other markedness constraints (26b,c,i) and faithfulness constraints (26cii) must also be blocked. The rankings laid out above are summarized in (26).

(26) **Neutralization of /\alpha/ to /\beta/ Ranking**

(a) \( \| \text{M}(\beta>\alpha) \rightarrow \neg \text{F}(\alpha) \| \)

(b) \( \text{There is no M}(\alpha>\beta) \) that outranks \( \text{M}(\beta>\alpha) \)

(c) For all segments \( \gamma \) (\( \alpha \neq \gamma \neq \beta \)),

- (i) some \( \text{M}(\beta>\gamma) \) outranks all \( \text{F}(\alpha>\gamma) \) and all \( \text{M}(\gamma>\beta) \)
- (ii) some \( \text{F}(\alpha>\gamma) \) outranks all \( \text{M}(\gamma>\beta) \) and all \( \text{F}(\gamma>\alpha) \),

\( \delta \rightarrow \beta \) or \( \beta \rightarrow \gamma \) over \( \alpha \rightarrow \gamma \) if \( \beta \rightarrow \gamma \) over \( \alpha \rightarrow \gamma \).  

- **Harmonically complete inventories: ranking**

A harmonically complete inventory is one that contains some segment \( \alpha \) and all less marked segments, but eliminates all segments that are more marked than \( \alpha \). For example, the inventory \( [p] \) contains \( [p] \) and all less marked segments (i.e. \( [t f] \)), but no more marked ones (i.e. \( [k] \)).
Section 6.3.4 shows why the marked-faithfulness approach works, and why alternatives cannot produce gapped inventories. Section 6.3.5 summarizes the findings in this section.

6.3.1 Description

Gapped PoA inventories are one of \( [K P T] \), \( [K T] \), \( [P T] \), or \( [K T] \). All of these inventories lack an element of intermediate markedness (\( T \) and/or \( P \)), but have a highly marked element (\( K \) and/or \( P \)), and the least marked element (\( T \) or \( T \) by virtue of Glottal Elimination).

Table 6.6 identifies gapped inventories for voiceless stops. For further examples and for other manners of articulation, see Appendix A. The languages listed under ‘Coda Inventory’ have the missing element(s) in onset position (e.g. Nambiquara has a \( p \) in onset position, and Fuzhou has \( k p t \) in onsets).

<table>
<thead>
<tr>
<th>k</th>
<th>p</th>
<th>t</th>
<th>Coda Inventory</th>
<th>Onset Inventory</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Cockney English</td>
<td>Hawaiian</td>
</tr>
<tr>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Nambiquara</td>
<td>Ayuila Mixtec, Arabic</td>
</tr>
<tr>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Ngunisan</td>
<td></td>
</tr>
<tr>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Fuzhou</td>
<td></td>
</tr>
<tr>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Mordvin</td>
<td>Japanese (Yamato &amp; Sino-Japanese strata)</td>
</tr>
</tbody>
</table>

I was unable to find languages with the onset inventories \( [k ?] \) and \( [p T] \). However, coda inventories with the form \( [k p ?] \) and \( [p T] ? \) exist. I consider these to be accidental gaps.

The primary empirical focus in this section will be on the gapped \( [p T] ? \) inventory. There are several reasons for choosing this inventory. One is that the gap – \( T \) – is unambiguously less marked than \( k \) and \( p \) (see §6 and ch.5 for discussion). Thus, \( [k p T] \) is clearly an inventory that has highly marked elements but no intermediate-marked element. In other words, the only crucial part of the PoA scale assumed here is that labials and dorsals are both more marked than coronals; the ranking between labials and dorsals is irrelevant.

6.3 Gapped inventories

A ‘gapped’ inventory is one that contains the least marked scale member and highly marked elements, but not those of intermediate markedness (the term ‘gapped’ is from Prince 1999). For example, the inventory of voiceless stops found in the Polynesian language Hawaiian has \( [k p t] \), but no \( [T] \) (Pukui & Elbert 1979). Here, the least marked \( [T] \) and highly marked \( [p] \) and \( [k] \) are present, but the intermediate marked \( [t] \) is missing.

Prince (1998) showed that a theory with marked-faithfulness constraints can produce gapped inventories. This section extends this observation, showing that analysis of gapped inventories requires marked-faithfulness constraints: no other constraint types can produce gapped inventories, given current theories of CON and EVAL. Thus, the existence of gapped inventories provides support for the present theory.

A number of theories of inventory structure have claimed that gapped inventories do not exist (e.g. Jakobson 1941, Prince & Smolensky 1993, Prince 1998). Counter to this claim, §6.3.1 identifies case of gapped inventories and introduces the main example used in this section: the coda inventory \( [k p t] \) found in Yamp hu (Rutgers 1998).

Section 6.3.2 identifies the ranking needed for gapped inventories. Marked-faithfulness constraints are shown to play a crucial role in this ranking.

Section 6.3.3 discusses other gapped inventories focusing on \( [k t T] \), found in the Uralic language Nganasan’s codas (Helimski 1998).
The stops will be the focus of this section since they provide the most PoA contrasts (see §6.6.1).

Elimination of coronals

Of the stops, only [k p ŋ] appear in codas. The coronal [t] can only appear in medial codas when it is part of a geminate: i.e. [t[t]]. [ts]: [ts]; this point will be discussed below. The bar on coronals runs throughout all manners of articulation: [n] is banned except before a homorganic consonant, and final [s] and [r] are also prohibited. The stops will be the focus of this section since they provide the most PoA contrasts (see §6.6.1).

There is abundant evidence that /t/ is eliminated in coda position through neutralization to [ʔ] i.e. debuccalization). The evidence for /t/→[ʔ] is laid out in (29). The leftmost column shows the debuccalized form; debuccalization is found before all consonant-initial suffixes and word-finally, although only the infinitive suffix [ma] is given here for consistency’s sake.

The final column provides evidence for the underlying form, consisting of the root plus a vowel-initial suffix (the root is underlined). Stops voice intervocally, so /h/ surfaces as [t] in vowel-initial position (cf [t'ep-

113 Yip (1994) argues that coda [ʔ] “is not a segment, but a feature of the entire morpheme”: [ʔ] behaves distinctly from other stop codas: it does not contribute to weight, so [CVG][p.k]] syllables are permissible, while *[CVG][p.k]] syllables are not. Even if [ʔ] is a feature, it is still possible that /h/ neutralizes to it, thus accounting for the gap in Chaoyang codas.

114 For many more final-h/ roots, see Rutgers (1998) – Rutgers helpfully provides underlying forms for all roots.

Table 6.7: Yamphu onset consonants

<table>
<thead>
<tr>
<th></th>
<th>labial</th>
<th>coronal</th>
<th>velar</th>
<th>glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td>stops</td>
<td>p</td>
<td>t</td>
<td>ts</td>
<td>k</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>t</td>
<td>ts</td>
<td>k</td>
</tr>
<tr>
<td>fricatives</td>
<td>s</td>
<td>h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>nasals</td>
<td>m</td>
<td>n</td>
<td>ŋ</td>
<td></td>
</tr>
<tr>
<td>liquids</td>
<td>r, j</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>glides</td>
<td>w</td>
<td></td>
<td>j</td>
<td></td>
</tr>
</tbody>
</table>

The stops are voiced intervocally and post-nasally, and are voiceless elsewhere. Syllables have the form (CV)(C)V(C)(C). Simple onsets can contain any of the consonants in Table 6.7 (except /h/ is marginal). In complex onsets, C1 can be a stop, fricative, or nasal; C2 may be the trill [r], flap [j], or glide [w].
(29) **Yamphu coda PoA neutralization**

(a) /t/ → [ʔ]
- [hæʔ-ʔa] ‘to bite’  [hæʔ-u-ʔ] ‘I nibbled at’
- [kæʔ-ʔa] ‘to recede’  [kæʔ-ʔat] ‘the dryness receded’
- [træʔ-ʔa] ‘contrary’  [kap-ʔrɔd-ʔ] ‘he has (unexpectedly)’
- [lɛʔ-ʔa] ‘to be brief’  [kæʔ-ʔlɛʔ-ʔ] ‘go briefly’
- [kɛʔ-ʔa] ‘to bring’  [jan-ʔi-ʔu-ʔ] ‘I brought it for him’
- [meʔ-ʔa] ‘to allow’  [ram-ʔɛʔ-ʔa] ‘they made me walk’
- [pɛʔ-ʔa] ‘important’  [rɪʔ-ʔɛʔ-ʔɛʔ-ʔ] ‘spread it (important)’
- [pʰɛʔ-ʔa] ‘recessive’  [lɛʔ-ʔɛʔ-ʔɛʔ-ʔ] ‘take it away’
(b) /p/ → /pʰ/
- [kʰɛʔ] ‘language’
- [tʃʊʔ] ‘everybody, all’
- [ɔɡɛʔ] ‘head scarf’
- [kɛʔ-ʔad-ʔ] ‘Let’s go sticking’
- [wɑʔ] ‘chick’
- [kɛʔ-ʔa] ‘stick + infinitive’
- [rɛʔʊʔ] ‘peeling of the skin’
(c) /k/ → /kʰ/
- [æʔʔkʰ] ‘bendy’
- [kʰɛkʰ-ʔa] ‘scrape one’s throat + perform act’
- [ɛkʰ] ‘like that’
- [tɔkʰʔ] ‘nasty, repugnant’
- [tɔkʰ-ʔu] ‘six days ago’
- [kʰɛkʰ-ʔa] ‘scrape one’s throat + infinitive’
- [imukʰ-ʔa] ‘what do you call it?’
- [akʰɛʔ] ‘buttocks’
(d) /t/ → /ʔ/ (30) **Debuccalization of /t/ before other suffixes**

- [tɛʔ-ʔa] ‘I lifted you’
- [tɛʔ-ʔɛʔ-ʔa] ‘we lifted you’
- [tɛʔ-ʔɛʔ-ʔɛʔ-ʔ] ‘you did not lift me’
- [tɛʔ-ʔɛʔ-ʔɛʔ-ʔ] ‘you did not lift me’
- [tɛʔ-ʔɛʔ-ʔɛʔ-ʔ] ‘you did not lift me’
- [tɛʔ-ʔɛʔ-ʔɛʔ-ʔ] ‘you did not lift me’
- [tɛʔ-ʔɛʔ-ʔɛʔ-ʔ] ‘you did not lift me’
- [tɛʔ-ʔɛʔ-ʔɛʔ-ʔ] ‘you did not lift me’

To complete the description, /t/ does not debuccalize before obstruents; it assimilates instead: /pit-kʰɛʔ-ʔa → [pikʰɛʔmitted] ‘it started boiling’ (p.42). /hɛʔ-ʔɛʔ-ʔa → [hɛʔɛʔ-ʔa] ‘to do’ (p.43). Underlying glottals also geminate: /hɛʔɛʔ-ʔa → [hɛʔɛʔ-ʔa] ‘where?’ /hɛʔɛʔ-ʔa → [hɛʔɛʔ-ʔa] ‘even only now’ (p.43). Geminate glottals are banned, so codas delete before glottals rather than debuccalize: /tɛʔ-ʔɛʔ-ʔa → [tɛʔɛʔ-ʔa], *[tɛʔɛʔ-ʔa] ‘I lift’ (p.605). An account of pre-glottal deletion will be provided below.

### 6.3.2 Ranking

A gapped inventory comes about through the action of faithfulness constraints that preserve marked features without preserving less marked elements. In the Yamphu case, the labial /p/ and dorsal /k/ are preserved by ranking some constraint that preserves both over all markedness constraints that ban them in favour of another segment. Anticipating further developments, the ranking needed has IDENT{KP} over *(K), *(KP), and *(KPT). The example in tableau (31) is [tsiptsok] ‘marshy, soggy’.

#### (31) **Preservation of the marked**

<table>
<thead>
<tr>
<th>/tsiptsok/</th>
<th>IDENT{KP}</th>
<th>*(K)</th>
<th>*(KP)</th>
<th>*(KPT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) tsiptso</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) tsiʔso</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(c) tsiʔso</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(d) tsiʔso</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

* **Neutralizing /t/**

As shown in §6.2, to neutralize /t/ to [ʔ] some markedness constraint against [t] must outrank all faithfulness constraints that preserve it: i.e. || *(KPT) > IDENT{KPT}, IDENT{KPT}) ||. The example used below is /natiʔ/ ‘daughter-in-law’, which surfaces as [namiʔ] (cf [namid-ʔaʔ] [instrumental, ergative]).
The formal expression of markedness – ch.6

(32) Neutralization of the unmarked

<table>
<thead>
<tr>
<th>/namciʔ</th>
<th>*(KPT)</th>
<th>IDENT(KPT)</th>
<th>IDENT(KPT?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) namci</td>
<td>!*</td>
<td>*!</td>
<td>*!</td>
</tr>
<tr>
<td>** (b) namaʔ</td>
<td>*!</td>
<td>*!</td>
<td>*!</td>
</tr>
</tbody>
</table>

As with Malay, /t/ is blocked from neutralizing in onsets by an onset-specific IDENT constraint: either onset-IDENT(KPT) or onset-IDENT(KPT?) outranks *(KPT). The opposite ranking would produce neutralization in all environments, as in Hawaiian and Yellowknife Chipewyan. Importantly, the two sets of rankings just identified are compatible – they contain no contradictions. Figure 6.3 graphically illustrates this point.

Figure 6.3: Yamphu’s gapped [k p t] coda inventory ranking

Tableau (33) illustrates Figure 6.3 with the word [sok+sæʔ] ‘squeeze+pull’, from /sok+sæʔ/.

<table>
<thead>
<tr>
<th>/sok+sæʔ</th>
<th>IDENT(KP)</th>
<th>IDENT(KPT)</th>
<th>IDENT(KPT?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) sok+sæʔ</td>
<td>*!</td>
<td>*!</td>
<td>*!</td>
</tr>
<tr>
<td>** (b) sok+sæʔ</td>
<td>*!</td>
<td>*!</td>
<td>*!</td>
</tr>
<tr>
<td>(c) soʔsæʔ</td>
<td>*!</td>
<td>*!</td>
<td>*!</td>
</tr>
<tr>
<td>(d) soʔʔsæʔ</td>
<td>*!</td>
<td>*!</td>
<td>*!</td>
</tr>
</tbody>
</table>

Candiates (c) and (d) go too far in neutralizing [k], thereby fatally violating IDENT(KP). Of the /h/-preserving candidates, (b) minimizes violations of *(KPT) by neutralizing /t/ to [ʔ]. The result is a coda inventory with [k p] and [ʔ], but not [t]. One final ranking is crucial in ensuring that /h/ neutralizes to [ʔ]: all constraints that favour coronals over glottals must be dominated by *(KPT). Most importantly, this includes the sonority-based Glottal Elimination constraint *-Δ≥(glottal). The opposite ranking will prevent /h/ from neutralizing to [ʔ], as shown in tableau (34) (also see §6.4, §6.6.3).

<table>
<thead>
<tr>
<th>/namciʔ/</th>
<th>*(KPT)</th>
<th>IDENT(KPT)</th>
<th>IDENT(KPT?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) namci</td>
<td>!*</td>
<td>*!</td>
<td>*!</td>
</tr>
<tr>
<td>** (b) namaʔ</td>
<td>*!</td>
<td>*!</td>
<td>*!</td>
</tr>
</tbody>
</table>

- **Medial assimilation**

To complete the account of Yamphu neutralization, something must be said about the behavior of coda [t] before stops and its appearance in geminates. As pointed out above, underlying /t/ does not turn into a [ʔ] before stops, it assimilates instead: /pit-kat-a/ → [pikʔa] ‘it started boiling’, *(piʔʔa) (p.42), /larʔ-pe-ma/ → [læʔpema] ‘to do’ (p.43). Similarly, underlying geminates remain faithful: e.g. *[siʔ-a] ‘hit-past’, *[siʔʔa].

This pattern is common in cases of neutralization: assimilation pre-empts neutralization medially, so that it is only seen in word-final codas or in environments where assimilation is blocked (e.g. before sonorants). An account of this particular case of gemination is provided in ch.7.§3.2. I will briefly summarize the account here.

Assimilation beats neutralization in medial codas because a constraint banning heterorganic stop clusters – called ASSIM here (see ch.7 for discussion) – outranks the markedness constraint *(KPT).

(35) Assimilation beats neutralization in Yamphu

<table>
<thead>
<tr>
<th>/larʔ-pe-maʔ/</th>
<th>ASSIM</th>
<th>*(KPT)</th>
<th>IDENT(KPT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) læʔpema</td>
<td>!*</td>
<td>*!</td>
<td>*</td>
</tr>
<tr>
<td>** (b) læʔpema</td>
<td>*!</td>
<td>*!</td>
<td>*</td>
</tr>
<tr>
<td>(c) læʔʔpema</td>
<td>!*</td>
<td>*!</td>
<td>*</td>
</tr>
</tbody>
</table>

The constraint ASSIM bans all stop clusters that disagree in PoA: this includes both [tp] in (a) and [ʔp] in (c). At this point, the only remaining candidate is (b), even though it has a labial in coda position. Candidate (b) incurs one violation of *(KPT) as the glottal contains a single root node; nothing hinges on this point.

Crucially, ASSIM does not require stop+sonorant clusters to agree in PoA, so /larʔ-ʔ/ will be realized as [lærʔʔa] since it does not violate ASSIM. In addition, ASSIM obviously cannot affect word-final consonants: /namciʔ/→[namciʔ].

The ranking in (35) predicts that [ʔ]+stop clusters will be avoided generally in Yamphu: since ASSIM bans [ʔ]+stop clusters and it outranks IDENT(KPT), glottal stops cannot be retained before stops. This is the correct prediction: underlying glottals also geminate (e.g. /ham-beʔ-teʔ/ → [hambetेʔ] ‘where?’).

The final issue relates to the lack of assimilation of dorsals and labials: *[pekʔʔ-ad-i] ‘let’s go sticking’, *[kekʔʔad-i]; *[atok], *[atok]. Chapter 7 shows that this is unremarkable behavior: labials and dorsals can be prevented from assimilating by IDENT(KP); thus, IDENT(KP) outranks ASSIM.
### 6.3.2.1 Glottal Elimination and gapped inventories

A gapped inventory with glottal elimination is one that lacks a labial and a glottal: i.e. [k t], [x], [ŋ n]. For example, Gilbertese has only [k t] in onsets (cf Ayutla Mixtec, with [k t ŋ] in onsets). Mordvin only allows [k t] in codas, but has [p] in onsets. Nunggubuyu also presents a good case of the [k t] type in codas: while onsets have dorsals, labials, and coronals [k p c t t t], codas can only contain dorsals and coronals: e.g. [nihk] ‘soft’, [wutpa] ‘cocky-apple’, [wapatar] ‘grevillea’. [paparara] ‘mat’ (Heath 1984:23); unfortunately, there are no alternations to show what happens to underlying /ŋ/. The same is true of Hixkaryana (Derbyshire 1985:177, 179).117

For voiceless fricatives, there are a number of languages that ban [f] but have [s] and [ʃ] (Yuma, Mansi, Atayal, Mataco-Noctenes). For nasals, Cayapa has [ŋ m n j] in onsets, but only allows [ŋ n] in codas.

- A gapped Cantonese secret language

An interesting case that illustrates a gapped glottal-less inventory for both stops and nasals is found in reduplicant codas in a Cantonese secret language (Chao 1931, Yip 1982:656, Trigo 1988:54).

Cantonese has the stops [p t ŋ k k̂] and nasals [m n ŋ], of which all but [ŋ] and [k̂] can appear in coda position.118 The secret language involves reduplication of the base with a number of attendant changes, exemplified by /kat → /кат-к--в/. The reduplicant’s vowel is neutralized to [i] and the base’s initial consonant is replaced with [t]. Of present interest is the fact that the reduplicant’s /k/ undergoes neutralization: /p/ realized as [t]. Since dorsals are blocked from assimilating, some dorsal-preserving constraint must outrank all markedness constraints that ban dorsals. The only dorsal-faithfulness constraint available is 

\[ ! * * \]

\[ \text{xj} \text{nd} \text{r} \text{nd} \text{d} \text{l} \text{n} \text{j} \] in codas.

For voiceless fricatives, there are a number of languages that ban [f] but have [s] and [ʃ] (Yuma, Mansi, Atayal, Mataco-Noctenes). For nasals, Cayapa has [ŋ m n j] in onsets, but only allows [ŋ n] in codas.

117 These particular examples are based on the proposal that dorsals are more marked than labials. Nevertheless, the argument stands even if the opposite holds since there are languages with [p t ŋ] and no [k], as shown in §6.2.i (e.g. Malay).

118 Some dialects of Hixkaryana are reported to devoice [k t] codas to [ʃ].

### 6.3.2.2 Gapped and reduplicated inventories

\[ \text{a) /t, n}/ → [t, n] \]

\[ /kət/ → [łak-kt] \]

\[ /kan/ → [łan-țën] \]

\[ /p, m/ → [t, n] \]

\[ /kap/ → [łap-ść] \]

\[ /t'ım/ → [lim-ńım] \]

\[ /k, b/ → [k, ŋ] \]

\[ /ćok/ → [łęk-ćęk] \]

\[ /łun/ → [łuń-ńń] \]

The focus here is coda neutralization, so this will be the primary focus of the following discussion.

To force neutralization of labials, a markedness constraint that bans them (\(*{KP}\)) must outrank all relevant faithfulness constraints. As with Malay reduplication, the faithfulness constraints refer to the reduplicant: i.e. \( \text{BR-IDENT\{KP\}} \) and \( \text{BR-IDENT\{KPT\}} \). For prior analyses that employ \( \text{BR-IDENT\{K\} constraints along the same lines, see} \) Alderete et al. (1999)’s analyses of Tubatulabal and Nancowry.

The fact that labials are kept in onsets and the base indicates that \(*{KP}\) is dominated by relevant IO and onset faithfulness constraints: e.g. \( \text{IO-IDENT\{KP\}} \).

Since dorsals are blocked from assimilating, some dorsal-preserving constraint must outrank all markedness constraints that ban dorsals. The only dorsal-faithfulness constraint available is \( \text{IDENT\{K\}} – this must outrank all markedness constraints, since all mention dorsals.

### 39. Gapping in Cantonese reduplicants

\[ /p, m/ → [t, n] \]

\[ /ćok/ → [łęk-ćęk] \]

\[ /łun/ → [łuń-ńń] \]

The final aspect of this part of the analysis is the ranking needed to eliminate glottals. Since [ʈ] and [ʂ] are banned in codas, \(*{KPT\} must outrank all glottal-preserving constraints \( \text{IDENT\{KPT\}} \) and \*{KPT}, as established above.

In short, the [k t] gapped inventory is produced by the rankings in Figure 6.4.
Several issues remain for this pattern. One major one is fixed segmentism: the reduplicant’s vowel is always [i] and the initial consonant of the base is [l]. For recent analyses of fixed segmentism, see Alderete et al. (1999); Yip (2000) provides an analysis of a closely related dialect. Since this issue is tangential to the main point, it will not be discussed further here.

### 6.3.2.2 Ranking schema

To generalize the result of the preceding two sections, a gapped inventory is one in which a less marked element is neutralized but a more marked element is not.

Suppose there is an inventory I that is gapped in terms of a scale S. Therefore, there must be some S-element \( \alpha \) that is neutralized – i.e. the rankings in (26) hold for /\( \alpha \)/.

There must also be some S-element \( \beta \) which is more marked than /\( \alpha \)/, but is preserved.

Therefore, some ranking in (26) does not hold for /\( \beta \)/.

A slightly simpler characterization of gapped inventories is offered in (40). This focuses on the ‘primary’ neutralization ranking, identified in (26a). Importantly, (40) does not replace the full set of conditions needed to ensure neutralization; it is only presented here to simplify exposition of the core rankings.

The constraint form \( \text{M}(\alpha > \beta) \) is a markedness constraint that favours \( \alpha \) over \( \beta \), \( \text{F}(\alpha) \) is a faithfulness constraint that preserves \( \alpha \).

(40) **Gapped inventory ranking schema**

For some scale S,

inventory I is gapped in terms of S if

(a) there is some \( x \in S \) such that for some \( z \) \( \text{M}(z > x) \supset \forall \text{F}(x) \)

and

(b) some \( y \in S \) s.t.

(i) \( \text{F}(y) \supset \forall \text{M}(w > y) \)

and

(ii) \( y \) is more marked than \( x \) in S.

Condition (40a) produces neutralization of scale element /\( \alpha \)/: some markedness constraint that disfavours [\( s \)] outranks all /\( s \)/-preserving faithfulness constraints. In contrast, there is some more marked element /\( \beta \)/ for which the opposite holds: some faithfulness constraint \( \text{F}(\gamma) \) prevents /\( \beta \)/ from neutralizing.

For example, Yamphu /\( t /\) satisfies condition (40a): \( \text{M}(\text{KPT} > \text{KPT}) \supset \forall \text{F}(\text{KPT}) \).

The more marked /\( p /\) satisfies condition (40b): \( \forall \text{M}(\text{KP} > \text{KP}) \supset \text{F}(\text{KP}) \).

### 6.3.3 Other gapped inventories

This section aims to show how the general result identified in the previous section can be extended to other gapped inventories.

The primary case discussed is Nganasan’s coda inventory of [p ?]. This inventory is gapped like Yamphu’s in that it lacks /\( t /\), but it is similar to Malay’s in lacking a [k].

#### 6.3.3.1 Nganasan

Nganasan has the consonants listed in Table 6.8, from Helimski (1998) and Olga Vaysman (p.c.).

<table>
<thead>
<tr>
<th>Table 6.8: Nganasan Consonants</th>
</tr>
</thead>
<tbody>
<tr>
<td>labial</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>stops</td>
</tr>
<tr>
<td>p</td>
</tr>
<tr>
<td>fricatives</td>
</tr>
<tr>
<td>b</td>
</tr>
<tr>
<td>nasals</td>
</tr>
<tr>
<td>m</td>
</tr>
<tr>
<td>liquids</td>
</tr>
<tr>
<td>l</td>
</tr>
</tbody>
</table>

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

Codas can only contain a proper subset of the consonants in Table 6.8 (Helimski 1998:484). Of the sonorants, codas can contain nasals homorganic to the following consonant and the coronal liquids. Of present interest is the obstruent coda inventory: only /p/ and /?/ are permitted. Helimski (1998) reports that the obstruents /k/ are all demonstrably neutralize to /?/; there are no clear alternations for the other obstruents (Helimski 1998:489). Examples for neutralization of coronals are provided in (41a), and for non-neutralization of labials in (41b).
(41) Nganasan coda neutralization

(a) /t, d/ → [ʔ]

/mat/ → {maʔ} ‘house’, cf [maŋ-ʔ] [genitive]
/kɑʊʔa-t/ → {kɑʊʔa-ʔ} ‘kill ’{3p}’, cf [kɑʊʔa-ʔ-ʊŋ] [{pl+object}]
/kɑbʊ-ʔ/ → {kɑbʊ-ʔ} ‘skin + {predic.}’, cf {kɑbʊ-t-ʊŋ} [{pl+indic.}]
/kɔtu-ʔ/ → {kɔtu-ʔ} ‘kill+imper.pres.2sg’, cf {kɔtu-ð-ə}
/jintʊ-ʔ/ → {jintʊ-ʔ} ‘aux. negative + 3pl.’, [jintʊ-ð-ɪ]

(b) /p, b/ → [p]

[ŋuŋgiŋ] ‘first’
[taŋkata] ‘from there’
[koŋuŋkoŋ] ‘kill {debitive, 1sg.}’
[kuχjumu ngatiga] ‘man or woman’
[kɔtʊrʊŋʊŋgiŋ] base for ‘continuously cause someone to kill’

• Analysis

The interesting aspect of Nganasan is that it not only eliminates [t] in codas, but [k] as well. Thus, it is a cross between Yamphu and Malay.

As in Yamphu, coda /t/ can be neutralized to [ʔ] through the ranking || *{KPT} » IDENT{KPT}, IDENT{KPT} ||, shown in tableau (42). As in Yamphu, onset neutralization is blocked by a constraint on onset preservation: onset-IDENT{KPT}.

(42) Elimination of /t/

/kotu-ʔ/ *{KPT} IDENT{KPT} IDENT{KPT}

(a) koʔu * * *

(b) koʔu * *

Again, /p/ can be preserved through the action of the faithfulness constraint IDENT{KP}; this must outrank all constraints that ban [p] – i.e. *{KP} and *{KPT}.

(43) Preservation of /p/

/pikt/ IDENT{KP} *{KPT} *{KP}

(a) pɪkt * * *

(b) pi * *

So far, nothing is different from the Yamphu ranking. However, the final analytic step is to neutralize /k/, setting Nganasan apart from Yamphu.

There is only one markedness constraint left that can be used to eliminate dorsals – *{K}. *{K} must outrank all faithfulness constraints that preserve dorsals – i.e. all faithfulness constraints. Since the other dorsal-eliminating constraints *{KP} and *{KPT} are already outranked by some faithfulness constraint, they cannot be used here.

(44) Neutralization of /k/

/pikt/ *{K} IDENT{K} IDENT{KP}

(a) pɪkt *!

(b) pi * *

Figure 6.5 summarizes the Nganasan ranking.

Figure 6.5: Nganasan’s gapped [p,ʔ] coda inventory ranking

\[ \text{onset-IDENT} \Rightarrow \text{IDENT} \Rightarrow \text{IDENT} \Rightarrow \text{IDENT} \]

In short, Nganasan shows that the rankings used to produce gapped inventories and to eliminate highly marked elements are compatible.

6.3.4 The essentials of gapping

The preceding sections have shown how gapping works under the present theory. This section is devoted to showing that the present theory is successful because it has marked-faithfulness constraints. In other words, the aim of this section is to show why marked-faithfulness constraints offer the only possible account of gapped inventories.

Although §6.3.2 showed that the present theory can produce gapped inventories, it did not explicitly demonstrate that the reason for this was the marked faithfulness constraints. This section considers alternative faithfulness theories; it shows that there must be constraints that exclusively preserve marked elements.

• IDENT{Place}

The need for marked-faithfulness constraints can be illustrated by a theory without them. For example, Prince (1998) entertains the hypothesis that only one PoA-faithfulness constraint exists.121 The faithfulness constraint IDENT{Place} preserves all PoAs equally.

121 Prince & Smolensky (1993:ch.9§2) arrive at the same conclusion, though in terms of the Parse-Fill theory, not correspondence.
Prince (1997c, 1998) shows that the IDENT[Place] theory cannot produce gapped inventories (also see Prince & Smolensky 1993:ch.9). I will expand on this point here.

To produce an inventory like Hawaiian’s [k p ʔ], the fact that /k/ and /p/ are retained can only be accounted for by ranking IDENT[Place] above all markedness constraints that ban [k] and [p] (i.e. *(K), *(KP), *(KPT)).

However, all markedness constraints that ban [t] also ban [k] and [p], and no faithfulness constraint preserves [k] and [p] without also preserving [t]. Therefore, there is no way to neutralize /t/.

(45) The need for marked faithfulness

<table>
<thead>
<tr>
<th>taka/</th>
<th>IDENT[Place]</th>
<th>*(K)</th>
<th>*(KP)</th>
<th>*(KPT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) taka</td>
<td>*(K)</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) taka</td>
<td>*(K)</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) taka</td>
<td>*(K)</td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For /t/ to be eliminated, *(KPT) would have to outrank IDENT[Place]. However, this would also incorrectly eliminate /p/ and /k/.

This result does not depend on the markedness theory assumed. Even with a fixed ranking theory || *(K) » *(P) » *(T) » *, the result is the same. To ban /t/, IDENT[Place] must be outranked by *(T), but this then implies that /k/ will also neutralize.

The same problem arises with faithfulness theories that have several different markedness constraints where none specifically preserve marked PoAs. For example, a theory with ‘unmarked’ faithfulness constraints (IDENT[?], IDENT[T], IDENT[TP], IDENT[TPK]) comes up against the same problem. For /t/ to neutralize, *(KPT) must outrank IDENT[T], IDENT[TP], IDENT[TPK]; this ranking will also force neutralization of /k/, though.

Thus, IDENT(KP) is essential in producing a [k p ʔ] inventory; analogously, IDENT[K] is necessary to produce [k t (ʔ)] inventories.

**The Markedness Alternative**

To show that the reasoning above is correct, it is also necessary to eliminate markedness-based alternatives. Without marked-faithfulness constraints, the only alternative is to rely on a markedness constraint to produce the right results. To eliminate [t] using a markedness constraint without eliminating any marked element would require a markedness constraint that assigns a violation to [t] but not to [k p] – i.e. *(T).

With the ranking || *(T) » IDENT[Place] » M(k,p) ||, where M(k,p) is the set of markedness constraints that ban [KP], only /t/ would be neutralized.122 Such an approach has obvious flaws. The constraint *(T) eliminates the markedness relations between PoA: under the ranking || *(T) » *(KP) ||, coronals are more marked than labials and dorsals. This raises significant problems for direction of neutralization: the ranking || *(T) » *(KP) || predicts a language in which all coronals neutralize to labials in codas. Such languages do not exist: neutralization always proceeds towards the unmarked end of the scale, meaning that coronals cannot neutralize to the more marked labial PoA (§6). Tableau (46) shows that *(T) produces such a situation. This language also has Glottal Elimination.

(46) No M(k,p > t)

<table>
<thead>
<tr>
<th></th>
<th>*(T)</th>
<th>IDENT[Place]</th>
<th>*(K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>/t/</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>/k/</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>/p/</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In short, a markedness-based approach to gapped inventories is doomed to failure – it requires markedness constraints that invert the markedness relations between scale elements. Since there is no markedness account of gapped inventories, faithfulness constraints bear the entire burden of accounting for their properties. A marked-faithfulness analysis therefore offers the only possible explanation of gapped inventories.

To summarize the reasoning presented above:

(a) As shown in (26), in order to preserve a PoA x, some faithfulness constraint that preserves x outranks all markedness constraints that disfavor x: || F(x) » M(x,y) ||. (b) The PoA-markedness constraints have the property that if y is less marked than x, then all markedness constraints that ban x also ban y.123 So, || F(x) » M(x,y) ||.

(c) Now, suppose there were no marked faithfulness constraints. This means that there are no markedness constraints that exclusively preserve marked elements. So, for all F(x), F(x) must also preserve all less marked elements y. Therefore, the final ranking is || M(x,y) » F(x,y) ||. (d) From this ranking, since some faithfulness constraint that preserves y (i.e. F(x,y)) outranks all markedness constraints against y (i.e. M(y)), then y cannot be eliminated. Thus, preservation of x implies preservation of all less marked elements y in a theory without marked faithfulness constraints.

**Surviving Theories**

Successful analysis of gapped inventories requires marked-faithfulness constraints. This leaves two general types of theory. One has faithfulness constraints that exclusively preserve marked elements. The marked-faithfulness theory presented here is of this type; as discussed in §6.1 the fixed ranking theory || IDENT[K] » IDENT[P] » IDENT[T] || also has this property. For example, the fixed ranking theory can produce elimination of /t/ and preservation of /k/ (i.e. part of the Yamp’ah system) through the ranking in (47).

122 As shown by the ranking, *(T) is not in a fixed ranking with other PoA constraints. So, this type of theory is only one in which *(T) may dominate *(K) and *(P).

123 Or, in a fixed ranking theory, all markedness constraints that ban x outrank all markedness constraints that ban y. The result is the same.
The other type of theory that can produce gapped inventories is a superset of the marked-faithfulness theories: it has both marked and unmarked faithfulness constraints; this type is discussed in chapter 7.

6.3.5 Summary

To summarize the findings of this section, marked-faithfulness constraints are essential in providing an account of gapped inventories. Without faithfulness constraints that preserve marked PoAs alone, only harmonically complete inventories can be produced (§3.3, Prince & Smolensky 1993:ch.9, Prince 1998).

In the present theory, a gapped inventory comes about when some PoA α is neutralized by the ranking \[ \text{EM}(\gamma \alpha) = \forall F(\alpha) \] while a more marked element β is preserved by the ranking \[ \exists F(\beta) = \forall M(\delta \beta) \] (M(α) refers to a markedness constraint that favours γ over α). The reason that these two rankings are compatible follows from the fact that the faithfulness constraint that preserves the more marked element β need not also preserve the lesser-marked element α. For the \( [k \ p \ t] \) inventory, this translates into the ranking \[ \text{IDENT}(K^P) > \text{IDENT}(K^P) \] as shown in tableau (48), reproduced from §6.3.2.

<table>
<thead>
<tr>
<th>/sok+sat/</th>
<th>IDENT[K]</th>
<th>* (KPT)</th>
<th>IDENT[T]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) sokset</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) so3æt</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(c) sokset</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>** (d) sokset</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

As a concluding comment, although gapped voiceless stop inventories have been the focus of this section, they are found with other manners of articulation as well. An interesting case is found in Caribbean Spanish, described by Trigo (1988:72fi) and mentioned in c.§5.1.3.2. For voiceless fricatives, [s] debuccalizes to [h] in codas: e.g. /tos/ \rightarrow [toh] ‘cough’ (cf [tos-eh] ‘coughs’) (Trigo 1988:72fi). However, /l/ only optionally debuccalizes: [difètera]–[dihteria] ‘diphtheria’. The effect is a gapped coda voiceless fricative inventory [h], lacking [s]. The same fact holds for nasals. Trigo argues that /m/ debuccalizes to [N]: /tren/ \rightarrow [treN] ‘train’ (cf [tren-eh] ‘trains’). Again, /n/ only optionally neutralizes: [album]–[albuN] ‘album’, [adam]–[adaN] ‘Adam’. However, nasal neutralization can be blocked by assimilation to the PoA of a following stop: e.g. [ten ke], *[ten ke] ‘train that’ (cf [iN-seguro] ‘insecure’, [iN-fìnito] ‘infinite’ – there is no assimilation to fricatives). This is analogous to stop assimilation in Yamphu: an assimilation constraint blocks neutralization.

The next step is to show that while marked-faithful constraints can produce gapped inventories, they cannot produce unattested inventories – i.e. the ‘disharmonic’ type.

6.4 Disharmonic inventories

The remaining type of inventory is neither harmonically complete nor gapped: ‘disharmonic’ inventories differ from the other types in that they lack a least marked element: i.e. \{K P\}, \{K\}, and \{P\}. As a note, strictly speaking, inventories consisting of \{K P T\} are disharmonic in terms of the PoA constraints. Glottal Elimination promotes coronal to least marked status, though, so \{K PT\} inventories will be called harmonically complete.

The present theory predicts that disharmonic inventories never come about through PoA neutralization. They may come about through other incidental processes, such as lenition (§6.5), but no process motivated by the PoA markedness constraints will ever produce a disharmonic inventory.

This section is based on the claim that disharmonic inventories do not exist. Section 6.5 discusses inventories that are apparently disharmonic.

Section 6.4.1 shows why the present theory cannot produce disharmonic inventories.

Section 6.4.2 discusses the relation of deletion to disharmonic inventories. This section shows that a theory with MAX-feature constraints can produce disharmonic inventories while a theory with feature-specific IDENT constraints cannot. Furthermore, segment deletion is shown to create only harmonically complete inventories in the present theory, therefore setting deletion apart from neutralization.

6.4.1 Ranking

Barring incidental processes (see sec.3.4), the least marked element cannot be eliminated by neutralization in the present theory. This prediction follows from a property of Optimality Theory dubbed ‘Harmonic Ascent’ by Moreton (1999) (for discussion see McCarthy 2001b:101ff).

For a candidate to win, it must fare better than all others on both faithfulness and markedness constraints: i.e. \( \exists \alpha \) so that \( \forall \beta \). As an example, from input /k/ the unfaithful candidate [G] could win over the faithful [k] because the markedness constraint *\{K\} favours the former over the latter. In contrast, from input /p/ the unfaithful candidate [p] can never win over [t] because no markedness constraint favours [p] over [t].
More generally, suppose that there is some segment α and no markedness constraint favours anything over α. There is then no way that any candidate but [α] can win given input /t/; no other candidate will be less marked, and all others will be less faithful.

In terms of the PoA constraints alone, this is the case for /t/. There is no PoA-markedness constraint that favours any other PoA over [t]. Therefore, from input /t/, the candidate [t] cannot lose to any other candidate on a markedness constraint, and it beats all others in faithfulness. Therefore, regardless of the ranking, /t/ will always emerge as [t].

To illustrate this point, table (49) shows the competition between [t] and the next least marked segment [i], from input /t/. The constraints IDENT[KPT?] and *[KPT?] are the only ones that mention glottals, so only they are relevant to the competition.

(49) No way to get rid of glottals

<table>
<thead>
<tr>
<th>/t/</th>
<th>*{KPT}</th>
<th>IDENT[KPT?]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) ?</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(b) t</td>
<td>*</td>
<td>*!</td>
</tr>
</tbody>
</table>

Tableau (49) shows that the ranking of IDENT[KPT?] and *[KPT?] is irrelevant; under either ranking /t/ will be faithfully realized. The fact that both (a) and (b) violate *[KPT?] illustrates a general point about markedness constraints: the only way for [t] to beat [?] is if a markedness constraint favoured [t] over [?] – i.e. assigned a violation to [?] but not to [t]. Since no markedness constraint does this, [t] can at best be equally as marked as [t]. Therefore, faithfulness inevitably proves decisive.

In short, in terms of the PoA constraints /t/ cannot be realized as anything but /t/.124

6.4.1.1 The glottal/coronal universal

The result that glottals cannot be neutralized is artificial in the sense that it holds only of the PoA markedness constraints. This result is thwarted somewhat by the Glottal Elimination constraint *-Δσ≥[glottal], which favours non-glottals over glottals. As shown in previous sections, if *-Δσ≥[glottal] outranks either (i) MAX or (ii) *[KPT?] and IDENT[KPT?], glottals can be eliminated from an inventory.

In this case, though, coronals graduate to ‘least marked’ status in terms of PoA. Having the least marked PoA, coronals therefore cannot be eliminated under any ranking. Tableau (50) illustrates this point. The ranking || *-Δσ≥[glottal] IDENT[KPT?], *[KPT?] || ensures that glottals are banned from the inventory. With this ranking, the PoA constraints cannot force neutralization of /t/.

(50) Promoting coronals

<table>
<thead>
<tr>
<th>/t/</th>
<th>*-Δσ≥[glottal]</th>
<th>*[KPT?]</th>
<th>IDENT[KPT?]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) t</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) t</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) pi</td>
<td>*</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>(d) ki</td>
<td>*</td>
<td>*!</td>
<td></td>
</tr>
</tbody>
</table>

The coronal [t] wins in (50) because it graduates to least marked status: since glottals are eliminated for incidental reasons, there is no less marked available PoA than coronal: the candidates [pi] and [ki] cannot win because no markedness constraint favours [p] or [k] over [t]; furthermore, both are less faithful than [t].

In short, the ranking of the PoA constraints in the marked-faithfulness theory is irrelevant to preservation of /t/ in neutralization.125 As long as the ranking in (50) holds – producing (emergent) glottal elimination – any ranking of the PoA-faithfulness constraints will allow /t/ to emerge as [t].126

• The Universal

While coronals can be promoted to ‘least marked’ status by Glottal Elimination, no similar process can promote dorsals or labials above coronals. Evidence from ephenthesis and targets of neutralization shows that dorsals or labials are never favoured over coronals by any markedness constraint (§6.6). Since there is no markedness constraint in CON that favours dorsals and/or labials over coronals, coronals and glottals cannot both be eliminated, leaving a [K P] inventory.

The result is the prediction for inventories in (51).

(51) Universal for PoA Inventories

For all inventories I, for all manners m in I, m contains

(i) a glottal, and/or (ii) a coronal

Section 6.5 will introduce further caveats to (51), namely that incidental processes may change the manner of articulation of coronals, leaving only dorsals and labials. For example, /t/ may be lenited to /s/, leaving just [k p] as voiceless stops. Even in these cases, though, the input coronal PoA cannot be changed to a more marked PoA.127

124 One may ask “What if there is never any /t/ in the input?” This question is irrelevant in OT given Richness of the Base.

125 Of course, /t/ may be eliminated due to other processes, like assimilation.

126 The only caveat relates to deletion. If both *[KPT?] and *-Δσ≥[glottal] outrank MAX (and other deletion-blocking constraints, like [OOG]) then /t/ will emerge as [s] (i.e. delete). However, in this case all other coronals will delete as well, regardless of their PoA. Of course, this does not create a system that lacks a [t] and [?], while retaining the more marked [p] and/or [k].

127 An interesting prediction relates to PoA for geminates. Geminate glottals /G35/ seem to be remarkably rare, and clearly avoided in a number of languages. Thus, in all cases of geminates, coronals present the least marked PoA. Therefore – putting aside other interfering processes – coronal voiceless stops should
Implications for Binary Scales

The result just outlined can be generalized to all scales. For binary scales, its implication is that there can be no inventory consisting of just the most marked element.

For example, a two-valued (i.e., binary) scale on vowel nasality ([Vnasal]) can be realized as two constraints: *[Vnasal], Voral] and *[Vnasal]. If *[Vnasal] outranks all faithfulness constraints that preserve vowel nasality, the result will be an inventory without nasal vowels. However, no ranking can eliminate oral vowels: if *[Vnasal], Voral] outranks all faithfulness constraints, oral vowels will still surface as oral. The only other option—a nasal vowel—fares no better on markedness and worse on faithfulness, so oral vowels can never be neutralized to nasal ones.

Quasi-tableau (52) illustrates this point. The *# symbols indicate potential winners under some ranking. In contrast, the form (c) in which the oral vowel /a/ has been neutralized to the nasal [õ] will always lose because it is ‘cumulatively’ harmonically bounded by (a) and (b). In other words, every ranking will produce either (a) or (b) as a winner, but no ranking will let (c) win.

<table>
<thead>
<tr>
<th>/potá/</th>
<th>*[Voral]</th>
<th>*[Vnasal], Voral]</th>
<th>IDENT[Voral]</th>
<th>IDENT[Vnasal], Voral]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) poá</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) poá</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(c) poá</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

The same result holds of all binary scales.

6.4.2 Deletion and MAX(Feature)

An aspect of the present theory that is crucial in banning disharmonic inventories is that neutralization is not allowed to compete with deletion.

To explain this point, the preceding sections have shown that a disharmonic inventory [k p] cannot come about through neutralization. However, inventories can also be formed by deletion. So, it is reasonable to be concerned that a disharmonic [k p] inventory could conceivably come about through deletion: i.e., /k/ or /p/ survive while /t/ and /d/ delete. Since disharmonic inventories are never observed, they cannot be allowed to come about through deletion. Thus, a comprehensive theory of inventories must explain why deletion does not produce disharmonic inventories.

In the present theory, the reason that deletion (symbolized as ∅) cannot produce disharmonic inventories relates to the relative harmony of [t] and ∅. The form of the present theory’s constraints ensures that if ∅ is more harmonic than [t] in a grammar, then ∅ is more harmonic than all other PoAs as well. Thus, if /t/ deletes, then so do [K] and [P] because ∅ avoids all PoA-markedness violations, and MAX is not sensitive to PoA distinctions, unlike IDENT.

More concretely, for /t/ to delete, some markedness constraint against [t] must outrank MAX—the constraint that bans deletion (McCarthy & Prince 1995). However, all markedness constraints that ban [t] in the present theory (i.e. *[KPT], *[KPT]) also ban all more marked elements—[p] and [k]. Therefore, if /t/ deletes, so do /p/ and /k/. This point is illustrated in tableau (53). The candidate with /t/-deletion only—(b)—loses to the candidate with deletion of all PoAs—i.e. (c).

<table>
<thead>
<tr>
<th>/kapíto/</th>
<th>*[KPT]</th>
<th>MAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) kapíto</td>
<td>* * * *</td>
<td>∅</td>
</tr>
<tr>
<td>(b) kapío</td>
<td>* *</td>
<td>*</td>
</tr>
<tr>
<td>(c) põta</td>
<td>* *</td>
<td>*</td>
</tr>
</tbody>
</table>

The next step is to show that no constraint can subvert the result in (53). In other words, there can be no constraint that bans (c) but not (b), while also eliminating (a).

For any constraint—markedness or faithfulness—to prevent deletion of K and P while letting /t/ delete, the constraint would have to favour K and P over both T and ∅. This way, both [kapíto] and [põta] would satisfy the constraint, but [kapíto] would win on MAX.

No markedness constraint can be used to subvert the result in (53). To do so, there would have to be a PoA-markedness constraint that favoured K or P over T. There is no such constraint in the present theory, nor could there be in any theory; if there were such a constraint, it would incorrectly predict that T could neutralize to K and P (see §6.6).

No faithfulness constraint can be invoked either. Such a faithfulness constraint would have to prevent /k/ and /p/ from deleting, without doing so for /t/. No faithfulness constraint in the marked-faithfulness theory can do this. For example, while IDENT[KP] prevents neutralization of /k/ and /p/ to a segment with a different PoA, it does not stop /k/ and /p/ from deleting. IDENT[KP] only requires corresponding segments to agree in PoA—it does not require every input segment to have an output correspondent. In effect, then, the marked-faithfulness constraints favour faithfulness and deletion equally: either staying faithful to the input or deleting will avoid violating IDENT. More concretely, candidates (a), (b), and (c) in (53) all violate IDENT[K], IDENT[KP], and IDENT[KPT] equally (i.e. not at all). Therefore, IDENT constraints cannot be used to favour (b) over (c).

The only way that a constraint like *[T] could exist in CON is if it were universally outranked by constraints against K and P.
6.4.2.1 MAX(Feature) and disharmonic inventories

The result identified above relies on there being no faithfulness constraint that favours K and/or P over T and Ø. If there were such a constraint, disharmonic inventories could come about through deletion.


(54) \[ \text{MAX}(F) \]  “Every input feature F has a corresponding feature F in the output and the values of F and F are identical.”

If there were POA-specific versions of MAX(feature) such as MAX(KP), then disharmonic inventories could occur. MAX(KP) requires an input dorsal or labial feature to be present in the output, and to retain the same value. Coupled with a ban on floating features, MAX(KP) can effectively prevent deletion of segments that contain an input dorsal or labial. Thus, /ka/ → [a] violates MAX(KP) while /ta/ → [a] does not.

In effect, MAX(KP) favours K and P over both T and Ø. The result is that input /k/ and /p/ can survive while both /t/ and /l/ delete.

(55)

<table>
<thead>
<tr>
<th>/pt/</th>
<th>/t/</th>
<th>/k/</th>
</tr>
</thead>
<tbody>
<tr>
<td>/t/</td>
<td>/t/</td>
<td>/k/</td>
</tr>
<tr>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(a)</td>
<td>(b)</td>
<td>(c)</td>
</tr>
</tbody>
</table>

In short, a theory with marked-MAX(feature) constraints predicts the existence of disharmonic inventories while a marked-IDENT theory does not. For other arguments against MAX-F (for completely different reasons), see Keer (1999:38ff) and Struijke (2001).

6.4.2.2 Limits on deletion

The present theory does not prohibit deletion entirely as an inventory-forming process. However, there are strong limits on deletion. To be precise, the theory makes the prediction in (56).

(56) Inventory-forming deletion prediction

Deletion can only form harmonically complete inventories

- Harmonically Complete deletion in Lardil

An example of how the theory can produce a harmonically complete inventory through deletion is found in Lardil (Hale 1973, Ito 1986, Wilkinson 1988, Prince & Smolensky 1993:ch.7).

Lardil has the consonants in Table 6.9, after Hale (1973). Hale’s diacritics have been converted into IPA diacritics.

Table 6.9: Lardil consonants (Hale 1973, adapted)

<table>
<thead>
<tr>
<th>Underlying</th>
<th>Nominate</th>
<th>Non-future</th>
</tr>
</thead>
<tbody>
<tr>
<td>/p/ → Ø</td>
<td>/t/</td>
<td>/k/</td>
</tr>
<tr>
<td>/t/ → Ø</td>
<td>/s/</td>
<td>/g/</td>
</tr>
<tr>
<td>/l/ → /l/</td>
<td>/l/</td>
<td>/l/</td>
</tr>
<tr>
<td>/k/ → Ø</td>
<td>/j/</td>
<td>/j/</td>
</tr>
<tr>
<td>/m/ → /m/</td>
<td>/n/</td>
<td>/n/</td>
</tr>
<tr>
<td>/n/ → /n/</td>
<td>/r/</td>
<td>/r/</td>
</tr>
<tr>
<td>/l/ → /l/</td>
<td>/y/</td>
<td>/y/</td>
</tr>
<tr>
<td>/r/ → /r/</td>
<td>/l/</td>
<td>/l/</td>
</tr>
<tr>
<td>/y/ → /y/</td>
<td>/y/</td>
<td>/y/</td>
</tr>
<tr>
<td>/t/ → /t/</td>
<td>/t/</td>
<td>/t/</td>
</tr>
<tr>
<td>/l/ → /l/</td>
<td>/l/</td>
<td>/l/</td>
</tr>
<tr>
<td>/k/ → /k/</td>
<td>/k/</td>
<td>/k/</td>
</tr>
</tbody>
</table>

Only the apicals in bold and homorganic nasals are allowed in codas. The exception is /t/, which turns into [t] in codas. All other consonants delete, as shown in (57).

(57) Inventory-forming deletion prediction

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<th>Nominate</th>
<th>Non-future</th>
</tr>
</thead>
<tbody>
<tr>
<td>/p/ → Ø</td>
<td>/t/</td>
<td>/k/</td>
</tr>
<tr>
<td>/t/ → Ø</td>
<td>/s/</td>
<td>/g/</td>
</tr>
<tr>
<td>/l/ → /l/</td>
<td>/l/</td>
<td>/l/</td>
</tr>
<tr>
<td>/k/ → Ø</td>
<td>/j/</td>
<td>/j/</td>
</tr>
<tr>
<td>/m/ → /m/</td>
<td>/n/</td>
<td>/n/</td>
</tr>
<tr>
<td>/n/ → /n/</td>
<td>/r/</td>
<td>/r/</td>
</tr>
<tr>
<td>/l/ → /l/</td>
<td>/y/</td>
<td>/y/</td>
</tr>
<tr>
<td>/r/ → /r/</td>
<td>/l/</td>
<td>/l/</td>
</tr>
<tr>
<td>/y/ → /y/</td>
<td>/y/</td>
<td>/y/</td>
</tr>
<tr>
<td>/t/ → /t/</td>
<td>/t/</td>
<td>/t/</td>
</tr>
<tr>
<td>/l/ → /l/</td>
<td>/l/</td>
<td>/l/</td>
</tr>
<tr>
<td>/k/ → /k/</td>
<td>/k/</td>
<td>/k/</td>
</tr>
</tbody>
</table>

The following analysis follows the one proposed by Prince & Smolensky (1993:98ff) in its essentials.
Deletion of non-coronals in Lardil can be produced by having (i) *{KP} outrank MAX and (ii) MAX outrank all markedness constraints that ban less marked elements (i.e. *{KPT}, *{KPT'}). Tableau (58) illustrates this ranking.

<table>
<thead>
<tr>
<th>/putuka'</th>
<th>*{KP}</th>
<th>MAX</th>
<th>*{KPT}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) putuk</td>
<td>* *</td>
<td>* *</td>
<td>* *</td>
</tr>
<tr>
<td>(b) putu</td>
<td>* *</td>
<td>* *</td>
<td>* *</td>
</tr>
</tbody>
</table>

Candidate (a) is ruled out by the *{KP} as it contains too many non-coronals compared with (a).

Other outcomes – epenthesis and neutralization – are blocked by ranking DEP and IDENT{KP} above MAX, as shown in tableau (59).

<table>
<thead>
<tr>
<th>/putuka'</th>
<th>*{KP}</th>
<th>IDENT{KP}</th>
<th>MAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) putuki</td>
<td>* *</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) putu</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

After Prince & Smolensky, ONSET blocks deletion in onsets, as shown below.

<table>
<thead>
<tr>
<th>/putuka'</th>
<th>ONSET</th>
<th>*{KP}</th>
<th>MAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) pu</td>
<td>* !</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) putuk</td>
<td>* !</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

The lamino-dental [t] and lamino-voalelor [t] are also banned in codas. Hamilton (1993) proposes that laminals have a feature [laminal], which is essentially the same as [+distributed] (T. Hall 1997:144). Thus, *{distributed} ranked above MAX will achieve the right result here.

Since [?] does not appear in Lardil, *{Α2; glottal} can also outrank MAX.

More extreme cases include Capanahua (Loos 1969) and Yaminawa Pano (Loos 1999), where all word-final stops delete.

- **Gapping and Deletion**

Deletion in Lardil is possible because the result is a harmonically complete inventory. The present theory predicts that the gap in gapped inventories cannot come about through deletion.

As an example, the lack of [t] in the gapped inventory [k p ?] can only be due to neutralization. If [u] were deleted, *{KPT} must outrank MAX. However, this ranking forces deletion of dorsals and labials as well. As discussed above, no constraint can prevent deletion of K and P without also preserving T. In short, there can be no language that is just like Yamphu except that coda /u/'s delete rather than neutralize.

An interesting case of a gapped coda inventory that further illustrates this point is found in Siuslawan (Frachtenberg 1922:456-7, Trigo 1988:108). Before [n], coda [k] and [t] are banned, leaving just [p] and a glottal. /h/ is eliminated by deletion: /taak-nxan'→[taaxn] 'this one thou', *[tahxn]. Therefore, *K must outrank MAX.

Since /p/ survives faithfully, MAX must outrank all markedness constraints that ban [p]; i.e. *{KP}, *{KPT}, *{KPT'}. Since MAX now outranks all markedness constraints that ban [t], [h] cannot be eliminated through deletion. Indeed, it neutralizes to [h]: [waayütn]→[waayütn] 'he is told', *[waayütn].

Similar facts are found in child language. For example, Pater & Barlow (to appear) report the speech of child LP65 to delete velars when possible: adult [klin] 'clean' vs LP65 [kn]; adult [kloob] 'clothes' vs LP65 [kooc]. In contrast, there seem to be no cases where children delete labials but keep dorsals (Joe Pater p.c.).

To conclude this section, the conclusions about MAX could also be extended to other non-IDENT faithfulness constraints like UNIFORMITY, LINEARITY, and DEP (McCarthy & Prince 1995). Like MAX, these constraints may not have feature-specific versions. The empirical implications of this point deserve separate exploration, so they will not be discussed further here (see Howe & Pulleyblank 2001 for feature-specific DEP constraints).

### 6.4.3 Summary

To summarize, marked-IDENT constraints do not allow disharmonic inventories. Two factors are essential in producing this result.

One factor is Harmonic Ascent (Moreton 1999). Harmonic Ascent prevents unfaithful candidates that are more marked than the faithful candidate from winning. Thus, the least marked element cannot be altered since no other candidate is less marked (or more faithful). As an example, /t/ cannot yield anything but [?] in terms of the PoA constraints alone: [t], [p], and [k] are all less faithful, and more marked.

Glottal Elimination can interfere with this result to promote coronals to least marked status. In such cases, coronals cannot be eliminated, again for Harmonic Ascent reasons. Taking Glottal Elimination into consideration, then, every manner in every inventory is predicted to have a glottal, a coronal, or both.

The other factor relates to the form of the marked-faithfulness constraints themselves. None of the marked-faithfulness constraints used here ensure preservation of marked elements over deletion. For example, IDENT{KP} is equally satisfied by deletion
of faithful preservation of /k/ and /p/. The effect is that disharmonic inventories cannot be produced by deletion. A disharmonic inventory consisting of just /k p/, having deleted /t/, would have to have some faithfulness constraint that favours preservation of [k] and [p] over [t], and deletion – the IDENT constraints do not fit this profile. In contrast, a constraint like MAX[KP] does, showing that MAX constraints cannot be feature-specific.

The lack of MAX(feature) constraints places a strong restriction on deletion as an inventory-forming process in the present theory: deletion can only produce harmonically complete inventories. This predicts that there can be no language with a gapped inventory where the gap comes about through deletion: i.e. there can be no Yamnaya-like language with a coda [kp/] inventory where /t/ deletes.

This section concludes with the point that the results in this section only hold in a localized sense: the theory predicts that disharmonic inventories cannot come about solely through the action of the PoA-markedness and -faithfulness constraints proposed here. However, CON contains a number of other constraints. The next section shows how these can create apparently disharmonic PoA inventories.

As a final note on deletion, the claim that MAX does not refer to subsegmental features does not mean that subsegmental features cannot play a role in deletion. Lombardi (1995) has observed that constraints like *[+voice] can motivate deletion of voiced segments through the ranking || *[+voice], IDENT[+voice] » MAX ||. Wilson (2000) observes that feature-referring constraints like *[K] could influence which of a set of consonants will delete. For example, *[K] would favour deletion of /k/ in both /kp/ and /pk/. However, Lombardi (1995) observes that in fact conditions on voicing cannot force deletion, and Wilson (2000) argues that PoA-markedness constraints cannot determine which consonant deletes. Unfortunately, Lombardi (1995) and Wilson (2000) propose theories that cannot be discussed here without going far from the theme of this chapter (cf McCarthy 2002b). So, in the interests of thematic unity, I regrettably forego discussion of their proposals here.

### 6.5 Interaction with other scales and processes

PoA neutralization can interact with many other processes. These processes can influence the outcome of PoA neutralization, producing apparently disharmonic inventories. The aim of this section is to show that processes such as lenition and nasalization can produce apparently disharmonic inventories, but that such cases are never the result of PoA neutralization.

Section 6.5.1 identifies several types of ‘manner neutralizations’. In many cases, the manner of articulation of a segment may be altered, as in lenition of /h/ to [t], and deletion – the IDENT constraints do not fit this profile. In contrast, a constraint like MAX[KP] does, showing that MAX constraints cannot be feature-specific.

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#### 6.5.1 Nasal conversion

Nasal conversion is found in languages like Dakota, where nasalization can produce apparently disharmonic inventories, but that such cases are never the result of PoA neutralization. This pattern is not motivated by a desire to eliminate coronal stops; instead, /k p/ are prevented from flapping by a constraint that prevents them from losing their Place of Articulation.

Section 6.5.1.1 examines cases of vowel+nasal coalescence. In some languages, only [m] appears in codas – [n] does not. This section shows that the marked-faithfulness constraints are crucial in producing this type of system: they prevent the /mn/ from coalescing with the preceding nasal to form a nasalized vowel, but they do not do the same for a coda /nd/.

Section 6.5.1.4 examines cases where allophony produces apparently disharmonic inventories. For example, in Gujarati /v/ is banned word-initially, so it changes into the voiced fricative [v]. However, since there are no other voiced fricatives, this creates a disharmonic inventory. This section shows how the present theory produces such cases.

#### 6.5.1.2 Lenition

Lenition, focusing on flapping. In some languages, only coronals undergo lenition (e.g. English). The remaining unlabeled stops can form a disharmonic inventory of [kp]. Again, it is argued that this pattern is not motivated by a desire to eliminate coronal stops; instead, /k p/ are prevented from flapping by a constraint that prevents them from losing their Place of Articulation.

Section 6.5.1.1 examines cases of vowel+nasal coalescence. In some languages, only [m] appears in codas – [n] does not. This section shows that the marked-faithfulness constraints are crucial in producing this type of system: they prevent the /mn/ from coalescing with the preceding nasal to form a nasalized vowel, but they do not do the same for a coda /nd/.

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#### 6.5.1.3 Nasalization

Nasalization can produce apparently disharmonic inventories, though in almost all cases they do so in a clearly transparent manner. A disharmonic inventory can come about through manner neutralization when segments less marked in terms of PoA undergo the neutralization while more marked ones do not. The case studies below show how this situation can come about. It will turn out that marked-faithfulness constraints will prove essential in accounting for the reported patterns.

Section 6.5.1.1 discusses a neutralization dubbed ‘nasal conversion’ here. This refers to a process that turns stops into nasals in codas. In Dakota, only /p/ and /t/ undergo this process, /s/ does not. The result is a disharmonic stop inventory consisting of [ks]{K} would favour deletion of /k/ in both /kp/ and /pk/. However, Lombardi (1995) observes that in fact conditions on voicing cannot force deletion, and Wilson (2000) argues that PoA-markedness constraints cannot determine which consonant deletes. Unfortunately, Lombardi (1995) and Wilson (2000) propose theories that cannot be discussed here without going far from the theme of this chapter (cf McCarthy 2002b). So, in the interests of thematic unity, I regrettably forego discussion of their proposals here.

### 6.5.2 Overview of Process+

Overview of Process+

### 6.5.3 Conclusion

Conclusion

Elimination is different from PoA neutralization, and (ii) that it is caused by a condition on sonority.

Section 6.5.3 summarizes the results of this section.

#### 6.5 Interaction with other scales and processes

PoA neutralization can interact with many other processes. These processes can influence the outcome of PoA neutralization, producing apparently disharmonic inventories. The aim of this section is to show that processes such as lenition and nasalization can produce apparently disharmonic inventories, but that such cases are never the result of PoA neutralization.

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Nasal conversion results in a disharmonic coda stop inventory consisting of just the velar [k]. However, it is clear that the disharmonic inventory is an incidental result of a non-PoA neutralization process. The reason that [k] does not nasalize is because the corresponding nasal [n] is banned in the language.\footnote{If the voiceless stops are not converted into nasals, they undergo voice assimilation to the following segment.}

Stop nasalization can be motivated by a ban on low sonority consonant segmants: i.e.\footnote{The only situation in which [n] can appear is before a dorsal stop. This comes about through assimilation of the coronal nasal only.} \(\Delta_{\mu}\leq\{+vd\}\) stop (cf Zec 1995). Assuming that codas are moraic in Dakota, \(\Delta_{\mu}\leq{+vd\}\) stop will ban all stops in codas. This constraint outranks all faithfulness constraints that preserve the stop’s nasality and voicing (i.e. IDENT\[nsal\], IDENT\[voice\]). The requirement that stops retain their value for [continuant] (i.e. IDENT\[\times\]cont\]) will ensure that stops turn into nasals rather than fricatives.

To prevent /k/ from nasalizing, a constraint against \[n\] must outrank \(\Delta_{\mu}\leq{+vd\}\) stop. The present theory provides such a constraint: \(+vd\)/nasal, a manner-specific version of \(+vd\)/stop. However, this is not enough: \(\Delta_{\mu}\leq{+vd\}\) stop could still be satisfied by both nasalizing /k/ and changing its PoA: e.g. /k/\(\rightarrow\)[n]. This indicates that a dorsal-preserving faithfulness constraint must outrank \(\Delta_{\mu}\leq{+vd\}\) stop as well (i.e. any PoA-faithfulness constraint). Since \[n\] is banned generally in the language, assuming that /k/ is eliminated through PoA neutralization, \(+vd\)/nasal must outrank IDENT\[K\].

The fact that /k/ doesn’t turn into [x] can be accounted for by ranking IDENT\[\times\]cont\] above \(\Delta_{\mu}\leq{+vd\}\) stop.

The formal expression of markedness – ch.6

### Dakota Stop Nasalization

(a) /p\rightarrow[m] in codas

| /RED-pot-a/ | [pot-pota] | [pom-pota] | ‘worn out, spoiled’ |
| /RED-top-a/ | [top-topa] | [top-topa] | ‘four’ |
| /nap-kaw/ | [n-pak-wa] | [nap-kaw] | ‘beckon with the hand’ |
| /kap/ | [xam] | cf [xap-a] | ‘to be stripped’ |

(b) /t\rightarrow[n] in codas

| /RED-\text{\textdagger}ot-a/ | [\textdaggerot-topa] | [\textdaggerot-pota] | ‘be many’ |
| /o-k\texthyp{\textdagger}at-\textdaggerjarp/ | [o-k\texthyp{\textdagger}at-jarp\textdaggeripa] | [o-k\texthyp{\textdagger}at-jarp\textdaggeripa] | ‘to be scorched in’ |
| /\texthyp{\textdaggerj}ot-ja/ | [\texthyp{\textdaggerj}ot-dja] | [\texthyp{\textdaggerj}ot-dja] | ‘to know’ |
| /\texthyp{\textdagger}ot/ | [\texthyp{\textdagger}on] | | ‘be smoky’ |

(c) /t\rightarrow[n] in codas

| /aki-RED-\texthyp{\textdagger}he\texthyp{\textdagger}tja/ | [aki-hen-he\texthyp{\textdagger}tja] | | ‘withered, nearly dead’ |
| /\texthyp{\textdagger}he\texthyp{\textdagger}ja/ | [\texthyp{\textdagger}en-ja] | | ‘dry’ |
| /\texthyp{\textdagger}i\texthyp{\textdagger}ja/ | [\texthyp{\textdagger}in-ja] | | ‘badly’ |
| /o-\texthyp{\textdagger}ja/ | [ojin-xa-\textdaggerka] | | ‘to act wickedly’ |
| /\texthyp{\textdagger}ot/ | [\texthyp{\textdagger}on] | | ‘be without, lack’ (cf [\texthyp{\textdagger}a-\texthyp{\textdagger}n\texthyp{\textdagger}a-\texthyp{\textdagger}j\texthyp{\textdagger}a]) |
| /\texthyp{\textdagger}ja/ | [\texthyp{\textdagger}a-\texthyp{\textdagger}z\texthyp{\textdagger}n] | | ‘elastic, flimsy’ (cf [\texthyp{\textdagger}a-\texthyp{\textdagger}z\texthyp{\textdagger}i-\textdaggerja]) |

(d) /\textdaggerk\rightarrow[\textdaggerg] in codas

| /\textdagger\textdaggerja/ | [\textdagger\textdaggerja-waqaq] | | ‘to see’ (cf [\textdagger\textdaggerja-waqaq\textdaggera]) |
| /\textdagger\textdaggerk\textdaggerja/ | [\textdagger\textdaggerk\textdaggerja-fog] | | ‘thick, solid’ (cf [\textdagger\textdaggerk\textdaggerja-fog\textdaggera]) |
| /\textdagger\textdaggerj\textdaggerja/ | [\textdagger\textdaggerj\textdaggerja-f\texthyp{\textdaggere}q\texthyp{\textdaggera}] | | ‘to stagger’ (cf [\textdagger\textdaggerj\textdaggerja-f\texthyp{\textdaggere}q\texthyp{\textdaggera}]) |
| /\textdagger\textdaggero\textdaggerk\textdaggerja/ | [\textdagger\textdaggero\textdaggerk\textdaggerja-b\texthyp{\textdaggere}g\texthyp{\textdaggera}] | | ‘to make dull noise’ (cf [\textdagger\textdaggero\textdaggerk\textdaggerja-b\texthyp{\textdaggere}g\texthyp{\textdaggera}]) |
| /\textdagger\textdaggerja-\textdaggerja/ | [\textdagger\textdaggerja-\textdaggerja-ojate-\textdaggerja] | | ‘the people’ (stylistic variation) |

Nasal conversion in Dakota

| /ok\texthyp{\textdagger}ja/ | \(+vd\)/nasal | IDENT\[K\] | \(+vd\) stop |
| /\textdaggerja/ | \(+vd\)/nasal | IDENT\[K\] | \(+vd\) stop |

(62) Nasal Conversion in Dakota

| /\textdaggerja/ | \(+vd\) stop | IDENT\[\times\]cont\] | IDENT\[\times\]voice |
| /\textdaggerja/ | \(+vd\) stop | IDENT\[\times\]cont\] | IDENT\[\times\]voice |

(63) Blocking velar nasal conversion

| /\textdaggerja/ | \(+vd\) stop | IDENT\[\times\]cont\] | IDENT\[\times\]voice |
| /\textdaggerja/ | \(+vd\) stop | IDENT\[\times\]cont\] | IDENT\[\times\]voice |

In summary, Dakota’s disharmonic coda stop inventory \[g\] is not due to PoA neutralization; it is the result of a ban on low sonority elements that is blocked for dorsals. Exactly the same pattern is found in Ecuador Quichua (Orr 1962). Of the stops /p b t d ts dz k g/ only /k g/ are found in codas (\{t\} can appear in medial codas). However, this correlates with the fact that Ecuador Quichua only has the nasals /m n n/.

Again, dorsal stops are blocked from nasalizing to [n], producing an apparently disharmonic inventory on the surface.

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### 6.5.1.2 Lenition and flapping

It is not uncommon for stop inventories in certain structural positions to be the disharmonic [k p] or [g b], lacking a coronal. In these cases, though, it is usually transparent that the coronal is not eliminated by PoA constraints, but by lenition: specifically, conversion to a flap [ɾ] (for an extensive survey, see Kirchner 1998:ch.4§1.2.1). The non-coronal segments are blocked from lenition, resulting in a disharmonic inventory.

For contrast, an example where all stops sprantize will be presented first. Tinugon Murut’s voiced stop inventory is [b d ɡ] (Prentice 1971). However, after vocoids, voiced stops, glottal stop, and clause-finally, these segments are lenited to [β r ɣ] respectively.

#### (65) Lenition in Murut (Prentice 1971:17)

<table>
<thead>
<tr>
<th>Murut form</th>
<th>PRA</th>
<th>Murut meaning</th>
<th>Lenition</th>
<th>IDENT[manner]</th>
</tr>
</thead>
<tbody>
<tr>
<td>/ɾaʔ/</td>
<td>‘inform’</td>
<td>[naʔ-ɾaʔ] ‘has informed’</td>
<td>IDENT[+nasal]</td>
<td>IDENT[manner]</td>
</tr>
<tr>
<td>/ɾuləʔ/</td>
<td>‘off’</td>
<td>[əɾaʔ-ɾuləʔ] ‘father off’</td>
<td>IDENT[+nasal]</td>
<td>IDENT[manner]</td>
</tr>
<tr>
<td>/ɾaləʔ/</td>
<td>‘will scrub’</td>
<td>[maɾəʔ-ɾaləʔ] ‘child off’</td>
<td>IDENT[+nasal]</td>
<td>IDENT[manner]</td>
</tr>
</tbody>
</table>

The constraint LENITE will be used to stand for the markedness constraints that motivate lenition. Lenition is taken to be essentially an increase in sonority here, brought about by assimilation to the manner (or [sonority]) features of neighbouring vowels. Following Kirchner’s proposals (1998), LENITE does not target specific places of articulation, but applies to all PoAs equally.

If LENITE outranks all faithfulness constraints that preserve manner of articulation (called IDENT[manner] for brevity here), stops will be converted into more sonorant counterparts. In Murut, LENITE forces all medial stops to turn into segments with as high a sonority as possible. There are two conditions on lenition: one is that the stops must retain their [-nasal] feature (IDENT[±nasal]), so preventing /ɾ/ from turning into [m]. The other is that stops must retain their input PoA (IDENT[KPT]); so /ɾ/ cannot turn into the coronal [ɾ].

#### (66) Murut lenition

<table>
<thead>
<tr>
<th>Murut form</th>
<th>IDENT[KPT]</th>
<th>IDENT[±nasal]</th>
<th>LENITE</th>
<th>IDENT[manner]</th>
</tr>
</thead>
<tbody>
<tr>
<td>/ɾəp/</td>
<td>IDENT[KPT]</td>
<td>IDENT[±nasal]</td>
<td>---</td>
<td>IDENT[manner]</td>
</tr>
<tr>
<td>(a) ɾəp</td>
<td>IDENT[KPT]</td>
<td>IDENT[±nasal]</td>
<td>#1</td>
<td>IDENT[manner]</td>
</tr>
<tr>
<td>(b) ɾəʔ</td>
<td>IDENT[KPT]</td>
<td>IDENT[±nasal]</td>
<td>#1</td>
<td>IDENT[manner]</td>
</tr>
<tr>
<td>(c) ɾəp</td>
<td>IDENT[KPT]</td>
<td>IDENT[±nasal]</td>
<td>#1</td>
<td>IDENT[manner]</td>
</tr>
<tr>
<td>(d) ɾəʔ</td>
<td>IDENT[KPT]</td>
<td>IDENT[±nasal]</td>
<td>#1</td>
<td>IDENT[manner]</td>
</tr>
</tbody>
</table>

The ranking that sets Abau apart from Murut relates to IDENT[KPT] for brevity here), stops will be converted into more sonorant counterparts. In Murut, LENITE forces all medial stops to turn into segments with as high a sonority as possible. There are two conditions on lenition: one is that the stops must retain their [-nasal] feature (IDENT[±nasal]), so preventing /ɾ/ from turning into [m]. The other is that stops must retain their input PoA (IDENT[KPT]); so /ɾ/ cannot turn into the coronal [ɾ].

#### (67) Abau lenition

For contrast, an example where all stops sprantize will be presented first.

<table>
<thead>
<tr>
<th>Murut form</th>
<th>Lenition constraints</th>
<th>IDENT[KPT]</th>
<th>IDENT[±nasal]</th>
<th>LENITE</th>
<th>IDENT[manner]</th>
</tr>
</thead>
<tbody>
<tr>
<td>/ɾəp/</td>
<td>IDENT[KPT]</td>
<td>IDENT[±nasal]</td>
<td>#1</td>
<td>IDENT[manner]</td>
<td></td>
</tr>
<tr>
<td>(a) ɾəp</td>
<td>IDENT[KPT]</td>
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<td>IDENT[±nasal]</td>
<td>#1</td>
<td>IDENT[manner]</td>
<td></td>
</tr>
</tbody>
</table>

As above, IDENT[KPT] prevents /ɾ/ from turning into the flap [ɾ]. In contrast, since /ɾ/ turns into [ɾ], *[{KP}/+CONT] will not block coronal lenition.

#### (68) Lenition constraints in Abau

<table>
<thead>
<tr>
<th>Murut form</th>
<th>Lenition constraints</th>
<th>IDENT[KPT]</th>
<th>IDENT[±nasal]</th>
<th>LENITE</th>
<th>IDENT[manner]</th>
</tr>
</thead>
<tbody>
<tr>
<td>/ɾəp/</td>
<td>IDENT[KPT]</td>
<td>IDENT[±nasal]</td>
<td>#1</td>
<td>IDENT[manner]</td>
<td></td>
</tr>
<tr>
<td>(a) ɾəp</td>
<td>IDENT[KPT]</td>
<td>IDENT[±nasal]</td>
<td>#1</td>
<td>IDENT[manner]</td>
<td></td>
</tr>
<tr>
<td>(b) ɾəʔ</td>
<td>IDENT[KPT]</td>
<td>IDENT[±nasal]</td>
<td>#1</td>
<td>IDENT[manner]</td>
<td></td>
</tr>
</tbody>
</table>

So, as with Dakota nasal conversion, the disharmonic [k p] inventory comes about because the output of lenition for non-coronals is banned. Again, PoA neutralization has nothing to do with the surface disharmonic inventory. However, PoA-faithfulness is crucial: because IDENT[KPT] outranks LENITE, non-coronals are not allowed to change their PoA, indirectly resulting in a disharmonic inventory.
Although voiceless stops have been the focus here, the same effects can be found for voiced stop inventories. There are several languages in which the only voiced stops are [b] and/or [g] — the coronal [d] is not present. However, in the majority of these languages it is transparently obvious that the lack of [d] is due to a general lenition process that converts voiced stops into resonants, usually the flap [r]. The reason it is obvious is due to the limited environments in which lenition applies — often only intervocally. For example, Sirionó, Oacama, and Warao have just [b], or [g], or both, but [d] and [r] are in free variation. Tigak and Roro have gone a step further: they both have [b] and [g], but [d] has lenited in every position to [r] (the same for Makurap, though this has a [g] and no [b]). In other words, the lack of [d] is not due to constraints against coronal place of articulation, but rather to a general process that does not target Place of Articulation.

In short, disharmonic stop inventories can occur, but only if some process affects coronals alone.

As a concluding note, the present theory's predictions are somewhat different for fricatives. Manner-changing lenition seems to apply to voiceless fricatives only rarely (Kirchner 1998). So, if there is no independent process that eliminates /s/ without eliminating other voiceless fricatives, no language can be without an [s] or [h]. The survey of languages reported in Appendix A did not yield any language that lacked both [s] and [h], having just [f, l].

6.5.1.3 Vowel+nasal coalescence

This section deals with a process that can produce disharmonic nasal inventories in codas. When only coronal nasals coalesce with a preceding vowel, the result can be a surface nasal inventory consisting of only non-coronals.

A relevant case is found in Chickasaw (Munro & Ulrich 1985, Trigo 1988:111). On the surface, the coda inventory is disharmonic, consisting solely of [m]. This is because underlying /Nn/ surfaces as a nasalized vowel: /cholhkan-an/ → [cholkãan] ‘spider-object’, cf [apa-ta-m] ‘eat-question-past’.

Such nasalization can be seen as arising from a general ban on codas (NOCODA). To motivate vowel-nasal coalescence, NOCODA must outrank UNIFORMITY — the anti-coalescence faithfulness constraint (for a full analysis of coalescence, see ch.8).

The reason that only /n/ coalesces can be related to the loss of consonantal place features. If /mn/ coalesces with a vowel, the /m’s labial PoA feature would be lost, fatally violating IDENT(KP). In contrast, /Nn/ coalescence would only require unfaithfulness to the coronal PoA.

Candidate (a) gratuitously violates NOCODA by retaining both nasals. In contrast, while candidate (c) satisfies NOCODA, it does so at the expense of losing the marked PoA feature ‘labial’. The coalescence of /an/ to [a] fatally violates IDENT(KP). In contrast, coalescing /am/ to [a] does not violate IDENT(KP) since the fusion only involves losing the unmarked coronal feature. As shown in the tableau, IDENT(KP) must be ranked below NOCODA for /n/-coalescence to take place at all.

In short, although Chickasaw has a disharmonic nasal coda inventory, it does not come about through PoA neutralization.

Vowel-nasal coalescence is fairly common, and usually has the same result as Chickasaw. However, some cases do not show overt alternations. For example, in Chaoyang coda coronals are banned, resulting in a nasal inventory of [m] (Yip 1994). Since nasal vowels are in complementary distribution with [Vm] and [Vŋ] sequences (i.e. *[Vm], *[Vŋ]), it is likely that nasal vowels derive from underlying /Nn/ sequences. Again, it is arguable that /n/ coalesces with a preceding vowel while other nasals do not (cf Yip 1994:3.1).

• Other nasal-eliminating processes

Two other processes can produce apparently disharmonic nasal inventories. One is where nasals are apparently neutralized to [ŋ], §6.6.1 argues that this is actually neutralization to [N] — a harmonically complete inventory. The other is conversion of nasals to laterals. For example, Lawton (1993:21) reports that [n] is in free variation with [l] in Kiririwina codas. This results in a coda nasal inventory that consists of [m] alone. As with lenition, this can be seen as a general process of nasal→liquid conversion, with /nl→l/ blocked by the PoA-faithfulness constraints since there is no labial liquid in the language.

6.5.1.4 Sonorant allophones

In the cases discussed so far, disharmonic inventories have come about when a highly marked segment has been blocked from undergoing an otherwise general...
neutralization of manner. An analogous situation is found with certain cases of allophony. For example, [v] is the only voiced fricative to appear on the surface in Gujarati. However, it is in complementary distribution with the glide [w], and the two are demonstrably related in alternations. This section will show how allophonic processes can produce apparently disharmonic inventories.

A number of languages have the voiced fricative [v] but not the coronal [z] (e.g. Abau). In all such cases, there is evidence that (i) voiced fricatives are banned in general and (ii) [v] is related to an approximant [w] or []. This section will focus on the Gujarati situation.

### Description
Gujarati’s consonant inventory is provided in Table 6.10 (Cardona 1965).

<table>
<thead>
<tr>
<th></th>
<th>labial</th>
<th>dental</th>
<th>alveolar</th>
<th>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>l</td>
<td>t</td>
<td>1</td>
<td>t</td>
<td>1</td>
</tr>
<tr>
<td>+vd stops</td>
<td>b</td>
<td>d</td>
<td>d3</td>
<td>d</td>
<td>q</td>
<td>q</td>
<td></td>
</tr>
<tr>
<td>fricatives</td>
<td>s (z)</td>
<td>(h)</td>
<td>n</td>
<td>(g)</td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>nasals</td>
<td>m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>laterals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>flap</td>
<td>w-v</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>glides</td>
<td>w-v</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Generally speaking, voiced fricatives are banned. [z] only appears in loanwords and [H] is banned. However, [v] does appear in certain environments: in monosegmental onsets (e.g. [vat] ‘manner’), and as the first member of bisegmental onsets (e.g. [vjas] ‘proper name’). Thus, in certain environments, there is a disharmonic voiced fricative inventory consisting of [v] alone.

The proposal advanced here is that this fact can be explained in much the same way as the cases discussed in previous sections. All voiced fricatives undergo a general neutralization process. However, neutralization of /v/ is blocked in specific environments (just as /k/→[g] is blocked in Dakota, or /b/→[p] is blocked in Abau). The result is an apparently disharmonic voiced fricative inventory.

To provide a full account of this proposal, it is necessary to point out that [w] and [v] are in complementary distribution, as described in (71).

### Gujarati [v]→[w] distribution

(a) [v] appears in
   (i) monosegmental onsets
     [vat] ‘manner’
     [swar] ‘morning’
   (ii) as the first member of complex onsets
     [vjas] ‘proper name’
     [vrit] ‘a vow’

(b) [w] appears in
   (i) codas
     [b`aw] ‘price’
     [kew.\*] ‘how big?’
   (ii) the second member of onsets
     [dwara] ‘by means of’
     [swikar] ‘acceptance’

### Eliminating /v/
Since [v] and [w] are in complementary distribution, it is likely they are allophones. Therefore, /v/ and /w/ must neutralize to [v] in the environments in (71a), and to [w] in the environments in (71b).

The fact that /v/ neutralizes to [w] gives a clue as to the fate of other voiced fricatives – it is reasonable to assume that they turn into sonorants.

138  Thus, a constraint that bans voiced fricatives (*VDFRIC for short) must outrank both IDENT[±vocoid] and IDENT[±sonorant]. On all other features, [v] and [w] agree.

### Blocking /v/→[w]
However, [v] surfaces faithfully when it appears as the first member of an onset: e.g. [v]art, [v]rit. This can be ascribed to avoidance of high-sonority onsets – i.e. glides. Such bans are found elsewhere, as discussed in §6.5.2.2. The prohibition is implemented by the constraint *-Δμ≥{glide}, which bans all segments that are equally or more sonorous than glides in onset position. With *-Δμ≥{glide} outranking *VDFRIC, /v/→[w] is blocked in onset position.

138  More precisely, /v/→[w], /z/→[], and /μ/→[w]. For discussion of the PoA of [w] and its participation in allophony, see Ohala & Lorentz (1977) and Appendix A.
The formal expression of markedness – ch.6

\[
\begin{array}{ccc}
\text{/wat/} & \text{*-\Delta}_{\text{fric}} & \text{*-vDfric} \\
(\text{a}) \text{ yat} & - & - \\
(\text{b}) \text{ wat} & +1 & - \\
\end{array}
\]

\[\text{/v/} \text{ cannot neutralize with any other segment because the faithfulness constraints on contiuancy, nasality, and voicing mentioned above block all other segments.} \]

However, \[\text{/v/} \text{ does surface as } [w] \text{ when it is the second member of an onset: e.g. [dvara], [d[\text{v}ara]]. This indicates that yet another constraint bans } [v] \text{ in just this position. A restriction on sonority-distance will achieve the right result: [d] and [v] are too close in sonority. More generally, only clusters where the second member is a sonorant are allowed in Gujarati. Thus, the constraint } \text{SONDIST must outrank } \text{*-\Delta}_{\text{fric}} \text{ (glide)} \text{ (for theories on the form of } \text{SONDIST see Baertsch 1998, Gouskova 2002 and references cited therein).} \]

\[
\begin{array}{ccc}
\text{/dvara/} & \text{SONDIST} & \text{*-\Delta}_{\text{fric}} \text{ (glide)} \\
(\text{a}) \text{ dvara} & - & +1 \\
(\text{b}) \text{ dvara} & + & - \\
\end{array}
\]

The same type of alternation does not happen for other voiced fricatives like /z/. Neutralization of /z/ does not encounter the same problems as [v] (i.e. *-\Delta_{fric} \text{ (glide)}) because /z/ can absolutely neutralize to the non-glide [r] (analogous to Latin). Since [r] is allowed in all positions, /z/ \text{->[r]} neutralization will never be blocked. Thus, for incidental reasons, the voiced fricatives only /v/ will ever be realized faithfully.

\[\text{• } /w/-/v/ \]

What makes Gujarati interesting is that there is a complementary process of /w/-/v/ neutralization. Thus, /w/ neutralizes to [v] in onset-initial position: *[wat], *[wras]. The same constraints that were identified above can be used here. With *-\Delta_{fric} \text{ (glide)} \text{ and } \text{SONDIST outranking all /w/-preserving constraints, /w/ will neutralize to [v] in onset-initial position.} \]

\[
\begin{array}{ccc}
\text{/wat/} & \text{*-\Delta}_{\text{fric}} \text{ (glide)} & \text{IDENT[+sonorant]} \text{ IDENT[+voice]} \\
(\text{a}) \text{ yat} & - & - \\
(\text{b}) \text{ wat} & +1 & - \\
\end{array}
\]

\[\text{/v/} \text{ neutralizes to [v] rather than some other segment because [v] is the most faithful available segment: it preserves all of /w/’s features (i.e. PoA, voice, continuinity) except for [+sonorant] and [+voice].} \]

\[\text{In summary, the Gujarati disharmonic voiced fricative inventory, consisting of just [v], comes about because (i) /w/-/v/ is blocked in certain environments, and (ii) /w/-/v/ is required in certain environments.} \]

\[\text{• Generalizing the result} \]

Allophony and blocking of neutralization produces disharmonic inventories in a number of languages.

\[\text{A number of languages take the Gujarati pattern further, neutralizing /w/ to [v] in all environments (e.g. Pāli \text{ – Geiger 1943, Fals 1985; most Polynesian languages \text{ – Clark 1976:20; Russian \text{ – Lightner 1965. In all these cases, there is no surface [w], and } [v] \text{ (by virtue of its derivation) acts like a surrogate glide. For example, } [v] \text{ behaves just like its close relative Maori’s [w] for several processes, including dissimilation (de Lacy 1997b). Pāli [v] acts like a glide in coalescence, a case described in detail in ch.8§8.5).} \]

\[\text{In a related example, the only voiced fricative in Huarapano is } [\text{f}] \text{ (Parker 1999a). Parker notes that its realization “fluctuates between a stop, a fricative, and a glide articulation”, Again, there is a correlation between the voiced fricative and glide.} \]

\[\text{An analogous situation can be ascribed to the relation between voiced stops and nasals in some languages.} \]

\[\text{This is arguably the case for Koasati [b] (Kimball 1991). The consonant inventory is as follows:} \]

\[\text{Table 6.11: Koasati consonant inventory} \]

\[\text{Paul de Lacy} \]

\[\text{The formal expression of markedness – ch.6} \]

\[\text{257} \]

\[\text{258} \]

\[\text{a less sonorous element: all other options are too unfaithful. Specifically, there is no segment that shares /j/’s PoA, continuancy, and voicing (as /w/-/v/ does): [z] is not palatal, [r] is not voiced, and [d] is not a continuant (after Clements 1999). Formally, this can be modeled by having IDENT[+voice], IDENT[+continuant], and IDENT[KPT] outrank } \]

\[\text{*-\Delta}_{\text{fric}} \text{ (glide).} \]

\[\text{In summary, the Gujarati disharmonic voiced fricative inventory, consisting of just [v], comes about because (i) /w/-/v/ is blocked in certain environments, and (ii) /w/-/v/ is required in certain environments.} \]

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\[\text{Paul de Lacy} \]

\[\text{The formal expression of markedness – ch.6} \]

\[\text{257} \]

\[\text{258} \]
to follow them. So, it is possible that the segment realized as [b] is derived from an underlying sonorant, or is even phonologically specified as a sonorant. The same situation (i.e. [b] but no [d]) occurs in other Muskogean languages (Alabama, Muskogee, Koasati, Chickasaw, and Choctaw).

Another relevant case is Mura-Pirahã, which is reported as having the consonants: [ptk ʔ b ɡ s h] (Heinrichs 1964). Notably, there is no [d]. However, Dixon & Aikhenvald (1999b:354) point out that /h/ has allophones [m] and a bilabial trill. /ɡ/ has a rather curious double-flap allophone (tʃ ʃ) (Everett 1982). Again, voiced stops are banned generally, but appear as allophones of sonorants.

In short, disharmonic inventories can come about through allophony as well as blocking of neutralization. The same pattern holds here as in the previous cases of manner neutralization: disharmonic inventories come about when – for incidental reasons – a neutralization that applies to all segments with a certain manner of articulation is blocked in a specific environment for only one of those segments.

### 6.5.2 Glottal Elimination

As mentioned in sections 6.2 and 6.3, languages may lack glottals. This section argues that the lack of glottals in those languages is not due to PoA neutralization. Instead, some other process is responsible for the elimination of glottals, just as flapping is responsible for the elimination of [t] in many languages, and nasal coalescence is responsible for the lack of [c].

There are two relatively independent parts to this section. The first (§6.5.2.1) argues that Glottal Elimination cannot be PoA neutralization. The arguments stem from facts relating to direction of neutralization and from asymmetric behavior in neutralization of non-glottal PoAs.

The second part (§6.5.2.2) proposes that Glottal Elimination derives from a ban on high sonority onsets. Glottals are argued to be highly sonorous elements. From this, Glottal Elimination is argued to be the elimination of highly sonorous segments in syllable margins, analogous to the elimination of glides in Gujarati.

#### 6.5.2.1 Glottal Elimination is not place neutralization

In the present theory, the lack of glottals in some languages cannot be ascribed to the action of the PoA constraints. As shown in §6.4, since ‘glottal’ is the least marked PoA, it cannot be eliminated by the PoA constraints alone.

- **The subset relation**

  There are empirical reasons to think that Glottal Elimination is not the same as PoA neutralization processes. A striking reason relates to the ‘subset’ relation between onsets and codas.

  141 Everett (1982) reports that /h/ → [k]. For women, /s/→[h] is sometimes everywhere. So, the woman’s register of Pirahã has only the phonemes /p t k ʔ b ɡ h/.

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• Theoretical Implications

Beckman (1998) provides an explanation for the asymmetric nature of non-glottal PoA neutralization. Beckman shows that context-free markedness constraints coupled with onset-specific faithfulness constraints cannot produce a system with more contrasts in codas than in onsets. Tableau (76) shows why this is so. The markedness constraint *{K} bans dorsals, IDENT({K}) preserves dorsals, and onset-IDENT({K}) preserves dorsals in onset position. #<## points to possible winners: i.e. winners under some ranking.

(76) The subset generalization in velar neutralization

<table>
<thead>
<tr>
<th>/kak/</th>
<th>onset-IDENT{K}</th>
<th>IDENT{K}</th>
<th>*{K}</th>
</tr>
</thead>
<tbody>
<tr>
<td>#&lt;## (a) kak</td>
<td>#&lt;##</td>
<td>#&lt;##</td>
<td>*&lt;##</td>
</tr>
<tr>
<td>#&lt;## (b) ka?</td>
<td>*&lt;##</td>
<td>#&lt;##</td>
<td>#&lt;##</td>
</tr>
<tr>
<td>(c) ?ak</td>
<td>*&lt;##</td>
<td>*&lt;##</td>
<td>*&lt;##</td>
</tr>
<tr>
<td>#&lt;## (d) ?a?</td>
<td>*&lt;##</td>
<td>#&lt;##</td>
<td>#&lt;##</td>
</tr>
</tbody>
</table>

The tableau shows that the form [?ak] cannot win under any ranking – this form neutralizes [k] in onsets but not in codas. It cannot win because it is collectively harmonically bounded (Samek-Lodovici & Prince 1999). If *{K} dominates, (c) will lose to (d); if IDENT{K} dominates, (c) will lose to (a); if onset-IDENT{K} dominates, (c) will lose to (b) or (a).

It is crucial, then, that no markedness constraint bans [K] in onsets alone: a constraint like *ONS/{K} would favour (c) over (a) and (b), and IDENT{K} would favour (c) over (d).

It is also crucial that there be no coda-specific faithfulness constraint: coda-IDENT{K} would favour (c) over (b) and (d), and *{K} would favour (c) over (a).

However, Glottal Elimination is not asymmetric. Therefore, one of the two options just identified must hold for glottals. Either there is a coda-specific faithfulness constraint that preserves glottals in codas: coda-IDENT{glottal}, or there is an onset-specific markedness constraint that bans glottals: *ONS/{glottal}.

Parker (2001) makes a proposal along the lines of the onset-markedness approach, so this approach will be examined here. The coda-faithfulness approach will not be considered here as it has not been proposed to this date.

From the point of view of the present theory, a constraint like *ONS/glottal presents a problem: it combines a subsegmental feature with a prosodic position. While this is a theory-internal concern, it does give pause: *ONS/glottal would be an anomaly as the only markedness constraint that referred to a prosodic position and a subsegmental feature.

In contrast, the present theory does allow for the combination of prosodic scales and prosodic positions. This leads to the notion that glottals are banned in onsets not because of their PoA, but because of some prosodic-scale related property. This proposal is developed in the next section.

6.5.2.2 Glottals and sonority

The previous section showed that a constraint banning glottals in onsets is necessary. The idea explored in this section is that such a constraint refers to the sonority hierarchy, not the PoA scale. More concretely, glottals are argued to be highly sonorous, so the constraints that motivate Glottal Elimination are those that ban highly sonorous elements in margins: *{k} ≥ {glottal} and *{k} ≥ {glottal}.

There are two parts to the argument in this section. The first part aims to show that highly sonorous elements are avoided in margins (Clements 1990, Prince & Smolensky 1993, Gnanadesikan 1995). The second part argues that glottals are more sonorous than their non-glottal counterparts.

• High sonority syllable onsets are undesirable

The Polynesian language Niuafo’ou bans high sonority onsets – glides – in stressed syllables (Tsukamoto 1988, de Lacy 2000b). So, while the high vowels /i u/ turn into glides pre-vocally, they will not do so if they end up in a stressed syllable.

(77) Niuafo’ou Glide Restriction (Tsukamoto 1988)

(a) Glide onsets in unstressed syllables

/ju.ni.ti/ ‘unit’ *{juuniti} 
[wa.e.a] ‘wire’ *{uaea} 
[we.li.ni.ta.pi] ‘Wellington’ *{uei.i.pi.na toile}

(b) No glide-formation before stressed syllables

/i.á.te/ ‘yard’ *{iá.te} 
[u.í.pi] ‘wharf’ *{u.í.pi} 
[ka.á.ta] ‘quarter’ *{ka.á.ta}

In de Lacy (2000b), I argue that a constraint against highly sonorous onsets blocked glide formation in Niuafo’ou. Glide formation comes about when ONSET outranks constraints that preserve underlyingly moraic vowels (IDENT-μ).

(78) Glide formation in Niuafo’ou

<table>
<thead>
<tr>
<th>/juniti/</th>
<th>ONSET</th>
<th>IDENT-μ</th>
</tr>
</thead>
<tbody>
<tr>
<td>#&lt;## (a) jú.i.ni.ti</td>
<td>#&lt;##</td>
<td>*&lt;##</td>
</tr>
<tr>
<td>#&lt;## (b) jú.í.pi</td>
<td>*&lt;&gt;##</td>
<td>#&lt;##</td>
</tr>
</tbody>
</table>

Note that *{vowel}[glottal] would be the only markedness constraint to combine glottals and prosodic conditions in the present theory. Faithfulness constraints – as generated by Positional Faithfulness theory – can refer to such positions. See ch.2§2.4.2.
The markedness constraint that bans glides in stressed syllable margins is \(^*\)-Δσ[glide]. With this outranking \textsc{onset}, glide formation will be blocked when it would place a glide in a stressed syllable:

(79) Blocking glide formation in stressed syllables

<table>
<thead>
<tr>
<th>/iætæ/</th>
<th>(^*)-Δσ[glide]</th>
<th>\textsc{onset}</th>
<th>\textsc{ident}-\textsc{μ}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) i.à.te</td>
<td>#</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) jù.te</td>
<td>#</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

The ranking \(\| ^*\)-Δσ[glide] \textsc{ident}-\textsc{μ} \| also allows inputs such as /iætæ/ to surface as [site] – this form satisfies \(^*\)-Δσ[glide], while the faithful [site] does not (see de Lacy 2000b for details).

An analogous case is found in the Australian language Alyawarra. In Alyawarra, main stress falls on the leftmost syllable with an onset, unless that onset is a glide (Yallop 1977:43).

(80) Alyawarra Stress

(a) i.í.pá | axe, \#i.í.pá |
(b) rín.ha | (3rd person pronoun) |
(c) jú.kún.rà | ashes, \#jú.kún.rà |
(d) wáljímpárəra | pelican, \#wáljímpárəra |

The constraint \textsc{align}-\textsc{φ}-\textsc{l} expresses the tendency for stress to appear at the left edge when the avoidance of onsetless syllables is prompted by the constraint \textsc{onset}, requiring that stressed syllables have onsets.

(81)

<table>
<thead>
<tr>
<th>/iipes/</th>
<th>\textsc{onset}</th>
<th>\textsc{align}-\textsc{φ}-\textsc{l}</th>
</tr>
</thead>
<tbody>
<tr>
<td>i.í.pá</td>
<td>#</td>
<td>*</td>
</tr>
<tr>
<td>rín.ha</td>
<td>#</td>
<td>*</td>
</tr>
</tbody>
</table>

(82)

<table>
<thead>
<tr>
<th>/rín.ha/</th>
<th>\textsc{onset}</th>
<th>\textsc{align}-\textsc{φ}-\textsc{l}</th>
</tr>
</thead>
<tbody>
<tr>
<td>rín.ha</td>
<td>#</td>
<td>!</td>
</tr>
</tbody>
</table>

145 Yallop (1997:43) proposes that word-initial glides form diphthongs with the following vowel, so they really form onsetless syllables. There is no independent evidence for this, though. One reason to think that glides are really onsets is the fact that they can appear in front of diphthongs, e.g. [ϊ.κwɔj.ka] am\textsc{tulare} eating (p.42). The nucleus in this word would have to be [wïj] – a triphthong, which is typologically marked, to say the least.

In short, neutralization, glide-formation, and stress assignment shows that high sonority margins are undesirable.

Niuafou and Alyawarra are not the only languages to avoid glide onsets in stressed syllables: Mahalay Atayal prevents glide-formation in stressed syllables too (Lambert 1999§3.3.2.3).

- Glottals and sonority

The aim of this part is to show that glottals are more sonorous than their non-glottal counterparts: i.e. [ʔ] is more sonorous than [p t k] and [h] is more sonorous than [f s x]. A good deal of previous work supports this proposal (Pike 1954, Chomsky & Halle 1968:301, Pinker & Birdsong 1979, Levin 1985, Trigo 1988:46, Parker 1989, 2002, Charma & Shi 1995, Gnanadesikan 1995, 1997). The sonority status of glottals is far from uncontroversial, though. Clements (1990:322) suggests that glottals “behave arbitrarily in terms of the way they class with other sounds”, effectively having no sonority value (also van der Hulst 1984, Boersma 1998). A number of authors have argued the opposite: that glottals have the same sonority as obstruents (Heffner 1950, Lass 1976, Dogil 1989, 1992, Zec 1988). The following paragraphs identify phonological evidence that glottals class with highly sonorous elements like glides and liquids.

Walker (2000, to appear) shows that the ability of segments to undergo nasal harmony follows the sonority scale, with more sonorous elements more susceptible to nasalization. Notably, the glottals are at the top of this list, classed with glides.


Another example relates to transparency in vowel copy. Vowel features can spread through intervening consonants. Gaños & Lombardi (1999) show that such spreading follows the sonority hierarchy, with glides more willing to allow spread than liquids, liquids more susceptible than nasals, and so on. Notably, glottals stand at the top of this hierarchy. For example, height and roundness features can spread leftward in Harar Oromo (Owens 1985), but only through glides, [h], and [ʔ], as shown in (84).

146 I am indebted to Steve Parker for a discussion of this issue. Parker (2002) provides an extensive survey of literature on sonority, on which the following discussion is based.

147 See esp. Walker (1998:sec.2.2.3). Walker’s arguments for the nasalization of glottals are based on her phonological analysis. See Walker (1998:56) for discussion of the relative nasalizability of glides and glottals.
6.5.2.3 Glottals are not placeless

To complete this discussion of glottals, this section discusses an alternative to the proposal above – that glottals lack place features entirely. A number of authors have argued for this idea (Clements 1985, Sagey 1986, Steriade 1987, Avery & Rice 1989, 1994, Rice 1995). Of course, this is not a theory of Glottal Elimination in itself – many authors have proposed a constraint that requires segments to have some PoA feature, thereby favouring K, P, and T over other segments (Padgett 1994, 1995, Causley 1999:100, Parker to appear, Broselow 2001).

However, McCarthy (1994) shows that the ‘Placeless Glottal’ proposal encounters a number of problems. He observes that if glottals are placeless, OCP restrictions on PoA should be unable to eliminate them. This is not so: gutturals and glottals act as a class in...
Arabic: no two elements from the set \( \{ \chi, h, y, h \} \) can appear in the same root (see also Hayward & Hayward 1989).

If glottals are placeless, they should also be unable to trigger assimilation. McCarthy (1994:207ff) shows that this is not the case for vowel-consonant assimilation involving glottals. He argues that vowels can assimilate to the PoA feature of glottals (and pharyngeals and uvulars), resulting in lowering. For example, the feminine /t/-e/ in Syrian Arabic lowers to /a/ after glottals, pharyngeals, and uvulars:

(86) Syrian Arabic Lowering (McCarthy 1994)

\[
\begin{align*}
\text{[dara\ñ-e]} & \quad \text{‘step’} \\
\text{[waçy-ha]} & \quad \text{‘display’} \\
\text{[mmiç-ha]} & \quad \text{‘good’} \\
\text{[daçaç-ñ-a]} & \quad \text{‘tanning’}
\end{align*}
\]

Rosé (1996) provides further examples.

Glottals can also trigger Place assimilation. For example, glottals require a preceding consonant to assimilate to their PoA in Yamphu (see ch.7§7.6.2.4): e.g. /mo-dok-ha/ → /modo[ha] ‘like those’, /la[=th-ema] → /la[ç-ema] ‘to be able to do’ (Rutgers 1998:48).

As Smolensky (1993) has shown, effects akin to placelessness can be derived by ranking constraints against the ‘placeless’ feature below all others; this dissertation and Prince (1997 et seq.) have shown that the same result follows from stringent constraints. These approaches have the advantages of the placeless proposal without the shortcomings, as shown in this chapter and for assimilation in ch.7§7.3.

- **Other placeless segments**

   It is worth pointing out that the placelessness proposal has been applied to other segments, raising the same problems. A number of authors have argued that coronals are placeless, given the fact that they are often the product of neutralization and can undergo processes while other segments do not (Paradis & Prunet 1991 and references cited therein). However, McCarthy & Taub (1992) and Steriade (1995b) have identified several areas where the ‘placeless coronal’ proposal encounters problems (see also ch.7§3.3). If coronals are placeless, then [coronal] should not trigger or block processes. However, coronals both trigger and block assimilation. A full account is presented in chapter 7.

   Schwa has also been argued to lack place features. Oostendorp (1995) proposes that the placelessness of schwa prevents it from bearing stress in Dutch. In other words, stressed syllables require their dependents to have place features – analogous to constraints that require dependents of onsets to have place features in order to ban glottals. The problem with this approach is that it fails to explain why other vowels can repel stress. For example, high vowels [i y u] in Nganasan avoid stress with the same alacrity as [a] and [ø], but these vowels cannot all be placeless (ch.3§3.2).

---

### Summary

In summary, the proposal that glottals are placeless encounters the same problems as previous claims that coronals and schwa are placeless. Placelessness results in inertness and predicts unique behaviour. However, glottals – like schwa and coronals – are not phonologically impotent: they can undergo and trigger processes just like non-glottals. Glottals are also not unique. While they may fail to undergo a certain processes in some language, other non-glottal PoAs can fail to undergo that same process in other languages.

### 6.5 Summary

In conclusion, disharmonic inventories can arise through processes that are not related to PoA. Section 6.5.1 identified several neutralizations involving a change in manner of articulation. For example, lenition can target coronals alone, resulting in a disharmonic inventory consisting of just dorsals, just labials, or both. The same was shown to happen for coalescence of vowels and nasals, and for a variety of other processes.

Finally, Glottal Elimination was argued to not be a PoA-related process. It is unlike other PoA neutralizations in that glottals can be eliminated in onsets but not in codas. Evidence that glottals are highly sonorous led to the proposal that Glottal Elimination is triggered by a ban on high sonority margins.

The important point of this section is that disharmonic inventories are not produced by PoA neutralization. Accordingly, there is no need for any constraints apart from the markedness and faithfulness ones proposed herein.

### 6.6 Neutralization targets

Trubetzkoy (1939) claimed that segments could only neutralize to the least marked element available. Thus, the output target of neutralization is always the unmarked scale element: e.g. /t/ → [ ][]. However, McCarthy & Taub (1992) and Steriade (1995b) have identified several areas where the ‘placeless coronal’ proposal encounters problems (see also ch.7§3.3). If coronals are placeless, then [coronal] should not trigger or block processes. However, coronals both trigger and block assimilation. A full account is presented in chapter 7.

Schwa has also been argued to lack place features. Oostendorp (1995) proposes that the placelessness of schwa prevents it from bearing stress in Dutch. In other words, stressed syllables require their dependents to have place features – analogous to constraints that require dependents of onsets to have place features in order to ban glottals. The problem with this approach is that it fails to explain why other vowels can repel stress. For example, high vowels [i y u] in Nganasan avoid stress with the same alacrity as [a] and [ø], but these vowels cannot all be placeless (ch.3§3.2).

### (87) Input neutralizes to

\[
\begin{align*}
/K/ & \quad \rightarrow \quad [T] \text{ or } [T] \\
/θ/ & \quad \rightarrow \quad [T] \\
/ð/ & \quad \rightarrow \quad [T] \\
/θ/ & \quad \rightarrow \quad [T]
\end{align*}
\]

---

168 This almost excludes the possibility of PoA-related chain shifts (i.e. /θ/→[θ], /θ/→[θ]), except perhaps for /θk/→[θ], /θk/→[θ]. I have found no cases of PoA chain-shifts reported in the literature.
6.6.1 The output of neutralization

It is common for glottals to be the output of neutralization (i.e. debuccalization), as discussed in §6.6.2 and §6.6.3. This section argues that this generalization follows from two facts: (i) the PoA-markedness constraints favour [ʔ] over all other PoAs, and (ii) marked-faithfulness constraints do not distinguish between different types of unfaithfulness.

6.6.1.1 The form of markedness constraints

The focus of discussion here will again be /k/-neutralization in Malay (§6.2). In that section, it was shown that the output of /k/-neutralization was [ʔ]; e.g. /baik/ → [balʔ].

In terms of the PoA constraints, the output of /k/-neutralization cannot be anything but [ʔ]. Part of the reason for this is that the PoA constraints favour glottals over all other PoAs, as shown in the tableau for /baik/-neutralization (89). As shown in §6.2, the ranking || *{K} » IDENT[KPT] || ensures that /k/ and no other PoA neutralizes. Tableau (89) shows that the remaining markedness constraints determine that the output of neutralization will be [ʔ], regardless of their ranking.

As an example, /k/ can neutralize to [ʔ] since it is the least marked PoA. /k/ can also neutralize to [t] if [ʔ] is ruled out by Glottal Elimination. However, /k/ can never neutralize to [p] because every inventory contains a less marked element – either [t] or [ʔ].

Section 6.6.1 identifies the factors responsible for the neutralizations listed above. One relates to the form of the markedness constraints: since ‘glottal’ is a local harmonic bound for all other PoAs, glottals will always be favoured as outputs over other segments. Another reason relates to the form of the faithfulness constraints: the constraints assign the same violations to all unfaithful elements. Together, these two factors result in the least marked PoA emerging as the target of neutralization: the form of the faithfulness constraints ensures that markedness constraints will determine the output’s form, and glottals harmonically bound all other PoAs, so the output of neutralization will typically be glottals.

Section 6.6.2 discusses the effect of Glottal Elimination on the output of neutralization. This section shows that Glottal Elimination can force neutralization to a coronal, even when a glottal is present in the language.

Section 6.6.3 discusses the relation of gapped inventories to possible outputs of neutralization. This section shows that only glottals can be the target of neutralization in a gapped inventory [k p ʔ]. More generally, it shows that dorsals and labials can never be the output of neutralization. An alternative proposal is also discussed – that velars are less marked than coronals in some grammars (Trigo 1988, Rice 2000a,b).

Section 6.6.4 discusses cases where glottals are neutralized, through Glottal Elimination.

Section 6.6.5 presents a summary.

<table>
<thead>
<tr>
<th>Tableau (89)</th>
<th>/baik/</th>
<th>*{K}</th>
<th>IDENT[K]</th>
<th>*{KP}</th>
<th>*{KPT}</th>
<th>*{KPTʔ}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) baik</td>
<td>¥!</td>
<td>¥!</td>
<td>¥!</td>
<td>¥!</td>
<td>¥!</td>
<td></td>
</tr>
<tr>
<td>(b) baip</td>
<td>¥!</td>
<td>¥!</td>
<td>¥!</td>
<td>¥!</td>
<td>¥!</td>
<td></td>
</tr>
<tr>
<td>(c) bait</td>
<td>¥!</td>
<td>¥!</td>
<td>¥!</td>
<td>¥!</td>
<td>¥!</td>
<td></td>
</tr>
<tr>
<td>(d) baɾʔ</td>
<td>¥!</td>
<td>¥!</td>
<td>¥!</td>
<td>¥!</td>
<td>¥!</td>
<td></td>
</tr>
</tbody>
</table>

The tableau shows that the ranking of the PoA-markedness constraints is irrelevant because [ʔ] is a local harmonic bound for both [t] and [p]. As discussed in ch.5, an alternative theory with a fixed ranking of constraints || *K » *P » *T || would achieve the same results.

So, the target of neutralization depends on the form of markedness constraints. Since /k/ neutralizes to [ʔ] and not [t] or [p] in Malay, there must be some constraint or constraints that favours [ʔ] over both [t] and [p] (*{KPT} here).

Similarly, since /k/ never neutralizes to [p] in any language, there cannot be any constraint that favours [p] over both [t] and [ʔ] (i.e. *{T2} or *{T}). The same is true for neutralization to [k]: since [k] is never the target of neutralization, constraints that favour [k] over both [t] and [ʔ] cannot exist in CON.
forms. In other words, IDENT{K} assigns the same violation to [p], [t], and [ʔ]. This fact allows markedness constraints to be solely responsible for the outcome of neutralization.

To clarify this point, suppose that faithfulness constraints assigned different violations based on the degree of difference along the scale; such faithfulness constraints will be called IDENT, to distinguish them from the standard IDENT constraints. For example, [k] and [p] are only one step away on the PoA scale, so IDENT{K} would assign one violation to the mapping /k/→/p/. Since [1] is two steps away from [k], /k/→[1] would incur two violations of IDENT{K}, and /k/→[ʔ] would incur three violations. Faithfulness constraints that are somewhat similar to this type are proposed by Gnanadesikan (1995).

With this type of faithfulness constraint, neutralization could produce the next least marked element on a scale (as shown by Gnanadesikan 1995). Tableau (90) illustrates this situation.

The tableau shows that this type of faithfulness constraint, ranked above all markedness constraints, can prevent markedness from having any say in the output of neutralization. Since /k/→[p] neutralization is not attested, this type of faithfulness constraint cannot exist.153

Not only does the lack of /k/→[p] ban the type of scalar-faithfulness just mentioned, it means that CON cannot contain any faithfulness constraint that favours /k/→[p] over /k/→[1] and /k/→[ʔ]. For example, suppose there were a faithfulness constraint IDENT{K}−coronal. This would not assign a violation to /k/→[p], but would assign one to /k/→[1]. In a language with Glottal Elimination, /k/ could therefore neutralize to [p]. Therefore, there is no constraint IDENT{K}−coronal. Generalizing, CON cannot contain faithfulness constraints that favour /m1[U]→[m2] over /m1[U]→[m2f], where /m1/ and /m2f/ are different marked elements on the same scale and /m2/ is the unmarked element.152 The problem with IDENT{K}−coronal is that it favours /k/→[p] (i.e. the neutralization of a marked feature to another marked feature) over /k/→[1] (i.e. the neutralization of a marked feature to an unmarked feature).

In contrast, the PoA-faithfulness constraints proposed conflate unfaithful categories. From input /k/, the outputs [p], [1], and [ʔ] are all equally unfaithful – they all incur exactly the same violations of IDENT{K}, IDENT{KP}, IDENT{KPT}, and IDENT{KPT'T}. This is illustrated in the violations of IDENT{K} in tableau (89). Because all unfaithful candidates are equally unfaithful, they allow the lower-ranked markedness constraints to make the crucial decision.

6.6.2 Coronal promotion

The output of PoA neutralization is not always a glottal: it can be a coronal. In these cases Glottal Elimination blocks glottals as outputs, either overtly or emergently. Glottal Elimination can favour coronals over glottals as the output because glottals are more marked than other PoAs in terms of sonority: i.e. *-Δ₂≥glottal.

In the trivial case, glottals are banned from an inventory, so the least marked PoA available is coronal. For example, /p/ neutralizes to [n] in Yecuautla Misantla Totonac (MacKay 1994:33): this language has no placeless [N] (cf Caribbean Spanish – §6.6.3.1).

A more interesting case is where dorsals and/or labials neutralize to coronal PoA, but a glottal is available. In these cases, Glottal Elimination has an emergent effect. A relevant case is found in a Taiwanese secret language: dorsal and labial stops in reduplicants neutralize to [t] in codas, despite the fact that [ʔ] is available (Li 1985). This case is discussed in §6.6.2.1.

Section 6.6.2.2 discusses whether labials and dorsals can be ‘promoted’ in the same way as coronals. This section shows that this is not possible under the proposals about constraint form in this chapter.

6.6.2.1 Emergent Glottal Elimination

The Taiwanese secret language described by Li (1985) is very similar to the Cantonese one discussed in §6.3.2.1: (i) the reduplicant’s vowel is neutralized to [i], (ii) its coda is neutralized to a coronal, and (iii) the base’s initial consonant is replaced with [l] (or [ʔ] if the following vowel is nasal). The differences are that /k/ neutralizes to [t] in the Taiwanese secret language (cf Cantonese), and the other is that Taiwanese allows coda [ʔ]. Relevant data is provided in (91); the reduplicant is underlined.

<table>
<thead>
<tr>
<th>(90)</th>
</tr>
</thead>
<tbody>
<tr>
<td>/baik/</td>
</tr>
<tr>
<td>(a) baik</td>
</tr>
<tr>
<td>(b) baap</td>
</tr>
<tr>
<td>(c) baip</td>
</tr>
<tr>
<td>(d) baip</td>
</tr>
</tbody>
</table>

The formal expression of markedness – ch.6

Paul de Lucy

151 Gnanadesikan (1995:ch.3) argues that faithfulness constraints with a similar effect account for chain shifts, where /k/→[y] but /y/→[ei]. Curiously enough, the consonant chain shifts discussed all involve increases in markedness, not neutralization to less marked elements (Gnanadesikan argues that the chain shifts are triggered by morphemes). Gnanadesikan’s proposal also predicts neutralizations whereby /m1[U]→[m2f] and /n1[U]→[m2f] (e.g. in coda position). I have not found any cases fitting this description. For vowel height chain shifts, see the alternative proposal in Kirchner (1994).

152 Elliott Moreton, cited in McCarthy (2000) dubs this property of faithfulness constraints ‘retentiveness’. He concludes that OT must have retentive faithfulness constraints to produce chain shifts. The result produced here shows that at the very least PoA-faithfulness constraints cannot be retentive. It may be that more generally faithfulness constraints on the same scale cannot be retentive, though retentiveness may emerge through the interaction of faithfulness constraints on separate scales.
There has been some discussion about the status of coda glottals in Taiwanese (Roberts & Li 1963, Yip 1995:19). This result is illustrated in tableau (94).

\[ \begin{align*}
\text{Candidate (a), with lenition only of } /\text{p}/, \text{ wins because it preserves non-coronal PoAs (unlike (d)), avoids the prohibited segment } [\text{b}] \text{ (unlike (c)), and does not avoid lenition entirely (cf (b)).}  \\
\text{However, suppose that } [\text{g}] \text{ is banned in the output, and is forced to neutralize to some other segment. Since } [\text{d}] \text{ is eliminated by lenition, could } [\text{g}] \text{ neutralize to } \text{[b]}? \text{ The answer is no: } [\text{g}] \text{ must neutralize to } [\text{r}]. \text{This result is illustrated in tableau (94).}
\end{align*} \]

In short, Glottal Elimination can have an emergent effect in the language, forcing neutralization to coronals. As a final point, glottals are not neutralized to coronals in the ranking above: /

\[ \text{ Glottals harmonically bound all other types of PoA in terms of the PoA markedness constraints. So the PoA-markedness constraints cannot be responsible for favouring neutralization to } [\text{t}] \text{ rather than } [\text{t}]; \text{ there must be some other markedness constraint that blocks neutralization to glottals but not coronals. The obvious candidate is the Glottal Elimination constraint } *\Delta [\text{glottal}]. \text{ This constraint must trump all constraints that favour glottals over coronals – i.e. } *\{\text{KPT}, \text{ as shown in tableau (92).} \]

\[ \begin{align*}
\text{Goal: } & \text{neutralization to coronals}  \\
\text{Result: } & \text{neutralization to coronals.}  \\
\text{Outcome: } & \text{neutralization to coronals.}
\end{align*} \]

In short, Glottal Elimination can have an emergent effect in the language, forcing neutralization to coronals.

In short, Glottal Elimination can have an emergent effect in the language, forcing neutralization to coronals. As a final point, glottals are not neutralized to coronals in the ranking above: /

\[ \text{Glottals are usually eliminated before other consonants, but always appear in word/phrase-final codas. There has been some discussion about the status of coda glottals in Taiwanese (Roberts & Li 1963, Yip 1995:19).} \]
### 6.6.3 Gapping and the output of neutralization

The issue raised in the last part of the previous section arises in gapped inventories: suppose that coronals are eliminated from an inventory, as in Yampu and Hawaiian. Could Glottal Elimination not emergently prevent neutralization to glottals? In this case, /k/ could only neutralize to [p] since [p] is the least marked non-glottal available.

The answer is again no. The reason follows from the ranking needed to eliminate coronals. As shown in §6.3, coronals are eliminated when *(KPT) outranks IDENT[manner] and IDENT{KPT}. However, one further ranking is necessary: *(KPT) > *(glottal). Without this ranking, coronals cannot be neutralized to glottals. In fact, glottals would be eliminated from the inventory. This is illustrated in tableau (95).

<table>
<thead>
<tr>
<th>/kat/</th>
<th>*(KPT)</th>
<th>*(glottal)</th>
<th>IDENT{KPT}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) ta</td>
<td>+1</td>
<td>0</td>
<td>+1</td>
</tr>
<tr>
<td>(b) 7a</td>
<td></td>
<td></td>
<td>+1</td>
</tr>
</tbody>
</table>

### 6.6.4 The velar-unmarkedness hypothesis

Although this section is something of a digression from the preceding discussion, it is necessary to point out that some researchers have claimed that dorsals – or more particularly velars – can be the targets of neutralization. The only element less marked than [t] is [?] Therefore, if [?] is eliminated, /t/ can only surface as [t].

The ranking || *(KPT) > *(glottal) || has another effect: it ensures that glottals are less marked than labials and dorsals. Since *(KPT) favours glottals over dorsals and labials, this means that dorsals can only neutralize to glottals.

<table>
<thead>
<tr>
<th>/kat/</th>
<th>*(KPT)</th>
<th>*(glottal)</th>
<th>IDENT{KPT}</th>
<th>*(KPT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) ka</td>
<td>+1</td>
<td>0</td>
<td>+1</td>
<td></td>
</tr>
<tr>
<td>(b) pa</td>
<td></td>
<td></td>
<td>+1</td>
<td></td>
</tr>
<tr>
<td>(c) la</td>
<td></td>
<td>0</td>
<td>+1</td>
<td></td>
</tr>
<tr>
<td>(d) Ta</td>
<td></td>
<td>0</td>
<td>+1</td>
<td></td>
</tr>
</tbody>
</table>

Therefore, if coronals are eliminated in a language, PoA neutralization can only produce glottals. This again follows from the fact that no markedness constraint favours labials and/or dorsals over coronals. If there were such a (freely rankable) constraint – *(KPT) – it would not only be an easy matter to create a gapped inventory where /K/ neutralized to [p], it would be an easy matter to have all non-labial segments neutralize to labials, as shown in the tableau below.

<table>
<thead>
<tr>
<th>/kat/</th>
<th>*(KPT)</th>
<th>*(glottal)</th>
<th>IDENT{KPT}</th>
<th>*(KPT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Takata</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) papapa</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In short, there can be no constraint that favours labials above coronals. The same goes for dorsals and their relation to labials and coronals – if there were a constraint *(PT?), all segments could neutralize to [k]. The lack of such a constraint in the present theory prevents this from happening.
As a preliminary remark, I consider the following discussion overly brief for what is a proposal with broad implications; nevertheless, some comment must be given here as the proposal directly challenges some of the premises of the present theory.

- **The hypotheses**
  Trigo (1988) proposes that coronals are least marked in onset position, but dorsals are least marked in coda position. Causley & Rice (1998) and Rice (2000, a, b) propose that there are two scales relevant to POA. One relates to structural complexity: on this scale, velars are less marked than coronals, labials, and other dorsals.154 However, POA can also be evaluated in terms of structural completeness, in which cases, coronals, labials, and non-velar dorsals are less marked than both velars and glottals. In effect, then, depending on the ranking a grammar can chose whether coronals are less marked than velars, or vice-versa.

- **Dorsal obstruents are not targets of neutralization**
  Both ‘velar-as-unmarked’ proposals predict that dorsals can be the target of neutralization in codas. However, of the languages listed in Appendix B, there are no convincing synchronous cases of neutralization to [k].

  The closest case is found in the Maracaibo dialect of Venezuelan Spanish. Guttart (1981) (cit Trigo 1988) reports that coda stops neutralize to [k] and fricatives to [x]: obsekoio [oksekoio], este [ekte]. However, these forms are in free variation with neutralizations to [i] and [h]: i.e. [ioksekoio], [ihete]. It is therefore unclear whether this constitutes evidence for neutralization to glottals, or dorsals.

  To conclude, unlike synchronous cases, there are clear examples of diachronic change of */t* to */k*. For example, Hawaiian [kanaka] ‘man’ is cognate with other Eastern Polynesian language’s [taata] (e.g. Māori), as is [ke] (determiner) with other languages’ [te]. The reconstructed forms for Proto-Eastern Polynesian have */t* (Clark 1976). Haas (1968) and Rice (1978) show that */t* has turned into */k* in two dialects of Chipewyan – Yellowknife and Fort Resolution respectively. In contrast, all the synchronous cases of */t/-elimination show neutralization to */i* (e.g. Cockney English, Yamplu, Refugee Tibetan – see §6.3). It is not clear what to make of this disparity between diachronic and synchronous change. Since the present theory focuses solely on synchronous grammar, though, this issue is put aside here. In short, there are no synchronous cases of stop neutralization to [k].

  For fricatives, I have found no cases where fricatives neutralize to the velar [x].

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154 Causley & Rice (1998) propose that glottals consist of a bare root node while velars are part of a Place node, but no place features. In contrast, coronals, labials, and non-velar dorsals have more complex structure: root nodes, Place nodes, and place features.

Chen (1973) argues that the development of coda consonants in Chinese dialects involved development of coronals into velars, both for stops */s/-and nasals */n/- (cf Zee 1985, who argued that */n/* developed into */n/). The same development occurred in Proto-Eastern Polynesian to Hawaiian, and in Chipewyan dialects (§6.6.3.1). Despite the */t/- to */k* change, the dialects do not provide evidence against the present proposal. One of the dialects – Fuzhou – has both */i* and [k] in codas (Yip 1982-466), an admissible inventory in the present theory (also see Wright 1983-260, Zhang 2000). Chen reports the Chaozhou dialect to have only [k] in codas; however, this also applies to the literary language: the colloquial language has deobucalized all consonants to */i*. In short, Chen’s (1973) proposals do not conflict with the present theory.

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155 Neutralization to a uvular has been reported for Carib (Hoff 1968, Gildar 1995-65). In codas, uvular [y] appears before obstruents and [i] before sonorants. Due to a process of apocope, consonants may end up in coda position. In this environment, they neutralize to [y] before obstruents and to [i] before sonorants: *[eŋŋa] ‘eat’, cf *[eŋŋa-ŋŋa] ‘eat repeatedly’. *[eŋŋa-ŋ] ‘be ate’ (Hoff 1968-58, Gildar 1995). It seems that the uvular [y] is at least treated like a glottal in this situation, since it parallels [i] in neutralization patterns above. In fact, [y] is in complementary distribution with [l], the latter appears in onsets while the former appears in codas. It is thus inviting to consider [y] not a true uvular, but perhaps [h] with some secondary articulation. Without close phonetic analysis, further speculation is unwarranted. I can only conclude by noting that Gildar’s (1995) survey of deobalization in other Carib languages shows that the target of neutralization in all other cases is a glottal. In any case, Carib does not provide support for the velar-as-unmarked hypothesis.

156 To be precise, */n/- */ŋ/- before pause, but in an unstressed syllable: *[kɔŋŋa]/ *[kɔŋŋa] ‘sardine’, cf *[ŋaŋŋa] ‘he will beg’ (Malaret 1981-20). Faithfulness to the stressed syllable blocks neutralization in this case (Brickman 1998).

157 For arguments that the English [ŋ] is [N], see McCarthy (2000). Apart from being banned in onsets, [ŋ] counts as moraic while [n] and [m] do not. Thus, [ŋ] cannot appear after a long vowel: e.g. [dŋŋ] down, *[dŋŋ] down.
medially /u/ assimilates (discussed below). The paradigm of the person pronoun /hæn/ shows the coda neutralization of [n].

(98) *Yamphu: neutralization of /n/ to [n]*

| cf | [hæn-æʔ] (ergative) | [hæn-iʔ] (plural) | [hæn-ι-æʔ] (pl.ergative) |

Other morphemes that show this alternation include /h-ı̩n- / (logical consequence (LC)) (e.g. [a-sa-hon] ‘whoever’), /h-ı̩n- / (interrogative), and the elative suffix /-pan- / (e.g. [tu-m-em-han] ‘be.3.pl. fact. elative’ – 278).

A number of languages neutralize stops to [ʔ] and nasals to [n]. It is common for languages to allow only [ʔ] and [n] in codas. For example, Makassarese only allows [ʔ] and [n] word-finally; notably, it does not allow word-final [k] (Aronoff et al. 1987, Basri et al. 1998, McCarthy & Prince 1994§5). Languages with the same restriction are Nantong Chinese (Ao 1993), Kelantan and Terengganu Malay (Teoh 1988), Selayarrese, and Konjo (Broselow 2001). Similarly, Caribbean Spanish neutralize fricatives to [h] and nasals to [n] (Trigo 1988/72ff). Other languages that allow only [h] and [n] in codas include Wayana (Jackson 1972), and Macushi (Abbott 1991 – only [h]). Finally, several Chinese secret languages neutralize codas in reduplicants to just [ʔ] and [n]. (Yip 1982, 2000:27).

In contrast, there is no language in which [n] as the result of neutralization parallels [k]: i.e. there is no language in Appendix B that bans all but [k] and [n] in codas. Assimilation in Yamphu also provides evidence that [n] is really [N], /u/ assimilates in PoA to a following obstruent. For example, /pem/ ‘sit’ is realized as follows: [mæm.bem] without sitting, [pen.go] ‘he doesn’t even sit’, [pen.go] ‘he really won’t sit’. Before /ʔ/ and /u/, /u/ is realized as [n]: [pej.ʔ] ‘he’s sitting’, [hæn-tu-æn-de] ‘can you open it?’ (p.44–5). Stops also assimilate before glottals, but to glottal PoA, not dorsal: /m-o-dok-ha/ → [modo] ‘like those’ (p.48). Again, [n] parallels [ʔ] in Yamphu also provides evidence that [n] is really [N], /u/ assimilates in PoA to a following obstruent. For example, /pem/ ‘sit’ is realized as follows: [mæm.bem] without sitting, [pen.go] ‘he doesn’t even sit’, [pen.go] ‘he really won’t sit’. Before /ʔ/ and /u/, /u/ is realized as [n]: [pej.ʔ] ‘he’s sitting’, [hæn-tu-æn-de] ‘can you open it?’ (p.44–5). Stops also assimilate before glottals, but to glottal PoA, not dorsal: /m-o-dok-ha/ → [modo] ‘like those’ (p.48). Again, [n] parallels [ʔ].

In summary, there is a variety of evidence that surface [n] in Yamphu is in fact glottal [N]. In terms of surface restrictions, [g] behaves like glottals: it can appear in codas but not in onsets, just like [ʔ] and [h] in many languages. In contrast, no language bans [k] and/or [x] in onsets but allows them in codas. Notably, assimilation of /u/’s PoA to a glottal [ʔ] or [h] results in [n] in Yamphu, indicating that [n] and [ʔ] share the same PoA. Finally, in languages with debuccalization of stops and/or fricatives, nasals often parallel these processes by neutralizing to [g]. It is never the case that neutralization of nasals to [n] is parallelized in other manners of articulation by neutralization to dorsals (e.g. stops to [k] or fricatives to [x]).

- **No epenthesis of dorsal obstruents**

   Epenthesis is not neutralization, but still directly reflects relative markedness, as discussed in ch.5§3.3.3. Therefore, the ‘velar-as-unmarked’ hypothesis (or at least

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Paul de Lacy

Causley & Rice’s version) predicts epenthesis of [k], [x], and [g], paralleling epenthesis of [ʔ], [h], and [n].

Trigo (1988) argues that two languages show epenthesis of velars: [k] and [n] in Uradhi (Hale 1976, Crowley 1983), and [g] in Murut (Prentice 1971). I have found two other relevant cases: Kojava (Ebert 1996) and Seri (Marlett 1981). While these cases deserve more discussion that presented here, it is possible to cast doubt on their validity.

As Broselow (1982) and many others have shown, consonant epenthesis takes place to satisfy general phonotactic requirements such as bans on onomatopoeic syllables (e.g. [h]-epenthesis in Slave – Rice 1989), or avoidance of adjacent identical consonants. However, none of the cases cited above are that straightforward. All involve ‘epenthesis’ of dorsals without a clear phonotactic motive for insertion.

The Dravidian language Kojava will be discussed here since – in my opinion – it offers the clearest and most detailed evidence of putative [k]-insertion of the cases cited above.

Kojava has the voiceless stops [p t tʃ k]. Syllable structure is CVX, where X is either a consonant or vowel; onsets are optional word-initially. Ebert (1996:9) reports that “euphonic [k] is inserted between roots ending in a vowel or [n] and a following [a]”, with the additional proviso that [k] voices after nasals. Examples are given in (99).

(99) **Kojava eufonic [k] (Ebert 1996)**

| /kʊdʊ-ʔa/ | [kʊdʊ] | ‘let’s drink’ (cf [kʊd] ‘drink’) |
| /ʔaːʔaː-ʔe/ | [ʔaːʔaː] | ‘without sitting down’ |
| /koŋ-ʔaː-ʔe/ | [koŋʔaː] | ‘do not give!’ |
| /ʔin-αːdʊ-ʔe/ | [ʔinαːdʊ] | ‘let him eat’ |
| /kɑːn-ʔa/ | [kɑːn] | ‘see you!’ |
| cf /lɑːʔaː-ʔe/ → [lɑːʔaː] | ‘don’t write’ (cf [ɑːʔaː] ‘write’) 

The problem with treating [k] as epenthetic here relates to the environment that triggers its insertion. If [k] were truly epenthetic, it should be inserted for phonotactic reasons, such as a requirement that syllables have onsets. However, epenthesis after /tʃ/-final roots is prosodically unnecessary: [kan-ʔa] could surface as [ka.na], since this form satisfies onset. Instead, [g] is epenthized (voiceless stops are banned after nasals): [ka.na].

There is not only no prosodic motivation for dorsal epenthesis here, the epenthesis creates a prosodically undesirable syllable – i.e. one with a coda.

Moreover, euphonic [k] is severely restricted in its distribution. It can only appear between a verb root and suffix. For example, /ʔ/kʊdʊʔ-ˈaː/ → [ʔkʊdʊnʔa.], /ʔ/kʊdʊʔ-ˈaː/ → [ʔkʊdʊnʔa.], /ʔ/kʊdʊʔ-ˈaː/ → [ʔkʊdʊnʔa.]

In short, [k] does not behave like epenthetic consonants in other languages. If anything, its distribution suggests that it has the status of a morpheme, much like the semantically contentless ‘thematic’ morphemes in Attic Greek (Lupas 1972).

The same point can be made for Seri, Murut, and Uradhi.

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159 Kojava epenthizes [n] after root-final consonants.

160 It could be that /k/ is part of the root. Exact determination of the status of /k/ awaits a detailed analysis of Kojava morphology.
In Seri, Marlett (1981:56) reports that [k] is epenthesized in a very specific morphological and phonological environment:  \( \mathcal{O} \to [k] / C^\text{moral} C^\text{oral}+. \) In other words, [k] is epenthesized after [t] and before a nasal that is part of a prefix: e.g. /\text{ha-tm-ay}/ \to /\text{[t]akutakay}/ ‘1-PS-ABIL-ggp’ / \text{t}-\text{tm}-\text{kap} / \to /\text{[t]akutakam}‘. 1-PS-ABIL-fly’ (p.56).  [m-t-\text{m-aa} \to /\text{[t]alkmakaa} ‘don’t you know it?’; /\text{t}-\text{m-piz}/ \to /\text{[t]ikompi} ‘didn’t he taste it?’ (p.72).

As in Koqawa, it is unclear what prosodic restriction motivates the ‘epenthesism’.  [k] is not epenthesized to avoid an ONSET or NOCODA violation.  Moreover, it may be accompanied by [o]-epenthesis: /\text{[t]ikompi} (see ch.4§4.4 for discussion).  It is unclear in this case why the output is not simply /\text{[t]ikmp} – this solves the problem of [tm] adjacency and avoids creating marked syllables.

As in Koqawa, Seri [k]‘epenthesism’ is limited to a very specific morphological environment – between prefixal elements (e.g. /\text{t}-\text{v-nas} → /\text{[t]utus}/ ‘OM-RL-resemble’ (p.56)). In fact, it effectively only shows up after two different morphemes: /tm/ and between [t] and /\text{m}/.  In short, Seri [k] does not act like an epenthetic element; its distribution may reasonably be called idiosyncratic, much like a morpheme’s.

Paradis & Prunet (1994) have already provided a detailed reanalysis of Uradhi; the reader is referred to their work for further details.

As for Murut, Trigo (1988:59ff) argues that a [y] that appears with certain reduplicants in Murut is epenthetic.  Data from Prentice (1971:121) includes /\text{RE}d\text{=a}n\text{kap} / \to /\text{[t]akutakup}/no gloss, /\text{RE}d\text{=in}s\text{i}\text{t} / \to /\text{[t]us\text{in}si}\text{t} ‘toothpick’ (cf /\text{hu}\text{-f\text{ulu}d}/ ‘ridges in which tuberous crops are planted’).  Notes that [y] reduplicates as [g] – this is due to the fact that voiced stops and voiced fricatives are in complementary distribution – voiced stops are banned intervocalically (they spirantize, as described in §6.5.1.2).

However, the appearance of [y] poses a number of puzzles if it is epenthetic.  One is why a less marked segment like the voiceless stop [k] is not epenthesized: it is perfectly acceptable in stem-initial position and intervocalically (e.g. /\text{kabul}/ ‘fan’, /\text{ku\text{tupus}/ ‘bangs, explosions’ (p.99); /naka\text{-}[\text{ulu}d]/ ‘has informed’ (p.17)).  The other issue is that [y]’s appearance is unpredictable.  It only occurs with some vowel-initial reduplicants.  Employ infixation: e.g. /\text{RE}d\text{+ulamp}\text{po}/ \to /\text{[u]lagamp\text{po}/ no gloss, /\text{RE}d\text{+in}d\text{im}\text{ol} / \to /\text{[i]d\text{im}dim}\text{ol} ‘about five times’.  If [y] appears to satisfy some prosodic requirement, it is difficult to see why it should only appear for some roots and not others.  Like the other cases cited above, [y]’s distribution is idiosyncratic and unpredictable, more reminiscent of a morpheme than an epenthetic element.

To conclude, there are no convincing cases of dorsal epenthesis, and therefore no reason to posit a markedness constraint that favours dorsals over coronals. 168 The lack of such a constraint ensures that neutralization can never produce dorsals, only glottals and coronals.

168 Yip (1992) reports that [ŋ] is inserted to meet a prosodic weight requirement in Kaingang (cit Lombardi 1998). Again, this can be treated as the glottal nasal [N].
The first step is to explain why fricatives are eliminated in Korean codas. The ranking \([\text{onset-IDENT} + \text{continuant}] \succ * + \text{continuant} \succ \text{IDENT} + \text{continuant}\) will achieve this result, as shown in tableau (101).

\[
\begin{array}{c|c|c|c}
\text{onset-IDENT} + \text{continuant} & * + \text{continuant} & \text{IDENT} + \text{continuant} \\
\hline
\text{a) swh} & * & * \\
\text{b) sut} & * & * \\
\text{c) sot} & * & * \\
\end{array}
\]

The issue of present interest is why /h/ neutralizes to the coronal [t] rather than any other stop. /h/ cannot neutralize to [ʔ] because glottal stops are banned in Korean (Ahn 1998:55). This can be formally implemented by the Glottal Elimination constraint \(\neg [\text{glottal}]\). To prevent elimination of /h/ in onsets, onset-IDENT(KP) can outrank this constraint.

With \(\neg [\text{glottal}]\) banning glottals, /h/ has no choice but to neutralize to one of \([p\ ’k’]\). The reason /h/ neutralizes to [t] rather than [p] or [k] is because [t] has the least marked PoA, as shown in tableau (102).

\[
\begin{array}{c|c|c|c|c}
\text{onset-IDENT} + \text{continuant} & * + \text{continuant} & \text{IDENT} + \text{continuant} & \text{IDENT} + \text{continuant} \\
\hline
\text{a) swh} & * & * & * \\
\text{b) sut} & * & * & * \\
\text{c) sot} & * & * & * \\
\text{d) sot} & * & * & * \\
\end{array}
\]

In short, neutralization of glottal \(/h/\) to a coronal is emergence of the unmarked. As predicted by the present theory, if glottals are eliminated, coronals are promoted to least marked status. Therefore, glottals neutralize to coronals.

### 6.6.5 Consistency of Neutralization Target

As a concluding point, one further prediction that follows from this approach is that the output target of neutralization for an individual language will be the same for every element, holding all else equal. So, if /h/ neutralizes to [ʔ] in a language and /p/ also neutralizes, /p/ will neutralize to [ʔ] as well. There is no language in which /h/ neutralizes to [ʔ] in codas while /p/ neutralizes to [ʔ]. In other words, the neutralization target within an individual language is consistent.

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163 This ranking does not mean that [ʔ] will also appear in onsets: /p/ may neutralize to [h] in onsets.

164 Aspirated consonants, tense consonants, and palato-alveolars are banned in codas.
6.7 Summary

The aim of this chapter was to show that highly marked elements can be preserved while less marked elements are not. More formally, the aim was to show the need for faithfulness constraints that preserved marked elements only.

Such constraints were argued to be crucial in accounting for ‘gapped’ inventories – ones that contained highly marked elements but lacked less marked ones. For example, coronals are eliminated in Yamphu codas, but the more marked labials and dorsals are permitted: /soksæt/ → [soksæt], *[so/ksæt], *[so/ksæ]. The same inventory is found in onsets in Hawaiian (Kupui & Elbert 1979) and a number of other languages (§6.3.1).

Section §6.3.4 showed that an adequate account of gapped systems required a constraint that preserved marked elements alone. In the case of Yamphu, this was the constraint IDENT[KP], which preserves input labial and dorsal specifications only. Tableau (103) shows how IDENT[KP] prevents /k/ from neutralizing to [t], but allows the less marked /t/ to debuccalize. To simplify matters, only violations of stop PoA will be shown for *[KPT].

(103) Gapped Inventories

<table>
<thead>
<tr>
<th>/soksæt</th>
<th>IDENT[KP]</th>
<th>*[KPT]</th>
<th>IDENT[KP]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) soksæ</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) soksæt</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(c) soksæt</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

Candidate (a) debuccalizes all stops in coda position. By doing so, it fatally violates IDENT[KP] because the dorsal PoA of input /k/ is not preserved in the output. Both candidates (b) and (c) avoid violations of IDENT[KP] by preserving /k/. However, candidate (c) is over-zealous in its preservation – it fails to capitalize on the fact that nothing prevents /t/ from debuccalizing. In contrast, candidate (b) minimizes violations of *[KPT] by eliminating output [t]. The result is a gapped coda inventory.

The marked-faithfulness constraints can generate all possible gapped and harmonically complete inventories. However, they cannot generate ‘disharmonic’ ones: those that fail to contain the least marked PoA element; by Harmonic Ascent, the least marked element cannot be eliminated through any ranking.

However, other processes may interfere to produce disharmonic inventories. For example, glottals may be eliminated through a ban on high sonority margins and coronals may undergo flapping, leaving only the voiceless stops [k p] in certain environments.

• Deletion vs Neutralization

The theory proposed here predicts that deletion and neutralization have different effects as inventory-forming processes. While neutralization may produce both gapped and harmonically complete inventories, deletion can only produce harmonically complete inventories.

More concretely, the gap in the Yamphu coda inventory must come about through neutralization: /t/ must neutralize to [t]. The present theory predicts that /t/ cannot delete in this case.

To explain, if /t/ is deleted, then *[KPT] must outrank MAX. However, since *[KPT] also bans dorsals and labials, it will be impossible to block their deletion as well. At this point, the form of the marked-faithfulness constraints is crucial: IDENT[KP] cannot prevent /t/ and /p/ from deleting: it is equally satisfied by both /k/→[k] and /k/→∅ (McCarthy & Prince 1995).
Languages relevant to this issue, cited in UPSID, are Jomang, Bandjalang, Yidiny, Dyirbal, Mbabaram.

Awetí may be the case that this language (and other reported cases) has unaspirated voiceless stops (like all other Polynesian languages); this was my impression on hearing Nukuoro spoken, though I took no measurements.

Polynesian language Nukuoro has been cited as having voiced stops but no voiceless ones (Carroll 1965). It

Ngunggabuyu). However, in these cases voiceless stops occur word-initially; the lack of voiceless stops elsewhere can be explained by an interfering process of intervocalic and post-sonorant voicing. The

Languages can have contiguous parts of the sonority hierarchy in onsets. For example, Mura-Pirahã has voiceless stops, voiced stops, and voiceless fricatives in onsets: higher sonority elements (voiced fricatives, nasals, liquids, and glides) are not present (except as allophones in restricted environments). In contrast, Maori has a gapped inventory: it has voiceless stops, voiceless fricatives, nasals, and liquids, but lacks voice stops and voiceless fricatives. The following table presents a fuller typology of gaps. The shaded boxes highlight the relevant gap in the inventory.

<table>
<thead>
<tr>
<th>Language</th>
<th>glides</th>
<th>liquids</th>
<th>nasals</th>
<th>+vd frics</th>
<th>-vd frics</th>
<th>+vd stops</th>
<th>-vd stops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aguaruna</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cubeo</td>
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<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Munduruku</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Djiapi</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
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<td>Gavião</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rarotongan</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Awetí</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

These gaps can be accounted for by the same method as PoA gaps: some faithfulness constraint preserves the marked (high sonority) elements, while lesser-marked elements are eliminated.

As with PoA, Harmonic Ascent predicts that the least marked element – voiceless stops – cannot be eliminated. In all the languages listed in Appendix B, this prediction holds.165

• Other Scales

The generalizations identified for PoA extend to other scales. With binary scales, the results are somewhat more limited. In a binary scale | B | α |, there can be only two inventories | B | α | and | α |. Since | α | is least marked, it cannot be eliminated: the disharmonic inventory | B | is therefore banned. There is no equivalent to a gapped inventory for binary scales, for practical reasons.

For example, if we take a vowel nasalization scale, with | VNasal | VNasal |, two types of inventory are predicted: one with only oral vowels, and one with both oral and nasal vowels.

This does not mean that the results only apply to PoA, though. For example, they apply to the sonority scale to explain the typology of manners of articulation. To explain, the sonority scale is repeated in (104).

(104) | glides | liquids | nasals | +vd frics | -vd frics | +vd stops | -vd stops |

Languages have contiguous parts of the sonority hierarchy in onsets. For example, Mura-Pirahã has voiceless stops, voiced stops, and voiceless fricatives in onsets: higher sonority elements (voiced fricatives, nasals, liquids, and glides) are not present (except as allophones in restricted environments). In contrast, Maori has a gapped inventory: it has voiceless stops, voiceless fricatives, nasals, and liquids, but lacks voice stops and voiceless fricatives. The following table presents a fuller typology of gaps. The shaded boxes highlight the relevant gap in the inventory.

Table 6.15: Gapped non-DTE inventories

165 A number of Australian languages are reported as having no voiceless stop phonemes (e.g. Ngunngabuyu). However, in these cases voiceless stops occur word-initially; the lack of voiceless stops elsewhere can be explained by an interfering process of intervocalic and post-sonorant voicing. The Polynesian language Nukuoro has been cited as having voiceless stops but no voiceless ones (Carroll 1965). It may be the case that this language (and other reported cases) has unaspirated voiceless stops (like all other Polynesian languages); this was my impression on hearing Nukuoro spoken, though I took no measurements. Languages relevant to this issue, cited in UPSID, are Jomang, Bandjalang, Yidiny, Dyirbal, Mbabaram.

Implications for Markedness Diagnostics

This section concludes with a point mentioned in the introduction, relating to the implications of this chapter for the concept of ‘markedness’. Given the existence of gapping, inventories can no longer be seen as diagnostics for markedness relations in scales. For example, the fact that [k] exists in Yamphu codas but not [t] does not imply that [k] is less marked than [t] in this – or any – grammar. In short, this chapter has all but eliminated inventory structure as a diagnostic for markedness.

The one exception relates to the least marked element. The present theory predicts that the least marked element of scale S can never be eliminated by S-referring constraints. To obscure the issue, nothing precludes another scale Z from having different markedness relations. Interaction of S- and Z-referring constraints can therefore confuse the surface picture. This chapter showed how PoA- and sonority-referring constraints did precisely this: while glottals are least marked in terms of PoA, the sonority constraints can eliminate them.

Even with the interference of sonority, though, the persistence of the least marked element comes through, embodied in the empirical claim that all manners in all inventories have a segment at either glottal or coronal PoA, or both.

In contrast, this chapter affirms that direction of neutralization and epenthesis both provide reliable diagnostics for markedness. Both direction of neutralization and epenthesis are free from the influence of faithfulness constraints, so they provide insight into the form of markedness constraints.
CHAPTER 7

FAITHFULNESS TO THE MARKED II:

AVOIDING HETERORGANIC CLUSTERS

7.1 Introduction

The aim of this chapter is to provide further evidence for the proposal that more marked elements can be preserved while less marked ones are not, formally expressed as faithfulness constraints that preserve marked elements without preserving less marked ones: e.g. IDENT[K], IDENT[KP]. A further aim is to show that there are no faithfulness constraints that preserve unmarked elements alone – e.g. IDENT[T], IDENT[PT].

As in chapter 6, the focus of this chapter is entirely on the proposal that marked elements are subject to greater faithfulness than unmarked ones. This chapter does not aim to show that faithfulness constraints must be formulated stringently; this is reserved for chapter 8.

The empirical focus of this chapter is heterorganicity-avoidance. A heterorganic consonant cluster is a sequence of consonants that disagrees in Place of Articulation: e.g. [tp kj nm nt nk]. Languages can avoid heterorganic clusters like [mk] in a variety of ways: deletion [k] (§7.5.1), epenthesis [mk] (§7.3.1), coalescence [k] (ch.8), neutralization [nk] (§7.6.1), metathesis [km] (§7.5.3), and – most commonly – assimilation [pk] (§7.1-§7.3). As indicated by the section references, almost all of these heterorganicity-avoidance techniques are discussed in this chapter, though assimilation is the primary focus.

Heterorganicity-avoiding processes provide evidence for the marked-faithfulness constraints. With neutralization (ch.6), the marked-faithfulness constraints can prevent marked elements alone from undergoing heterorganicity-eliminating processes.

- The usefulness of marked-faithfulness

For example, assimilation is used to eliminate certain heterorganic clusters in Catalan. However, only coronals undergo assimilation in Catalan; labials and dorsals are exempt (Mascaró 1976, 1986, Hualde 1992, Palma 1994). A full description and analysis is provided in §7.2; (1) summarizes the data.

(1) Catalan Coronal-Only Assimilation (in brief)
(a) Coronals assimilate
    [som b`us] som amics ‘they are friends’
    [som b`us] som amics ‘we are friends’
    [som b`us] som amics ‘we are Pegues’
    [som b`us] som amics ‘we are few’
    [som dos] som dos ‘we are two’
(b) Labials do not assimilate
    [t`(k) pa] tinc pa ‘I have bread’
(c) Dorsals do not assimilate
    [t`(k) presa] tinc pressa ‘I’m in a hurry’

In informal terms, /n/ and /m/ do not assimilate in Catalan because they are highly marked, and their high markedness excites greater preservation. In contrast, the coronal /n/ is less marked, and – in Catalan – it is not marked enough to warrant preservation. So, /n/ undergoes assimilation while the more marked elements do not.

In formal terms, Catalan-type systems result from a ranking in which IDENT[KP], which preserves dorsals and labials alone, outranks the markedness constraint that bans heterorganic clusters. In such a ranking, it is more harmonic to retain marked feature values – i.e. labial and dorsal specifications – than assimilate. In contrast, nothing prevents coronals from assimilating – faithfulness constraints that preserve coronals (IDENT[KPT]) are dominated by the anti-heterorganic markedness constraint. This analysis builds on previous OT analyses by Kiparsky (1994) and Jun (1995). Tableaux (2) and (3) illustrate this ranking; the constraint ASSIM bans heterorganic clusters.

\[
\begin{array}{|c|c|c|c|}
\hline
\text{IDENT[KP]} & \text{ASSIM} & \text{IDENT[KPT]} \\
\hline
\text{som b`us} & * & * \\
\hline
\text{som dos} & & *
\end{array}
\]

Tableau (2a) shows that coronals undergo assimilation because ASSIM outranks all coronal-preserving faithfulness constraints. In contrast, tableau (2b) shows how the more marked labial and dorsal PoAs can be exempt from assimilation: IDENT[KP] prevents the input labial /m/ from being unfaithful, as regressive assimilation requires.

- The need for marked-faithfulness

Catalan shows how marked-faithfulness constraints can be useful, but it does not show that they are necessary – in other words, it does not rule out analyses without marked-faithfulness constraints. For example, Catalan could also be analyzed by invoking a constraint that just rules out coronal-non-coronal clusters, dubbed the ‘Markedness-Reliant’ approach here. In this type of analysis, only coronals would assimilate because no markedness constraint would ban non-coronals in heterorganic clusters.
Section 7.3 examines the Markedness-Reliant approach. It shows that it is both too restrictive and not restrictive enough.

Evidence that the Markedness-Reliant approach is too restrictive comes from systems that have more than one method of avoiding heterorganic clusters. For example, Ponapean avoids coronal+non-coronal heterorganic clusters by assimilation /tp/→/mp/, but eliminates other heterorganic clusters by epenthesis /nl/→/[mgl] (Rehg & Sohl 1981, Goodman 1995). A theory without marked-faithfulness constraints is argued to predict that the Ponapean system is impossible.

Evidence that the Markedness-Reliant approach is not restrictive enough comes from neutralization. A constraint that targets coronal+non-coronal heterorganic clusters alone can produce a type of neutralization whereby coda coronals become non-coronal: e.g. /tankal/ → [anka]. As established in ch.6§6.6, this type of neutralization is unattested.

- No need for unmarked-faithfulness

The second half of this chapter (§7.4-§7.6) is devoted to showing why there is no need for ‘unmarked’-faithfulness constraints – faithfulness constraints that only preserve unmarked elements, like IDENT[T] and IDENT[PT]. The theory proposed here demotes that such constraints exist in CON.

On the surface, theories without unmarked-faithfulness constraints face a challenge in systems like Sri Lankan Portuguese Creole’s (Smith 1978, Hume & Tserdanelis 1999). This language is the exact complement to Catalan: labials and dorsals assimilate while coronals do not (for analogous cases involving voice assimilation, see §7.4.4, Wetzels & Mascaro 2001). Selected data is given in (4), taken from both Smith (1978) and Hume & Tserdanelis (1999). See §7.4.2 for details.

(4) Sri Lankan Portuguese Creole marked-only assimilation (in brief)

(a) Coronals do not assimilate

/ka líz/²+/p²/ → ‘turkey (dative sg.)’

/ta⁄/+ko/ → ‘bell (verbal noun)’

/ko kid kɔ/ → ‘the ringing of bells’

(b) Labials assimilate

/ma:n+sə/ → [mɑnʃu] ‘hand+[genitive]’

/pikin’ɔn kɔ:aŋ/ → [pikin’ɔŋkɔːŋ] ‘small house’

/ma:n+kι/ → [mɑŋkis] ‘hand [verbal noun]’

(c) Dorsals assimilate

/misiŋpiŋ/ → [misiŋpɑ] ‘meeting (dative sg.)’

/ŋp ’ɔ八字u/ → [ʊn pɔ ’ɔ八字u] ‘one pound’

/misiŋp πu/ → [misiŋpu] ‘meeting (genitive)’

Section 7.4 will argue that faithfulness constraints are not responsible for the lack of coronals assimilation (cf Catalan). Instead, the SLP Creole system will be shown to follow from the proposal that heterorganic clusters differ in markedness. Specifically, heterorganic clusters without coronals are less marked than those with coronals. So, coronal+C heterorganic clusters are exempt from assimilation in SLP Creole because they are already adequately unmarked.

This idea is implemented by combining all context-free PoA markedness constraints with themselves, forming constraints such as *{KP} {KPT}, which bans clusters consisting of either a dorsal or labial, followed by a dorsal, labial, or coronal. This theory differs from previous approaches in OT, which have typically treated all heterorganic clusters as being equally marked (e.g. Lombardi’s 1995, 1999 AGREE theory).

In short, systems like SLP Creole’s do not provide evidence that unmarked-faithfulness constraints are necessary.

- Not all heterorganic clusters are equal

Sections 7.5 and 7.6 present two pieces of evidence that anti-heterorganicity constraints like *{KP} {KPT} are independently necessary.

Section 7.5 discusses the triggers of heterorganic-avoidance. For example, in Attic Greek only heterorganic clusters in which the second member is a non-coronal are avoided (Steriade 1982, Bubeník 1983). The net result of this restriction was that only (i) homorganic clusters and (ii) non-coronal+coronal clusters are allowed on the surface: e.g. /reδ+peŋ+κλ+α/ → [pepeka] ‘I have persuaded’ (S217), cf /dioŋ+apo/ → [dioŋap] ‘persecutor [acc masc sg.]’. This system and others like it are shown to fall out from the proposal that heterorganic clusters differ in markedness. In fact, the formal account employs a constraint that is the mirror image of the one used for SLP Creole (*{KP} {KPT}).

Section 7.6 discusses neutralization. Specifically, Kiowa (casual register) neutralizes PoA distinctions in medial codas but not final ones: /t’ɔŋkɔ/ → /t’ɔŋɔ/ ‘shoot [neg]’, cf /tāp/ ‘deer’. This neutralization pattern is shown to require a constraint that specifically targets certain types of heterorganic cluster without targeting others.

The relation between medial assimilation/neutralization and final neutralization is also discussed in this section. In short, the constraints used for SLP Creole are shown to be independently necessary, again providing support for the proposal that unmarked-faithfulness constraints are unnecessary.

- Empirical observations

Apart from the theoretical points, this chapter makes novel empirical observations, and provides more evidence for some previous proposals relating to assimilation.

One observation is that there are no implicational relationships in relation to undergoers of assimilation (and heterorganicity-avoiding processes in general). As Table 7.1 shows, any subset of [dorsal, labial, coronal] can undergo assimilation. For example, only dorsals are exempt from assimilation in Inuktitut, only labials are exempt in

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196 This claim disagrees with a great deal of previous work that has held that if coronals undergo assimilation, so do non-coronals. For the most recent and extensive discussion, see Cho (1990), Mohanan (1993, 76), and Jun (1995§2.2).
Harar Oromo, and only coronals are exempt in SLP Creole. See the sections cited for references to the language in the table.

Table 7.1: Undergoers of assimilation

<table>
<thead>
<tr>
<th>K</th>
<th>P</th>
<th>T</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Diola Fogny (J Sapir 1965:16)</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Sri Lankan Portuguese Creole (§7.4.1), Nunggubuyu (§7.4.4)</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Harar Oromo (§7.4.3.2)</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>NBA Inuktitut (§7.2.2), (Korean – §7.5.2)</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Catalan (§7.2.1), Yamphu (§7.2.2)</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Gunin/Kwini (§7.1)</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Chukchi, Uradhu (§7.4.3.1)</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Southern Sierra Miwok (§7.6.2.2)</td>
</tr>
</tbody>
</table>

In contrast, evidence is provided for Mohanan’s (1993) (also see Jun 1995) observation regarding triggers of assimilation: if a less marked element triggers assimilation, so does a more marked one. In slightly different terms, if heterorganic clusters of the form C(onsonant)+coronal undergo assimilation, then so do clusters of the form C+labial and C+dorsal. This allows for languages where coronals do not trigger heterorganicity-avoidance (e.g. Attic Greek) and where neither coronals nor labials trigger assimilation (e.g. Korean), while excluding languages where coronals alone trigger assimilation.

Finally, this chapter identifies a number of predictions about the relations among medial assimilation, medial neutralization, and final neutralization (§7.6.2). As Table 7.2 shows, almost every possible combination is attested except for one in which there is final PoA neutralization and neither assimilation nor neutralization medially. See §7.6.2 for references to the languages cited.

Table 7.2: Medial-final PoA relations

<table>
<thead>
<tr>
<th>medial codas</th>
<th>word-final codas</th>
<th>/amkam/167</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>×</td>
<td>[amkam]</td>
<td>Southern Sierra Miwok</td>
</tr>
<tr>
<td>neutralize</td>
<td>×</td>
<td>[amkam]</td>
<td>Kiowa</td>
</tr>
<tr>
<td>assimilate</td>
<td>×</td>
<td>[aŋkam]</td>
<td>Harar Oromo, Diola Fogny</td>
</tr>
<tr>
<td>✓</td>
<td>neutralize</td>
<td>[amkam]</td>
<td>impossible</td>
</tr>
<tr>
<td>neutralize</td>
<td>neutralize</td>
<td>[aŋkam]</td>
<td>Selayarese, Tzutujil</td>
</tr>
</tbody>
</table>

As a final comment, while this chapter is primarily concerned with the PoA scale, attention is also given to the (obstruent) voicing scale [ +voice ] -voice [; all sections conclude by showing how the proposals for the PoA scale extend to the voicing scale.

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167 The systems listed here apply to assimilations of both nasals and stops. So, the input /apkap/ is more appropriate for some of the systems listed (i.e. Kiowa – see §7.6.1, Nganasan – ch 6 §6.3).
marked feature value alone. M motivates unfaithfulness; its ranking over IDENT[marked,unmarked] ensures that unmarked values undergo the process.168

(5) Unmarked Undergoers Only

\[ \text{IDENT[marked]} = \text{M} = \text{IDENT[marked,unmarked]} \]

The ranking in (5) can be easily extended to deal with scales with several steps; an example is given below for the 4-member PoA scale.

For processes that avoid heterorganic clusters, the ranking in (5) will prevent clusters with marked elements from being eliminated, but allow clusters with less marked elements to be dispensed with. As mentioned in §7.1, this type of system is found in Catalan, where only coronals undergo assimilation. Jan’s (1995) and Cho’s (1999) surveys of Place assimilation identify several other Catalan-type systems, including Brussels Flemish, German, Keley-i, Japanese, Lithuanian, Polish, Sanskrit, and Toba Batak. Meccan Arabic can be added to this list (Bakalla 1973:508-513).

At face value, the Catalan-type system conflicts with the predictions of markedness theory (at least the Prague School conception): an unmarked element is converted into something more marked (i.e. /tl/ \rightarrow /n\lf, /lt/ \rightarrow /\lp\n/), while more marked elements are prevented from becoming less marked: e.g. /mt/ does not undergo assimilation to *\[nt\], even though the resulting [n] would have the less marked coronal PoA.

Section 7.2.1 shows that marked-faithfulness constraints provide a solution to this conundrum. Specifically, the constraint IDENT[KP] prevents marked elements from assimilating, but allows coronals to be affected. This analysis builds on previous work in OT, especially Kiparsky (1994) and Jun (1995). Underspecification approaches to the Catalan system are also discussed (Kiparsky 1982, Cho 1999). They are argued to be inadequate for reasons relating to the typology of undergoers in assimilation.

Section 7.2.2 identifies the further typological predictions of the theory. Section 7.2.3 provides a summary.

7.2.1 Catalan

PoA assimilation in Catalan has been the subject of a number of descriptions and analyses (Mascaró 1976, 1986, Wheeler 1979, Kiparsky 1985, 1994, Recasens 1991, Hualde 1992, Palmada 1994). The analysis presented in this section owes much to this previous work, especially Kiparsky’s (1994) OT analysis. The following sections recast the analyses in terms of the present theory and consider a number of related facts about heterorganic-avoidance in Catalan.169

Section 7.2.1.1 describes aspects of Catalan phonotactics relevant to assimilation, and the process of nasal assimilation itself. Section 7.2.1.2 presents an analysis. Section 7.2.1.3 discusses related processes in Catalan.

### 7.2.1.1 Description

<table>
<thead>
<tr>
<th>Catalan consonants</th>
<th>labial</th>
<th>dental/ alveolar</th>
<th>alveo-palatal</th>
<th>palatal</th>
<th>dorsal</th>
</tr>
</thead>
<tbody>
<tr>
<td>stops</td>
<td>p</td>
<td>t</td>
<td>k</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>d</td>
<td>g</td>
<td></td>
<td></td>
</tr>
<tr>
<td>affricates</td>
<td>(ts)</td>
<td>(t∫)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(dz)</td>
<td>(d∫)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>fricatives</td>
<td>f</td>
<td>s</td>
<td>l</td>
<td></td>
<td></td>
</tr>
<tr>
<td>nasals</td>
<td>m</td>
<td>n</td>
<td>n</td>
<td></td>
<td></td>
</tr>
<tr>
<td>laterals</td>
<td>n</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>rhotics</td>
<td>f r</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>glides</td>
<td>w</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Syllables have the form (C(C)V(C)(C)). Singleton onsets can consist of any consonant except [f], the affricates, [ŋ], and [w]. Codas can contain any segment except voiced obstruents, which demonstrably neutralize to their voiceless counterparts.

Onset clusters consist of a stop or [f] plus a coronal liquid [r l], with the exception of [tl]. Examples are [prum] ‘promise’, [blaw] ‘blue’, [kla] ‘clear’, [fis] ‘first’ and [dz] ‘cold’ (Hualde 1992:380). Almost the same facts hold for coda clusters, though the order of segments is reversed. Word-finally, liquid+stop clusters are admissible, with the exception of [lt].170

In addition, the following clusters with [s] are admissible: [sp st sk ns ls].

168 Unmarked feature values might not undergo the process triggered by the markedness constraint if there is no more harmonic candidate. This situation relates to Harmonic Ascent, and is discussed in detail in chapter 6. For assimilation, the issue does not arise since there is no heterorganic cluster that is less marked than a homorganic one. Under some rankings, though, certain heterorganic clusters may be equally as marked as homorganic ones. For example, the constraint *(k){KPT} can motivate [\(^{\text{\#}}\)] to either be realized as homorganic [mp] or for the \(^{\text{\#}}\) to neutralize to [n] (i.e. [np]) – both outcomes satisfy the constraint. See §7.6 for discussion of relevant cases.

170 As Hualde (1992) points out, there are several dialects of Catalan, differing in a number of phonological features. The following generalizations refer (at least) to Eastern Catalan.

Obstruent voicing neutralizes in codas, so \[dl \rightarrow [l]\], hence coda [ld] clusters are ruled out independently.

169 My thanks to Eva Huarnos for her native speaker intuitions regarding the data in this section and for help with the transcriptions and glosses.

171 Obstruent voicing neutralizes in codas, so \[df \rightarrow [f]\], hence coda [ld] clusters are ruled out independently.
Two types of PoA assimilation are distinguished here. One is assimilation of major PoA – i.e. labial, coronal, and dorsal specifications. The other is assimilation of minor PoA – i.e. distinctions within the major PoA categories, such as bilabial vs labio-dental for labials, and dental vs alveolar vs palatal in the coronal category. The focus of this section is major PoA assimilation; minor PoA will be discussed when relevant.


(6) Major PoA Assimilation in Catalan

<table>
<thead>
<tr>
<th>/son/ 'they are'</th>
<th>/son/ 'we are'</th>
<th>/af/ 'year'</th>
</tr>
</thead>
<tbody>
<tr>
<td>amis 'friends'</td>
<td>son ãniks</td>
<td>ãnik</td>
</tr>
<tr>
<td>pocx 'few'</td>
<td>som ãniks</td>
<td>ãnik</td>
</tr>
<tr>
<td>beus 'voices'</td>
<td>som ãniks</td>
<td>ãnik</td>
</tr>
<tr>
<td>felixus 'happy pl.'</td>
<td>som ãlikus</td>
<td>ãlikus</td>
</tr>
<tr>
<td>tontus 'stupid'</td>
<td>son ãlikus</td>
<td>ãlikus</td>
</tr>
<tr>
<td>docils 'amenable'</td>
<td>son ãlikus</td>
<td>ãlikus</td>
</tr>
<tr>
<td>fkûks 'boys', fop 'wet'</td>
<td>son ãlikits</td>
<td>ãlikits</td>
</tr>
<tr>
<td>rossus 'blonde'</td>
<td>son ãlikits</td>
<td>ãlikits</td>
</tr>
<tr>
<td>liures 'free pl.'</td>
<td>son ãlikus</td>
<td>ãlikus</td>
</tr>
<tr>
<td>cosins 'cousin pl.'</td>
<td>son kuzins</td>
<td>kuzins</td>
</tr>
<tr>
<td>grans 'big pl.'</td>
<td>son ãlikus</td>
<td>ãlikus</td>
</tr>
</tbody>
</table>

The forms [tî] pressa tinc 'pressa 'I'm in a hurry' and [ti] pa tinc 'pres 'I have bread' show that the dorsal [t] does not assimilate either (Palmada 1994:109, Mascaro 1976 resp.).

The same restrictions hold morpheme-externally. In other words, homorganic nasal+C clusters and heterorganic clusters consisting of a labial followed by a non-labial are permitted.

(7) Morpheme-internal NC clusters

(a) homorganic

[kambt] cambt 'change'
[kompina] kompana 'bell'
[kambtjama] kampta 'Cambodia'
[komdi] komdi 'candor' 'candour'
[kampur] camgar 'kangaroo'
[kumbari] conqueror 'conquering'

7.2.1.2 Analysis

PoA assimilation comes about when a constraint against heterorganic clusters outranks all relevant PoA-faithfulness constraints. The constraint that bans heterorganic clusters will be called *HETERORGANIC here. This constraint is formally identical to Lombardi’s (1996, 1999) Agree[Place] constraint (also see Baković 1999a,b). However, it will be replaced by a theory of anti-heterorganicity constraints presented in §7.4. This section explicitly argues against the Agree theory, so – to avoid the semblance that the Agree theory is adopted here – the name *HETERORGANIC is employed instead.

For assimilation of coronals to take place, *HETERORGANIC must outrank all faithfulness constraints that preserve coronals: i.e. IDENT[KPT], repeated in (8).

(8) IDENT[KPT] ‘If x is dorsal or labial or coronal, then x has the same place of articulation as x', where x is the correspondent of x.”

To be even more precise, the relevant IDENT[KPT] in Catalan refers to the relation between inputs and output correspondents (i.e. IO-IDENT[KPT]). For discussion of this point, see §7.7.4. Unless otherwise stated, all IDENT constraints mentioned in this chapter refer to the Input→Output dimension. Tableau (9) shows the assimilation ranking at work.

(9) Basic anti-heterorganicity ranking

<table>
<thead>
<tr>
<th>/son kuzins/</th>
<th>*HETERORGANIC</th>
<th>IDENT[KPT]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) son kuzins</td>
<td>(b) son kuzins</td>
<td>*1</td>
</tr>
</tbody>
</table>

The constraint *HETERORGANIC is violated by all heterorganic clusters. So, candidate (a)’s [nk] cluster incurs a violation, while (b)’s [pk] cluster does not. Candidate (a)’s violation is fatal, as shown above.

- Blocking labial and dorsal assimilation

*HETERORGANIC assigns a violation to all heterorganic clusters, not just those with [n]. Section 7.3 will show that this is a necessary fact: there is no constraint that bans coronal+non-coronal clusters alone. However, *HETERORGANIC’s generality raises the question of why labials, palatals, and dorsals do not assimilate in Catalan.
The relevant constraint in the marked-faithfulness theory is IDENT(KP), which preserves input labial and dorsal specifications. With IDENT(KP) outranking *HETERORGANIC, the marked categories are prevented from assimilating. This approach follows Kiparsky’s (1994) analysis.

(10) Blocking assimilation of the marked

<table>
<thead>
<tr>
<th>/som kuzins/</th>
<th>IDENT(KP)</th>
<th>* HETERORGANIC</th>
<th>IDENT[KPT]</th>
</tr>
</thead>
<tbody>
<tr>
<td>#? (a) som kuzins</td>
<td>*!</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) soř̚ kuzins</td>
<td>*!</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

Candidate (b) fatally violates IDENT(KP) because the input labial specification is lost in the output: /m/→ /m/. In other words, IDENT(KP) blocks assimilation, rendering the constraint *HETERORGANIC inactive.

The Catalan ranking therefore illustrates the blocking effect of marked-faithfulness constraints. The constraint IDENT(KP) specifically preserves marked PoA values, so blocking the markedness constraint that promotes unfaithfulness – *HETERORGANIC. However, the markedness constraint outranks all faithfulness constraints that preserve unmarked feature values – IDENT[KPT] – with the result that only unmarked values undergo assimilation.

As a side note, it is impossible to determine the ranking of IDENT[K] in this system (cf §7.2.2). Since IDENT[K] incurs a subset of IDENT(KP)’s violations, ranking it either above or below IDENT(KP) will have no effect in relation to the markedness constraints discussed so far.

• Avoiding Other Outcomes

Like standard OT markedness constraints, the anti-heterorganic markedness constraints only eliminate candidates; they do not specify which of the surviving candidates will win. Thus, *HETERORGANIC bans candidates with a heterorganic cluster like [ŋŋ], but does not specify which of the alternatives – deletion [ŋ], epenthesis [ŋŋ], assimilation [ŋŋ], or coalescence [m] – will apply.

The choice of winner falls to other constraints. Since deletion and epenthesis are ruled out in Catalan, the anti-deletion constraint MAX and anti-epenthesis constraint DEP must both outrank *HETERORGANIC. Tableau (11) illustrates this ranking.

(11) Blocking deletion and epenthesis

<table>
<thead>
<tr>
<th>/som kuzins/</th>
<th>IDENT(KP)</th>
<th>MAX</th>
<th>DEP</th>
<th>*HETERORGANIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>#? (a) som kuzins</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) soř̚ kuzins</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(c) sokuzins</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(d) som kuzins</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

The competition between (a), (c), and (d) shows the need for the ranking || MAX, DEP » *HETERORGANIC ||. If *HETERORGANIC outranked either MAX or DEP, the /mk/ cluster would be resolved by deletion or epenthesis. This point is discussed in detail in §7.3, where epenthesis is used to avoid heterorganic clusters (in Ponapean), and §7.5 where deletion is employed (in Attic Greek).

Other outcomes are ruled out by other faithfulness constraints. For example, coalescence of /mk/ is blocked by the anti-coalescence constraint UNIFORMITY (McCarthy & Prince 1995). Neutralization and metathesis will not improve on *HETERORGANIC, so – by process of elimination – the only option available is assimilation.

• Direction of Assimilation

One further comment is needed in relation to the faithful mapping /som tontus/→ /som tontus/. Significantly, the coronal onset does not assimilate here: *[soñ̌tontus]. An onset-faithfulness constraint will be used to deal with this directionality effect, after Beckman (1998) and Lombardi (1995, 1999).

As Lombardi (1995, 1999) shows, a faithfulness constraint that specifically preserves PoA values in onsets produces regressive assimilation. In the present instance, such a constraint blocks assimilation of onsets if it outranks *HETERORGANIC.

(12) /som tontus/ | IDENT(KP) | onset-IDEN[KPT] | *HETERORGANIC |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>#? (a) som tontus</td>
<td>*!</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) som pontus</td>
<td>*!</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

For further discussion of directionality, see §7.4.

• Ranking summary

Figure 7.1 summarizes the ranking established above.

---

173 I adopt the proposal that (true) palatals are a type of dorsal (coroно-dorsals, or [→-back] dorsals – Keating 1988, E. Pulleyblank 1989) (cf alveo-palatals, which are [→anterior] coronals). So, IDENT(KP) will prevent [ŋf from assimilating to [t] in [æŋ toňus], *[an toňus].
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7.2.1.3 Stop gemination

The PoA-faithfulness constraint IDENT(KP) has visible effects throughout Catalan’s phonology, not just in major PoA assimilation. Another effect is found in stop gemination.

Coda coronal stops in Catalan geminate with a following onset consonant, but labials and dorsals geminate only if their input PoA specification would not be lost. The data in (13) is taken from Palmada (1994:82) and Hualde (1992:397).

(13) Stop gemination

<table>
<thead>
<tr>
<th>Catalan word</th>
<th>English translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>pok 'villages'</td>
<td>set 'seven'  cap 'none'  pok 'few'</td>
</tr>
<tr>
<td>kamp 'field'</td>
<td>capkamp  pokkamp</td>
</tr>
<tr>
<td>bygis 'loos',  bo 'good'</td>
<td>capbygis  pokbygis</td>
</tr>
<tr>
<td>mal 'pain'</td>
<td>capmal  pokmal</td>
</tr>
<tr>
<td>labials 'labials'</td>
<td>cablabials  poklabials</td>
</tr>
<tr>
<td>iures 'free'</td>
<td>cabiures  pokiures</td>
</tr>
<tr>
<td>iuras 'free'</td>
<td>pok iuras</td>
</tr>
</tbody>
</table>

Gemination can be seen as ‘total assimilation’, and is a method of avoiding heterorganic clusters. Like assimilation, gemination is blocked only when it would force unfaithfulness to input dorsal or labial specifications.174 So, /cap mal/→[capmal] is permissible because the input /p/’s labial feature is preserved in the output [m]. However, /pok mal/→[pokmal] is prohibited because the input dorsal specification is lost. Similarly, /cap labial/→[caplabial] is banned because the input /p/ loses its labial specification in the output.

Gemination can be motivated by constraints on syllable contact. As Vennemann (1988) has argued, many languages require a sonority fall from coda to onset segments. Such a condition would rule out the level sonority heterorganic stop-stop clusters and rising sonority [t1], [t1m], and [t1x] clusters. Geminates avoid syllable contact violations because they have a single root node, so there is no sonority cline at all. As expected under a syllable-contact approach, nasal and lateral codas do not geminate (for fricatives, see below): e.g. [son tontus], *[sotontus]; [zontus], *[zontus]. This follows from the use of SYLLCON here – the clusters [nt] and [lt] have falling sonority.

For a recent theory of syllable contact set within Optimality Theory, see Gouskova (2002). The constraint SYLLCON will be used here (Davis 1998), with the caveat that it can no doubt be reduced to the interaction of several different constraints. In any case, the constraint *HETERORGANIC cannot be used instead of SYLLCON here. * HETERORGANIC only motivates PoA assimilation, predicting /set labials/→[/set labials/]; conversely, SYLLCON cannot take over *HETERORGANIC’s role: SYLLCON cannot motivate nasal assimilation: /son pok/→*[sompok] does not violate SYLLCON, and neither does /sompok/.

174 Other assimilation requirements are at work in these alternations: voice assimilation is required (e.g. /pok labial/→[pok labial/]); for discussion of strident-sonorant voice assimilation, see Jun (1995). Some dialects require assimilation in nasality (Hualde 1992:397).
Again, IDENT[KP] outranks SYLLCON, preventing dorsals and labials from geminating.

<table>
<thead>
<tr>
<th>Case</th>
<th>IDENT[KP]</th>
<th>SYLLCON</th>
<th>IDENT[KPT]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) cap[k~amp]</td>
<td>*</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>(b) cal[k~amp]</td>
<td>*!</td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

One assumption that underlies the analysis here is that consonants coalesce to form a geminate. This means that both /p/ and /l/ correspond to output [kp] in candidate (b) below. Because the labial /p/ corresponds to (b)'s dorsal [k], IDENT[KP] is violated. Further discussion of coalescence is provided in chapter 8. Clearly, this approach differs from the traditional analysis that gemination involves an opaque process of coda deletion followed by compensatory lengthening. For relevant discussion, see chapter 8.

- **Liquid assimilation**
  Finally, the ranking established above also accounts for liquid assimilation. For example, the non-palatal lateral [l] assimilates in pataility, but the palatal [l] does not.

<table>
<thead>
<tr>
<th>Case</th>
<th>IDENT[KP]</th>
<th>*HETERORGANIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) cap[k~amp]</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(b) cal[k~amp]</td>
<td>*!</td>
<td></td>
</tr>
</tbody>
</table>

As with nasal assimilation, /l/ can assimilate to palatals without hindrance, due to the dominance of *HETERORGANIC over IDENT[KPT].

As a concluding note, Rice & Avery (1991:116), citing J. Mascaro (p.c.), report that /l/ is realized as [l\^] before labials and [l] before dorsals. Other sources report velarization but not labialization (Wheel 1979:301), and others that /l/ does neither (Hualde 1992:396). Dialects that block velarization and/or labalization can be accounted for by having constraints that ban these marked segments outranking the constraint that motivates place assimilation – i.e., || *I* » *{KPT}*[KPT] ||. The opposite ranking obtains in languages with velarization or labalization.

### 7.2.2 Typology of unmarked-undergoer systems

Catalan represents just one of several types of system in which only unmarked elements undergo assimilation. While Catalan employs IDENT[KP] to block assimilation, others use IDENT[K] or IDENT[KPT]. The result is the typology of unmarked-undergoer systems in Table 7.4.

To explain the notation used in the table, the columns K, P, T, ? indicate whether a certain PoA undergoes assimilation or not. An ✗ indicates that the PoA does not assimilate, and the ✓ indicates that it does assimilate. The grayed box under the ? column indicates that the language bans glottal PoA. For example, the Catalan entry indicates that both dorsals and labials do not undergo assimilation while coronals do; there is no glottal counterpart that is relevant, so the glottal box is grayed-out.

| Table 7.4: Unmarked undergoer systems |
|-----------------|-------------------|
| K   | P | T | Language      | Type          |
| ✓   | ✓ | ✓ | Diola Fongy   | nasal assimilation |
| ✗   | ✓ | ✓ | NBA Inuktitut | stop clusters |
| ✓   | ✗ | ✓ | Yamplu        | stop assimilation |
| ✗   | ✓ | ✓ | Catalan       | nasal assimilation |
| ✗   | ✗ | ✓ | Gujarati      | nasal assimilation |
| ✗   | ✗ | ✗ | Southern Sierra Mowok | nasal assimilation |

The gap in the table is a language that (i) has a glottal element and (ii) assimilates all PoAs except dorsals. This is no doubt an accidental gap given that this system is so like NBA Inuktitut's.

All the cases listed in the table – apart from Catalan – are discussed in turn below.

- **Preservation of all PoAs**
  At one extreme of preservation, IDENT[KPT] outranks *HETERORGANIC. Such a language has no assimilation at all, as in Southern Sierra Mowok (Broadbent 1964).

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175 The constraint on [l] and [l\^] might be considered a manner-specific instantiation of *{KP} - *{K}/liquid.
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N.B.A. Inuktitut shows that faithfulness constraints must distinguish between dorsals and non-dorsals. In short, faithfulness constraints must not only distinguish coronals from non-coronals, but make distinctions among the non-coronals as well.

- **Non-glottal preservation**

As discussed in ch.5, ‘glottal’ is the least marked PoA in the present theory (also Lombardi 1998). Thus, glottals can pattern with coronals in unmarked-undergoer systems. For example, only glottals and coronals undergo assimilation in Yamphu – like Catalan, labials and dorsals are exempt (Rutgers 1998; also see ch.6).

In Yamphu, glottal and coronal stops assimilate to the PoA of a following obstruent while dorsals and labials do not. The data in (21) is from Rutgers (1998:43); for justification of underlying forms, see Rutgers (1998) and ch.6 § 6.3.

(21) **Yamphu assimilation**

(a) /C\ + C/ → [C]

| /ham-beʔ/ → [hambetɛ] | ‘where?’ |
| /haŋpʊ-noʔ-so/ → [haŋpono] | ‘even only now’ |

(b) /h + C/ → [C]

| /paχk\-æ/ → [pako] | ‘it started boiling’ |
| /laʃp-æ-ma/ → [lapɔ] | ‘to do’ |
| /kit-si-ma/ → [kisɔma] | ‘to feel fear’ |

(c) /p + C/ → [pC]

| [ɔpŋŋ] | ‘head scarf’ |
| [kʊpɔk\-æ-ʃi] | ‘Let’s go sticking’ |
| [wæŋa] | ‘chick’ |

(d) /k + C/ → [KC]

| [kʊpɔ] | ‘scrape one’s throat + perform act’ |
| [ʃɛkɔk] | ‘like that’ |
| [tsɔkʊʔ] | ‘nasty, repugnant’ |
| [tsʊkʊm] | ‘six days ago’ |

An alternation that shows [C]-assimilation is found with the possessive suffix. The possessive is underlyingly /æʔzæː:/ e.g. [k-æʔzæː] ‘1+{possessive}’, but before consonants the final vowel deletes: e.g. [pʊw-æʔzæː-ma] ‘river-poss.-down’. Vowel-final deletion often creates a [ʔ]-obstruent cluster. As expected, the [ʔ] is eliminated through gemination: e.g. /hæŋpy-aʔzæː-tʃuʔ-ɛl/ → [hapuŋtshwe] → [hapuŋtʃwe] ‘of the one of Hartjuwa’ (p.65); /maŋpʊw-æʔzæː-tʃuʔ-ɛl/ → [makpʊŋtʃwe] ‘of Magwua’. It is also worth noting that [ʔ]s are not generally banned in codas – only before a following obstruent (cf. [kʊʔ-ma] ‘to fear’ – ch.6 § 3).

As in Catalan, dorsal and labial assimilation is blocked by IDENT[KP]. The following tableaux illustrate the ranking.

| (17) Southern Sierra Miwok lack of assimilation |
| [simpy] ‘close eyes’ | [ponpy] ‘to get dusk’ | [kawɛʔp] ‘shout at s.o.’ |
| [θimpy] ‘to sing’ | [θiŋpy] ‘to think’ | [koŋp] ‘crooked’ |
| [momkʊʔ] ‘moccasins’ | [tyŋkʊʔ] ‘to nam’ | [çiŋkʊʔ] ‘seed basket’ |

At the other extreme, all PoAs asssimilate, as in Dsola Fogny (J.Sapir 1965:16).

(18) **Dsola Fogny nasal assimilation**

| /h+RED+qam/ → [maŋŋɔm] | ‘I judge’ |
| /θan+p+maŋj/ → [paitʃmaŋm] | ‘you (pl) will know’ |
| /θan+RED+qɔŋ/ → [kiloŋ] | ‘they sent’ |
| /apa+RED+qɔŋ/ → [nəŋŋoŋ] | ‘he cut (a) through’ |

- **Dorsal preservation only**

The marked-faithfulness constraints also predict a language in which only dorsals are preserved in heterorganic clusters, since dorsals are the most marked elements. This system is found in Northern Baffin-Aivilik Inuktut (Dorais 1986): this language allows for the surface geminates [p-t] and any cluster starting with a dorsal – either the velar [k] or uvular [q].

To generalize over the data, N.B.A.Inuktut requires coda consonants to either be homorganic or dorsal. For concreteness, assimilation will be assumed to eliminate underlying heterorganic clusters. Accordingly, *HETERORGANIC must outrank all faithfulness constraints that preserve coronals and labials – i.e. IDENT[KP] and IDENT[KP].

(19) **Coronal and Labial Undergoers**

| /tanka/ | *HETERORGANIC | IDENT[KP] |
| (a) tanka | * | |
| * | (b) tarpık’a |

Since dorsals do not undergo assimilation, IDENT[K] must outrank the markedness constraint, as shown in tableau (20).

(20) | /tampaka/ | IDENT[K] | *HETERORGANIC | IDENT[KP] |
| (a) tampana | * | |
| * | (b) tampaka |

There are no alternations to support this assumption. However, by Richness of the Base (P&S 1993) underlying heterorganic clusters must be disposed of in some manner.
Underspecification and the typology of undergoers

It is important to point out that the present theory relies entirely on constraint ranking rather than representation or underspecification to produce the typology of unmarked-undergoer systems reported above. Following Prince & Smolensky (1993), feature values are assumed to be fully specified in the output. As discussed in ch.5§5.3, the coronals – and even the glottals – bear a place feature (Lombardi 1998:6). In fact, the typology of undergoers in assimilation shows that an underspecification approach to unmarked-undergoer systems is unworkable. The underspecification approach to a system like Catalan’s is based on the assumption that segment x can (more readily) undergo assimilation if it lacks place features. For example, if coronal segments have no PoA features in Catalan, the specified PoA features [labial] and [dorsal] may spread into codas without hindrance (Kiparsky 1985:97, Avery & Rice 1989, Cho 1999 and references cited therein).

The typology of undergoers presents two major problems for this approach. One is that only one PoA feature value may be underspecified per language: if two segments both lacked PoA features, they would be phonologically indistinguishable for PoA. Problems therefore arise in a system like Yamphu’s, in which both coronals and glottals undergo assimilation while dorsals and labials do not. The same problem arises for N.B.A. Inuktut, where both coronals and labials assimilate. If ability to undergo assimilation equates with lack of PoA features, then two segment types must lack PoA features in both these languages, making them phonologically indistinguishable.

7.2.2.1 Underspecification and the typology of undergoers

Gujarati presents a case that is similar to Yamphu, but differs in that (i) only nasals assimilate and (ii) only the ‘glottal’ nasal assimilates (see ch.5 for discussion; Trigo 1988): e.g. /aN-tap/→[⟨[ntap⟩] ‘affliction’, cf [⟨dʒɔnato⟩] ‘dining’, [mɛŋpajap] ‘soothing of mind’, [kɒŋbi] ‘peasant’ (Cardona 1965:27). In this language, IDENT{KPT} outranks *HETERORGANIC, preventing all but glottals from assimilating.

<table>
<thead>
<tr>
<th>(22)</th>
<th>/ham-beʔeʔe/</th>
<th>IDENT{KP}</th>
<th>*HETERORGANIC</th>
<th>IDENT{KPT}</th>
<th>IDENT{KPT?}</th>
<th>IDENT{KPT}</th>
</tr>
</thead>
<tbody>
<tr>
<td>– (a) hambeʔe</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– (b) hambeʔe</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(23)</th>
<th>/aktok/</th>
<th>IDENT{KP}</th>
<th>*HETERORGANIC</th>
<th>IDENT{KPT}</th>
</tr>
</thead>
<tbody>
<tr>
<td>– (a) aktok</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– (b) atok</td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

Another problem is that there are languages in which the exact opposite to the Catalan situation holds: dorsals and labials undergo assimilation while coronals do not (see §7.5.1). If ability to undergo assimilation indicates lack of place features, dorsals and labials must lack PoA features in such languages, effectively reversing PoA markedness. In short, proposing that certain segments lack PoA features offers no explanation of asymmetries in undergoers of assimilation once the full typology is considered. In contrast, the present theory has no need to appeal to underspecification – failure to assimilate is solely due to the interaction of constraints (also see Smolensky 1994, Lombardi 1995, 1998, Jun 1995:17ff).

For discussion on the shortcomings of underspecification theory in other areas, see ch.§53, McCarthy & Taub (1992), Kaun (1993), Mohanan (1993), Prince & Smolensky (1993), and Steriade (1995b).

7.2.3 Summary

The aim of this section was to show that there are systems in which marked elements are exempt from processes that avoid heterorganic clusters. The theory not only predicts that unmarked-undergoer systems exist, but that for every possible set of marked feature values there can be a system in which only those values are exempt from assimilation (or some other anti-heterorganic process). With the PoA scale [dorsal] {coronal} [glottal], then, there should be a system in which elements from the following sets are exempt from assimilation: {dorsal}, {dorsal, labial}, {dorsal, labial, coronal}.

North Baffin Aiviluk Inuktitut was shown to be of the first type, with only dorsals avoiding assimilation. Catalan and Yamphu are of the type where dorsals and labials, but not coronals (or glottals), are preserved. In Gujarati all but glottals avoid assimilation. In all cases, the ranking has the same character: a faithfulness constraint that picked *HETERORGANIC, avoiding assimilation. Catalan and Yamphu are of the type where dorsals and labials, but not coronals (or glottals), are preserved. In Gujarati all but glottals avoid assimilation.

7.2.3.1 Unmarked undergoers and the Voice scale

The marked-faithfulness theory applies to every scale, not just to PoA. Therefore, effects similar to those discussed above should be found in the assimilation of every scale/feature. This prediction is borne out for obstruent voicing: the marked [+voice] specification can be exempt from undergoing voicing assimilation (Cho 1999:110, 123ff). Standard Ukrainian provides a relevant case (Bethin 1987, Butska 1997). The marked voiced segments are exempt from voice assimilation.178

177 To clarify, full output specification does not imply that segments may lack features, but rather that features cannot be filled in at the end of the derivation (i.e. after candidate evaluation). The proposal that glottals have a place feature is therefore a separate issue.

178 There is no word-final devoicing. See §7.5.2 for discussion of the relation of medial assimilation to final neutralization.
(24) Ukrainian Voicing
(a) C+vd → C+voC
/borot + ba/ → [borodba] ‘fight’
/pros’ + ba/ → [proz’ba] ‘request’
/jak + ze/ → [jaepe] ‘how’
/vok + zal/ → [vogzal] ‘station’
/jos’ + de/ → [ozide] ‘here/there’
(b) C+vd does not assimilate to [−voice]
[du’ga] ‘handle’
[vezty] ‘to drive’
[xobta] ‘trunk (gen.sg.)’
[ridko] ‘rarely’
[x’vhyd + ko] ‘quick’
[vi’d + pov’idage] ‘answer (imperative)’

The Ukrainian system can be generated using the same ranking schema identified above. For the voicing scale [+voice]→[−voice], there are two faithfulness constraints IDENT[+voice] and IDENT[−voice]. The ranking needed to produce Ukrainian is || IDENT[+voice] → *HETERO-voice → IDENT[−voice] ||, where *HETERO-voice bans clusters that disagree in voicing. Analogous to Catalan, onset-IDENT[−voice] forces assimilation to be regressive.

(25)

<table>
<thead>
<tr>
<th>/borot + ba/</th>
<th>IDENT[+voice]</th>
<th>*HETERO-voice</th>
<th>IDENT[−voice]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) borotba</td>
<td>*1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) borodba</td>
<td></td>
<td>*1</td>
<td></td>
</tr>
</tbody>
</table>

(26)

<table>
<thead>
<tr>
<th>/ridko/</th>
<th>IDENT[+voice]</th>
<th>*HETERO-voice</th>
<th>IDENT[−voice]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) ridko</td>
<td>*1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) ridko</td>
<td></td>
<td>*1</td>
<td></td>
</tr>
</tbody>
</table>


As a closing note, only coda-onset assimilation has been discussed here. The existence of marked faithfulness constraints makes predictions for within-constituent assimilation as well. By having a ranking such as the one provided in ch.8§8.4 for Swedish, within-constituent assimilation can be to the unmarked value: e.g. /albt/ → [apt], /apdt/ → [apt]. In contrast, by having IDENT[+voice] ranked appropriately, voice assimilation in coda constituents can be to the marked value: i.e. /albt/ → [abd], /apdt/ → [abd]. The former of these cases is examined in a number of languages, as observed by Baković (1999b). Baković claims that the latter type is not attested, though the empirical grounds for this assertion are not made clear. Future research will no doubt determine whether within-constituent assimilation can be to either marked or unmarked values, and if – like Catalan – marked elements can be exempt from assimilation.

7.3 The need for marked-faithfulness

The preceding section aimed to show that the marked-faithfulness constraints are desirable – they have attested empirical effects. The aim of this section is to go one step further, showing that the marked-faithfulness constraints are necessary, given certain standard assumptions about CON’s contents.

To elaborate on this aim, the preceding section did not show that marked-faithfulness constraints offer the only solution to unmarked-undergoer systems (i.e. languages of the Catalan type). The alternative is a ‘markedness-reliant’ approach: one that relies on the form of anti-heterorganicity constraints to account for the asymmetric behaviour of undergoers.

For Catalan, a markedness-reliant approach would employ a markedness constraint that only bans coronal+non-coronal clusters, called *{T}{KP} here. *{T}{KP} assigns violations to [nk np], but not to [mk mt]. As the following tableaux show, *{T}{KP} can be used to produce the Catalan system without appealing to marked faithfulness constraints. The only faithfulness constraint used here is one that preserves all desirable – they have attested empirical effects. The aim of this section is to go one step further, showing that the marked-faithfulness constraints are necessary, given certain standard assumptions about CON’s contents.

The Markedness-Reliant approach to unmarked-undergoer systems

(27)

<table>
<thead>
<tr>
<th>/son kosins/</th>
<th>*{T}{KP}</th>
<th>IDENT[Place]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) sonkosins</td>
<td>*1</td>
<td></td>
</tr>
<tr>
<td>(b) sorjkosins</td>
<td></td>
<td>*1</td>
</tr>
</tbody>
</table>

In short, only coronals undergo assimilation in a markedness-reliant approach because only they are subject to active markedness constraints.

The aim of this section is to show that the Markedness-Reliant approach to unmarked-undergoer systems is both too restrictive and not restrictive enough. The marked-faithfulness theory will therefore be argued to offer the only account of unmarked-undergoer systems.

Section 7.3.1 shows that the markedness-reliant approach cannot produce every system that the marked-faithfulness ones can. Specifically, marked-faithfulness constraints can account for certain systems that employ more than one method of avoiding heterorganic clusters while markedness-reliant approaches cannot.
Section 7.3.1 Multiple methods for avoiding heterorganicity

There are several ways to avoid heterorganic consonant sequences. For example, the heterorganic cluster /np/ could be eliminated through assimilation [mp], deletion [p], epenthesis [m], or coalescence [m]. In fact, it is possible for more than one method to be employed in the same language, as happens in Ponapean (Rehg & Sohl 1981, Ito 1986:120ff). The term ‘multiple method system’ will be used below to refer to such cases.

The aim of this section is to show that the Ponapean multiple-method system is amenable to an analysis with marked-faithfulness constraints and that no Markedness-Repliant account of Ponapean is possible, under standard assumptions. Section 7.3.1.1 describes the Ponapean system. Section 7.3.1.2 provides an analysis using the marked-faithfulness constraints. Section 7.3.1.3 shows that a Markedness-reliant approach to Ponapean cannot work. Section 7.3.1.4 identifies predictions of the marked-faithfulness approach for systems that avoid heterorganic clusters in several ways.

7.3.1.1 Ponapean: Description

The following description is based on Rehg & Sohl (1981) and Goodman (1995). The consonants of Ponapean are given in Table 7.5.

Table 7.5: Ponapean consonant inventory

<table>
<thead>
<tr>
<th></th>
<th>labial</th>
<th>dental/ alveolar</th>
<th>palatal</th>
<th>dorsal</th>
</tr>
</thead>
<tbody>
<tr>
<td>stops</td>
<td>p, pʰ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>fricatives</td>
<td></td>
<td>s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>nasals</td>
<td>m, mʰ</td>
<td>ŋ</td>
<td>ŋ</td>
<td></td>
</tr>
<tr>
<td>liquids</td>
<td></td>
<td></td>
<td>ŋ</td>
<td>ŋ</td>
</tr>
</tbody>
</table>

Ponapean has five vowels [i e a o u] (some dialects also have [ɔ]). Long counterparts. Syllables have the shape CV(X), where X is either lengthening of the vowel or a consonant. Onsets are optional in word-initial position only. Word-final position licenses a further consonant, allowing final syllables of the shape CVCC and CV:C in addition to the other types.

Heterorganic clusters are banned in the output. Only sonorant geminates and homorganic nasal+obstruent clusters are allowed, as illustrated in (29).

7.3.3 summarizes the findings of this section.

The formal expression of markedness – ch.7

(29) Ponapean Clusters
(a) Medial Clusters
(i) Nasal+Obstruent
   [manta] ‘next day’
   [sampaçi] ‘world, earth’
(ii) Sonorant Geminates
   [kowal] ‘to rest’
   [nalpē] ‘heaven’
(b) Word-final clusters
   [kens] ‘yaws’
   [mal] ‘forest clearing’
(c) Word-initial clusters
   [na] ‘full’
   [nta] ‘to say’

The restriction to homorganic nasal+obstruent and geminate sonorant clusters can be actively seen in reduplication and certain compounds. For example, the reduplicated form of /pap/ is [sampap] ‘to swim’, not *[papap] since obstruct geminates are not permitted.

- Avoidance of heterorganic clusters 1: prefix+root and classifier+noun

The ban on heterorganic clusters is evident in a number of alternations. Relevant examples at the prefix+root boundary are given in (30). The set in (30a) show changes in the prefix /nan/ ‘in’ – the final /n/ assimilates in PoA to a following obstruent, and totally assimilates to a following sonorant. The data in (30b) show changes with the prefix /lim/ {numeral}. Again, heterorganic clusters are avoided, but in this case through epenthesis.

(30) Prefix+Root heterorganicity elimination
(a) Coronal + Non-Coronal: Assimilation
   [nan + n*] ‘in that house’
   [nan + par] ‘in trade wind season’
   [nam+pʻurpa] ‘between them’
   [nan + selt] ‘in the ocean’
   [na] + kēp ‘inlet’

(b) Word-final clusters
   [na] + kēp ‘inlet’

The markedness constraint needed in a markedness-repliant approach to Catalan – *(T){KP} – predicts an unattested type of neutralization.

- Avoidance of heterorganic clusters 2: prefix+root and classifier+noun

The aim of this section is to show that the Ponapean multiple-method system is amenable to an analysis with marked-faithfulness constraints and that no Markedness-Repliant account of Ponapean is possible, under standard assumptions.
Heterorganic clusters are avoided by assimilation, while non-coronal heterorganic clusters are eliminated by epenthesis.

The following section provides an analysis of this system, starting with the processes employed at the prefix-root/classifier+noun boundaries. It concludes with an account of the differences at the root+suffix juncture.

7.3.1.2 Ponapean: Analysis

There have been a number of analyses of Ponapean heterorganicity-avoidance or processes related to it (Ito 1986, 1989, Blevins & Garrett 1993, Goodman 1995). Goodman (1995) provides an in-depth OT analysis of the assimilation facts and of Ponapean phonotactics in general. The following analysis follows Goodman’s in many respects, primarily differing in its use of the marked-faithfulness constraints and Correspondence Theory (McCarthy & Prince 1995).

For assimilation to eliminate coronal+non-coronal clusters, *HETERORGANIC must outrank all faithfulness constraints that preserve coronal P0A (IDENT[KPT], IDENT[KPT]).

As discussed in the Catalan analysis, further rankings are needed to ensure that assimilation takes place rather than some other phenomenon. To prevent both deletion and epenthesis, both MAX and DEP must outrank IDENT[KPT]. Tableau (34) illustrates the ranking for DEP.

<table>
<thead>
<tr>
<th>(nan-para)</th>
<th>*HETERORGANIC</th>
<th>DEP</th>
<th>IDENT[KPT]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) nampar</td>
<td>$^*$</td>
<td></td>
<td>$^*$</td>
</tr>
<tr>
<td>#*</td>
<td>(b) nampar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) nanpar</td>
<td>$^*$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Candidates (b) and (c) both satisfy *HETERORGANIC – neither has a heterorganic cluster. However, (c) is ruled out by DEP because it has epenthesis; candidate (b) incurs the least significant violation by being featurally unfaithful (i.e. violating IDENT[KPT]).

- **Blocking non-coronal assimilation**
  - Ponapean is like Catalan in that labials and dorsals do not assimilate. So, the Catalan solution can be invoked for Ponapean: IDENT[KP] must block assimilation.
  - However, Ponapean is unlike Catalan in that heterorganic clusters starring with a labial or dorsal are not tolerated on the surface: they are eliminated by epenthesis (e.g. /lim+tip/ → [limatip]). In constraint terms, [limatip] violates DEP but not IDENT[KP].

---

For discussion of changes in manner, such as coda stop nasalization, see Rehg & Sohl (1981:58f) and Goodman’s (1995) extensive analyses.

There is word-final apocope in Ponapean, accounting for the loss of the final /a/ in /tan-para/. I leave analysis of this fact aside here (see Goodman 1995:10ff).
indicating that the latter outranks the former. Furthermore, to get epenthesis at all, *HETERORGANIC must outrank DEP. Tableau (34) illustrates these rankings.

\[
\begin{array}{|c|c|c|c|}
\hline
\text{lim+tip} & \text{*HETERORGANIC} & \text{IDENT[KP]} & \text{DEP} \\
\hline
\text{(a) limtip} & \text{!} & \text{!} & \text{!} \\
\text{(b) lintip} & \text{!} & \text{!} & \text{!} \\
\text{(c) limatip} & \text{!} & \text{!} & \text{!} \\
\hline
\end{array}
\]

The markedness constraint *HETERORGANIC eliminates the fully faithful candidate (a), leaving the assimilated form (b) and the form with epenthesis (c). *HETERORGANIC must outrank DEP otherwise no assimilation would take place in Ponapean at all (cf the Catalan ranking).

The competition between (b) and (c) shows why IDENT[KP] must outrank DEP: (b) is fatally unfaithful to the input labial specification of /n/, so violating IDENT[KP]. In contrast, the candidate with epenthesis (c) only violates the relatively low-ranked DEP.

The ranking established above will still allow coronals to assimilate: since IDENT[KP] does not apply to coronals, it will be inactive in competitions such as [nampar] – *[nangpar], allowing DEP to eliminate the unattested form, as in (34).

Significantly, this analysis relies on the existence of the marked-faithfulness constraint IDENT[KP]. Without a faithfulness constraint that specifically preserves labials and dorsals, there would be no way to prevent non-coronals alone from assimilating rather than having epenthesis.

To summarize, Ponapean is much like Catalan. In both languages, the marked PoA labial and dorsal are preserved. The difference is that Ponapean does not tolerate heterorganic sequences at all, so an alternative non-feature-changing process is employed for non-coronal+C clusters. In ranking terms, the difference relates to the place of DEP.

The constraint *HETERORGANIC only outranks IDENT[KPT] in Catalan; the other faithfulness constraints MAX and DEP outrank *HETERORGANIC, ensuring that neither deletion nor epenthesis could be employed as a secondary method of heterorganicity-avoidance. In Ponapean *HETERORGANIC outranks both DEP and IDENT[KPT], so allowing both assimilation and epenthesis as methods of eliminating heterorganic clusters.

- **Root faithfulness and boundary differences**

  This analysis concludes with an account of the behaviour of coronals at the root+suffix boundary. While coronals assimilate at prefix+root and classifier+noun boundaries, they behave like labials and coronals at the root+suffix boundaries: e.g. /sapan+ki/ → [sapan'ki], *[sapan'ki]. To account for this difference, the constraint Root-IDENT[KPT] is employed here; this constraint requires input PoA specifications of root segments to be preserved (after McCarthy & Prince 1995, Beckman 1998).

  Root-IDENT[KPT] functions like IDENT[KP] in Ponapean: it outranks DEP, so preserving coronals in roots, and therefore preventing assimilation. The result is illustrated in tableau (36).

\[
\begin{array}{|c|c|c|c|}
\hline
\text{/sapan+ki/} & \text{*HETERORGANIC} & \text{Root-IDENT[KPT]} & \text{DEP} \\
\hline
\text{(a) sapanki} & \text{!} & \text{!} & \text{!} \\
\text{(b) sapat'ki} & \text{!} & \text{!} & \text{!} \\
\text{(c) sapan'ki} & \text{!} & \text{!} & \text{!} \\
\hline
\end{array}
\]

The assimilation candidate (b) is ruled out because the input coronal /n/ is part of the root, and so its change to [n] violates Root-IDENT[KPT]. The only remaining candidate is (c), with epenthesis.

In contrast, Root-IDENT[KPT] will not prevent prefix-final consonants from assimilating. For example, the /n/ in /nan-para/ is not part of a root, so Root-IDENT[KPT] will not prevent it from assimilating to [nampar].

- **Ranking summary**

  Figure 7.2 summarizes the rankings identified for Ponapean.

\[
\text{Figure 7.2: Ponapean anti-heterorganicity ranking}
\]

\[
\begin{array}{|c|c|c|c|}
\hline
\text{MAX} & \text{*HETERORGANIC} & \text{IDENT[KP]} & \text{Root-IDENT[KPT]} \\
\hline
\text{DEP} & \text{!} & \text{!} & \text{!} \\
\text{IDENT[KPT]} & \text{!} & \text{!} & \text{!} \\
\hline
\end{array}
\]

As in Catalan, the ranking of IDENT[K] is indeterminate, so it is not included in the diagram above.

7.3.1.3 The failure of Markedness-Reliant approaches

It is now possible to consider an alternative analysis of Ponapean – one in which there are no marked-faithfulness constraints (e.g. see Prince 1998). In other words, this section deals with a hypothetical CON that does not contain faithfulness constraints that preserve marked PoAs alone. This rules out constraints like IDENT[K], IDENT[KP], and IDENT[P], but still allows hypothetical constraints like IDENT[KPT2], IDENT[PT2], and IDENT[T2], none of which preserves marked elements exclusively. Conversely, this section aims to ask whether a theory without a faithfulness constraint that preserves just non-coronals – i.e. IDENT[KP] – can produce the Ponapean system.
The epenthesis ranking

Epenthesis eliminates heterorganic clusters consisting of a non-coronal and another consonant in Ponapean: *lim-tip ⇄ [limtap], *[lintip]. At least two rankings are needed to produce epenthesis. *HETERORGANIC must outrank DEP, in the familiar way.\(^{183}\)

The other ranking needed to eliminate the candidate with assimilation – *[lintip]. To ban this form, some constraint C that favours [limtap] over *[lintip] must outrank DEP; the faithful form may or may not violate C – this violation is irrelevant because the faithful form is eliminated by *HETERORGANIC in any case. The ranking is therefore || *HETERORGANIC, C » DEP ||.

(37)

<table>
<thead>
<tr>
<th>/lim-tip/</th>
<th>*HETERORGANIC</th>
<th>C</th>
<th>DEP</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) limtip</td>
<td>*†</td>
<td>(†)</td>
<td></td>
</tr>
<tr>
<td>(b) lintip</td>
<td></td>
<td>*†</td>
<td></td>
</tr>
<tr>
<td>(c) limtap</td>
<td></td>
<td></td>
<td>*†</td>
</tr>
</tbody>
</table>

Of course, all constraints not mentioned in (37) that favour (b) over (c) must be ranked below C.

What is C?

But what is the constraint C?\(^{184}\)

Suppose that C is a markedness constraint of the standard type – one that assigns a violation based on some output property. Then, *[lintip] must have some property p that [limtap] does not have, and C must assign a violation to p (i.e. C is *p). Furthermore, there is no other constraint D that outranks C and favours a candidate with property p over one without p; more concretely, D does not favour *[lintip] over [limtap].

However, C’s ranking poses a problem for forms with property p. C outranks DEP, and tableau (37) establishes that property p can be avoided through epenthesis. Therefore, since C outranks DEP, there should be no occurrence of p on the surface in Ponapean: all inputs with property p should be realized without p on the surface.\(^{184}\)

Since *[lintip] contains property p, *[lintip] must contain some property that is never faithfully realized. In other words, some aspect of *[lintip] is absolutely ill-formed in Ponapean.

The problem is that nothing in *[lintip] is absolutely banned in the output: *[lintip] contains no feature value or prosodic structure that is not found in other attested forms. Of most relevance, [nt] sequences are found elsewhere: e.g. [manta] ‘next day’, so C cannot be a constraint like NOCODA, *COMPLEX, or the far more specific *[nt]. All of these constraints would trigger epenthesis since they outrank DEP. Therefore, paradoxically, *[lintip] cannot contain p.

This paradox shows that the premise was incorrect: C cannot be a markedness constraint.

Assimilation ranking

Since C is not a markedness constraint, C must therefore be a faithfulness constraint. The only faithfulness difference between [limtap] and *[lintip]’s favour is that the loser fails to preserve the input labial specification. So, C must be a faithfulness constraint that requires preservation of input labial specifications.

In a theory with no marked-faithfulness constraints, though, C cannot preserve labial PoA alone; a constraint like IDENT[P] preserves a marked value without preserving a lesser marked one (i.e. T), and so is a marked-faithfulness constraint. Thus, C must at least require both labials and coronals to surface faithfully in the output: i.e. it is IDENT[PT] (or any other faithfulness constraint that preserves both labials and coronals).

In short, the ranking needed for epenthesis is || *HETERORGANIC, IDENT[PT] » DEP ||.

Unfortunately, this ranking incorrectly predicts that coronal-non-coronal clusters cannot be eliminated through assimilation. For example, there are two significant candidates from input /nan-par/: the form with assimilation [nampar] and the form with epenthesis *[nana]. The ranking || IDENT[PT] » DEP || will incorrectly favour the epenthesis candidate over the former since only *[nana] satisfies IDENT[PT], by preserving the coronal PoA.

In short, a theory without marked-faithfulness constraints predicts that the Ponapean system is impossible. The only way around this problem is to employ a faithfulness constraint that preserves labials but not coronals: IDENT[KP]. This constraint correctly favours [limtap] over *[lintip], but does not favour *[nana] over [nampar].

The next section generalizes this result by identifying the types of ‘multiple-method’ systems – those in which heterorganic clusters are eliminated by two or more different methods – that can be produced using marked-faithfulness constraints.

7.3.4 Marked faithfulness and Multiple Method systems

Theories with only marked-faithfulness constraints, like the present one, make a prediction with regard to multiple-method systems like Ponapean’s.\(^{185}\)

If a language employs both assimilation and another non-PoA changing process (e.g. epenthesis, deletion) to eliminate heterorganic clusters, then the elements that assimilate will always be the least marked ones.

\(^{183}\) The prediction holds only if there are no MAX constraints that refer to marked features – see ch.6 for discussion.
Therefore, /anka/ can never surface as Catalan relies on the existence of a markedness constraint that bans coronal+C clusters.

As discussed in the introduction to this section, the markedness-reliant approach to Catalan relies on the existence of a markedness constraint that bans coronal+C clusters and not assimilation \(*[ampa]a\), some IDENT constraint that preserves coronals – i.e. IDENT[KP] – must outrank DEP. This way, IDENT[KP] will eliminate \([ampa]\), leaving \([anga]\). No faithfulness constraint other than IDENT[KP] can be used here; crucially, since only marked faithfulness constraints are allowed, any constraint that preserves coronals must also preserve labials.

However, this ranking prevents /an-ta/ from assimilating. The assimilated form [anta] will be eliminated by IDENT[KP], meaning that the form with epenthesis *[amta] will win.

- **Generalizing the result**

This result follows from the nature of the different types of faithfulness constraint. IDENT constraints block candidates with assimilation, but not deletion or epenthesis. Because of the form of marked-IDENT constraints, if assimilation of s is blocked, then assimilation of all more marked values is also blocked. So, since assimilation of coronals is blocked in the putative case above, labials cannot assimilate either. Therefore, if assimilation takes place in a system at all, it must happen to the least marked element.

- **Comparison with free-reference theories**

This prediction not only sets the MRH apart from theories without marked-faithfulness constraints, but also apart from theories that allow both marked- and unmarked-faithfulness constraints. Because these theories can contain virtually any IDENT constraint, they will be called ‘free-reference’ theories.

A theory that allows unmarked-faithfulness constraints like IDENT[T] predicts that Anti-Ponapean could exist. Its ranking would be analogous to the one presented for Ponapean using the marked faithfulness theory: i.e. \(*\text{HETERORGANIC, IDENT[T]} \gg \text{DEP} \gg \text{[other IDENTs]}\]. In this ranking, IDENT[T] blocks assimilation of coronals, forcing epenthesis; since DEP outranks all the other IDENT constraints, though, labials and dorsals assimilate.

In short, the present theory predicts that Anti-Ponapean systems cannot exist: in a multiple-method system, assimilation will always apply to the least marked elements.

As a final note, this section has shown that a theory without marked-faithfulness constraints cannot account for multiple-method systems in Ponapean. Therefore, a theory that relies on markedness constraints alone to produce Catalan-type systems is too restrictive; it predicts that systems like Ponapean’s should not exist. The next section is devoted to showing that markedness-reliant approaches are not restrictive enough.

### 7.3.2 Neutralization and the Markedness-Reliant theory

As discussed in the introduction to this section, the markedness-reliant approach to Catalan relies on the existence of a markedness constraint that bans coronal+C clusters alone – \(*[T]\{KP\}\). However, this constraint has an undesirable side effect: it can motivate an unattested type of neutralization.

The unattested system is one in which word-medial coronal codas neutralize to labials: i.e. input /an-ka/ surfaces as [ama] (the symbol \(\sharp\) marks a universally unattested output, given the input) (cf cases where medial codas neutralize to less marked PoAs – §7.6). This type of neutralization is easy to generate with the constraint \(*[T]\{KP\}\), as shown in tableau (39).

![Tableau](image)

The constraint \(*[T]\{KP\}\) rules out the candidate with a coronal+non-coronal sequence (a), leaving \([ampa]\) and \(*[apka]\). IDENT[KP] is irrelevant in selecting the winner – its role is simply to ensure that dorsals are not neutralized in every position (by outranking \(*K\)).

The crucial constraint for choosing between [anka] and *[apka] is the context-free markedness constraint \(*K\), which is violated for every instance of a dorsal in the output. As shown, \(*K\) favours [anka] over [apka], thus producing neutralization of /n/ to \(m\). All constraints that favour [apka] over [ampa] are ranked below \(*K\) (e.g. \(*\text{HETERORGANIC}\)).

The neutralization of /n/ to \(m\) would only apply in heterorganic clusters. Homorganic codas remain faithful: [anta] will surface as [anta] since \(*[T]\{KP\}\) is not violated by homorganic sequences. Furthermore, there is no constraint that favours [anta] over [ampa] – such a constraint would have to be \(*T\), with a variety of undesirable consequences detailed in ch.6.

In short, the constraint \(*[T]\{KP\}\) can produce a system in which coda /n/ neutralizes to \(m\) in heterorganic clusters. Such neutralization is unattested: it goes against the generalization that all ‘horizontally context-free’ neutralizations – i.e. those that are not influenced by neighbouring segments (as in assimilation, dissimilation) – result in a less marked segment (see chapters 8 and 9, Trubetzkoy 1939:81ff).

This point is rather unsurprising, given that the context-free constraint \(*T\) has equally undesirable effects in neutralization: a constraint \(*T\) could cause coronals to neutralize to more marked elements, a point discussed in detail in ch.6§6.

In short, the markedness-reliant approach to Catalan necessarily invokes a markedness constraint that makes unattested typological predictions. Therefore, the only

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180 To anticipate the constraints proposed in §7.4, the Cluster constraints cannot produce this unattested neutralization. No Cluster constraint favours [anka] over [anka]. Specifically, [mk] violates \(*KP\{KP\}\), \(*KP\{KP\}\), and \(*KP\{KP\}\) [mk] violates all of these constraints plus \(*KP\{KP\}\), \(*KP\{KP\}\). In short, [mk] is a local harmonic bound for [mk] in terms of the Cluster constraints. Therefore, /anka/ can never surface as \(\sharp\)[anka] – [anka] will always win.
remaining option is a marked-faithfulness approach, so affirming the existence of marked-faithfulness constraints.

7.3.3 **Summary**

The aim of this section was to show that the marked-faithfulness constraints are a necessary part of CON. Two arguments for marked-faithfulness constraints were presented. The first argument focused on multiple-method systems. It showed that the ranking \[ \text{IDENT(KP)} \gg \text{DEF} \gg \text{IDENT(KPT)} \] is crucial in preventing non-coronals from assimilating, so allowing epenthesis to apply. Alternative analyses in which markedness constraints are responsible for the Ponapean system were shown to be impossible.

The second argument showed that a markedness account of Catalan relies on markedness constraints that ban coronal+non-coronal clusters. Such constraints predict unattested neutralizations, in which \(/n/\) surfaces as \(/m/\) in heterorganic clusters, regardless of the PoA of the following consonant.

In short, only a marked-faithfulness analysis of unmarked-undergoer systems is viable; the alternatives are both too restrictive – failing to account for multiple-method systems like Ponapean’s – and not restrictive enough, producing unattested neutralizations.

7.4 **Eliminating faithfulness to the unmarked**

The preceding sections aimed to show that marked faithfulness constraints exist in CON. The following sections deal with the second aim: to show that no other faithfulness constraints need exist.

In the present theory, if a faithfulness constraint preserves a feature value it also preserves all more marked values. This requirement rules out the PoA-faithfulness constraints in (40).

\[
(40) \quad \text{Non-existing PoA-faithfulness constraints}
\]

\[
\text{IDENT(T)}, \text{IDENT(T)}, \text{IDENT(P)}, \text{IDENT(T)}, \text{IDENT(P)}, \text{IDENT(T)}, \text{IDENT(P)}, \text{IDENT(T)}
\]

This and the following section aim to show that heterorganicity-avoiding processes do not require any of the constraints in (40).

A challenge for this proposal is provided by languages in which only unmarked elements are exempt from assimilation. For example, in Sri Lankan Portuguese (SLP) Creole, only labials and dorsals assimilate – coronals do not: e.g. \(/\text{m}a\text{ŋ}k\text{i}/\rightarrow[\text{m}a\text{ŋ}k\text{i}]\) ‘hand {verbal noun}’. *[\text{m}a\text{ŋ}k\text{i}]; cf \(/s\text{i}\text{ŋ}k\text{i}/\rightarrow[s\text{i}\text{ŋ}k\text{i}]\), *[s\text{i}\text{ŋ}k\text{i}] (Smith 1978, Hume & Tserdanelis 1999).

Such ‘marked-undergoer’ systems have two possible analyses. One invokes a faithfulness constraint that blocks coronals from assimilating. However, this faithfulness constraint necessarily refers to coronals alone: \[ \text{IDENT(T)} \gg \text{*HETERORGANIC} \gg \text{IDENT(KPT)} \gg \text{IDENT(T)} \] is one of the constraints ruled out by the present theory.

The other possible analysis is a markedness-reliant one, and is the one proposed here. The markedness-reliant analysis maintains that coronals are exempt from assimilation in SLP Creole because they are already ‘adequately unmarked’. In other words, SLP Creole tolerates coronal+non-coronal sequences because they are the least marked of all the heterorganic clusters.

Behind this proposal is the idea that not all heterorganic clusters are equally marked. A formal implementation of this idea is presented in §7.4.1. This section proposes a set of constraints that replaces the constraint \(*\text{HETERORGANIC}\) used above. The combined effect of these constraints is to favour clusters composed of less marked elements over those with more marked elements; they are accordingly called the ‘Marked-Cluster’ constraints.

Section 7.4.2 presents an analysis of the SLP Creole system in terms of the Marked-Cluster constraints, showing that an unmarked-faithfulness constraint like IDENT(T) is unnecessary.

The Marked-Cluster constraints predict other marked-undergoer systems, specifically ones in which only dorsals undergo assimilation, and one in which only dorsals and coronals – not labials – assimilate. Section 7.4.3 identifies and analyzes such systems, in Chukchi and Harar Oromo respectively. As for SLP Creole, the Marked-Cluster constraints are shown to eliminate need for non-marked-faithfulness constraints (specifically IDENT(P) and IDENT(K)).

Since the existence of marked-undergoer systems has been explicitly denied in previous work, §7.4.4 identifies other relevant cases, and extends the analysis to unmarked-undergoer systems in voicing assimilation.

As a side-note, Wetzel’s & Mascaró (2001) have identified systems of voicing assimilation that are analogous to SLP Creole’s PoA assimilation (also see Baković 1999b). An analysis of such systems within the present theory is given in §7.4.4.

7.4.1 **The Marked-Cluster constraints: Heterorganicity-avoidance**

There are two leading ideas behind the form of the markedness constraints presented in this section. One is that all homorganic clusters are favoured over heterorganic ones. The other is that some heterorganic clusters are more marked than others. Specifically, those with highly marked components are more marked than those with lesser-marked components.\(^{187}\) For example, \([\text{kp}]\) is universally more marked than \([\text{pt}]\).

The entire set of anti-heterorganic cluster constraints – called the ‘Marked-Cluster’ constraints – is given in (41); their definition is provided in schematic terms in (42). The

187 The earliest precursor to the present theory is Cairns & Feinstein’s (1982) theory of onset cluster markedness (also see Morelli 1998). For recent approaches to cluster constraints in Optimality Theory, see Baertsch (1998) and Gouskova (2002).
Marked-Cluster constraints effectively combine the sets of PoA specifications allowed by the present theory.\(^\text{188}\) As above, K stands for ‘dorsal’, P for ‘labial’, T for ‘coronal’, and ‘F’ for glottal; the constraints in (41) do not refer to a particular manner of articulation; though manner-specific instantiations may be possible (see below for discussion). The constraints are freely rankable.

(41) The Marked-Cluster Constraints (anti-heterorganic markedness constraints)

\[
\begin{align*}
\ast \{K\}\{KP\} & \ast \{K\}\{KPT\} & \ast \{K\}\{KPT^2\} \\
\ast \{KP\}\{K\} & \ast \{KP\}\{KP\} & \ast \{KP\}\{KPT\} & \ast \{KP\}\{KPT^2\} \\
\ast \{KPT\}\{K\} & \ast \{KPT\}\{KP\} & \ast \{KPT\}\{KPT\} & \ast \{KPT\}\{KPT^2\} \\
\ast \{KPT^2\}\{K\} & \ast \{KPT^2\}\{KP\} & \ast \{KPT^2\}\{KPT\} & \ast \{KPT^2\}\{KPT^2\}
\end{align*}
\]

(42) Interpretation of the anti-heterorganic constraints

\(\astXY\) “Assign a violation for every pair of adjacent segments such that

(i) the first segment has a feature \(f_1\) from set X

and (ii) the second segment has a feature \(f_2\) from set Y.”

As an example, the constraint \(\ast\{K\}\{KPT\}\) assigns a violation to all clusters that consist of a dorsal followed by a labial or coronal: e.g. \([pp]\), \([p]\).

Importantly, the constraint does not assign a violation to homorganic sequences – \([p]\). This effectively adopts the autosegmental approach that a sequence of featurally identical elements – a geminate – has a single root node (Halle & Vergnaud 1980, Steriade 1982, Clements 1985, Hayes 1986, Sagé 1986, Schein & Steriade 1986).\(^\text{189}\) Thus, the constraint \(\ast\{K\}\{K\}\) does not assign a violation to the geminate \([kk]\): \(\ast\{K\}\{K\}\) bans two adjacent segments with dorsal PoA, while \([kk]\) is a single segment (i.e. consists of a single root node). Note that \(\ast\{K\}\{K\}\) will assign a violation to ‘fake’ geminates \([kk]\), consisting of two root nodes (a distinction needed in Tigrinya – Schein & Steriade 1986, also see Ker 1999 for discussion of fake geminates).

To provide further examples, \(\ast\{KPT^2\}\{KPT^2\}\) assigns a violation to every sequence with non-identical PoA specifications – i.e. all heterorganic clusters. In contrast, \(\ast\{KP\}\{KPT\}\) only assigns violations to sequences where the first member is a non-coronal: e.g. \([pg]\), \([g]\), \([m]\), \([mp]\), \([mt]\), \([mnp]\). Similarly, \(\ast\{KPT\}\{KP\}\) is only violated by clusters where the second member is non-coronal: e.g. \([pk]\), \([k]\), \([kp]\).

It is worth pointing out that the validity of the Marked-Cluster constraints does not stand or fall on the validity of the autosegmental representation of geminates. The central points here are that (i) there are constraints that assign violations to heterorganic clusters and that (ii) the constraints favour some types of heterorganic cluster (namely, those with highly marked components) over other types (i.e. those with less marked components). Even so, the structural description of the constraints is straightforwardly expressed assuming autosegmental representation, so it will be assumed throughout.

- **Undergoers**

  It is useful to distinguish two general types of Marked-Cluster constraints. In one type, the leftmost set of elements is a subset of the rightmost one: e.g. \(\ast\{K\}\{KPT\}\), \(\ast\{KP\}\{KPT\}\). In the other type, the rightmost set of elements is a subset of the leftmost set: e.g. \(\ast\{KPT\}\{K\}\), \(\ast\{KPT\}\{KP\}\). The different types have distinct empirical effects.

  Constraints of the first type, like \(\ast\{K\}\{KPT\}\), affect undergoers. For example, \(\ast\{K\}\{KPT\}\) will ban clusters consisting of a dorsal+non-dorsal \([pp\;p]\), but will not mitigate against any other heterorganic cluster \([mk\;nt\;np]\). Thus, if \(\ast\{K\}\{KPT\}\) is the only active constraint in a grammar, only dorsal+non-dorsal clusters would be eliminated. This situation happens in Chukchi §7.4.1.3, where only dorsals assimilate.

  The combined effect of the Marked-Cluster constraints is to favour clusters starting with a low-marked element over all those with a highly marked leftmost element. The result is that KC clusters, where C is any consonant that disagrees in PoA with the preceding segment, are local harmonic bounds for PC, TC, and \(\mathcal{C}\) clusters in terms of Marked-Cluster constraints with the form \(\ast\{s\}\{KPT\}\); the same is true of PC as a local harmonic bound for TC and \(\mathcal{C}\) and TC as a local harmonic bound for \(\mathcal{C}\). Thus, the constraints can be used to avoid any contiguous set of these clusters. For example Sri Lankan Portuguese Creole (§7.4.2) avoids KC and PC heterorganic clusters, but allows TC clusters.

  Importantly, the constraints do not present the same problem as the Markedness-Reliant approach discussed in sections 7.2-7.3. That discussion showed that a constraint like \(\ast\{T\}\{KP\}\) has undesirable consequences. In the theory of cluster markedness presented here, there is no constraint \(\ast\{T\}\{KP\}\). Moreover, no ranking of the constraints can be used to ban coronal+non-coronal clusters. More concretely, coronal+non-coronal clusters violate the constraints \(\ast\{KPT\}\{KP\}\), \(\ast\{KPT\}\{KPT\}\), and \(\ast\{KPT\}\{KPT^2\}\). However, labial+non-labial and dorsal+non-dorsal clusters also violate all these constraints. Thus, the constraints could not be used to provide a markedness-reliant account of Catalan – i.e. an analysis without marked-faithfulness constraints.

- **Triggers**

  Constraints of the second type – e.g. \(\ast\{KPT\}\{K\}\) – place restrictions on triggering elements. For example, \(\ast\{KPT\}\{K\}\) bans all heterorganic clusters with a dorsal second member: \([mk\;nk]\), but no others \([pp\;pt\;nt\;np]\). If \(\ast\{KPT\}\{K\}\) were the only active constraint in a grammar that eliminated clusters through assimilation, it would effectively only force assimilation before dorsals. Such a case is found in Korean in §7.5.1.2 (with slightly more complexity).

\(^{188}\) One might enquire as to whether the constraints are formed through local conjunction (Smolensky 1993). They cannot be formed solely through local conjunction since \(\ast\{KPT\}\&\ast\{K\}\) does not specify linear order (e.g. \([mp]\) violates \(\ast\{KPT\}\&\ast\{K\}\), but not \(\ast\{KPT\}\&\ast\{K\}\)) nor adjacency (e.g. \([pp]\) violates \(\ast\{KPT\}\&\ast\{K\}\) – see Alderete 1997 for relevant discussion). For present purposes, it is enough that the constraints favour homorganic clusters over heterorganic ones and establish a ranking between different types of heterorganic clusters.

\(^{189}\) The constraints could be straightforwardly adapted to Selkirk’s (1991) two-root theory, where geminates have two root nodes but still share features. If the constraints banned adjacent PoA features rather than segments with features, Selkirk’s two-root geminates would not violate them. Selkirk’s two-root theory was designed to deal with processes of geminate fission; for discussion of such cases using the single-root approach, see Ker (1999).
Together, these ‘triggering’ constraints also impose relations between different types of cluster: CK clusters, where C is a heterorganic consonant, are local harmonic bounds for CP, CT, and Cʔ clusters in terms of Marked-Cluster constraints with the form *[KP]{KPT}]. Similarly, CP is a local harmonic bound for CT and Cʔ and CT for Cʔ. In short, clusters with a dorsal as the rightmost member are the worst kind in terms of triggering, followed by those with a labial as the second member, and so on. In effect, this means that there can be a language where only dorsals trigger assimilation (Korean), one in which only dorsals and labials trigger heterorganicity-avoidance (Attic Greek – §7.5.1.1), and one in which dorsals, labials, and coronals – but not glottals – trigger assimilation.

Of course, the constraints are not mutually exclusive. They can be intermingled to produce systems with restrictions on both undergoers and on triggers. The following sections will generally focus on grammars with conditions on one or the other. However, the analysis of Kui (§7.5.1.3) shows the need for constraints of the form *[K]{KP}, where coronals are neither undergoers nor triggers.

- Elaborations

As stated in (41), the constraints apply to any type of segment. Since there are often different conditions on heterorganic clusters of different manners of articulation, it is quite possible that there are specific instantiations of the constraints in (41) for certain manners of articulation. Since the aim of this section is to determine the form of faithfulness constraints, little time will be devoted to developing this notion (see §7.6) – the exact form of the markedness constraints will be made clear for each of the case studies as they arise.

Similarly, the constraints in (41) do not refer to constituency, only linear order. So, the constraint *[KP]{KPT} bans heterorganic clusters in any position, regardless of whether they consist of two onset segments, two coda segments, or a coda+onset sequence. While it is possible that further investigation will show the need for versions of these constraints to refer to constituency, the cases studies discussed below provide no relevant evidence (also see Steriade 1995a for relevant work that does not refer to constituency). Again, while this issue is worthy of future attention, it is tangential to the main point here and – more importantly – has no bearing on the claims about faithfulness constraints made in this section.

In fact, for the purposes of this chapter it is only essential that there are markedness constraints that (i) favour homorganic over heterorganic clusters and (ii) distinguish different types of heterorganic cluster, based on PoA markedness. The constraints in (41) are employed because they fulfill these two functions. Supporting evidence is provided in the following sections.

189 I do not mean to imply that there should be a constraint for every possible combination of manner of articulation with PoA. Such an approach would fail to capture the implicational relations in manner of articulation for assimilation, as demonstrated by Padgett (1994) and Jun (1995). Clearly, the role of manner in place assimilation is significant and deserves careful formal development; unfortunately, this is beyond the scope of this chapter.

190 For discussion of Lombardi’s (1995 et seq.) AGREE[F] constraints, see §6.2.

7.4.2 Marked undergoers: Sri Lankan Portuguese Creole

Sri Lankan Portuguese (SLP) Creole is the exact opposite to Catalan: only coronals are exempt from assimilation in the former while only coronals undergo assimilation in the latter (Smith 1978, Hume & Tserdanelis 1999). This section argues that the SLP Creole system – and all ‘marked-undergoer’ systems – comes about through a ban on highly marked clusters. For SLP Creole, this idea is implemented by the constraint *[KP]{KPT}, which only bans heterorganic clusters with a non-coronal as the leftmost element. In effect, then, coronals are already ‘adequately unmarked’ in SLP Creole – they do not assimilate because doing so will not sufficiently improve their markedness.

As a final note, four previous proposals relating to assimilation are compared to the Marked-Cluster theory in the following sections. Sections 7.5 and 7.6 discuss theories that do not make distinctions between different types of heterorganic cluster (e.g. AGREE[Place]), after Lombardi (1995), and those that seek to reduce assimilation to conditions on independent PoA in codas (Ito 1986, Cho 1999). Section 7.7 focuses on two recent theories that have been used to deal with marked-undergoer systems like SLP Creole’s – Lakesovic’s (1999) constraint conjunction approach and McCarthy’s (2002a) Comparative Markedness theory.

7.4.2.1 Description

SLP Creole has the following consonant phonemes:

- The formal expression of markedness – ch. 7
Table 7.6: Sri Lankan Portuguese Creole consonants

<table>
<thead>
<tr>
<th>stops</th>
<th>labial</th>
<th>coronal</th>
<th>palatal</th>
<th>dental</th>
</tr>
</thead>
<tbody>
<tr>
<td>p</td>
<td>t</td>
<td>k</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>d</td>
<td>g</td>
<td></td>
<td></td>
</tr>
<tr>
<td>affricates</td>
<td>tʃ</td>
<td>ʈʃ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fricatives</td>
<td>f</td>
<td>s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>nasals</td>
<td>m</td>
<td>n</td>
<td>j̃</td>
<td>ñ</td>
</tr>
<tr>
<td>laterals</td>
<td>l</td>
<td>r</td>
<td></td>
<td></td>
</tr>
<tr>
<td>rhetics</td>
<td>r</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>glides</td>
<td>w</td>
<td>j</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The short vowels are [i e a o u], with long counterparts [ɪ ɛ ɑ ɔ u]. Syllables have the structure (C)(C)V(C). Complex onsets consist of (1) an obstruent+r] (excepting [ʃ]), and – rarely – (2) an obstruent+tʃ] or (3) [s] followed by a stop. Word-medial codas must be sonorants.

- **Assimilation**

  There are also restrictions on heterorganicity. Labial and dorsal codas require the following obstruent to be homorganic, both within words and across word boundaries. This requirement can be seen in the alternations in (43); the annotation (xx#yy) refers to the page number and example number respectively in Smith (1978), whereas (H&T) refers to Hume & Tserdanelis (1999).

  (43) SLP Creole assimilation data

  (a) /m+C assimilation

  | /muːm/ | → | /muːm/ | ‘I am sweating’ | (100#739) |
  | /maːŋ+s/ə/ | → | /maːŋ+s/ə/ | ‘hand+{genitive}’ | (100#736) |
  | /raːʃəŋ+leʃ/ | → | /raːʃəŋ+leʃ/ | ‘reasonably’ | (100#740) |
  | /boŋ+fiŋtis/ | → | /boŋ+fiŋtis/ | ‘good people’ | (100#738) |
  | /pikinim+kə+wa/ | → | /pikinim+kə+wa/ | ‘small house’ | (100#737) |
  | /maːŋ+kə/ | → | /maːŋ+kə/ | ‘hand {verbal noun}’ | (H&T) |

  (b) /p+fiŋtis assimilation

  | /pikinim+kə+wa/ | → | /pikinim+kə+wa/ | ‘meaning {dative sg.}’ | (H&T) |
  | /un+paːn/ | → | /un+paːn/ | ‘one pound’ | (102#758) |
  | /un ʃək/ | → | /un ʃək/ | ‘one knife’ | (102#757) |
  | /un maːŋ/ | → | /un maːŋ/ | ‘one hand’ | (102#760) |
  | /un ɡaːnu/ | → | /un ɡaːnu/ | ‘for one day’ | (102#758) |
  | /maːŋ+s/ə/ | → | /maːŋ+s/ə/ | ‘meaning {genitive}’ | (H&T) |
  | /aləfiŋtis/ | → | /aləfiŋtis/ | ‘some people’ | (102#756) |

  In contrast, the nasal [n] allows consonants with any PoA to follow it, as shown in (44).194

  (44) /n+C = no assimilation

  | /kaːkəŋ+pə/ | → | /kaːkəŋ+pə/ | ‘turkey {dative sg.}’ | (100#741) |
  | /səŋ+pə/ | → | /səŋ+pə/ | ‘bell {dative sg.}’ | (H&T) |
  | /ɡaːŋ+paːŋ+paːŋ/ | → | /ɡaːŋ+paːŋ+paːŋ/ | ‘grandfather’ | (73#492) |
  | /koːʃəŋ/ | → | /koːʃəŋ/ | ‘convent’ | (102#757) |
  | /səŋ+ki/ | → | /səŋ+ki/ | ‘bell {verbal noun}’ | (H&T) |
  | /səŋ kiːdəq/ | → | /səŋ kiːdəq/ | ‘the ringing of bells’ | (67#465) |

  The same is true of the coronal codas [l r].

  (45) Liquid clusters

  (a) /ʃ]+C

  | /ʃiŋtis/ | → | /ʃiŋtis/ | ‘guih’ | (100#740) |
  | /ʃiŋtis/ | → | /ʃiŋtis/ | ‘guih’ | (100#740) |
  | /ʃiŋtis/ | → | /ʃiŋtis/ | ‘guih’ | (100#740) |

  (b) /ʃ]+C

  | /ʃiŋtis/ | → | /ʃiŋtis/ | ‘guih’ | (100#740) |
  | /ʃiŋtis/ | → | /ʃiŋtis/ | ‘guih’ | (100#740) |

  In short, only labials and dorsals are undergoers in SLP Creole assimilation; coronals are exempt.

---

193 That ‘one’ is underlyingly /nɪŋ/ can be seen by its form before vowel-initial forms like /səŋ+maːŋ+paːŋ/ ‘sometimes’ (101#748, 749).

194 I was unable to find relevant data for the palatal nasal [ŋ] because it does not occur word-finally. In addition, [ŋ] does not occur word-initially, and in intervocalic position it optionally becomes a nasalized glide /n/ (Smith p.92). This means that [ŋ] has a rather marginal phonemic status, only obligatorily occurring in medial codas before a palatal, [ŋp] and [ŋp]. It is therefore possible to treat [ŋ] as an allophone of /n/ here, assimilating to palatals (as in Creado).
7.4.2.2 Analysis

The leading idea behind the following analysis of SLP Creole is that coronals do not assimilate because they are already 'adequately unmarked'. In other words, coronal+C clusters are less marked than non-coronal+C clusters, so allowing them to survive in SLP Creole.

The leading idea is formalized in the present theory through the structure of the anti-heterorganic markedness constraints. In terms of the Marked-Cluster constraints of the type *(x)[KPT], coronal+C clusters incur a proper subset of the violations of other clusters. Specifically, while [n[p,k]] violates only *(KPT)[KPT], [m[t,k]] violates *(KP)[KPT] as well, and [η[p,t]] further violates *(K)[KPT]. Because of this local harmonic bounding relation there is a hierarchy of cluster types: [η] > [m] > [n] > [η].

In effect, SLP Creole only aims to avoid the most marked clusters: it makes a cut above [n[p,k]] clusters, and bans all those that are more marked.

- Avoiding marked clusters

  The Marked-Cluster constraint that is responsible for the SLP Creole system is *(KP)[KPT]. This constraint bans non-coronal+C clusters but not coronal+C ones. *(KP)[KPT] must outrank all PoA-faithfulness constraints that preserve dorsal or labial PoA – i.e. all faithfulness constraints that are satisfied for (i) unmarked coronals alone outranking all PoA-faithfulness constraints that preserve those elements and (ii) faithfulness constraints that preserve unmarked elements outranking all markedness constraints that would eliminate those elements.

  For example, in SLP Creole the constraint *(KP)[KPT] targets marked consonant clusters alone. This constraint outranked all PoA-faithfulness constraints. Since the unmarked coronals did not undergo assimilation, IDENT(KPT) had to outrank all markedness constraints that banned heterorganic coronal-initial clusters (e.g. *(K)[KPT]). This point is schematized in Figure 7.3, which shows the rankings identified above.

(46)

<table>
<thead>
<tr>
<th>(m[pt]+np)</th>
<th>*(KP)[KPT]</th>
<th>IDENT(KPT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) m[pt]+n[p]</td>
<td>*(KP)[KPT]</td>
<td>IDENT(KPT)</td>
</tr>
<tr>
<td>(b) m[pt]+n[p]</td>
<td>*↑</td>
<td>*↑</td>
</tr>
</tbody>
</table>

The ranking in tableau (46) cannot force coronal+non-coronal clusters to assimilate. For example, from /s[qn-pq]/, the faithful output [qnpq] will not violate *(KP)[KPT] because it has a coronal as its first member. Thus, nothing favours the assimilated form *[qnpq], and so the faithfulness constraint IDENT(KPT) makes the crucial decision, favouring the unassimilated [qnpq].

(47)

<table>
<thead>
<tr>
<th>/s[qn-pq]/</th>
<th>*(KP)[KPT]</th>
<th>IDENT(KPT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) s[qnpq]</td>
<td>*(KP)[KPT]</td>
<td>IDENT(KPT)</td>
</tr>
<tr>
<td>(b) s[qnpq]</td>
<td>*↑</td>
<td>*↑</td>
</tr>
</tbody>
</table>

Further to this ranking, to ensure that coronals do not undergo assimilation some faithfulness constraint to coronals – i.e. IDENT(KPT) – must outrank all constraints that ban coronal+non-coronal clusters – i.e. *(KPT)[KPT] (and also *(KPT)[KP], *(KPT)[K]).

7.4.2.3 Summary

To summarize, systems in which unmarked elements are exempt (marked-undergoer systems) come about through the action of markedness constraints. In effect, unmarked elements are exempt in such systems because they are already 'unmarked enough'.

In general terms, the ranking needed for marked-only undergoer systems involves (i) a markedness constraint that targets marked elements alone outranking all faithfulness constraints that preserve those elements and (ii) faithfulness constraints that preserve unmarked elements outranking all markedness constraints that would eliminate those elements.

For example, in SLP Creole the constraint *(KP)[KPT] targets marked consonant clusters alone. This constraint outranked all PoA-faithfulness constraints. Since the unmarked coronals did not undergo assimilation, IDENT(KPT) had to outrank all markedness constraints that banned heterorganic coronal-initial clusters (e.g. *(K)[KPT]). This point is schematized in Figure 7.3, which shows the rankings identified above.

Figure 7.3: Sri Lankan Portuguese Creole assimilation ranking

Again, onset-IDENT[KPT] ensures that assimilation is regressive.

- Alternatives: unmarked faithfulness

  The alternative to the analysis just provided relies on faithfulness to block coronal assimilation. One could appeal to a constraint that only preserves coronals (IDENT[T]) outranking all anti-heterorganicity constraints (analogous to the Catalan analysis). So, from /s[qn-pq], the assimilated candidate *[qnpq] would be eliminated due to the fact that it is unfaithful to the input coronal specification, violating IDENT[T]. Crucially, from /m[pt]-k[f], the candidate [m[pt]k] does not violate IDENT[T], allowing the anti-heterorganic constraints to do their job.

  While an analysis with the unmarked-faithfulness constraint IDENT[T] does in principle work for SLP Creole, §7.5 will show that it cannot replace the Marked-Cluster...
constraints. In contrast, the Marked-Cluster constraints are needed for independent reasons, so unmarked-faithfulness constraints are redundant.

7.4.3 Marked undergoers II: Avoiding dorsals

The Marked-Cluster constraints not only predict a language like SLP Creole, where only labials and dorsals undergo assimilation; they can also generate a language in which only dorsals undergo assimilation. The aim of this section is to show that these predictions of the Marked-Cluster constraints for undergoers are borne out.

Section 7.4.3.1 presents an example of a dorsal-undergoer system – nasal assimilation in Chukchi.

Section 7.4.3.2 discusses a case where only labials undergo assimilation. This system is produced by having both Marked-Cluster constraints and marked-faithfulness constraints active in the same grammar.

7.4.3.1 Chukchi

The most marked cluster consists of a dorsal+C. Such a sequence violates all of the relevant markedness constraints: *{K}{KPT}, *{KP}{KPT}, and *{KPT}{KPT}. The constraint *{K}{KPT} sets dorsal+non-dorsal clusters apart from all other types, predicting a language that tolerates all heterorganic clusters except for this type: i.e. ∗{nt np nk}, ∗{rp np}, ∗{rp pr}.

Chukchi provides a relevant system (Bogoras 1922, Krause 1980, Odden 1988). In this language, only /ŋ/ assimilates to the PoA of a following consonant; /m/ and /n/ remain unchanged. Chukchi consonants are provided in Table 7.7.

<table>
<thead>
<tr>
<th>Table 7.7: Chukchi consonants</th>
</tr>
</thead>
<tbody>
<tr>
<td>stops</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>fricatives</td>
</tr>
<tr>
<td>nasals</td>
</tr>
<tr>
<td>rhotics</td>
</tr>
<tr>
<td>glides</td>
</tr>
</tbody>
</table>

The /ŋ/ assimilation examples below use the morpheme /ŋ/ (e.g. [təŋ-əŋ]-[təŋ-ŋ]) ‘good’. The examples marked (O) below are from Odden (1988:12), those from Bogoras (1922) are marked (B), and those from Krause (1980) are marked K.

(49) Chukchi /ŋ/ assimilation

(a) /ŋ/ assimilates

| [tam-pera-k] | ‘to look good’ (O) |
| [tam-pera-ŋ] | ‘be appeared well’ (B655) |
| [ŋəm-ŋən] | ‘mushroom’ (K21) |
| [tam-vaiʒin] | ‘good state of things’ (B655) |
| [tam-waŋin] | ‘good life’ (K21) |
| [tam-warŋin] | ‘good work’ (B655) |
| [tan-fai] | ‘good tea’ (B655) |
| [tan-fotŋt] | ‘good pillow’ (K21) |
| [tan-[ŋmpt] | ‘good story’ (O) |
| [t[ŋn-ç] | ‘drawers’ (cf [t[ŋn-ç])/K21) |
| [tan-leut] | ‘clean head’ (B655) |
| [telen-remkin] | ‘ancient people’ (B655) |
| [tan-ran] | ‘a good house’ (B655) |
| [tan-[ŋkad] | ‘good breastband’ (O) |
| [telen-jep] | ‘long time ago’ (B655) |
| [ten-ŋajŋ] | ‘to sleep well’ (K21) |

(b) /m/ and /n/ do not assimilate

| [valvintilaŋ] | ‘to Raven-Man’ (B667) |
| [qımın] | ‘my left hand’ (B659) |
| [nimı-ç] | ‘place near the water’ (K41) |
| [qıak-ŋı] | ‘hummock (abs.sg.)’ (K40) |
| [ŋmıc-kiŋ] | ‘often’ (O) |
| [ramkif] | ‘people’ (B665) |
| [tumy-ç-tun] | ‘comrade’ (K40) |
| [nme-erŋplı] | ‘sacrificing shaman’ (B660) |
| [mŋq] | ‘polar bear’ (K40) |
| [n-i-np-u-qın] | ‘old one’ (B658) |
| [ya-n-pera-w-ʃen] | ‘decorated’ (O) |
| [mit-i-nmu-u] | ‘we killed your(sg)’ (B659) |
| [mnglın] | ‘hand’ (B658) |
| [qıŋeq] | ‘boy (abs.sg.)’ (K40) |

The restriction identified above holds of all NC clusters: whether morpheme internal or across morpheme-boundaries, /m/ and /n/ can appear before any consonant, but /ŋ/ can only appear before a velar (Bogoras 1922:652).

- **Glottal or velar?**

  Given the distinction between glottal and velar nasals discussed in ch.5, one may ask whether the surface /ŋ/ cited above is a glottal [N] rather than a velar (cf Trigo 1988). As discussed in ch.5, both glottal and velar nasals are realized with velar constriction, so they are phonetically indistinguishable. Nevertheless, there is phonological evidence that the segment realized as /ŋ/ is underlyingly a velar, not a glottal.

---

195 A process of vowel harmony is responsible for the alternations in the vowels (Bogoras 1922, Krause 1980).
Velars alone undergo a process of spirantization before nasals. Krause (p.18) observes that the velar stop /k/ spirantizes to the velar [ɣ] before all consonants except for [k ɣ j j̚] before which it remains faithful; /ɯ/ does not undergo any analogous change.\(^\text{196}\)

The examples in (50) are taken from Krause (p.18).

(50) Chukchi /k/-lenition

- [ŋәŋ-яя̞-งо̞] cf [ŋәŋ-яя̞-งо̞-л̑] 'the wind blew'
- [ŋәŋ-яя̞-งо̞] cf [ŋәŋ-яя̞-งо̞-л̑] 'he grew up'
- [ŋәŋ-яя̞-งо̞] cf [ŋәŋ-яя̞-งо̞-л̑] 'he woke up'
- [ŋәŋ-яя̞-งо̞] cf [ŋәŋ-яя̞-งо̞-л̑] 'to grow somewhat'
- [ŋәŋ-яя̞-งо̞] cf [ŋәŋ-яя̞-งо̞-л̑] 'he raised slightly'

Notably, /ŋ/ behaves in a similar way. As shown in (49), /ŋ/ assimilates before almost every manner of articulation. However, assimilation is blocked before other nasals. In this environment, /ŋ/ spirantizes, as shown in (51) (from Krause 1980:20).

(51) Chukchi pre-nasal /ŋ/-lenition

- [ŋәŋ-яя̞-งо̞] cf [ŋәŋ-яя̞-งо̞-л̑] 'we competed'
- [ŋәŋ-яя̞-งо̞] cf [ŋәŋ-яя̞-งо̞-л̑] 'let’s build a place to live'
- [ŋәŋ-яя̞-งо̞] cf [ŋәŋ-яя̞-งо̞-л̑] 'he presented him'
- [ŋәŋ-яя̞-งо̞] cf [ŋәŋ-яя̞-งо̞-л̑] 'boy with a cold'

In contrast, /m/ and /n/ remain faithful before another nasal (e.g. [ŋәŋ-яя̞-งо̞] ‘my left hand’, [ŋәŋ-яя̞-งо̞-у̞] ‘sacrificing shaman’, [ŋәŋ-яя̞-งо̞-у̞] ‘we killed you’) – Bogoras 1922.

There are two points to note here. One is that /ŋ/ behaves like the velar /k/ in the fact that it spirantizes, and unlike labials and coronals. The other is that /ŋ/ lenites to a velar [ɣ] rather than a consonant with some other PoA (e.g. [ŋj]). Both of these facts suggest that /ŋ/ is phonologically a velar. If [ŋ] were a glottal nasal [N], its behaviour is more difficult to explain, especially considering that the glottal stop /ʔ/ does not behave analogously to /ŋ/ (i.e. /ŋ/ remains faithful before other consonants and undergoes several processes that /ŋ/ does not – Krause 1980:95ff). For these reasons, Chukchi will be treated as having a velar nasal rather than a glottal [N].

- **Analysis**

In the present theory, only dorsal+non-dorsal clusters violate the constraint *{K}[KPT]. So, with this Marked-Cluster constraint outranking all faithfulness constraints, only dorsal+non-dorsal clusters will be eliminated. To prevent assimilation of labials and coronals, at least IDENT[KPT] must outrank all other cluster constraints (i.e. *{KPT}[KPT], *{KPT}[KPT]).

\(^\text{196}\) The exception is before /ŋ/, before which /k/ is realized as /ŋj: e.g. cf [ŋәŋ-яя̞-งо̞] cf [ŋәŋ-яя̞-งо̞-л̑] 'to sew footwear' (Krause 1980:18).

### 7.4.3.2 Harar Oromo

To complete the typological picture, the present theory predicts that a language could combine properties of Chukchi and Catalan. This section argues that such a case is found in Harar Oromo. Harar Oromo is like Catalan in that a marked PoA is exempt from assimilation (i.e. labials) but a less marked PoA (coronal) is not. However, Harar Oromo is also like SLP Creole in that a marked PoA (dorsal) undergoes assimilation while a less marked one (labial) does not. The net result is that only labials are exempt from assimilation.

- **Assimilation**

Harar Oromo has the consonants in Table 7.8 (Owens 1985, Lloret 1992).

#### Table 7.8: Harar Oromo consonants

<table>
<thead>
<tr>
<th>Stops</th>
<th>Labial</th>
<th>Coronal</th>
<th>Palatal</th>
<th>Dorsal</th>
<th>Glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td>[+v]</td>
<td>t</td>
<td>t̚</td>
<td>(k)(^\text{197})</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>[-v]</td>
<td>p̌</td>
<td>t̚</td>
<td>t̚</td>
<td>ǩ</td>
<td></td>
</tr>
<tr>
<td>+im</td>
<td>ď</td>
<td>ď</td>
<td>ď</td>
<td>ǧ</td>
<td></td>
</tr>
<tr>
<td>-im</td>
<td>ď</td>
<td>ď</td>
<td>ď</td>
<td>ǧ</td>
<td></td>
</tr>
<tr>
<td>Fricatives</td>
<td>f</td>
<td>s</td>
<td>f</td>
<td>x</td>
<td>h</td>
</tr>
<tr>
<td>Nasals</td>
<td>m</td>
<td>n</td>
<td>ň</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Liquids</td>
<td>l</td>
<td>r</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Glides</td>
<td>w</td>
<td>j</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Syllables have the form (C)V(2/C).

\(^\text{197}\) [(k)] only appears as a geminate or as the second consonant of a consonant cluster: [мүлүүн] ‘trees, forest’, [ылï] ‘sea’.
Harar Oromo Assimilation

(a) Dorsal + C₁ → C₂

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Rule</th>
<th>Source(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>/hok' + /ne/</td>
<td>→ [hojnne] 'we scratched'</td>
<td>(24)</td>
</tr>
<tr>
<td>/mek' + /te/</td>
<td>→ [mej'te'] 'you turned'</td>
<td>(22)</td>
</tr>
<tr>
<td>/d'ig' + /ne/</td>
<td>→ [d'iq'jna] 'we wash'</td>
<td>(23)</td>
</tr>
<tr>
<td>/fiq' + /te/</td>
<td>→ [fiq'dde] 'you escaped'</td>
<td>(23)</td>
</tr>
<tr>
<td>/d'ug'j + /ne/</td>
<td>→ [d'ug'jne] 'we drank'</td>
<td>(23)</td>
</tr>
<tr>
<td>/be' + /ne/</td>
<td>→ [be'jne] 'we know'</td>
<td>(optional)</td>
</tr>
</tbody>
</table>

(b) Labial + [C₂] → No change

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Rule</th>
<th>Source(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>/f'ap' + /ti/</td>
<td>→ [f'ap't'i] 'it (fem.) breaks'</td>
<td>(22)</td>
</tr>
<tr>
<td>/k'ab + /ta/</td>
<td>→ [k'ab'ada] 'you have'</td>
<td>(23)</td>
</tr>
<tr>
<td>/gub + /tan/</td>
<td>→ [gub'dan] 'you (pl) burn something'</td>
<td>(23)</td>
</tr>
</tbody>
</table>

There are no root/suffix alternations showing that coronals assimilate in PoA since all suffixes seem to only contain coronals. However, coronal nasals in prefixes assimilate to the PoA of a following stem consonant: / hin-wa/ → [hiwawu] 'he doesn’t bake', /hin-ja/ → [hija'du] 'he doesn’t think', /hin-ra/ → [hira'fu] 'you don’t lie down'.

Coronas also assimilate in manner and voice: e.g. /d'jifa'rul/ → [d'jina] 'we kick'; /d'id-ne/ → [dinne] 'we refused'; /hajj'de/ → [hajj'te] 'mother [nominative]' (p.24).

The same assimilation pattern is also found in the Southern Oromo languages Borana, Orma, and Waata for plain stop+coronal clusters (Lloret 1992:259ff). The Western Oromo languages differ in that only coronals assimilate (i.e. the Catalan system).

It is important to point out that input labial clusters surface faithfully in the language: e.g. [lapp'eq] 'heart', [gubbaq] 'on top' (p.14). So, the failure of labials to assimilate cannot be ascribed to a surface ban on labial geminates.

**Analysis**

Since coronals undergo assimilation, the Marked-Cluster constraint *(KPT)[KPT]* must outrank IDENT[KPT]. No other relevant Marked-Cluster constraint (i.e. *(K)[KPT]* and *(K){KPT}* can be used because these do not ban coronal+non-coronal clusters.

**Why Harar Oromo is like Catalan**

The Catalan-like aspect of Harar Oromo relates to labials. As in Catalan, labials are exempt from assimilation but the less marked coronals are not. As shown for Catalan, the only way to account for this fact is to have a marked-faithfulness constraint blocking assimilation of labials. In ranking terms, the constraint IDENT[KP] must outrank *(KPT){KPT}*, as shown in tableau (56).

**Why Harar Oromo is like Chukchi**

However, there is an important difference between Harar Oromo and Catalan. Neither labials nor dorsals assimilate in Catalan, but dorsals assimilate in Harar Oromo. In this respect, Harar Oromo is like Chukchi – dorsals assimilate while the less marked labials do not.

As in Chukchi, then, some constraint that bans dorsal+non-dorsal clusters must dominate all constraints that preserve dorsals – i.e. IDENT[KP], IDENT[K]. This ranking is shown in tableau (57).

**Tableau 56**

<table>
<thead>
<tr>
<th>Cluster</th>
<th>IDENT[KP]</th>
<th>*(KPT){KPT}</th>
<th>IDENT[KPT]</th>
</tr>
</thead>
<tbody>
<tr>
<td>/f'ap'+/ti/</td>
<td>IDENT[KP]</td>
<td>*(KPT){KPT}</td>
<td>IDENT[KPT]</td>
</tr>
<tr>
<td>/f'ap't'i</td>
<td>IDENT[KP]</td>
<td>*(KPT){KPT}</td>
<td>IDENT[KPT]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cluster</th>
<th>IDENT[KP]</th>
<th>*(KPT){KPT}</th>
<th>IDENT[KPT]</th>
</tr>
</thead>
<tbody>
<tr>
<td>/mej'te'</td>
<td>IDENT[KP]</td>
<td>*(KPT){KPT}</td>
<td>IDENT[KPT]</td>
</tr>
<tr>
<td>/mej't'e'</td>
<td>IDENT[KP]</td>
<td>*(KPT){KPT}</td>
<td>IDENT[KPT]</td>
</tr>
</tbody>
</table>

No other markedness constraint will work. For example, *(K){K}[KPT]* must be ranked below IDENT[KP], otherwise labials would assimilate. Similarly, there is no faithfulness constraint that can force dorsals to assimilate. Figure 7.4 shows the full ranking of the constraints.

Figure 7.4: Harar Oromo assimilation ranking

```
*(K)[KPT]*
<table>
<thead>
<tr>
<th>IDENT[KP]</th>
<th>IDENT[K]</th>
</tr>
</thead>
<tbody>
<tr>
<td>*(KPT){KPT}</td>
<td>*(KPT){KPT}</td>
</tr>
</tbody>
</table>
```

---

198 Assimilation is accompanied by diphthongization, described by Owens (p.24) as “a strong palatalization in the vowel preceding the velar consonant: e.g. /bok'ne/ → [boq'ne] ‘we scratched’. The diphthong formed has almost the same status as underlying /j/ clusters, shown by the fact that a rule of raising (/aj/ → /i/) – e.g. /a[ji]p'uf/ → [a[ji]p'uf] ‘make someone hear’ – can optionally apply to them: e.g. /a[ji]p'uf/ → [a[ji]p'uf] ‘river is mom’. For further discussion, see Owens (1985:20, 23-4).

199 Consonant clusters with /f/ as the first member are also banned. These are eliminated by assimilating the /f/ to the preceding vowel: /d'f'aja'fi/ → [d'ja'faj]. *(d'ja'faj)* ‘she returns’ (Owens 1985:20). Clusters with /f/ as the first member are not reported by Owens.

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Rule</th>
<th>Source(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>/hin-wa/</td>
<td>→ [hiwawu] 'he doesn’t bake'</td>
<td>(54a)</td>
</tr>
<tr>
<td>/hin-ja/</td>
<td>→ [hija'du] 'he doesn’t think'</td>
<td>(24)</td>
</tr>
<tr>
<td>/hin-ra/</td>
<td>→ [hira'fu] 'you don’t lie down'</td>
<td>(24)</td>
</tr>
<tr>
<td>/d'jifa'rul/</td>
<td>→ [d'jina] 'we kick'</td>
<td>(54b)</td>
</tr>
<tr>
<td>/ja'/</td>
<td>→ [jine] 'we know'</td>
<td>(optional)</td>
</tr>
<tr>
<td>/f'ap'/</td>
<td>→ [f'ap't'i] 'it (fem.) breaks'</td>
<td>(22)</td>
</tr>
<tr>
<td>/k'ab/</td>
<td>→ [k'ab'ada] 'you have'</td>
<td>(23)</td>
</tr>
<tr>
<td>/gub/</td>
<td>→ [gub'dan] 'you (pl) burn something'</td>
<td>(23)</td>
</tr>
</tbody>
</table>

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334

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335
7.4.4 Exempting the unmarked elsewhere

Since it has been claimed that marked-undergoer systems do not exist (Mohanan 1993:63,76, Jun 1995:33,70ff), this section provides further evidence for this type of assimilation system.

The SLP Creole-type system is common among Australian languages. For example, Alyawarra allows both homorganic and coronal codas, but no other types: e.g. [inpima] 'get', [aranka] 'beard', [antira] 'fat', [ampa] 'child', [arka] 'child' (Yallop 1977). Other examples include Bardi (McCall 1975), Kuuku Ya’u (Thompson 1988), Lardil (Hale 1973), Ngawun Mayi (Breen 1981), Ngiyambaa (Donaldson 1980), Nhanda (Blevins 2001), and Nunggubuyu (Heath 1984). Sources for several of the languages show alternations. For example, Nunggubuyu eliminates dorsals in heterorganic clusters in a variety of ways, but always retains coronals.

(58) Nunggubuyu: marked-undergoers only

(a) ñy assimilation and ñy deletion

root [qimun] 'belly' [wulaq] 'soft'

+pergressive [ama-qimun-baŋ] [ama-wulu-baŋ]

=locative [qimun-diŋ] [wulu-diŋ]

+relative [ama-qimun-piŋŋiŋ] [ama-wulu-piŋŋiŋ]

(b) ñ/ and ñ/ preservation

[man-bajama] ‘group to keep going’ [wadbar] ‘grevellea’

[a-μn-baŋ] ‘by foot’ [ŋindjaŋ] ‘to prod’

[dan-guru-ŋiŋ] ‘to have a bellyache’

Outside Australia, the Uralic language Saami has the same restriction (Bye 2001:139).

The Dravidian language Tamil exhibits the same restriction in syllable-initial codas: dorsal and labial nasals undergo assimilation, and coronals do not (e.g. [tun.bã] ‘sorrow’, cf [mo.n-μn-tuŋ] ‘tree (emphatic)’ (Beckman 1998:2.4.4, Asher 1985, Christdas 1988).
It is important to point out that codas are not devoiced in Mekkan (59c), so the fact that they appear voiceless in front of voiceless segments must be due to assimilation. This pattern of assimilation can be accounted for by having cluster constraints for the voicing scale [+]voice – [-voice] analogous to the ones proposed for PoA above. This would produce four constraints, listed in (60).

(60) Voicing-Cluster Constraints

- *[±vd][+vd] bans voiceless+voiced clusters
- *[±vd][±vd] bans voiceless+voiced and voiced+voiceless clusters
- *[+vd][±vd] vacuously satisfied
- *[+vd][±vd] bans voiced+voiceless clusters

As an example, *[+vd][±vd] bans clusters of a voiced segment followed by a voiceless segment – as with the PoA cluster constraints, clusters that agree in voicing are not banned. Mekkan Arabic can be produced by ranking a constraint that specifically targets voiced segments – i.e. *[±vd][±vd] – over all faithfulness constraints, which in turn outrank the anti-heterorganic constraint against voiceless elements: i.e. *[±vd][±vd]. The result is illustrated in the following two tableaux.

(61) [\(\text{?a\text{q}\text{a}\text{t}\text{a}\text{b}\text{a}\text{s}}\) *{[+vd][±vd]} IDENT{[±vd]} *[±vd][±vd]]

<table>
<thead>
<tr>
<th></th>
<th>*[+vd][±vd]</th>
<th>IDENT{[±vd]}</th>
<th>*[±vd][±vd]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (\text{?a\text{q}\text{a}\text{t}\text{a}\text{b}\text{a}\text{b}})</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) (\text{?a\text{q}\text{a}\text{t}\text{a}\text{b}\text{a}\text{b}})</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

(62) [\(\text{?a\text{k}\text{a}\text{b}\text{a}\text{r}}\) *{[+vd][±vd]} IDENT{[±vd]} *[±vd][±vd]]

<table>
<thead>
<tr>
<th></th>
<th>*[+vd][±vd]</th>
<th>IDENT{[±vd]}</th>
<th>*[±vd][±vd]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (\text{?a\text{k}\text{a}\text{b}\text{a}\text{r}})</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) (\text{?a\text{k}\text{a}\text{b}\text{a}\text{r}})</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

In short, marked-undergoer systems are neither particularly rare nor confined to PoA assimilation. To summarize, this section has argued that systems in which only unmarked elements undergo assimilation do not require faithfulness constraints that specifically preserve unmarked elements. The markedness constraints of the present theory provide an adequate solution. The next section provides independent evidence for the Marked-Cluster constraints.

7.5 Triggering heterorganicity avoidance

The aim of the preceding section was to show that there is no need to appeal to unmarked-faithfulness constraints like IDENT{T} to account for systems in which only marked elements undergo assimilation. The argument presented was that such ‘marked-undergoer’ systems fall out from the proposal that heterorganic clusters differ in markedness, as formally expressed by the Marked-Cluster constraints.

The aim of this section and §7.6 is to show that the Marked-Cluster constraints are needed independently, for phenomena other than marked-undergoer systems. Since the Marked-Cluster constraints are necessary in any case, they not only pose an alternative to the unmarked-faithfulness constraints, but also render them redundant.

The rest of this section presents evidence for the Marked-Cluster constraints from ‘triggers’ of heterorganicity-avoidance. For example, only dorsal and labial onsets trigger deletion of preceding non-homorganic consonants in Attic Greek. For example, underlying /k/ is deleted before [k]: e.g. \(\text{?a\text{n}\text{u}\text{t}\text{k}a\text{a}}\) → [anuka], \(\text{?a\text{n}\text{u}\text{t}\text{k}a\text{a}}\) ‘I have accomplished’. In contrast, stops are not deleted before [t]: e.g. \(\text{?a\text{n}\text{u}\text{t}\text{k}a\text{a}}\) → [anuka].

The following case studies affirm the typological generalization made by Mohanan (1993:75.6) that there is an implicational relationship between different PoA types in terms of triggering elements (also see Jun 1995:71,78). That is, if x triggers avoidance of heterorganic clusters, then all segments with a more marked PoA also trigger heterorganicity-avoidance.\(^{201}\) For example, [p] in Attic Greek triggers heterorganicity-avoidance: it forces deletion of a preceding segment that disagrees in PoA. This implies that [k] will do the same, but does not imply that [t] will do so. In Korean (§7.5.1.2), dorsal clusters before preceding elements to assimilate to them, but labials and coronals do not.

In contrast, there is no language in which only coronals trigger assimilation (or deletion, or any other heterorganicity-avoiding process).

This asymmetry is shown to follow from the form of the Marked-Cluster constraints. The Marked-Cluster constraints favour clusters with a less marked rightmost element over those with a more marked rightmost element: [pk, tk, kp, tp] kt, pt. From this, the following sections show that a language cannot both avoid clusters with a rightmost coronal and tolerate clusters with a more marked second member.

Section 7.5.1 discusses Attic Greek. This section provides evidence for the constraint *[KPT]* [KP].

Section 7.5.2 presents an analysis of assimilation in Korean, in which dorsals trigger assimilation in preceding elements, but labials and coronals do not (with the added

\(^{201}\) To be accurate, Mohanan (1993) only refers to assimilation. I generalize the prediction here to all processes that are used to avoid heterorganic clusters (e.g. deletion, epenthesis, coalescence, metathesis).
complexity that coronals always undergo assimilation). This section is shown to provide evidence for the constraint *(KPT)K.K.

Section 7.53 fills out the typology by showing the need for the constraint *(K)KP, which accounts for interesting effects in Kui metathesis.

By showing that constraints of the sort *(KPT)KP, *(KPT)K, and *(K)KP exist, it is clear that different types of heterorganic clusters have different markedness. Having shown that these constraints are independently necessary, the SLP Creole system is argued to follow accordingly. Section 7.54 presents this argument in detail.

Section 7.6 presents evidence for the Marked-Cluster constraints from neutralization. Section 7.7 discusses two recent theories that aim to account for marked-undergoer systems – Bakovic’s (1999ab) theory of markedness faithfully constraint conjunction, and McCarthy’s (2002a) theory of Comparative Markedness.

7.5.1 Triggering deletion in Attic Greek

Yip (1991) observes that heterorganic clusters with a coronal member can be exempt from heterorganicity-eliminating processes. In this respect, such clusters are treated like homorganic ones. Yip terms the ban on heterorganic clusters without a coronal the ‘Cluster Condition’. This section expresses the Cluster Condition in terms of the Marked-Cluster constraints, focusing on stop+stop clusters in Attic Greek.

This section shows that Attic Greek is the mirror image of SLP Creole. In SLP Creole, coronal+non-coronal clusters escape elimination (through assimilation) because they are the least marked cluster type (formally expressed by *(KP)KPT). In Attic Greek, non-coronal+coronal clusters escape elimination (through deletion) for the same reason, though a different constraint – *(KPT)K – is responsible.

The striking aspect of the Attic Greek case (and the others reported in the following sections) is that the featural content of the second cluster element determines whether the cluster is eliminated; this contrasts with a language like Catalan where any consonant – labial, palatal, or dorsal – may trigger assimilation of a preceding coronal.

It is also worth pointing out that the Attic Greek restriction is not unique: a number of other Indo-European languages share this property. Apart from English, another striking example is Swedish. Just like Attic Greek, the permissible clusters (in both medial and word-final position) are (1) K{K,T}, (2) P{P,T}, and (3) TT: i.e. homorganic clusters and clusters with a coronal as the second member (Sigurd 1965).202

7.5.1.1 Description

Attic Greek consonant clusters have been described extensively by Lupas (1972), Sommerstein (1973), Steriade (1982) and Bubeník (1983). Stop clusters are the focus of this section; their relation to other cluster types is discussed at the end.

---

202 The one exception is [mk], which is found medially (but not [mg]). More precisely, [nasal+C] clusters show this pattern, [stop+C] clusters also show this pattern, with the restriction that homorganic stop-stop clusters (i.e. geminates) are banned. Clusters of a moraic sonorant ([l r]) + C allow the C to have any PoA.

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The consonants of Attic Greek are given in Table 7.9. There are three series of stops, contrasting in voicing and aspiration; each series contrasts three places of articulation.203

<table>
<thead>
<tr>
<th>Stops</th>
<th>Labial</th>
<th>Coronal</th>
<th>Palatal</th>
<th>Dorsal</th>
<th>Glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>t</td>
<td>k</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pʰ</td>
<td>tʰ</td>
<td>kʰ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>d</td>
<td>q</td>
<td></td>
<td></td>
<td>h</td>
</tr>
</tbody>
</table>

Nasals:

<table>
<thead>
<tr>
<th>Nasals</th>
<th>M</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquids</td>
<td>i</td>
<td>r</td>
</tr>
<tr>
<td>Glides</td>
<td>w</td>
<td>j</td>
</tr>
</tbody>
</table>

In word-internal stop clusters the second consonant must be either coronal or homorganic to the preceding consonant: [pt kt bd cd tʰ kʰ] are admissible, while *[tp tk pk db dʰ kʰ] are not (Steriade 1982, Bubeník 1983:89ff).204

---

203 [b] occurred only initially and [p] only before dorsals. There are five short vowels [i y e a o] and accompanying long vowels (see ch. 8.2 for further discussion).

204 Obstruent clusters have to agree in voicing and aspiration, hence the absence of [pd kd bt g pʰ kʰ]. [gʰ] is only attested medially.

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Paul de Lacy

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The data in (a) shows elimination of [tʰk] clusters through deletion of the first member; (b) and (c) are provided for way of comparison. The annotation [Sxx] refers to page numbers in Steriade (1982).

---

341

Alternations that show the stop-cluster restrictions in action are given in (64). The data in (a) shows elimination of [tʰk] clusters through deletion of the first member; (b) and (c) are provided for way of comparison. The annotation (Sxx) refers to page numbers in Steriade (1982).
7.5.1.2 Analysis

The leading idea behind the following analysis of Attic Greek is that non-coronal+coronal clusters are distinguished because they are already ‘adequately unmarked’. This is formally expressed through the constraint */KPT|KP*, which bans heterorganic clusters with a non-coronal as the second member.

Since the response to heterorganic clusters in Attic Greek is deletion, two rankings are needed. One is that */KPT|KP* must outrank MAX (the anti-deletion constraint – McCarthy & Prince 1995), as shown in tableau (65).

| /anut\+k\+\+a/ | */KPT|KP* | MAX |
|---------------|--------|-----|
| (a) anutka     | *!     |     |
| (b) anukka     |        | *!  |

The other ranking ensures that deletion takes place rather than assimilation or epenthesis: i.e. [\[\]] DEP, IDENT[KPT] > MAX [[\[\]]. Tableau (66) illustrates this ranking.

A separate issue is why the rightmost consonant of the cluster survives. The constraint \σ\-CONTIGUITY will be employed here, after Lamontagne & Rice (1995) (for an alternative see Wilson 2000, and McCarthy’s 2002b critique). \σ\-CONTIGUITY requires every segment within a syllable to have contiguous correspondents in the input. So, [anu\ka] satisfies \σ\-CONTIGUITY because /\mu/ are contiguous, as are /\ka/. However, */anu\ta|* violates \σ\-CONTIGUITY because /\hi/ and /\ai/ are not contiguous.

\σ\-CONTIGUITY can almost be ranked in any position (analogous to the behaviour of onset-IDENT[KPT] in Catalan). At the very least, it must outrank */\{K* and */KP*, otherwise deletion will be sensitive to featural content (cf Wilson 2000).

- Coronals

The ranking established above does not eliminate clusters with a rightmost coronal member. Tableau (67) illustrates this point for /di\o\k\+\i\e\n/, in which the /\kt/ cluster surfaces faithfully: [di\o\k\te\n].
7.5.1.3 Alternatives: Faithfulness and Agreement

Approaches to Attic Greek that rely on faithfulness constraints to obtain the right results face significant difficulties.

The problem with a faithfulness analysis is that there are no asymmetries in faithfulness in Attic Greek: every segment type can undergo deletion – dorsals delete in /kp/ clusters, labials delete in /pk/ clusters, and coronals delete in /k/ and /tp/ clusters. So, a faithfulness constraint that preserves labials and/or dorsals will ‘over-preserves’, preventing deletion in /kp/ and /pk/ clusters.205

Unmarked-faithfulness constraints (like IDENT{T}) also cannot be used to deal with the Attic Greek system. In short, the empirical effects of Marked-Cluster constraints and unmarked-faithfulness constraints are distinct: Marked-Cluster constraints provide a solution to Attic Greek, while unmarked-faithfulness constraints do not.

As a final note, the only type of faithfulness approach that can be used in Attic Greek is one that invokes a context-sensitive faithfulness constraint: specifically, a constraint like MAX{/coronal}, which bans deletion before a coronal. A more formal definition is given in (68).

(68) \( \text{MAX} \{/\text{coronal}\} \) “For all \( x \) such that \( x \) precedes a coronal in the input, \( x \) has an output correspondent \( x \).”

Similar ‘pre-coronal’ faithfulness constraints have been proposed in previous work – specifically Jun’s (1995:129) IDENT constraints. However, they have undesirable typological effects. A set of faithfulness constraints of the form IDENT{\( x \)}, where \( x \) is a set of PoAs (after Jun 1995) effectively preserves PoA in word-medial codas.206 Their existence in CON therefore predicts a language with more PoA contrasts in codas than in onsets. For example, the ranking \( \| \text{IDENT} \{/\text{KPT}\} \rightarrow *\{/\text{K}\} \rightarrow \text{onset-IDENT} \{/\text{K}\}, \text{IDENT} \{/\text{K}\} \| \)

...
7.5.1.4 Relation to other processes and clusters

To round off the analysis of Attic Greek, this section examines the relation of the ranking above to the process of stop deletion. It concludes by discussing cooccurrence restrictions on clusters other than stop+stop ones.

- **Stop deletion**
  
  Stops delete word-finally in Attic Greek, illustrated in (70) (Steriade 1982, Ito 1986:104).

  \[(70)\] /onomat/ → [onoma] ‘name {nom.sg.}’ cf [onomat-os] {gen.sg.}
  /brɔmat/ → [brɔma] ‘solid food {nom.sg.}’ cf [brɔmat-os] {gen.sg.}
  /gınaik/ → [gına] ‘woman {voc.}’ cf [günıaik-a] {acc.sg.}
  /galaik/ → [gala] ‘milk {acc.sg.}’ cf [galaık-os] {gen.sg.}

  Word-final stop deletion is no doubt motivated by a different process than deletion in clusters (cf Ito 1986:104f). Word-final stop deletion can be motivated by the constraint \(\Delta \mu \leq \Delta \mu_{\text{STOP}}\), which bars segments with equal or less sonority than a stop as moraic DTes (coda consonants are taken to be moraic here); this constraint is essentially the same as Ito’s (1986:105) coda condition for Attic Greek. If \(\Delta \mu_{\text{STOP}}\) outranks MAX, coda stops will be deleted.

  To prevent \(\Delta \mu_{\text{STOP}}\) from deleting medial stop codas, the constraint I-\text{CONTIG} can be employed (McCarthy & Prince 1995); I-\text{CONTIG} requires input segments to have contiguous outputs, so banning deletion internal to a string (also see Kenstowicz 1994b). In short, [I-\text{CONTIG} = \*\(\mu_{\text{STOP}}\) = \*MAX].

  The tableau below illustrates this ranking with the word /paraptomat/ ‘a false step’ ([paraptomat] {nom.sg.}, [paraptomatos] {gen.sg.}).

\[\begin{array}{c|c|c|c}
\text{/paraptomat/} & \text{I-\text{CONTIG}} & \*\(\mu_{\text{STOP}}\) & \text{MAX} \\
\hline
(a) \text{paraptomat} & \* & \* & \* \\
(b) \text{paraptomat} & \* & \* & \* \\
(c) \text{paraptomat} & \* & \* & \* \\
\end{array}\]

The constraint I-\text{CONTIG} is violated by (c) because the output substring [at] is not a contiguous string in the input. This leaves candidates (a) and (b); (a) violates \*\(\mu_{\text{STOP}}\) twice because it has two stop codas. So, (b) wins.

---

\[\begin{array}{c|c|c|c|c}
\text{\textit{anuit+k+a/}} & \*\{\text{KPT}\} & \{\text{KP}\} & \text{I-\text{CONTIG}} & \*\(\mu_{\text{STOP}}\) & \text{MAX} \\
\hline
(a) \text{anutka} & \*1 & \* & \* & \* & \* \\
(b) \text{anuka} & \* & \* & \* & \* & \* \\
\end{array}\]
Nasals are most likely to assimilate, followed by stops; fricatives and non-nasal sonorants are least likely to assimilate (p.69).

The difference can be dealt with in the present theory by employing separate anti-heterorganic constraints for different manners of articulation. Thus, there can be separate constraints for Stop+Stop sequences, Nasal+Stop clusters, and Liquid+Stop sequences. In Attic Greek, then, *{t[mn]}{[kpt]} rules out all but homorganic nasal+stop clusters, while */{[kpt]}{[kp]} deals with stop+stop clusters.

This extension to the theory will not be pursued further here, but merely note that it offers a way to distinguish between the behaviour of different clusters (see Jun 1995, and ch.5 for discussion).

7.5.1.5 Summary

In summary, the account of Attic Greek presented above crucially relies on the fact that a markedness constraint distinguishes different types of heterorganic clusters. Specifically, */{KPT}{KP} only bans heterorganic clusters with a non-coronal second member. The previous sections argued that alternative solutions without such a constraint face significant difficulties.

There are a number of similarities between the present theory and Yip’s (1991) Cluster Condition. In effect, Yip’s Cluster Condition draws a distinction between lesser-marked heterorganic clusters and more marked ones, just as the Marked-Cluster constraints do. As with the Marked-Cluster constraints, the Cluster Condition has a potentially symmetric effect: it allows coronal+C or C+coronal heterorganic clusters to be the least marked type in a particular grammar, depending on other conditions in the language (i.e. Attic Greek cf SLP Creole).

One of the major differences between the Cluster Condition and the present theory is that the Marked-Cluster constraints distinguish several different degrees of heterorganic-cluster markedness, with coronal+C/C+coronal clusters simply the least marked. The next section shows that this difference is warranted: C+dorsal clusters are also distinct from all other types (also cf Chukchi and Harar Oromo, which treat dorsal+non-dorsal clusters as more marked than all other types).

As a concluding note, the Attic Greek cluster restriction is found in a number of Indo-European languages (Yip 1991). For a recent discussion relating to its activity in English, see Lamontagne (1993).

208 Yip (1990:64) accounts for asymmetries in Attic Greek (i.e. *[bk] vs *[hl]) by requiring the leftmost consonant to contain the marked (i.e. labial or dorsal) PoA. Thus, the Cluster Condition does not necessarily have a symmetric effect – i.e. it does not necessarily ban both non-coronal+C and C+non-coronal clusters in a language. The similarities between the present theory and the Cluster Condition mean that Jun’s (1995:22) criticism of the Cluster Condition applies equally to the present theory. Jun points out that Yip’s condition allows for a language with (1) homorganic clusters, (2) coronal+C clusters, and (3) C+coronal clusters; the only clusters banned would therefore be *[kp] and *[fh]. The present theory predicts the same: */{KPT}{KP} = *[menn][KPT] in Jun observes that such a system is unknown. However, one possibility is Lariani Trail (1970), which allows *[pt], *[kt], and *[fk] codas (there is no mention of *[tp]). I do not consider such a system to be impossible, just likely to be rare.

7.5.2 Korean: Assimilation to the marked

The aim of this section and §7.5.3 is to show that the typological predictions of the Marked-Cluster constraints are borne out. This is not only of typological interest; it will prove to be significant in distinguishing the Marked-Cluster theory from alternative theories proposed by Baekovic (1999a,b) and McCarthy (2000a).

Attic Greek shows the need for the constraint */{KPT}{KP}, in which only dorsals and labials trigger heterorganicity avoidance. Another relevant constraint in the present theory is */{KPT}{K}; this constraint can produce a system in which only dorsals trigger assimilation. Korean provides a relevant case, though with additional interesting complexities.

7.5.2.1 Description

Table 7.10 lists consonant contrasts found in Korean (Cho 1999:83, see Ahn 1998:37 for a full list of allophones).

Table 7.10: Korean consonants

<table>
<thead>
<tr>
<th></th>
<th>labial</th>
<th>coronal</th>
<th>dorsal</th>
<th>glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td>*{KPT}</td>
<td>p</td>
<td>t</td>
<td>t’</td>
<td>k</td>
</tr>
<tr>
<td>*{KP}</td>
<td>p’</td>
<td>t’</td>
<td>t’</td>
<td>k’</td>
</tr>
<tr>
<td>*{P}</td>
<td>s</td>
<td>s’</td>
<td></td>
<td>h</td>
</tr>
<tr>
<td>*{m}</td>
<td>m</td>
<td></td>
<td>n</td>
<td>η</td>
</tr>
<tr>
<td>*{l}</td>
<td>l</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Certain consonants in syllable codas undergo assimilation. Diagram (74) summarizes the assimilation pattern.

7.5.2.2 Summary

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<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
<th>Assimilation?</th>
</tr>
</thead>
<tbody>
<tr>
<td>/K + P/</td>
<td>[KP]</td>
<td>×</td>
</tr>
<tr>
<td>/K + T/</td>
<td>[KT]</td>
<td>×</td>
</tr>
<tr>
<td>/P + K/</td>
<td>[KK]</td>
<td>✓</td>
</tr>
<tr>
<td>/P + T/</td>
<td>[PT]</td>
<td>×</td>
</tr>
<tr>
<td>/T + K/</td>
<td>[KK]</td>
<td>✓</td>
</tr>
<tr>
<td>/T + P/</td>
<td>[PP]</td>
<td>✓</td>
</tr>
</tbody>
</table>


348
Korean labial assimilation

(a) /t, t\̂/ + dorsal = assimilation

<table>
<thead>
<tr>
<th>Rule</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>/t[t̂]̄/</td>
<td>/t\̂/ + p̄</td>
</tr>
<tr>
<td>/k[k]̄/</td>
<td>/k\̂/ + t̄</td>
</tr>
<tr>
<td>/k[k]̄/</td>
<td>/k\̂/ + t̄</td>
</tr>
<tr>
<td>/k[k]̄/</td>
<td>/k\̂/ + t̄</td>
</tr>
<tr>
<td>/p[p]̄/</td>
<td>/p\̂/ + t̄</td>
</tr>
<tr>
<td>/k[k]̄/</td>
<td>/k\̂/ + t̄</td>
</tr>
<tr>
<td>/p[p]̄/</td>
<td>/p\̂/ + t̄</td>
</tr>
<tr>
<td>/k[k]̄/</td>
<td>/k\̂/ + t̄</td>
</tr>
</tbody>
</table>

Dorsals in Korean do not assimilate at all.

Korean coronal (alveolars, alveo-palatales) assimilation

(a) /t, t\̂/ + labial = assimilation

<table>
<thead>
<tr>
<th>Rule</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>/t[t̂]̄/</td>
<td>/t\̂/ + p̄</td>
</tr>
<tr>
<td>/k[k]̄/</td>
<td>/k\̂/ + t̄</td>
</tr>
<tr>
<td>/p[p]̄/</td>
<td>/p\̂/ + t̄</td>
</tr>
<tr>
<td>/t[t̂]̄/</td>
<td>/t\̂/ + k̄</td>
</tr>
<tr>
<td>/k[k]̄/</td>
<td>/k\̂/ + k̄</td>
</tr>
<tr>
<td>/n[n]̄/</td>
<td>/n\̂/ + t̄</td>
</tr>
</tbody>
</table>

(b) /t, t\̂/ + coronal = no assimilation

<table>
<thead>
<tr>
<th>Rule</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>/t[t̂]̄/</td>
<td>/t\̂/</td>
</tr>
<tr>
<td>/n[n]̄/</td>
<td>/n\̂/</td>
</tr>
<tr>
<td>/t[t̂]̄/</td>
<td>/t\̂/</td>
</tr>
<tr>
<td>/n[n]̄/</td>
<td>/n\̂/</td>
</tr>
<tr>
<td>/k[k]̄/</td>
<td>/k\̂/</td>
</tr>
</tbody>
</table>


7.5.2.2 Analysis

The following analysis pursues the idea that Korean is similar to Catalan. Thus, coronals undergo assimilation while (generally) non-coronals do not. The complexity is that dorsals trigger assimilation regardless of the preceding consonant.

Like Catalan, coronals undergo assimilation while labials and dorsals (generally) do not because the marked-faithfulness constraint IDENT[KP] preserves labials and dorsals. Tableau (78) shows that coronals undergo assimilation, while tableau (79) shows that labials and dorsals do not. These tableaux will not be discussed further here because the same ranking has been discussed in previous sections.

7.5.2.3 Labial and Dorsal Undergoers

<table>
<thead>
<tr>
<th>Rule</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>/n[n]̄/</td>
<td>/n\̂/</td>
</tr>
<tr>
<td>/k[k]̄/</td>
<td>/k\̂/</td>
</tr>
<tr>
<td>/k[k]̄/</td>
<td>/k\̂/</td>
</tr>
</tbody>
</table>

7.5.2.4 Dorsal Undergoers

<table>
<thead>
<tr>
<th>Rule</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>/t[t̂]̄/</td>
<td>/t\̂/</td>
</tr>
<tr>
<td>/k[k]̄/</td>
<td>/k\̂/</td>
</tr>
<tr>
<td>/h[h]̄/</td>
<td>/h\̂/</td>
</tr>
<tr>
<td>/m[m]̄/</td>
<td>/m\̂/</td>
</tr>
<tr>
<td>/k[k]̄/</td>
<td>/k\̂/</td>
</tr>
<tr>
<td>/n[n]̄/</td>
<td>/n\̂/</td>
</tr>
<tr>
<td>/k[k]̄/</td>
<td>/k\̂/</td>
</tr>
</tbody>
</table>

10 There is also minor PoA assimilation: /k[t̂]̄/ + [kot\̂pə] ‘let’s uncover’ (Ahn 1998:100). [t̂] is a coronal here (cf true palatales, which are dorso-coronas (c) - cf §7.2).
The next step is to explain why labials assimilate to dorsals, but dorsals do not assimilate to labials (or any other consonant). The ranking above does not account for this pattern: it predicts that /kam-ki/ should surface as *[kamki], due to IDENT[KP].

The idea presented here is that dorsals trigger assimilation regardless of the preceding PoA. The constraint *(KPT)[K] requires assimilation to dorsals. With *(KPT)[K] outranking IDENT[KP], labials will assimilate to dorsal PoA.

\[(80) \text{Labial + Dorsal}\]

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) kamki</td>
<td>*'</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) kajki</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

The labial /m/ assimilates to dorsal PoA in the tableau above because *(KPT)[K] compels assimilation to dorsals. However, labials do not assimilate to every PoA in this ranking: *(KPT)[K] does not compel assimilation to coronals, so labials will remain faithful in this environment.

\[(81) \text{Labial + Coronal}\]

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) sumta</td>
<td>*'</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) sunta</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

In short, the Korean ranking can be seen as a combination of the Attic Greek and Catalan rankings. Like Attic Greek, it is selective about triggers: only dorsals trigger assimilation in all environments. Like Catalan, it is selective about undergoers: only coronals assimilate in every situation.

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7.5.3 Metathesis, triggers, and undergoers

To complete the typology, a remaining type of system is one that has limits on both triggers and undergoers: essentially a combination of Attic Greek for triggers and Chukchi for undergoers. This type of system is revealed in a remarkable way in Kui, a Dravidian language (Winfield 1928, 1929; Hume 1997, 1998, 2001). Kui has a process of metathesis that reverses the order of dorsal-labial stop clusters: /kp/→[pk]. The process can be clearly seen in the second and fourth conjugations of verbs. The examples below are from the second conjugation, showing the combination of a C-final root with the future /te/, past tense /te/, the present participle /pi/, and the infinitive /pa/. The examples below are taken from Winfield (1928, 1929) and Hume (1997); the description and analysis given here owes much to Hume (1997).

\[(82) \text{Kui metathesis (Winfield 1928, 1929; Hume 1997, 2001)}\]

<table>
<thead>
<tr>
<th>Root</th>
<th>Future /f/</th>
<th>Participle /pi/</th>
<th>Infinitive /pa/</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>/bluk/</td>
<td>bluki</td>
<td>blukte</td>
<td>bhpki</td>
<td>bhpka</td>
</tr>
<tr>
<td>/kok/</td>
<td>koki</td>
<td>kokte</td>
<td>kopki</td>
<td>kopka</td>
</tr>
<tr>
<td>/mluk/</td>
<td>mluki</td>
<td>mlukte</td>
<td>mlipki</td>
<td>mlipka</td>
</tr>
<tr>
<td>/pok/</td>
<td>pokki</td>
<td>pokste</td>
<td>pwpki</td>
<td>pwpka</td>
</tr>
<tr>
<td>/luk/</td>
<td>leki</td>
<td>lekte</td>
<td>lepki</td>
<td>lepka</td>
</tr>
<tr>
<td>/al/</td>
<td>agle</td>
<td>agle</td>
<td>abqi</td>
<td>abqa</td>
</tr>
<tr>
<td>/nog/</td>
<td>nogde</td>
<td>nogde</td>
<td>noibi</td>
<td>noeba</td>
</tr>
<tr>
<td>/gwp/</td>
<td>gwpde</td>
<td>gwpde</td>
<td>gwpbi</td>
<td>gwpba</td>
</tr>
<tr>
<td>/pwp/</td>
<td>pwpgi</td>
<td>pwpgi</td>
<td>pwpbi</td>
<td>pwpba</td>
</tr>
<tr>
<td>/lp/</td>
<td>lupa</td>
<td>lupa</td>
<td>lupa</td>
<td>lupa</td>
</tr>
<tr>
<td>/xwp/</td>
<td>xwp</td>
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</tr>
<tr>
<td>/lp/</td>
<td>lupa</td>
<td>lupa</td>
<td>lupa</td>
<td>lupa</td>
</tr>
<tr>
<td>/kup/</td>
<td>kup</td>
<td>kup</td>
<td>kup</td>
<td>kup</td>
</tr>
<tr>
<td>/mil/</td>
<td>milte</td>
<td>milte</td>
<td>milpi</td>
<td>milpa</td>
</tr>
<tr>
<td>/mup/</td>
<td>mupa</td>
<td>mupa</td>
<td>mupa</td>
<td>mupa</td>
</tr>
</tbody>
</table>

To complete the table above, /coronal + dorsal/ clusters do not undergo metathesis, as shown by the combination of root+/ka/ 'plural': [ut-ka] ‘kneel+pl’, [st-ka] ‘accuse+pl’, [ru-ka] ‘crush+pl’, [ma-ka] ‘give birth+pl’. From the forms with the suffix /-te/, it is clear that there is no general ban on coda /l/. Instead, as Hume (1997) argues, the ban specifically targets [dorsal+labial] clusters. In the present theory, such a ban comes about through the constraint *(K)[KP]. This constraint targets dorsal+labial clusters without banning any other sequence: i.e. labial+dorsal, dorsal+coronal, coronal+lateral, lateral+dorsal.

After Hume (1997), the constraint *(K)[KP] must outrank the metathesis-banning constraint LINEARITY (McCarthy & Prince 1995).
5.5 from assimilating outside prefixes.

clusters in roots: structure-preservation does not block input /nk n

that is not otherwise permitted. Notably, there is no ban on [nk

view, the failure of /n/ to assimilate to [k] is due to structure-preservation: doing so would create a segment

further complexities relate to English

reduces to the fact that dorsal nasals are banned in prefixes (for relevant discussion about the behaviour and

Bl[imt], *[nks]

Attic Greek, Korean, and Kui provide support for this claim: in these systems,

121 Nasal POA assimilation in some dialects of English (e.g. Received Pronunciation) behaves in a way that on the surface suggests that labials trigger assimilation while dorsals do not: e.g. *[lk] → *[lk] ‘impossible’, *[lk] → *[lk] ‘impossible’. *[lk] → *[lk] ‘impossible’, *[lk] → *[lk] ‘incomplete’. However, I suggest that this case reduces to the fact that dorsal nasals are banned in prefixes (for relevant discussion about the behaviour and featural content of English [k], see McCarthy 2001a, see Oostendorp 1999 for related comments on Dutch; further complexities relate to English con- and its realization under stress, which I put aside here). Under this view, the failure of /lk/ to assimilate to [k] is due to structure-preservation: doing so would create a segment that is not otherwise permitted. Notably, there is no ban on [nk] in roots: structure-preservation does not block input [nk nk nk] from assimilating outside prefixes. My thanks to John McCarthy and Joe Pater for discussing this case with me.

7.5.4 Theoretical implications

The existence of the Attic Greek, Korean, and Kui systems provides independent support for the principle behind the Marked-Cluster constraints.

Typology

Table 7.11 summarizes the typological findings of this section.

<table>
<thead>
<tr>
<th>Language</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Korean, Kui</td>
<td>§7.5.2, §7.5.4</td>
</tr>
<tr>
<td>Attic Greek</td>
<td>§7.5.1</td>
</tr>
<tr>
<td>Catalan</td>
<td>§7.2</td>
</tr>
</tbody>
</table>

The table expresses the claim that there is an implicational relationship between triggers (Mohanan 1993). In general terms, if coronals trigger heterorganic-avoidance in a language, so will the more marked labials and dorsals. If labials are triggers, dorsals are sure to be so, but coronals may not (e.g. Attic Greek). If dorsals are triggers, then labials and coronals may not be (e.g. Korean, Kui).

To be more precise, the implicational relations relate specifically to the element that undergoes assimilation. Recall that the present theory does not predict that if a forces y to assimilate z will also force every other segment to assimilate. For example, dorsals force preceding labials to assimilate in SLP Creole (/amka/ → *[apka]), but dorsals do not force preceding coronals to assimilate (/anka/ → [anka]), *[arka]). Therefore, assimilation-triggering can only be discussed in relation to particular preceding elements. Generalization (86) states the Triggering Implication more carefully.

\[(x, y, z) \text{ triggers assimilation of } y \text{ if } z \text{ is more marked than } x \text{ and } y \text{ triggers assimilation of } z.\]

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\[(x, y, z) \text{ triggers assimilation of } y \text{ if } z \text{ is more marked than } x \text{ and } y \text{ triggers assimilation of } z.\]

To complete the ranking picture, since metathesis is preferred over deletion or epenthesis, MAX and DEP must also outrank LINEARITY.

In effect, Kui is a combination of Attic Greek in terms of triggers and Chukchi in terms of undergoers. Like Inuktitut, only dorsals are undergoers: only *[k][k][c] clusters are banned; and like Attic Greek only dorsals and labials are triggers: i.e. only *[k][g][p] is admissible.

To summarize, Kui represents a language which exhibits restrictions on both undergoers and triggers. As a parting note, a system of metathesis identical to Kui’s is found in Mokilese (Harrison 1976, Hume 1997:13).

7.5.4 Theoretical implications

The existence of the Attic Greek, Korean, and Kui systems provides support for the proposal that heterorganic clusters differ in markedness, formally expressed by the Marked-Cluster constraints. The systems provide support, albeit slightly indirect, for the analyses of SLP Creole, Chukchi, and Harar Oromo in §7.4.

The argument presented in §7.4 was that marked-undergoer systems are not produced through the action of faithfulness constraints – specifically faithfulness constraints that preserve unmarked elements. Instead, they fall out from the proposal that different types of heterorganic cluster differ in markedness. Attic Greek, Korean, and Kui provide support for this claim: in these systems, certain heterorganic sequences are less harmonic than others. Moreover, these systems were shown to be not amenable to any analysis except for one that employs a markedness constraint that distinguishes certain types of heterorganic cluster from others. Thus, the
where /akta/ → [ata] and /apta/ → [ata], but all other clusters surface faithfully (/kp tp tk/).

The typology in Table 7.11 is supported by child language. Pater (1997) and Pater & Werle (2001) identify a number of cases where dorsal stops assimilate (or more precisely, consonant harmony) in child speech. In these systems, only dorsals trigger assimilation, not labials or coronals. In contrast, there are no reports of systems in which only labials trigger consonant harmony (Joe Pater p.c.). This fits in exactly with the typology above.

This typological generalization falls out from the form of the Marked-Cluster constraints. If x is a trigger in a grammar, then a Marked-Cluster constraint that mentions x as its rightmost member is active. However, if x is mentioned, then all more marked elements are also mentioned. For example, *[KPT][KP] mentions labials as one of its rightmost members, so it also mentions the more marked dorsals. There is no Cluster-Markedness constraint that mentions labials in this way without also mentioning dorsals (i.e. no *[KP][P]). This asymmetry implements the hierarchy of triggers. If x triggers heterorganicity avoidance involving a preceding segment y, then all elements that have more marked PoA specifications than x will also trigger heterorganicity-avoidance involving y.

As a final comment on the typology, glottals as triggers are not mentioned in the table above because they are rarely in a position to trigger assimilation. However, they can do so, as shown in Yamphu. In Yamphu, stops assimilate to /ʔ/ and /h/. Before /h/, stops are realized as [ʔ]: /mo-dok-ʔal → [modoʔa] ‘like those’, /laʔi-le-ma → [laʔi lemma] ‘to be able to do’ (Rutgers 1998:48). [ʔ] clusters optionally simplify to [ʔ]. Before /ʔ/, stops are also banned: a stop-ʔ cluster emerges as a single glottal stop [ʔ], presumably because geminates [ʔʔ] is banned: e.g. /laʔ-a-ʔa-ma → [laʔa lemma] ‘go and do’, /hʔik-ʔuʔ → [kʔʔuʔʔ] ‘it’s bitter’. The fact that glottals trigger assimilation shows that an assimilation constraint that mentions glottals is necessary: i.e. *[KPT][KPTʔ].

### 7.6 Neutralization and cluster markedness

The aim of this section is to show that the Marked-Cluster constraints are needed for reasons that are entirely independent of the ones given in §7.4. The empirical focus here is cases with neutralization medially but not finally. As a reminder, the term ‘neutralization’ is used as in ch.6: it refers to non-assimilative, non-dissimilative neutralizations – i.e. those feature changes that are not influenced by nearby segments. This section argues that such cases show the need for constraints that (i) refer to heterorganic clusters and (ii) distinguish between types of heterorganic clusters. More directly, this section shows that the constraint used in the analysis of SLP Creole – *[KP][KPT] – is needed to explain certain neutralization patterns.

The point of showing that Marked-Cluster constraints exist is to demonstrate that the unmarked-faithfulness analysis of SLP Creole is redundant, so showing that a theory with only marked-faithfulness constraints is empirically adequate.

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Section 7.6.1 discusses medial neutralization in Kiowa. In this language, medial codas debuccalize while final ones do not. This section argues that an adequate analysis of this system requires Marked-Cluster constraints. To provide support for the argument made in §7.6.1, a typology of the relation between final neutralization and medial assimilation and neutralization is presented in §7.6.2.

### 7.6.1 Medial neutralization in Kiowa

This section focuses on PoA neutralization in medial codas in Kiowa (Watkins 1984). Section 7.6.1.1 describes the relevant facts. Section 7.6.1.2 presents an analysis that makes crucial use of the constraint marked-cluster constraint *[KPT][KPTʔ].

#### 7.6.1.1 Description

Kiowa has the consonants listed in Table 7.12 (Watkins 1984:7).

| &-vd & effective & aspirated & | & | & | & |
|---|---|---|---|---|---|---|---|---|
| stops | labial | coronal | palatal | dorsal | glottal |
| p | t | c | k | ? |
| p' | t' | c' | k' |
| b | d | g |
| nasal | m | n | | |
| lateral | l | | | |
| glides | | | | | j |

Syllables have the shape (C)V(ʔ)(C). Dorsals are only found in onsets. Codas can contain the sonorants [m n l j] and voiceless stops. Exactly which voiceless stops are permitted depends on the speech style. In both careful and casual speech, the singleton [p t ʔ] are permitted in word-final codas. In word-medial codas, though, there is a difference in register: while [p t ʔ] are permitted in careful speech, only [ʔ] is allowed in casual register.

(87) **Kiowa coda stops**

(a) Word-final codas

| sep | descendent, sew (p.8) |
| tsep | ‘bear’ (p.8) |
| [kʰəp] | ‘bullboat’ (p.21) |
| [tʰəp] | ‘flood’ (p.21) |
| [kip] | ‘shade, breeze’ (p.21) |
| [kʰəp] | ‘design’ (p.21) |

(b) Medial codas
To summarize, PoA neutralizes to /j/ only in medial codas in casual Kiowa speech; word-final codas do not neutralize. There is good evidence that word-final consonants are codas, and not extra-prosocic or onsets to degenerate syllables. One reason relates to shortening of long vowels in closed syllables: e.g. /tᵊ'tʃə/ ‘beyond’ cf /tᵊ'tʃə-p/ ‘away beyond’, /tᵊ'tʃə-dekɪ/ ‘next day’. As is clear from /tᵊ'tʃə-p/, word-final consonants induce shortening, showing that they are part of the final syllable. Apart from the specific PoA neutralization discussed above, medial codas and final consonants act in exactly the same way. Both positions ban dorsals, for example. Similarly, both word-final and medial codas undergo voice neutralization /caʔ/ → /cæ/ ‘doorway’, cf /caʔp/ ‘doorway at’.

Thus, the difference between medial and final codas cannot be ascribed to a difference in prosodic structure (for further reasons, see §7.6.2).

7.6.1.2 Analysis

The following analysis treats the Casual Kiowa neutralization pattern as being similar in kind to SLP Creole’s. There is a bar on marked heterorganic clusters: /pk tp pt/. The difference in Kiowa is that this language employs neutralization to resolve the problem rather than assimilation, deletion, epenthesis, or metathesis. By converting the coda into a /j/, the medial cluster becomes adequately unmarked: [¿P] clusters are the least marked type of heterorganic cluster in the present theory.

- General neutralization: eliminating dorsal codas

Dorsals are banned in both medial and final codas in Kiowa. Coda neutralization comes about through two rankings, as shown in detail in chapter 6, following Beckman (1998) and Lombardi (1999). One ranking has a context-free markedness constraint – *(K) in this case – outranking all relevant faithfulness constraints: IDENT(KPT), IDENT(KP), IDENT(K). This will ensure that dorsals neutralize. To prevent them from being eliminated in onsets, an onset-specific faithfulness constraint must outrank *(K). The ranking is illustrated in tableau (88).

<table>
<thead>
<tr>
<th>Careful</th>
<th>Casual</th>
</tr>
</thead>
<tbody>
<tr>
<td>[tᵊ'tʃeɪj]</td>
<td>[tᵊ'tʃeɪj]</td>
</tr>
<tr>
<td>[tᵊ'tʃeɪ]</td>
<td>[tᵊ'tʃeɪ]</td>
</tr>
<tr>
<td>[tᵊ'tʃeɪ]</td>
<td>[tᵊ'tʃeɪ]</td>
</tr>
<tr>
<td>[baʔp]</td>
<td>[baʔp]</td>
</tr>
</tbody>
</table>

For further discussion of this type of analysis, see ch.6.

- Medial neutralization only: Marked-Cluster constraints

Neutralization of medial codas in the Casual register is quite different from dorsal neutralization in a formal sense. The ranking used for dorsal neutralization cannot be used for medial PoA neutralization. If the context-free constraint *(KPT) was used to motivate labial and coronal neutralization, it would incorrectly predict that these contrasts should be eliminated in final codas as well. In short, the ranking with the context-free constraint can only produce neutralization in all codas.

The Marked-Cluster constraints provide a solution to this problem. The constraint *(KPT)(KPT?) militates against all medial clusters consisting of a non-glottal followed by another consonant. With *(KPT)(KPT?) outranking IDENT(KPT), medial coda consonants can neutralize, as shown in tableau (89).

<table>
<thead>
<tr>
<th></th>
<th>IDENT(KP)?</th>
<th>IDENT(K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) batp</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) baʔp</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

This analysis formally expresses the idea that medial neutralization in Casual Kiowa is really a method of avoiding marked heterorganic clusters. By neutralizing codas to /j/, medial clusters become the least marked type possible. All other clusters are relatively more marked.

- The competition

An important competing candidate for /baʔp/ is *[bap], with a fully assimilated coda. Since *(KPT)(KPT?) does not ban homorganic clusters, it does not eliminate *[bap]. In other words, some other constraint must favour /baʔp/ over *[bap]. The deciding constraint is UNIFORMITY, a constraint that bans coalescence (McCarthy & Prince 1998, see ch.8 for discussion). By fully assimilating into a geminate, the two underlying root nodes /pt/ coalesce into a single one.²¹⁴ So, UNIFORMITY will favour /baʔp/ over *[bap]. Tableau (90) illustrates this ranking.

²¹⁴ This analysis relies on the proposal that geminates have a single root node. Nevertheless, Selkirk’s (1991) two-root theory of geminates can be accommodated here: instead of violating UNIFORMITY, two-root geminates would violate the OCP, which bans adjacent identical elements (Goldsmith 1976).
So, it is crucial that UNIFORMITY outrank all Marked-Cluster constraints that ban glottal+non-glottal clusters; i.e. *(KPT2)KPT7). The opposite ranking would favour *(bapτ2) over [baτp3]. UNIFORMITY is essential because the Marked-Cluster constraints do not ban homorganic clusters. So, *(bapτ2) cannot be ruled out by a Marked-Cluster constraint, or perhaps any markedness constraint in CON that would also rule out [baτp3]. Furthermore, the Marked-Cluster constraint *(KPT7)KPT7 must be ranked below UNIFORMITY in Kiowa as this constraint favours [pτ] over [ʔp]. In short, UNIFORMITY plays a crucial role in ensuring that [ʔp] is the result of medial neutralization and not *(pτ). Section 7.6.1.3 will return to this point, using it to account for the lack of “medial neutralization without final neutralization” cases generally.

As a final note, UNIFORMITY does not eliminate underlying geminates, as in /etpτ→ [etpτ] ‘big’ (sg. inv.) (p.13). The faithfulness constraint UNIFORMITY only militates against geminate-formation, so allowing underlying geminates to be preserved faithfully.

**Medial clusters**

It is essential that the markedness constraint that motivates medial neutralization in Kiowa favours unmarked heterorganic clusters [7C] over marked ones [pC 1C] otherwise there would be no neutralization at all.

For example, the input /tτpτkτ/ would surface as *(tτpτkτ) with a constraint like AGREE[Place], not *(tτpτkτ). The following tableau illustrates this point; the constraint AGREE[Place] is violated by all heterorganic sequences equally (after Lombardi 1995, 1999).

<table>
<thead>
<tr>
<th>/tτpτkτ/</th>
<th>AGREE[Place]</th>
<th>IDENT[KPT7]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) tτpτkτ</td>
<td>*f</td>
<td>*</td>
</tr>
<tr>
<td>(b) tτpτkτ</td>
<td>*f</td>
<td>*</td>
</tr>
</tbody>
</table>

The tableau above shows that without a constraint that favours [ʔk] over [pκ], [tτpτkτ] could never win: both *(tτpτkτ) and *(tτpτkτ) are harmonic bounds for [tτpτkτ]. Even if a constraint that ruled out *(tτpτkτ) were introduced, it would still be impossible to rule out *(tτpτkτ) without appealing to a markedness constraint that favoured [ʔk] over [pκ].

### Alternatives

The Casual Kiowa system shows why assimilation cannot be motivated by constraints that ban independent PoA in codas (Ito 1986). A ban on independent PoA specifications in codas could motivate assimilation in Kiowa, but it incorrectly predicts that neutralization should also take place in final codas. In contrast, the Marked-Cluster constraints can be used to apply specifically to medial clusters, accounting for the lack of an implicational relation between the two positions.

As a final note, a positional-faithfulness constraint cannot be invoked to preserve word-final codas. Word-final position is not prominent – it is not always stressed (Watkins, p.38). Stress placement depends on a variety of factors, including moraic content and tone. Of present interest is that codas debuccalize in /[k1pτd]-[k1oτd] even though it is in a stressed syllable (compare [batpτ]-[baτp3]).

Secondly, a constraint that specifically preserves word-final codas would have adverse typological effects: it would allow a language that has neutralization of voice distinctions medially but not finally – §7.6.2 shows that such a system is unattested.

In short, medial neutralization in Casual Kiowa requires a markedness constraint that favours unmarked clusters over marked ones – i.e. *(KPT7)KPT7.

### Typology

As a comment on the typological applicability of this proposal, another system of medial PoA neutralization without final neutralization is found in Menomini (Bloomfield 1962, Yip 1991:64ff). Menomini has the obstruents [p t t d] i s t h e r e s u l t  o f 

### Summary

To summarize, Kiowa provides support for two proposals embodied in the Marked-Cluster constraints. One is that assimilation is driven by constraints on heterorganic clusters rather than by a ban on independent PoA in codas (cf Ito 1986). Kiowa provides evidence for this by having medial neutralization without final neutralization.

The other point made by Kiowa is that some heterorganic clusters are more marked than others. Specifically, [ʔ]+C heterorganic clusters are the least marked of all, so allowing other heterorganic clusters to neutralize to them, as in /[ʌpʊp]→*[bʊpʊp]. The proposal that [ʔ]+C heterorganic clusters are the least marked type is also supported by the facts of Kagoshima Japanese: Kaneko & Kawahara (2002) report that the only stop codas allowed in this language are either homorganic to a following consonant or [ʔ]; e.g. [k1ʔn] ‘to that degree’, [maʔnʔ] ‘pine tree’, [nanaʔ] ‘tear’, [nataʔ] ‘become’ , [finuʔ] ‘heart’. Like Casual Kiowa, the only heterorganic clusters permitted are [ʔ]+C ones.
7.6.1.3 Conditions on medial neutralization

As pointed out in the analysis of Kiowa above, the Marked-Cluster constraint *{[KPT]}{KPT}\textsuperscript{\textdagger} does not rule out a candidate with a homorganic cluster: i.e. from \[\text{butp}\]\textsuperscript{\textdagger} \[\text{bar}\]. In fact, if the choice was left up to the Marked-Cluster constraints, *{[bar]}\textsuperscript{\textdagger} would win: it beats \[\text{bu}\{[\text{p}\}]\] in terms of *{[KPT]}{KPT}\textsuperscript{\textdagger}, and no Marked-Cluster constraint favours \[\text{b}\{[\text{p}\}\} over \[\text{b}\]. In fact, *{[bar]}\textsuperscript{\textdagger} only loses in Kiowa because its creation results in an incidental faithfulness violation – of UNIFORMITY. Thus, neutralization only comes about ‘incidentally’.

In other words, UNIFORMITY is crucial in producing medial neutralization rather than medial assimilation. If UNIFORMITY did not block geminate formation, the result would have been /butp\textsuperscript{\textdagger}\textrightarrow /bar\textsuperscript{\textdagger}.

This analysis makes significant implications for cases where the competing candidate is not a geminate. For example, is it possible for the input /mk/ to be avoided by neutralization to [nk] rather than assimilation \[\text{[p]}\]? Unlike gemination, \[\text{[p]}\] does not violate any faithfulness constraints that \[\text{[n]}\] does not also violate – both violate \[\text{IDENT}{[\text{KPT}]}\]. Most significantly, \[\text{[p]}\] does not violate UNIFORMITY: this constraint is only violated when segments coalesce, not when they assimilate. Because \[\text{[p]}\] does not fare worse than \[\text{[n]}\] on faithfulness and the homorganic \[\text{[p]}\] fares better on the Marked-Cluster constraints than the heterorganic [n], \[\text{[p]}\] will always win. In other words, medial codas alone cannot neutralize if an assimilation alternative is not blocked for faithfulness reasons. So, there should be no language in which nasals neutralize to \([n]\) before stops medially, while no neutralization happens finally.

Medial voice neutralization without final neutralization

To put this point in more concrete terms, Wetzels & Mascaró (2001) have observed that there is no language that has medial voice neutralization without also having neutralization finally. For example, in no language does underlying /ladab/ surface as /zdab/.

The reason such a system is impossible relates to the immediately preceding discussion. The Cluster constraints provide no way to eliminate sequences that agree in a feature: no Cluster-Voicing constraint of the ones given in (60) (§7.4.4) bans clusters that agree in voicing. So, there is no motivation for /ladab/ to change to /zdab/ because its faithful competitor /ladab/ will not violate any cluster markedness constraints. Moreover, /ladab/ will fare better on faithfulness constraints than /zdab/. In short, the only way that such a system could be produced in the present theory is if there was some independent constraint that banned clusters that agreed in [+voice].

A typology of the relation between medial and final processes is discussed in §7.6.2.

- Theoretical implications

The points just made have significant theoretical implications for the analysis of Kiowa. They show that the Casual Kiowa neutralization pattern cannot be produced by invoking a faithfulness constraint that targets word-final codas. If there were a constraint...
Section 7.6.2.2 shows how the medial-final implications are produced in the present theory.

7.6.2.1 Typology

This section discusses the relation between medial and final positions for processes that affect voice and PoA. The voice typology will be presented first since it has received most attention in the literature. It also provides a useful contrast to the PoA typology.

Lombardi (1999) and Wetzels & Mascaro (2001) present a typological survey of the relation between final and medial codas for [voice] contrasts. The following table is adapted from Wetzels & Mascaro (2001). The ‘×’ symbol indicates that neither neutralization nor assimilation takes place in that position.

<table>
<thead>
<tr>
<th>Table 7.13: Medial-final voicing relations</th>
</tr>
</thead>
<tbody>
<tr>
<td>medial codas</td>
</tr>
<tr>
<td>×</td>
</tr>
<tr>
<td>neutralize</td>
</tr>
<tr>
<td>assimilate</td>
</tr>
<tr>
<td>neutralize</td>
</tr>
</tbody>
</table>

As an example, medial codas in Yiddish assimilate in voicing and final codas do not neutralize. There are two gaps. One is where neutralization takes place medially but not finally. The other is where final codas neutralize but medial codas neither assimilate nor neutralize. I consider both gaps theoretically significant.

- Place of articulation typology

The facts for PoA are similar to those for voice, but not identical. The following table is compiled from my own research (for a list of languages consulted, see Appendix B). Cases where word-final consonants assimilate to the initial consonant of the following word are not considered. The examples given below neutralize to coronals rather than glottals (i.e. /m̩/→[n], /p̩/→[t]). This was an arbitrary choice, made for consistency and ease of exposition. Whenever ‘neutralization’ is mentioned, it refers to neutralization to any PoA – i.e. coronals or glottals.

<table>
<thead>
<tr>
<th>Table 7.14: Medial-final Place of Articulation relations</th>
</tr>
</thead>
<tbody>
<tr>
<td>medial codas</td>
</tr>
<tr>
<td>×</td>
</tr>
<tr>
<td>neutralize</td>
</tr>
<tr>
<td>assimilate</td>
</tr>
<tr>
<td>×</td>
</tr>
<tr>
<td>neutralize</td>
</tr>
<tr>
<td>assimilate</td>
</tr>
</tbody>
</table>

I found no cases in which PoA is neutralized finally, but medial codas neither assimilate nor neutralize. In other words, there is no language in which only coronals are allowed word-finally while medial codas are fully preserved: e.g. /akpak/ → [akpat].

In short, if something happens finally, something must also happen medially, but not vice-versa. The difference between the PoA and voicing typology is that a system with medial neutralization but not final neutralization is attested for PoA. This type of system was examined in detail in the previous section, so will not be discussed here. To recall from §7.6.1.4, the difference in behaviour was argued to follow from incidental factors: in almost all cases of this type, medial assimilation beats medial neutralization; only when an incidental factor (like faithfulness) intervenes does medial assimilation win. PoA presents such an opportunity; [voice] does not.

The following section shows why systems with final neutralization but no change medially – found in both typologies – fall out from the Marked-Cluster constraints.

7.6.2.2 Rankings

Both typologies cannot produce a system with final neutralization but no change medially – neither assimilation nor neutralization. For voice, this means that there is no language in which input /abdab/ surfaces as [abtabdab] and input /abtab/ surfaces as [abtapped]. For PoA, this means that there is no language in which input /amkam/ surfaces as /amkan/.

Such systems cannot be produced by the Marked-Cluster or marked-faithfulness constraints. This follows because no constraint specifically targets final codas. To produce final PoA neutralization, a context-free PoA constraint like *{KP} must outrank IDENT{KPT} (as shown in ch.6). However, this ranking will produce neutralization in medial codas as well as final ones.

- Medial assimilation + final neutralization

There are only two potential ways a medial coda could be prevented from neutralizing. One way is to employ a markedness constraint that only targets medial...
codas. If \( m \) prevents /\( ml \) from neutralizing to [n] medially but not finally, then medial neutralization would be blocked.

The only constraints that can do this in the present theory are the Markedness constraints. A constraint like \(*\{K\}{KPT}\), for example, will eliminate the candidate [ankam] from input /amkam/. However, \(*\{KPT\}{KPT}\) does not simply block medial neutralization, it requires assimilation: it favours [\( \text{arkam} \)] over the final-neutralization candidate [\( \text{amkam} \)]. In short, attempting to block medial neutralization by a Marked-Cluster constraint will result in a system with medial assimilation and final neutralization, as attested in Selayarese and Tzutujil for PoA, and Walloon and Catalan for voice.

The ranking for a system with medial assimilation and final neutralization is given in (92). \( mI \) is the marked value(s) of feature \( f \), and \( aI \) is the unmarked value(s). The constraint \(*\{mI\}{aI}\) is a Marked-Cluster constraint for feature \( f \).

(92) Medial assimilation + final neutralization ranking schema
\[ || \text{onset}-\text{IDENT}\{mI\}, \*\{mI\}{aI}\{mI\} \overset{*} {\rightarrow} \*\{mI\} \overset{\text{IDENT}\{f\}}{\rightarrow} \]

The ranking \( || \text{onset}-\text{IDENT}\{mI\} = \*\{mI\} \overset{\text{IDENT}\{f\}}{\rightarrow} \*\{mI\} \overset{\text{IDENT}\{f\}}{\rightarrow} \) is needed to produce final neutralization, after Beckman (1998) and Lombardi (1999). By ranking the Marked-Cluster constraint \(*\{mI\}{aI}\{mI\} \overset{*} {\rightarrow} \*\{mI\} \overset{\text{IDENT}\{f\}}{\rightarrow} \) assimilation takes place medially rather than neutralization. For example, from /ankam/, \(*\{KPT\}{KPT}\) eliminates the medial-neutralization candidate [\( \text{ankan} \)], favouring the assimilation candidate [\( \text{akan} \)].

• The role of marked-faithfulness

Returning to the issue of systems with final neutralization and no change medially, the only other potential way for medial neutralization to be blocked is through the action of a faithfulness constraint. For example, if there were a faithfulness constraint that only preserves medial codas, it could block medial neutralization but allow it finally, medial assimilation could also be blocked in this grammar by ranking the Marked-Cluster constraints below all relevant faithfulness constraints.

As discussed for Attic Greek in §7.5.1.3, there is good reason to believe that there is no such medial-faithfulness constraint.

It is worth noting, though, that the same statement does not hold in regard to deletion: there are languages with final coda deletion but no medial elements – contiguity (McCarthy & Prince 1995). For discussion of this ranking, see §7.5.1.4.

In short, neither markedness nor faithfulness constraints can block medial deletion without also producing assimilation. So, the lack of (1) a markedness constraint that specifically promotes neutralization in final position and (2) a faithfulness constraint that preserves in non-final positions only ensures that no language neutralizes finally without something – either neutralization or assimilation – happening medially.
IDENT constraints (because all IDENT constraints preserve dorsals). To prevent neutralization, all context-free markedness constraints (*{K}, *{KP}, *{KPT}) are ranked below a faithfulness constraint.

\[
\begin{array}{ccc}
\text{bakh’} & *{K} \mid \text{KPT} & \text{IDENT(KPT)} \\
\text{bakh} & *{K} \mid \text{KPT} & \text{IDENT(KPT)} \\
\text{bath} & *{K} \mid \text{KPT} & \text{IDENT(KPT)}
\end{array}
\]

Similar facts hold for voicing assimilation. Lombardi (1995) and Wetzels & Mascaro (2001:216ff) identify Yiddish as a relevant case; there is no word-final devoicing ([briʃ] ‘letter’, [voʊɡ] ‘weight’), but medial obstruent codas assimilate in voicing to a following obstruent ([briʃ+tʃeɡ] ‘mailman’, [vɔk+ʃo] ‘scale’). The analysis of such a system proceeds as for Harar Oromo: i.e. \( *{[+vd]} \mid [+vd] \Rightarrow \text{IDENT([+vd])} \Rightarrow *{vd} \).

\[
\begin{array}{ccc}
\text{meʃe} & *{K} \mid \text{KPT} & \text{IDENT(KPT)} \\
\text{meʃe} & *{K} \mid \text{KPT} & \text{IDENT(KPT)} \\
\text{meʃe} & *{K} \mid \text{KPT} & \text{IDENT(KPT)}
\end{array}
\]

This type of system is significant in evaluating alternative theories of the triggers of assimilation. In autosegmental theories, assimilation was conceived as a process of neutralization/delinking of coda PoA followed by regressive spreading from the following onset (Cho 1999 and references cited therein). However, if coda neutralization were a necessary prelude to assimilation, it would be impossible to produce a language like Harar Oromo with medial assimilation and final inaction. The first step in the assimilation process is to delink PoA in all codas, so producing neutralization. Therefore, it is impossible to get to assimilation without neutralizing finally. A similar problem arises with theories that trigger assimilation by banning independent PoA specifications in codas (e.g. Ito 1986). In other words, constraints that propose that codas are unable to support (or ‘license’) their own PoA, so must share that of an onset. In such theories, a constraint against independent coda PoA outranks faithfulness constraints to produce assimilation (called "CODAPOA here). To produce assimilation, *CODAPOA must outrank all relevant faithfulness constraints (i.e. IDENT[KPT], etc.). However, this ranking not only applies to medial codas, but to final codas as well. Thus, final neutralization cannot be blocked without also blocking medial assimilation with such a constraint.218

218 Pre-OT theories avoided this problem by invoking extrametricality – if the word-final consonant is extrametrical, it will avoid violating *CODAPOA. However, extrametricality – or any device that exempts word-final consonants from neutralizing – raises a typological problem. There are no languages where word-final codas neutralize in voicing but medial ones do (i.e. /abdab/ \( \Rightarrow [apdap])\). Such languages are easy to produce with extrametricality, though.

The formal expression of markedness – ch.7

In short, the only way to produce a “medial assimilation-final inaction” system is with a markedness constraint that specifically targets clusters (or medial codas), like the Marked-Cluster constraints.219

Summary

Table 7.15 summarizes the rankings identified in this section. All the rankings assume that onset-IDENT[f] is undominated, so preventing neutralization in onsets.

Table 7.15: Typology of rankings for medial-final relations

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Medial</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDENT[f] ( \Rightarrow *{[mf]} \Rightarrow \text{M-C} )</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>IDENT[f] ( \Rightarrow *{[mf]} \Rightarrow \text{M-C} \Rightarrow \text{IDENT[f]} )</td>
<td>neutralize</td>
<td>neutralize</td>
</tr>
<tr>
<td>IDENT[f] ( \Rightarrow *{[mf]} \Rightarrow \text{M-C} \Rightarrow \text{IDENT[f]} )</td>
<td>assimilate</td>
<td>x</td>
</tr>
<tr>
<td>M-C ( \Rightarrow \text{IDENT[f]} \Rightarrow *{[mf]} \Rightarrow \text{IDENT[f]} )</td>
<td>assimilate</td>
<td>neutralize</td>
</tr>
</tbody>
</table>

As discussed in §7.6.1, the ranking \( \text{M-C} \Rightarrow \text{IDENT[f]} \Rightarrow *{[mf]} \) can also be used to produce neutralization medially and inaction finally under restricted circumstances.

Therefore, the only system that cannot be produced is one with medial inaction and final neutralization.

7.6.3 Summary

To summarize the findings of this section, the Marked-Cluster constraints are needed to produce systems with medial neutralization but no final neutralization. Specifically, *{KPT}{KPT} forces medial coda consonants to neutralize to \{K\} in Kaowa, but allows final codas to remain faithful. The crucial part of this analysis is that the constraint *{KPT}{KPT} favours certain heterorganic clusters over others: specifically, clusters with an initial \{K\} are more harmonic than those that begin with a more marked PoA.

The constraint *{KP}{KPT} was shown to have a similar effect in Menomini. The theoretical import of these cases is that Marked-Cluster constraints are necessary, quite independently of their use in marked-undergoer systems like SLP Creole’s (§7.4).

So, because Marked-Cluster constraints are necessary in any case, they cannot be excluded as providing a solution for marked-undergoer systems. This effectively renders unmarked-faithfulness constraints redundant – while they can provide an account of SLP
Creole, they can do nothing that the Marked-Cluster constraints cannot also do in regard to marked-undergoer systems. Because the Marked-Cluster constraints have a wide variety of independent support, there is therefore no evidence that unmarked-faithfulness constraints exist, as predicted by the marked-faithfulness theory.

7.7 Typology and Issues
This section discusses the typological implications of the present theory and compares it with alternatives.

Section 7.7.1 discusses the systems of surface heterorganic clusters predicted by the Marked-Cluster and marked-faithfulness constraints. Of 64 possible systems, the present theory predicts that 27 are possible. For direction of assimilation, the present theory is shown to allow both regressive and bi-directional coda-onset assimilation, but not allow systems with uniformly regressive assimilation.

Section 7.7.2 discusses an alternative approach to marked-undergoer systems: Buković’s (1999a,b) and McCarthy’s (2002) ‘Relative Markedness’ theories. This section argues that the present theory is more typological adequate than the alternatives.

Section 7.7.3 discusses the predictions of the present theory for assimilations involving three or more elements. As Lombardi (1995, 1999) and Buković (1993a,b) have observed, constraints of the sort proposed here produce ‘Majority Rule’ effects, where the output’s feature value is the same as the value of the majority of input segments.

Section 7.7.4 deals with the dimension over which IDENT constraints may apply. After Pater (1995, 1999), the ‘asymmetric’ nature of the present constraints is discussed: where IDENT constraints can assign a violation to /oF/−∥/oF/ but not necessarily /bF/−∥/oF/. Fully symmetric IDENT theories (McCarthy & Prince 1995, Buković 1999) are rejected, and the empirical effects of Output—Input IDENT constraints are examined.

7.7.1 Typology of assimilation effects
The aim of this subsection is to identify the predictions of the Marked-Cluster constraints and marked-faithfulness constraints for the typology of assimilation effects.

Section 7.7.1.1 discusses direction of assimilation. It shows that the cluster constraints allow certain types of progressive and bi-directional assimilation but cannot produce uniformly progressive assimilation.

As shown in preceding sections, not all elements in a language need undergo assimilation, and not all elements necessarily trigger assimilation. Section 7.7.1.2 identifies the possible arrangements of undergoers and triggers predicted by the present theory.

7.7.1.1 Direction
“Direction” of assimilation refers to the element that assimilates. In regressive assimilation, /x/ takes on a following /y/’s features in an /xy/ cluster to produce [yy]; in progressive assimilation, /xy/ → [xx]. For bi-directional assimilation, the assimilating element is not consistently the leftmost or rightmost in a cluster – some other factor determines which element assimilates.

To some extent, the Marked-Cluster constraints are irrelevant to direction of assimilation. This follows from the fact that the constraints only ban a surface structure; they do not specify how to eliminate heterorganic clusters. For example, the constraint *{K}{KP} bans the cluster /p/y, but does not specify whether regressive or progressive assimilation should apply: both /p[k]/ and /mp/ satisfy *{K}{KP}. Therefore, for the majority of cases, direction of assimilation must be determined by faithfulness in the present theory. After Lombardi (1995, 1996, 1999) and Beckman (1998), positional faithfulness constraints provide an account for this fact. A constraint such as ONSET-IDENT{KPT} preserves PoA features in onsets, with the result that coda features must change to satisfy the Marked-Cluster constraints. This is a desirable result – the majority of assimilations are regressive, and progressive assimilation often seems to be conditioned by non-phonological factors (Lombardi 1996).

Nevertheless, the present theory does allow for bi-directional assimilation.

- Bi-directional systems
The marked-faithfulness constraints can produce bi-directional assimilation. For example, if IDENT(K) outranked all onset-IDENT constraints, segments would assimilate to dorsals regardless of whether they are in codas or onsets: i.e. /p[金奖] → /p[k]/, /nk/ → /n[k]/. Tableau (99) illustrates this situation.

<table>
<thead>
<tr>
<th>Candidates</th>
<th>IDENT{K}</th>
<th>ONSET-IDENT{KPT}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) antarjan</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) antarjk</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(c) apana</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(d) antarjan</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(e) antarj</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

Candidate (a) has heterorganic clusters, so is eliminated by the cluster constraint *{KPT}{KPT}; all remaining candidates have homorganic clusters. Candidates (b) and (c) have uniformly regressive and progressive assimilation respectively; by doing so they both violate IDENT[K] because they do not preserve the underlying dorsals. In contrast, (d) manages to retain the dorsals by having progressive assimilation in the first cluster and regressive assimilation in the second. In effect, the need to retain the marked dorsal feature determines the direction of assimilation. This is a ‘bi-directional marked’ assimilation system – where assimilation can be regressive or progressive, depending on the nature of the cluster involved. Candidate (e) also employs bi-directional assimilation, but fatally preserves the unmarked element (cf ch.8:3).

No bi-directional marked systems have yet been reported, as Lombardi (1995) has observed for voicing assimilation. Whether there are no bi-directional marked systems at all is an issue that awaits a far more detailed typological investigation than has been carried out to date.
out here, though recent work in child language is suggestive (see below). In contrast, a bi-directional unmarked system has received a good deal of discussion—voicing assimilation in Swedish (see ch.8§8.3.1 for detailed references).

In short, if there are no bi-directional marked systems then there is a fault with the present theory (though see Baković 1998i,b for discussion on how to rectify it).

However, it is important to point out that the marked faithfulness constraints cannot force uniformly progressive coda-onset assimilation. While they constraints allow for bi-directional systems—both marked (as shown above) and unmarked (ch.8§8.3.1) – and can interact with positional faithfulness constraints to produce uniformly regressive assimilation, neither constraint type permits a system in which assimilation is always progressive (unless some other non-phonological factor intervenes – Lombardi 1996). This follows from the nature of the constraints: the marked-faithfulness constraints simply preserve marked elements, regardless of their position; so they cannot be used to uniformly force assimilation in a particular direction.

• Trigger-restricted bi-directional assimilation and progressive assimilation

With the present constraints it is possible to get the surface effect of progressive assimilation, though only when the sole trigger of assimilation is the most marked element. Such systems, though, are identical to bi-directional marked systems that allow only marked triggers.

Pater & Werle (2001) identify the ranking for a system of this kind. Their constraints are identical to a subset of the Marked-Cluster constraints, namely *[K] {KPT} and *[KPT] {K}.

Pater & Werle (2001:126) show that if *[K] {KPT} outranks IDENT {KPT} non-dorsals will assimilate to a preceding dorsal (e.g. /akda/ → [akda]). However, non-dorsals will not assimilate to a following dorsal (e.g. /adka/ → [adka], *[akja], *[adta]). Tableau (100) summarizes the argument.

<table>
<thead>
<tr>
<th>akda</th>
<th>*[K] {KPT}</th>
<th>IDENT {K}</th>
<th>ONSET-IDENT {KPT}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>akda</td>
<td>*</td>
<td>[a]</td>
</tr>
<tr>
<td>(b)</td>
<td>akja</td>
<td>*</td>
<td>[a]</td>
</tr>
<tr>
<td>(c)</td>
<td>adta</td>
<td>*</td>
<td>[a]</td>
</tr>
</tbody>
</table>

In contrast, /akda/ will surface as [adka] – this form does not violate *[K] {KPT}, so there is no motivation to assimilate to *[akja].

The net result of this ranking is progressive assimilation to dorsals. However, there is a restriction: such a system can only occur when the only triggering element is the most marked one. For example, a minimally different constraint system is one with *[KP] {KPT} highest-ranked. However, this constraint will produce bi-directional assimilation of P to K: i.e. /akba/ → [akba] and /akba/ → [akba], as both satisfy *[KP] {KPT} and IDENT {K}. This minor change shows that the system in (100) is formally a bi-directional marked assimilation system with a limitation on triggers.

It is important to note that Pater & Werle (2001) provide empirical evidence that such ‘bi-directional systems with restricted triggers’ exist. In one case they report, non-dorsals assimilate to a following dorsal (e.g. [kɛŋ] ‘good’, *[kpa]). However, non-dorsals do not assimilate to a preceding dorsal (e.g. [ŋkɛ] ‘good’, *[ŋkpa]). Their argument is summarized in the following tableaux.

(101)

<table>
<thead>
<tr>
<th>/p[0]a</th>
<th>g</th>
<th>‘plug’</th>
<th>*[KPT]</th>
<th>IDENT {KPT}</th>
<th>IDENT {K}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>paʃ</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td>paŋ</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(c)</td>
<td>paʃ</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

(102)

<table>
<thead>
<tr>
<th>/ˈɡɛː/</th>
<th>‘good’</th>
<th>*[KPT]</th>
<th>IDENT {KPT}</th>
<th>IDENT {K}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>ɡɛː</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b)</td>
<td>ɡɛː</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(c)</td>
<td>ɡɛː</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

Importantly, positional faithfulness constraints cannot be used to produce the directional effect here—a constraint like ONSET-IDENT {KPT} would incorrectly result in progressive assimilation in /p[0]a|g|, producing [paŋ]. For further discussion of this pattern and others like it, see Pater & Werle (2001) and Pater (2002, to appear).

For voicing, the prediction is that there can be uniformly progressive assimilation to the marked value, using the constraints *[+vd] {[v]} and IDENT {+vd}. /akba/ surfaces as [akja] to satisfy *[+vd] {[v]} and IDENT, while /appa/ surfaces faithfully. However, there can be no progressive assimilation from voiceless (i.e. unmarked) segments: /appa/ must surface as [apja] – the assimilated *[ajka] does not violate *[+vd] {[v]}.

In summary, cases like those reported by Pater & Werle (2001) follow from the present theory—they are bi-directional systems in which only marked elements trigger assimilation. The fact that the Marked-Cluster constraints can produce the effects discussed above is clearly desirable—it accounts for the child language pattern. However, no analogous cases have been found in adult language. As Lombardi (1996) argues, adult language assimilation is overwhelmingly regressive; progressive assimilation only happens under duress, when regressive assimilation is impossible. The theoretical import of this difference between adult and child language deserves more discussion than can be afforded here; I merely note the typological implications here.

7.7.1.2 A typology of surface assimilated clusters

As shown in sections 7.2 and 7.4, languages differ in terms of the elements that undergo trigger assimilation. For example, only coronals assimilate in Catalan, while only dorsals force labials to assimilate in Korean. From a more surface-oriented perspective, languages differ in terms of the surface heterorganic clusters they allow.
Catalan permits [KP KT PK PT] and not [TP TK], while Korean allows [KP KT PT] but not [PK]. For heterorganic clusters involving K, P, and T, there are 64 possible surface systems (i.e. the subsets of {KP, KT, PK, PT, TK, TP}). This section aims to identify the subsets that are predicted to exist by the marked-cluster and marked-faithfulness constraints. It concludes that 27 systems are possible. The 37 that are banned violate one or more of the implicational relations in (103).

(103) **Surface heterorganic cluster implicational relations**
(a) If [TK] is permitted, then [TP] is permitted
(b) If [PK] is permitted, then [PT] is permitted
(c) If [KP] is permitted, then [KT] is permitted
• Assume that K, P, and T are permitted generally in the language.

The aim of this section is to generalize over the results of the previous sections for undergoers and triggers of assimilation, to determine the implicational universals in assimilation systems that are predicted by the present theory. This section takes a slightly different approach to typology than the previous discussion. Instead of focusing on the relation between inputs and outputs, it focuses on the distribution of surface clusters, asking whether the existence of cluster \(c_1\) in a language implies the presence of cluster \(c_2\).

### Voicing and surface clusters

The discussion will start with the typology of voice assimilation. As pointed out in previous discussion, the Marked-Cluster constraints do not allow for every possible assimilation system. Most obviously, they do not allow systems that contain clusters that disagree in feature \(f\) while banning all clusters that agree in feature \(f\). For example, there can be no language that allows clusters that disagree in voicing ([pd], [bt]), but bans clusters that agree in voicing (i.e. *[pt]*, *[bd]*). This follows from the fact that the former are local harmonic bounds for the latter in terms of the Marked-Cluster constraints: no Marked-Cluster constraint favours clusters that disagree in voicing over those that agree. In short, if a language allows clusters that disagree in some feature \(f\), then it also allows clusters that agree in \(f\) (barring incidental restrictions like a general ban on voiced stops).

Apart from this general prohibition, the Marked-Cluster constraints produce no implicational relations for clusters in terms of voicing. Table (104) illustrates this point. A *\(\checkmark\)* indicates that the cluster is permitted on the surface.

**Typology of surface clusters for voicing**

<table>
<thead>
<tr>
<th>[+vd][±vd]</th>
<th>[±vd][+vd]</th>
<th>Description</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No assimilation</td>
<td>Herber</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>Assimilation of [+vd] only</td>
<td>Mekkan Arabic</td>
</tr>
<tr>
<td>✓</td>
<td>x</td>
<td>Assimilation to [+vd] only/or assimilation of [±vd] only</td>
<td>Ukrainian</td>
</tr>
<tr>
<td>x</td>
<td>x</td>
<td>Assimilation of/to [±vd]</td>
<td>Serbo-Croatian</td>
</tr>
</tbody>
</table>

### PoA surface clusters: Marked-Cluster predictions

The typology of surface clusters that differ in terms of Place of Articulation is more complex than for voicing. The complexity arises from the greater number of PoA distinctions – K vs P vs T vs ?. The first step will be to focus on the predictions for surface clusters that follow solely from the Marked-Cluster constraints. In other words, the discussion immediately below will effectively assume that there is only one faithfulness constraint for PoA – i.e. IDENT[KPT]. In addition, due to the rarity of heterorganic clusters with glottals, only clusters consisting of K, P, or T will be considered.

Quasi-tableau (105) shows the local harmonic bounding relations between heterorganic clusters in terms of the Marked-Cluster PoA constraints. The results are summarized in lattice (106). The arrows \(c_2 \rightarrow c_3\) indicate that cluster \(c_2\) is a local harmonic bound for \(c_3\) in terms of the Marked-Cluster constraints, or that the presence of \(c_2\) implies the presence of \(c_3\).

**Surface heterorganic cluster implicational relations**

(a) If [TK] is permitted, then [TP] is permitted
(b) If [PK] is permitted, then [PT] is permitted
(c) If [KP] is permitted, then [KT] is permitted

**PoA surface clusters: Marked-Cluster predictions**

Systems that allow all types of surface cluster – and therefore no assimilation – have faithfulness constraints outranking all relevant Marked-Cluster constraints. The opposite ranking produces languages that lack clusters that disagree in voicing.

Languages that ban *[+vd][±vd]* clusters like *[bt]* but allow *[pd]* come about through the action of an asymmetrically formulated Marked-Cluster constraint: *[+vd][±vd]* in this case. With faithfulness constraints outranking *[±vd][±vd]*, /pd/ will surface faithfully while /bt/ will not (see §7.4.4).

Languages that ban [+vd][±vd] clusters like *[pd]* but allow *[bt]* can do so by two different methods. In one method, only marked elements trigger assimilation, effected by the constraint *[+vd][±vd]*. The other method is for marked elements to be exempt from assimilation, due to IDENT[+vd]. It is impossible to determine which analysis is appropriate on the basis of surface clusters alone in these cases; other processes must be brought to bear to determine the ranking of IDENT[+vd].

**Typology of surface clusters for voicing**

<table>
<thead>
<tr>
<th>PoA</th>
<th>[KPT]</th>
<th>[KP]</th>
<th>[KT]</th>
<th>[PK]</th>
<th>[PT]</th>
<th>[TK]</th>
<th>[TP]</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>(KPT)</em></td>
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<td><em>(KPT)</em></td>
<td><em>(KPT)</em></td>
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<td><em>(KPT)</em></td>
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</tr>
<tr>
<td><em>(KP)</em></td>
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<td><em>(KPT)</em></td>
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<td><em>(KP)</em></td>
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<tr>
<td><em>(KPT)</em></td>
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<td><em>(KPT)</em></td>
<td><em>(KPT)</em></td>
<td><em>(KPT)</em></td>
</tr>
</tbody>
</table>
Local harmonic bounds: Marked-Cluster constraints

\[
\begin{array}{ccc}
\text{TP} & \text{PT} & \text{TK} \\
\text{KT} & \text{KP} & \text{PK} \\
\end{array}
\]

Lattice (106) indicates that [TP] is a harmonic bound for [TK] in terms of the Marked-Cluster constraints. In other words, if the Marked-Cluster constraints were the only ones relevant in a language (i.e. if interfering constraints like the Marked-Faithfulness ones were ranked appropriately low), the presence of [TK] would imply the presence of [TP]. Of course, the homorganic clusters [TT], [PP], [KK] do not violate any of the Marked-Cluster constraints, so they are guaranteed to be in every system (unless a particular feature is banned entirely).

The net result is that the Marked-Cluster constraints predict the existence of 14 patterns of surface heterorganic clusters; the patterns with all heterorganic clusters (i.e. no assimilation) and no heterorganic clusters (i.e. total assimilation) are omitted in table (107).

Heterorganic cluster typology due to marked-cluster constraints

<table>
<thead>
<tr>
<th>KT</th>
<th>KP</th>
<th>PK</th>
<th>PT</th>
<th>TP</th>
<th>TK</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SLP Creole – §7.4.2</td>
</tr>
<tr>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Attic Greek – §7.5.1</td>
</tr>
<tr>
<td>√</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Chukchi – §7.4.3</td>
</tr>
<tr>
<td>√</td>
<td>√</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td>(–Korean) – §7.5.2</td>
</tr>
<tr>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td>Kui – §7.5.3</td>
</tr>
</tbody>
</table>

The Marked-Cluster constraints have been used in two ways in previous sections: (1) to account for marked-undergoer systems, where clusters with unmarked elements are the only ones tolerated (e.g. SLP Creole), and (2) to account for marked-trigger systems, where only marked elements trigger assimilation (e.g. Korean, Harar Oromo). Thus, all the systems listed in table (107) have some marked-undergoer and/or marked-trigger aspect to them.
• **Marked-faithfulness**

  The marked-faithfulness constraints are the other important factor for the typology of surface heterorganic clusters. If there were no Marked-Cluster constraints — only one against heterorganic clusters in general (e.g. AGREE[Place]) — the marked-faithfulness constraints would predict four types of language, given in table (108).

(108) **Marked-faithfulness typology (regressive assimilation only)**

<table>
<thead>
<tr>
<th>Surface Heterorganic Clusters</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>KP KT</td>
<td>Diola Fogny — §7.2.2</td>
</tr>
<tr>
<td>KP KT PK PT</td>
<td>Catalan — §7.2.1</td>
</tr>
<tr>
<td>KP KT PK PT TK TP</td>
<td>Sierra Miwok — §7.6.2.2</td>
</tr>
</tbody>
</table>

As established in previous sections, if a marked-faithfulness constraint like IDENT{KP} outranks all assimilation-inducing constraints, all heterorganic clusters except those containing both dorsals and labials will be eliminated (i.e. *[KT PT TK TP]*). Other factors may intervene to limit the attrition: in Catalan, ONSET-IDENT{KPT} saves the clusters [KT PT], with the result that only [TP TK] are banned on the surface. The remaining task is to show how the marked-faithfulness and marked-cluster constraints interact.

• **The interaction of marked-faithfulness and Marked-Cluster constraints**

  The following discussion will focus on languages that resolve heterorganic clusters through regressive assimilation. A graphical representation of the interaction of the marked faithfulness constraints IDENT{K} and IDENT{KP} is given in (109).

(109) **Marked-Cluster + marked-faithfulness constraints**

<table>
<thead>
<tr>
<th>TT</th>
<th>PK</th>
<th>KP</th>
<th>PT</th>
<th>TP</th>
<th>TK</th>
</tr>
</thead>
</table>

The dotted lines enclose clusters that IDENT{KP} and IDENT{K} can save from elimination by regressive assimilation. For example, IDENT{K} preserves the K in KT and KP. With IDENT{K} active, the implicational restrictions imposed by the marked-cluster constraints are somewhat curtailed. For example, while it is true that the marked-cluster constraints on their own cannot produce a [KP KT TP] system, combination of IDENT{K} and the marked-cluster constraints can.

Diagram (109) provides a representation of the possible surface cluster inventories, if read with the guidelines in (110).

(110) **Interpretation of Diagram (109)**

  (a) Select one of the sets of elements enclosed by dotted lines (i.e. [KT KP] or [KT KP PT PK]).

  (b) Remove or add clusters under the following conditions:

  (i) If cluster $c_1$ is removed, then remove all clusters that are more marked than $c_1$ (e.g. if KT is removed, also remove KP).

  (ii) If cluster $c_1$ is added, then add all clusters that are less marked than $c_1$ (e.g. if TK is added, then also add TP).

  Algorithm (110) produces the possible systems in table (111). Systems identical to those in table (107) are greyed out.

(111) **Marked-Cluster + marked-faithfulness typology**

<table>
<thead>
<tr>
<th>KT</th>
<th>KP</th>
<th>PK</th>
<th>PT</th>
<th>TP</th>
<th>TK</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
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<tr>
<td>✔</td>
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<tr>
<td>✔</td>
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</tr>
</tbody>
</table>

If only clusters inside the dotted circles of (109) are taken, they form systems with [KT KP] and [KP KP PK PT] as the only heterorganic clusters (e.g. Inuktitut and Catalan resp.). These systems have the ranking \([\text{IDENT}[K], \text{IDENT}[KP]] > *\{KPT\}[KPT] > \text{IDENT}[KPT]\) with all marked-cluster constraints below IDENT{KPT}. As another example, if the clusters inside the smaller circle (produced by IDENT{K}) are taken [KT...
contain TP. The same holds for the other implicational relationships. 

As with table (107), there are many gaps. Again, these gaps may not be empirically significant, but rather follow from the limitations of the typological survey reported here. Again, the ‘easiest’ systems are identified above – those that pose little complexity. For example, the [TP KT KP] system is one in which only labials undergo assimilation (as in Gunin), and dorsals trigger assimilation (as in Korean). The rarity of systems with limitations on both triggers and undergoers means that the lack of such a system is unsurprising.

- What doesn’t exist
  While the Marked-Faithfulness and Marked-Cluster constraints can produce a wide variety of different cluster types, they do not allow every possible system. Table (112) summarizes the restrictions on surface clusters imposed by the present theory.

(112) Surface heterorganic cluster implicational relations
  (a) If [TK] is permitted, then [TP] is permitted
  (b) If [PK] is permitted, then [PT] is permitted
  (c) If [KP] is permitted, then [KT] is permitted
  • Assume that K, P, and T are permitted generally in the language.

In other words, if a language permits a TK cluster on the surface and resolves heterorganic clusters through regressive assimilation, it also allows TP (assuming that P is permitted in the language, of course). If PK is permitted, then so is PT; the same holds for KP and KT. These restrictions rule out 37 possible systems.

The relations in (112) hold because of the nature of the Marked-Cluster and Marked-faithfulness constraints. On the markedness side, TP is a harmonic bound for TK, as is PT for PK, and KT for KP. Therefore, the Cluster-Markedness constraints cannot be used to produce systems with TK and not TP, and so on. Therefore, such systems could only come about through markedness constraints.

However, faithfulness constraints cannot preserve TP from regressive assimilation without also preserving TK. To prevent T from assimilating to P in TP (i.e. /TP/ → /TP/), the constraint IDENT[KP] must be employed. However, this constraint will also preserve T in /TK/. In short, faithfulness constraints cannot distinguish the TP and TK for regressive assimilation: unfaithfulness to T in either cluster incurs the same faithfulness violations.

So, because faithfulness constraints cannot distinguish the two types of cluster and markedness constraints universally favour TP over TK, every inventory with TK must also contain TP. The same holds for the other implicational relationships.

7.7.2 Relative Markedness theories

The preceding sections have presented a particular view of ‘marked undergoer’ systems – i.e. systems in which only marked values undergo assimilation. To return to the example of SLP Creole, only coronals fail to undergo assimilation in this language: e.g. /ŋi

This result relates to the discussion of possible triggers in §7.5.4. It was claimed that if x triggered assimilation, then all elements more marked than x would also trigger assimilation. So, there can be no language in which labials force a segment y to assimilate without dorsals also doing so. In such a language, /TP/ would be eliminated (i.e. to [TT]) but /TK/ would remain faithful; in other words, the surface clusters would include [TK] but not [TP]. In short, the discussion above accords with the Trigger Implication in (86).

The formal expression of markedness – ch. 7

The leading idea behind the present theory is that unmarked elements do not undergo assimilation in marked undergoer systems because they are already ‘adequately unmarked’. In SLP Creole, coronals are the least marked type of element, so there is no pressure on them to assimilate. This is formally expressed in the theory as a markedness constraint that bans non-coronal+C heterorganic clusters *[K][KP] – this constraint puts no pressure on coronals to assimilate.

However, there is a class of theory that offers a potential alternative to systems like SLP Creole’s. Such theories would see SLP Creole as a case where coronals do not undergo assimilation because the outcome is relatively more marked. In other words, they ban assimilations that result in an increase in markedness. For example, if /lu/ assimilates to [p] or [k], the output increases in markedness relative to /lu/ – the process will turn a coronal element into something more marked – a labial [mp] or a dorsal [kp].

Theories based on this leading idea will be called ‘Relative Markedness (RM) theories’ here.

The aim of this section is to compare two recently proposed Relative Markedness (RM) theories to the current approach. They are Bäkovic’s (1999, 2000) theory of faithfulness constraints with the conjunctial encoding on Lulowicz (1981, 1988), and McCarthy’s (2002a) theory of Comparative Markedness.

This section aims to show that RM theories and the Marked-Cluster theory differ in their predictions regarding the typology of assimilation. The conclusion will be that – for the typology of assimilation – the Marked-Cluster constraints are needed regardless of RM theories.

It is important to point out that the aim of this section is not to show that either Bäkovic’s (1999, 2000) nor McCarthy’s (2002a) theories are flawed. The aim is to show that they cannot provide a complete account of the attested cases of assimilation, thus showing that the leading idea behind the Marked Cluster theory is correct. Bäkovic’s and McCarthy’s theories deal with many issues apart from assimilation, including derived environment effects, opacity, and the ‘Majority Rule’ problem (Lombardi 1996, 1999).

The Marked-Cluster approach solely focuses on dealing with asymmetries in assimilation, and as such has nothing to say about these other phenomena.

In any case, the RM theories discussed in this section do not offer an alternative to the main point of this chapter – i.e. that marked-faithfulness constraints are necessary. The
issue discussed here relates solely to the Marked-Cluster constraints and the particular issue of languages in which only marked elements undergo assimilation. Languages with unmarked undergoer systems – like Catalan – still stand as evidence for marked-faithfulness constraints regardless of RM theories.

7.7.2.1 Behind the theories

A marked undergoer system like SLP Creole’s can be informally characterized in a number of ways. The leading idea behind the present theory is that “coronals do not assimilate because they are already adequately unmarked.” In other words, assimilation is considered a markedness-reducing operation: elements undergo assimilation to produce a less marked structure – i.e. a homorganic cluster. However, if a segment already has marked features, it may have nothing to gain by assimilating. Coronals, for example, are the least marked of PoA features, so they are exempt from assimilation in SLP Creole.

To cast this intuitive characterization a little more precisely, coronals are considered adequately unmarked in SLP Creole so that no pressure is placed on them to assimilate. The present theory formally expresses this intuition by having a markedness constraint that specifically bans non-coronal+C heterorganic clusters: i.e. *[KP][KPT].

In grammars where *[KP][KPT] is the only active markedness constraint, there is no pressure on coronals to assimilate to non-coronals, so they are exempt from undergoing assimilation.

There is another informal way to characterize the SLP Creole system: “Coronals do not assimilate because doing so would create something too marked.” For example, if /s/ as in [spit] were realized as [sp], the unmarked coronal /s/ would end up with a marked PoA: labial [m]. In short, the leading idea behind this approach is that a process can be blocked if it creates something more marked out of something less marked. This informal characterization lies behind analyses of marked undergoer systems proposed by Baković (1999a,b) and McCarthy (2002a). Both theories employ constraints that mitigate against elements that become more marked, though they do so in significantly different ways.

The following section shows how the theories approach a system like SLP Creole’s. The result will be that both an RM theory and the present approach can deal with marked undergoer systems of precisely SLP Creole’s type. However, they diverge in their predictions for other marked undergoer systems. RM theories predict a type that is unattested and ban attested types, while the present approach predicts the opposite.

7.7.2.2 RM theories and SLP Creole

Baković (1999a,b) has presented the earliest RM theory, which also has the distinction of being the first theory applicable to marked undergoer systems (for voice assimilation). Baković’s proposal is that a markedness and faithfulness constraint can be conjoined to block creation of a marked element. For example, *[+voice] & IDENT[+voice] prevents a segment from becoming more marked – i.e. voiced (e.g. /p/ → [b]), but does not block a segment from becoming less marked (e.g. /b/ → [p]). This theory will be called the ‘Relative Markedness Conjunction Theory’ here (RMCT).

Baković (1999ab) shows that locally conjoined constraints, along with a restriction on its ranking, is able to deal with the ‘Majority Rule’ effect of Lombardi (1996, 1999) and provide insight into the analysis of certain Dominant-Recessive vowel harmony systems. Both of these issues are beyond the scope of this section. Instead, the following discussion will focus on the ability of RMCT to explain unmarked-undergoer systems of assimilation.

To give a brief explanation of why RMCT offers some possibility for analysis of unmarked-undergoer systems, consider the case of Mekkan Arabic voicing assimilation from §7.4.4 (for an analogous case, see Baković 1999b). In this language, voiced sounds assimilate to voiceless ones: e.g. /maghul/ → [maktu] ‘killed’. However, voiceless sounds do not assimilate to voiced ones: e.g. /taku/ → *[za]ku ‘older’. RMCT offers an explanation for why voiceless segments do not assimilate to voiced ones. If a voiceless sound did assimilate to a voiced one, it would be both unfaithful to its input [voice] specification – i.e. violate IDENT[+voice] – and it would violate *[+voice]. Thus, from input /taku/, the candidate *[za]ku is eliminated by the conjunction *[+voice] & IDENT[+voice]. In contrast, voiced sounds can assimilate to voiceless ones; although /g/ in /maghul/ is unfaithful in [maktu], it does not violate *[+voice]. In other short, the RMCT conception of Mekkan Arabic is that it avoids creation of marked elements.

However, I suggest that the RMCT approach to unmarked-undergoer assimilation works for incidental reasons relating to binary scales, and does not cut to the heart of the problem posed by unmarked-undergoer systems. PoA assimilation in SLP Creole provides support for this contention.

As a reminder, dorsals and labials undergo assimilation in SLP Creole, but coronals do not. So, the relevant conjoined constraint would be *[KP] & IDENT[KPT]. The effect of this conjoined constraint is “Don’t both have a marked PoA (i.e. dorsal or labial) and be unfaithful”. So, the conjoined constraint would block a mapping where a coronal becomes more marked – i.e. a labial or a dorsal. In such a case, the output would violate IDENT[KPT] because it is unfaithful and *[KP] because it is a non-coronal, thus incurring a violation of the conjunction of the two.

Tableau (113) illustrates *[KP] & IDENT[KPT]’s application. The constraint ASSIM bans heterorganic clusters.221

220 To expand on this point, RM theories cannot deal with unmarked-undergoer systems where only unmarked elements undergo assimilation. Since RM theories ban an increase in markedness, they cannot provide an account of systems in which the only assimilations that take place create more marked outputs (as in Catalan, where only coronals assimilate, producing more marked elements).

221 It is argued below that the Marked-Cluster constraints provide an alternative to an RM account of assimilation. Therefore, only RM theories that do not employ Marked-Cluster constraints will be considered here. The constraint ASSIM is a cover term for assimilation-motivating constraints in such theories.
The assimilated candidate (b) violates \(*\{KP\} & IDENT\{KPT\}\) because \(m\) violates \(*\{KP\}\) (because it is a labial) and is unfaithful to the underlying PoA feature of \(/m/\). This violation blocks the influence of ASSIM, allowing the unassimilated candidate to win.

In contrast, the ranking does not (entirely) ban assimilation of dorsals and labials. If ASSIM outranks all dorsal- and labial-preserving constraints (i.e. IDENT\{K\}, IDENT\{KP\}, IDENT\{KPT\}), labials and dorsals will assimilate to coronals without hindrance, as shown in tableau (114).

The assimilated candidate (b) does not violate \(*\{KP\} & IDENT\{KPT\}\); while output \([n]\) is unfaithful to input \(/n/\) (thereby violating IDENT\{KPT\}), it crucially does not violate \(*\{KP\}\). This allows ASSIM to assign the crucial violation, favouring the assimilated candidate (b) over (a).

However, there is an empirical problem with the RMCT analysis. As shown above, the ranking \(\equiv \{KP\} & IDENT\{KPT\} \gg \text{ASSIM} \equiv \{KP\} & IDENT\{KPT\}\) is necessary, but predicts that \(/\text{mp}\ pæ/\) will not assimilate to \([\text{mp}\ pæ]\). The faithful candidate \([\text{mp}\ pæ]\) is predicted to win under this ranking because \([\text{mp}\ pæ]\) violates \(*\{KP\} & IDENT\{KPT\}\); \([m]\) is both unfaithful and violates \(*\{KP\}\). In contrast, \([\text{mp}\ pæ]\) violates only \(*\{KP\}\), so does not incur a violation of the conjointed constraint:

There is no way to avoid this problem in RMCT. If the conjointed constraint only banned unfaithfulness and labials (i.e. IDENT\{KPT\} & \(*\{P\}\) ), then \(\text{mp}\-\text{ku}\) should assimilate to \(*\{mp\ pæ\}\). The only other option is to employ a faithfulness constraint that preserves coronals only: i.e. \(*\{KP\} & IDENT\{T\}\), but this defeats the purpose entirely: with IDENT\{T\}, the SLP Creole analysis has no need of a conjointed constraint.

To give an informal characterization of the problem, the RMCT approach sets a markedness threshold on unfaithful elements. The constraint \(*\{KP\} & IDENT\{KPT\}\) requires unfaithful elements to not be highly marked (i.e. K or P). However, this is not precisely what happens in SLP Creole: rather, the process is that "unfaithful elements must not become more marked." Thus, \(/\text{n}\ pæ\text{zu}/\rightarrow [\text{ump}\ pæ\text{zu}]/\) is permitted because \(/y/\) has not become relatively more marked by turning into \([m]\).

While RMCT does face an empirical problem, the problem is not a general property of RM theories as shown by the fact that another Relative Markedness approach – McCarthy’s (2002a) Comparative Markedness theory – can successfully deal with SLP Creole.

- **Comparative Markedness: McCarthy (2002a)**

  McCarthy (2002a) proposes a new type of markedness constraint that can be used to deal with marked undergoer systems. The theory is called ‘Comparative Markedness’ (CM), a term that characterizes the constraints proposed.

  CM constraints are violated when two conditions are met: (i) the output form meets the constraint’s structural description and (ii) the violation is ‘new’. A violation is ‘new’ if it has no analogue in the fully faithful form. For example, the CM constraint \(s^*(\{KP\})\) is only violated by candidates that have a dorsal or labial that is not present in the input/fully faithful form.

  For example, the fully faithful candidate from input \(/s\text{mp}\ pæ/\) is \([s\text{mp}\ pæ]\). This has one violation of the standard \(*\{KP\}\) constraint – i.e. in \([p]\). However, \([s\text{mp}\ pæ]\) has no violations of \(s^*(\{KP\})\) – compared to the fully faithful form (i.e. itself), \([s\text{mp}\ pæ]\) does not have any different violations of \(*\{KP\}\).

  In contrast, the output form \([s\text{mp}\ pæ]\) violates \(*\{KP\}\) twice and \(s^*(\{KP\})\) once. It violates \(*\{KP\}\) twice for obvious reasons – there are two labials in the output. It violates \(s^*(KP)\) once because there is a violation of \(*\{KP\}\) that is present in \([s\text{mp}\ pæ]\) but not in the fully faithful form \([s\text{mp}\ pæ]\). Importantly, \(s^*(\{KP\})\) is not violated twice by \([s\text{mp}\ pæ]\); \([p]\) does not register a violation because it is not a ‘new’ violation – it has an analogue in the fully faithful form. In effect, then, \(s^*(\{KP\})\) is penalizing \([s\text{mp}\ pæ]\) for introducing a more marked element.

  In short, CM captures the RM theory intuition in a rather straightforward manner. \(s^*(\{KP\})\) is (essentially) violated when an input coronal turns into something more marked. Hence, \(s^*(\{KP\})\) provides a straightforward account of SLP Creole. The use of \(s^*(\{KP\})\) to account for SLP Creole follows McCarthy’s (2002a) analysis.223

\[\begin{array}{ccc}
  & /s\text{mp}\ pæ/ & s^*(\{KP\}) & \text{ASSIM} & \{KP\} \\
  \text{a) } & \text{si} & \ast & \ast & \ast \\
  \text{b) } & \text{mp} & \ast & \ast & \ast \\
\end{array}\]

Candidate (a) is the fully faithful form. It incurs one violation of \(*\{KP\}\) – i.e. by means of \([p]\). In contrast, \(\{s\text{mp}\ pæ]\) incurs two violations of \(*\{KP\}\) – one for \([m]\) and one

---

222 This is casting the theory in a much simpler way than it really is. However, for present purposes it is accurate enough; the reader should consult McCarthy (2002a) for in-depth discussion.

See McCarthy (2003a:9 and fn.9) for a circular chain shift of attribution.
Finally, asymmetries in triggering elements are discussed. The cluster-markedness constraints are argued to be necessary regardless of whether CM constraints exist or not.

- A Dorsal-Undergoer Language

CM and the present theory differ in regard to predictions about a system in which only the most marked PoA – dorsals – undergoes assimilation while coronals and labials do not. Chukchi was argued to be such a system in §7.4.3.1; Harar Oromo is also a relevant system: dorsals assimilate while labials do not (§7.4.3.2). A dorsal-undergoer system is illustrated schematically in (118).

(118) Dorsal-Undergoer System

(a) Dorsals assimilate

/altern/ → /antern/

(b) Labials do not assimilate

/amkau/ → /amkau/, *[/amtkau/]

(c) Coronals do not assimilate

/aman/ → /aman/, *[/aman/]

This type of system presents a difficulty for CM in that dorsals assimilate while the less marked labials do not. The problem involves transitivity of ranking. The fact that dorsals assimilate shows that the assimilation-inducing markedness constraint must outrank all faithfulness constraints against dorsals: i.e. \[\text{ASSIM} \rightarrow \text{IDENT}[K], \text{IDENT}[KP], \text{IDENT}[KPT]\].

However, if ASSIM outranks all faithfulness constraints, what prevents coronals and labials from assimilating? CM provides a partial answer in the form of the comparative markedness constraint: \(s^*[KP]\) will block assimilation of coronals to something more marked, as shown for SLP Creole.

However, labials present a significant difficulty. While the mapping /aman/ → /aman/ can be blocked by a CM constraint \(s^*[K]\), no constraint can block /antan/ → /antan/. There is no faithfulness constraint available that can favor /antan/ over /antan/ (because both are equally unfaithful – see ch.6.6), nor can any comparative markedness constraint ban /mnt/ → /mnt/ since the output is less marked than the fully faithful form.

This conundrum is a general problem for RM theories. Since RM theories rely on the idea that change to a more marked element is banned, there is no RM-based way to prevent a change from a more to a less marked element.

The only way around the problem is to propose significantly different faithfulness constraints and then appeal to a Catalan-style analysis. If there were a constraint IDENT[PoA], for example, then IDENT[PoA] would outrank ASSIM, preventing assimilation. Crucially, the faithfulness constraint cannot preserve dorsals as well, otherwise dorsals would fail to assimilate. However, proposing a separate IDENT[PoA] has a problematic ripple
introduces a new violation of \( \*{K} \) (cf. fully faithful \([amka]\)), thus fatally violating \( N*{K} \).

\( N*{KP} \) » ASSIM ||. The input /am-ka/ cannot emerge as \([a\text{marked}]\). Interestingly more Blocking: where a segment will only assimilate to something \( N*{K} \), the system differs from SLP Creole: in SLP Creole, only coronals were prevented from assimilating; labials could assimilate to the more marked dorsals, and dorsals to labials.

The implication is that the markedness constraint \( \*{(K)}{KP} \) is necessary regardless of whether CM constraints exist or not. If this is the case, it is a small step to assume that there is a constraint \( \*{(K)}{KPT} \). However, if this is so, then there is no need for a CM analysis of SLP Creole, as shown in §7.4.3.1. The crucial part of the analysis provided there was that there is some markedness constraint that specifically bans dorsal+non-dorsal clusters. This analysis captures the intuition behind the present approach: labials do not assimilate because they are already unmarked enough. Formally, there is no active markedness constraint that bans labial+coronal clusters, so labials are never under pressure to assimilate in Chukchi.

In contrast, the present theory can account for dorsal-undergoer systems, as shown in §7.4.3.1. This implies that labials are more marked than dorsals. Proposing an \( \text{IDENT}[P] \) constraint then turns into a ‘local’ solution, good only for Chukchi. The \( \text{IDENT}[P] \) approach then faces the exact same problem with systems in which labials are the only undergoers (Gunin/Kwini – §7.1) — such systems are predicted to not exist in a CM theory with \( \text{IDENT}[P] \) for the same reasons that Chukchi is not predicted to not exist with a CM theory with \( \text{IDENT}[K] \).

Progressive Blocking

RM theories also predict a type of system that is as yet unknown; the present theory does not. The system is one in which assimilation is blocked only when it would create a more marked segment. This type of system is called a ‘progressive blocking’ system since it bans outputs that are progressively more marked. The system is illustrated in (119).

(119) Progressive Blocking (PB) Language

(a) Dorsals assimilate to coronals and labials
\[
/\text{ant-pa}/ \rightarrow [\text{ampa}]
\]
\[
/\text{ant-ta}/ \rightarrow [\text{anta}]
\]

(b) Labials assimilate to coronals, but not dorsals.
\[
/\text{an-ka}/ \rightarrow [\text{amka}]
\]
\[
/\text{an-ta}/ \rightarrow [\text{anta}]
\]

(c) Coronal do not assimilate at all.
\[
/\text{an-ka}/ \rightarrow [\text{anka}]
\]
\[
/\text{an-pa}/ \rightarrow [\text{ampa}]
\]

In other words, from the scale \( \{\text{dorsal}\} \) labial \( \{\text{coronal}\} \), assimilation only takes place if the output contains a strictly less marked sound: i.e. /na/→/n[\text{n}]\, but not to /[g]/. This system differs from SLP Creole: in SLP Creole, only coronals were prevented from assimilating; labials could assimilate to the more marked dorsals, and dorsals to labials.

This type of system can be produced in the CM theory with the ranking \( \| \, n^*{K} \), \( n^*{KP} \rightarrow \text{ASSIM} \|. \) The input /an-ka/ cannot emerge as \([\text{antka}]\) because this form introduces a new violation of \( \*{K} \) (cf. fully faithful \([amka]\)) but this fatally violating \( n^*{K} \).

As with SLP Creole, this ranking does not block the assimilation of labials and dorsals to coronals, or to dorsals and labials. Tableau (120) illustrates this point.

<table>
<thead>
<tr>
<th>/amkamta/</th>
<th>( n^*{K} )</th>
<th>( \text{ASSIM} )</th>
<th>( *{K} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) amkamta</td>
<td>( # )</td>
<td>( # )</td>
<td>( # )</td>
</tr>
<tr>
<td>(b) amkanta</td>
<td>( # )</td>
<td>( # )</td>
<td>( # )</td>
</tr>
<tr>
<td>(c) amkanta</td>
<td>( # )</td>
<td>( # )</td>
<td>( # )</td>
</tr>
</tbody>
</table>

In contrast, the present theory cannot produce a Progressive Blocking system. The reason can best explained by returning to the intuition behind the theory: “a segment may be exempt from assimilation if it is already adequately unmarked”. Coronals are very unmarked, so they can be exempt from assimilation. However, when it comes to labials, the theory gives one of two choices: either they assimilate or they don’t. So, if the answer to the question “Are labials adequately unmarked?” is positive, then labials cannot assimilate at all, if it is negative, then labials will assimilate to both dorsals and labials.

To give a formal account of the problem posed by labials, consider the ranking needed for assimilation of /am-ta/ to /[anta]/. Some markedness constraint that bans [labial+coronal] clusters (i.e. \( \*{(KP)}{KPT} \)) must outrank all faithfulness constraints that preserve labials (\( \text{IDENT}[KP] \), \( \text{IDENT}[KPT] \)).

However, with this ranking nothing prevents labials from assimilating to dorsals. To ban labial→dorsal assimilation, some faithfulness constraint that preserves labials (i.e. \( \text{IDENT}[KP] \) or \( \text{IDENT}[KPT] \)) must outrank all markedness constraints that ban labial-dorsal clusters — i.e. \( \*{(KP)}{x} \), \( \*{(KPT)}{x} \), where \( x \) is any set of elements. This ranking directly contradicts the one needed for labial→coronal assimilation. This result relates to a general prediction made by the present theory (discussed in §6.3): if \( x \) assimilates to \( y \), then \( x \) assimilates to \( z \), where \( z \) is more marked than \( y \).

In contrast, the present theory can produce the SLP Creole system because it is not a progressive markedness system: all segments that fail to assimilate before some other segment do not assimilate at all (i.e. /na/).

So far, no progressive blocking system has been reported. This fact does not weigh in favour of either theory at this point, though, since very few marked-undergoer systems have been identified at all (cf. Račović 1999a, Wetzel & Masurco 2001, and most extensively in this chapter). However, it is notable that the predictions of RM and the present theory are different, and thus will ultimately provide a way to tell which is more empirically adequate.

Triggering

CM and the present theory make significantly different predictions regarding the elements that trigger assimilation. Specifically, with only a markedness constraint like \( \text{ASSIM} \), CM predicts that there is no system that is the exact opposite of Progressive Blocking: where a segment will only assimilate to something more marked. Interestingly
enough, such a system has already been identified in Korean (sec. 7.5.2), repeated briefly in (121).

(121) Korean: A progressively more marked system

(a) coronals assimilate to labials and dorsals
   /an pat'/ → *[ampat']
   /han kar/ → *[kar[kar]]

(b) labials assimilate to dorsals but not coronals
   /kam[k]u/ → *[kar[k]]
   /sum-ta/ → *[sun[tta]], *[sun[tta]]

(c) dorsals do not assimilate
   /pat' pota/ → *[pat'pota], *[pampota]
   /ik ta/ → *[ikt], *[ikt]

Without any other markedness constraint, CM constraints cannot produce the Korean system. In fact, it runs exactly counter to what is expected under CM: elements only assimilate if they become more marked, not less.

Section 7.5.2 showed that the present theory can account for Korean. However, it crucially relied on an ‘asymmetric’ assimilation constraint *[KPT][K]. This constraint requires assimilation to dorsals, and is based on the idea that more marked elements promote greater assimilation.

Given the necessity of *[KPT][K], a ‘plausibility’ argument for the current theory will be made here. If even the CM theory needs asymmetric assimilation constraints like *[KPT][K] to deal with Korean, then there is no a priori objection to a constraint such as *[K][KPT] for Chukchi (or *[KP][KPT] for SLP Creole). If this is the case, then there is then need for CM constraints to produce marked undergoer systems.

7.7.2.4 Conclusions

To conclude, RM theories do not provide a full account of undergoer systems in assimilation. While RM theories can potentially deal with certain types of marked undergoer system (i.e. one in which the least marked element of a scale fails to undergo assimilation – Mekkan Arabic, SLP Creole), they cannot account for other attested types (i.e. where only the most marked element of a >2-step scale is an undergoer). Moreover, they predict the existence of an otherwise unattested system in which only assimilation to a one value of a feature, and such constraints produce Majority Rule effects, as found in Korean. In contrast, the Marked-Cluster theory accounts for all attested marked assimilation patterns as well as triggering. It also predicts that the unattested ‘Progressive Marked’ type of system cannot exist.

So, the asymmetric assimilation constraints are needed independently of RM theories. Currently known cases of asymmetries in undergoers therefore provide no evidence that exclusively supports Comparative Markedness constraints.

This result supports the intuition behind the present theory’s approach to SLP Creole: coronals do not undergo assimilation because they are already adequately unmarked; there is no evidence that the difference between input and output markedness is taken into account in PoA assimilation.

As a concluding note, both Baković’s and McCarthy’s theories have more uses than just accounting for asymmetries in undergoer systems. The formalism behind Baković’s theory was first proposed by Lubowiąz (1998) to deal with derived environment effects (cf. Lindblom 1999, McCarthy 2002a). Moreover, Baković’s theory provides a solution to Majority Rule effects, discussed in §7.7.3.

McCarthy argues that Comparative Markedness can also be used to deal with types of opacity, derived environment effects, non-iterating processes, and non-structure-preserving coalescence. While RM theories may have application in other domains, the argument presented here is simply that they cannot adequately deal with the range of attested assimilation patterns, and that the Marked-Cluster constraints are necessary regardless of RM constraints.

7.7.3 Majority Rule

Lombardi (1996, 1999) identified a problem that is relevant to the faithfulness proposals raised here. IDENT[tvoice] can ensure that the voicing value that is prevalent in the input is preserved in assimilation. In such a system, because there are two [+voice] segments in [gbt] and only one [-voice] one, the output will be [gbt]; in contrast, there are more [+voice] in [pbt] than [+voice] ones, so the output cluster will be [pbt]. In other words, whatever input feature value is in the majority appears in the output, hence the term ‘Majority Rule’ (Baković 1999a).

Lombardi (1999a,b) and Baković (1999a,b) claim that Majority Rules do not exist – there is no attested assimilation pattern like the one just described. Therefore, the Majority Rule issue is significant for the proposals here. As one of the consequences of the proposals in this Part is that there are faithfulness constraints that preserve more than one value of a feature, and such constraints produce Majority Rule effects, it is necessary to make some comment on the present theory’s proposals and Majority Rules.

The following discussion owes a significant debt to Baković’s (1999a,b) work on the Majority Rule problem. I conclude that (a) there is little empirical support for the claim that Majority Rules do not exist, and (b) the Majority Rule problem – if it does exist – must be solved without rejecting the existence of faithfulness constraints that preserve two or more feature values.

Section 7.7.3.1 discusses the Majority Rule problem in more detail, and generalizes it to coalescence as well. Section 7.7.3.2 identifies the rankings for Majority Rule effects, and section 7.7.3.3 discusses some solutions.
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### 7.7.3.1 The empirical generalization

Before discussing the ranking that produces the Majority Rule effects, it is necessary to discuss whether Majority Rule effects ever have the opportunity to arise. I can add little to Balačević’s (1999b§4) discussion of this point so I quote the relevant passage here.

(122) “In order to garner any evidence from actual alternations, a language must at least have obstruent-final items, suffixes consisting of nothing other than an obstruent (or obstruents), and the ability to tolerate the resulting tautosyllabic obstruent cluster — each a taller order than the last. Indeed, even when such a language is in evidence, as in the case of Yiddish, there are insufficient data to truly see the full range of possibilities. I have no doubt that Lombardi is right in her suspicion that no language could have the equivalent of ‘majority rule’, but it would seem that this is not really possible to know for sure. Other assimilation processes do not seem to offer any solace.”

Balačević (1999b§4)

However, Balačević then goes on to argue that non-local assimilation — i.e. harmony — does provide relevant situations. For example, if all vowels in a word must agree in [ATR], then a Majority Rule for ATR harmony would require a word with more +ATR input vowels than –ATR ones to surface with all +ATR vowels, while the opposite input situation would produce an entirely –ATR output. One issue this proposal raises is whether local assimilation and harmony are similar enough, formally speaking, so that the Majority Rule problem for harmony systems is not mitigated by incidental factors, such as the form of the markedness constraints that trigger the process. Balačević (1999a,b) assumes that AGREE constraints trigger both local assimilation and harmony, so the Majority Rule arises in the same way for both processes in this system. It is imaginable, though, that the form of harmony-triggering markedness constraints may reduce the Majority Rule problem, though pursuing this ill-defined thought would be tangential to this discussion.

In any case, the Majority Rule problem also potentially arises outside of assimilation — in coalescence. In the following discussion, I will assume that the reader has examined chapter 8, so as to avoid duplication of material here.

In coalescence, input elements fuse into a single output segment. In formal terms, two or more input segments may correspond to a single output one. So, /dkt/ may coalesce to form [g]. The Majority rule problem can arise in cases where three or more elements coalesce. In a Majority Rule-controlled coalescence, /gkt/ would coalesce to [dkt], preserving the [+voice] specification because more input elements are [+voice]. In contrast, /gpt/ would surface as [tkt]. Again, the constraint IDENT[+voice] would be responsible for this outcome.

However, clear cases of coalescence are hard to find, and cases involving three separate segments are even rarer. Nevertheless, I discuss in ch.8§5.2.4 – presents the right context for a Majority Rule coalescence to occur: it coalesces three elements into one (e.g. /sak1,t2u/ → [sak2,1,3,ii] ‘be able+arist+3p.sg.’). In this particular case, though, the marked dorsal feature always survives — there is no Majority Rule effect. So, while it is possible for coalescence to provide the opportunity for a Majority Rule to occur, finding enough relevant cases to determine whether Majority Rules do or do not exist in coalescence will prove to be a significant challenge.

To summarize, it is not obvious that Majority Rule effects are impossible. While there is some intuitive validity to such a claim, a much wider range of appropriate data is needed before any claim can be made about the existence of Majority Rules. Even so, the following sections will assume that Majority Rules cannot exist, and determine their relevance to the present theory.

### 7.7.3.2 Rankings

The Majority Rule ranking is provided in (123); it is based on Lombardi (1996, 1999) and Balačević (1999a,b). For consistency, I use constraints introduced in this chapter rather than those in the works cited.

(123)

```
<table>
<thead>
<tr>
<th></th>
<th>*{[+v]}</th>
<th>IDENT[+v]</th>
<th>ONSET-IDENT[+v]</th>
<th>*{[v]}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td><img src="image1.png" alt="image" /></td>
<td><img src="image2.png" alt="image" /></td>
<td><img src="image3.png" alt="image" /></td>
<td><img src="image4.png" alt="image" /></td>
</tr>
<tr>
<td>(b)</td>
<td><img src="image5.png" alt="image" /></td>
<td><img src="image6.png" alt="image" /></td>
<td><img src="image7.png" alt="image" /></td>
<td><img src="image8.png" alt="image" /></td>
</tr>
<tr>
<td>(c)</td>
<td><img src="image9.png" alt="image" /></td>
<td><img src="image10.png" alt="image" /></td>
<td><img src="image11.png" alt="image" /></td>
<td><img src="image12.png" alt="image" /></td>
</tr>
</tbody>
</table>
```

Candidate (a) is eliminated because the cluster [bt] disagrees in voicing. Of the two remaining candidates, (b) wins because it preserves the most input values. The tableau shows that ONSET-IDENT[+v] must be dominated by IDENT[+v], otherwise the underlying voicing of the onset consonant will determine the outcome. Similarly, IDENT[+v] must outrank the markedness constraint *[+v][t] otherwise the voiceless candidate will always win, regardless of the outcome (see ch.8§5.3.1 for an example of the opposite ranking).

One further ranking not shown in the tableau above relates to IDENT[+v] — this must be dominated by IDENT[+v] otherwise the output will always be voiced (i.e. even /kpt/ would surface as [gbd]).

To complete the picture, tableau (124) shows how the ranking produces /gpt/ → [kpt] rather than *[gpt].

(124)

```
<table>
<thead>
<tr>
<th></th>
<th>*{[+v]}</th>
<th>IDENT[+v]</th>
<th>ONSET-IDENT[+v]</th>
<th>*{[v]}</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td><img src="image13.png" alt="image" /></td>
<td><img src="image14.png" alt="image" /></td>
<td><img src="image15.png" alt="image" /></td>
<td><img src="image16.png" alt="image" /></td>
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<tr>
<td>(b)</td>
<td><img src="image17.png" alt="image" /></td>
<td><img src="image18.png" alt="image" /></td>
<td><img src="image19.png" alt="image" /></td>
<td><img src="image20.png" alt="image" /></td>
</tr>
<tr>
<td>(c)</td>
<td><img src="image21.png" alt="image" /></td>
<td><img src="image22.png" alt="image" /></td>
<td><img src="image23.png" alt="image" /></td>
<td><img src="image24.png" alt="image" /></td>
</tr>
</tbody>
</table>
```

The formal expression of markedness — ch.7

Paul de Lacy
Lombardi (1996, 1999) and Baković (1998b, 3.1) identify the source of the Majority rule problem and discuss the constraint IDENT[±vd]. This constraint penalizes unfaithfulness in a gradient fashion: the more unfaithful segments, the more violations.

This gradience effectively favors candidates that differ as little from the input, so favoring assimilations that cause the least number of changes.

Another crucial property is that this constraint preserves more than one feature value – i.e. both + and −. If it only preserved one value (e.g. IDENT[±vd]), there would be no Majority Rule effect – the output would always preserve the value specified. In other words, for Majority Rule effects to exist, it is crucial that some faithfulness constraint conflates two or more values of a feature in terms of faithfulness – i.e. unfaithfulness to either feature value incurs equal violations.

Of course, Majority Rules could in principle exist for all features, including Place of Articulation, nasality, vowel features, and so on. For example, the faithfulness constraint IDENT[KP] could result in a POA assimilation that makes /akbka/ → [akgka] and /apbpa/ → [apbpa], where the output cluster’s POA is the same as the majority of the input segments (although such a POA assimilation seems unlikely to exist).

To generalize over the preceding discussion, existence of IDENT constraints that preserve more than one value of a feature result in Majority Rule effects. Therefore, Majority Rules pose a problem for the present theory (with the empirical caveats discussed in the preceding section).

### 7.7.3.3 Solutions

The aim of this subsection is to identify some methods of avoiding the Majority Rule problem and discuss their effectiveness and relation to the present theory. Baković (1998b, 2) discusses two solutions, suggested by Lombardi (1999); one involves redefining IDENT constraints so that they are evaluated non-gradually in relevant environments, and another relies on MAX-feature constraints. Baković shows that neither of these results is satisfactory; for discussion of the MAX-feature solution, see ch.6.6.4.2. Other solutions will be discussed here.

- **Privativity**
  
  Since IDENT[±voice] is the problem, one obvious step would be to eliminate it. Two different theories provide this result. One is the notion that features are privative. If [voice] is a privative feature, there can be no faithfulness to [−voice], so there can be no constraint that preserves both values of [voice] equally. The problem with this approach is that faithfulness to [−voice] is demonstrably necessary in some cases. For example, Lombardi (1999) shows that [−voice] is explicitly preserved in Swedish assimilation (also see ch.8§8.3.1 and Wetzel & Mascaró 2001). Chapter 8 also provides examples where [−voice] survives in coalescence. Moreover, this type of solution only works for binary scales and features. For POA, there must be faithfulness constraints that explicitly preserve both dorsal and labial values because coronal (or glottal) is the unmarked (i.e. unspecified) value (see ch.6). However, a constraint like IDENT[KP] also results in Majority Rule effects, as discussed above.

<table>
<thead>
<tr>
<th>(a)</th>
<th>(b)</th>
</tr>
</thead>
</table>

The constraint *(±voice)&IDENT[±voice] penalizes candidate (a) because /p/ is unfaithful to its input [voice] specification in [b] and is the marked value [+voice]. In contrast, no segment in (b) is both unfaithful and marked: /g/ and /d/ are the unmarked [−voice]. In short, this solution allows faithfulness constraints to preserve multiple values of a single feature, while eliminating Majority Rules.

Unfortunately, the Bakovićionian solution is not entirely compatible with the present theory, and perhaps with scales that have three or more values. For example, the present theory’s constraints in locally conjoined terms would allow *(KP)&IDENT[KP], penalizing segments that are both unfaithful and are highly marked. Unfortunately, in clusters consisting solely of dorsals and labials, the Majority rule problem again appears for POA: e.g. /mg/ → [mbp] and /gpf/ → [pk].
provide a more adequate explanation of alternations in Eastern Massachusetts

IDENT constraints to all values of a certain feature, then, the debate over symmetric and asymmetric evidence that such constraints are necessary, crucially allowing faithfulness 'conflation'.

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English. These proposals support the idea that an IDENT theory must be weakly asymmetric.

• **OI-IDENT**

The bifurcation of IDENT constraints into Input→Output and Output→Input versions raises an important issue: if OI-IDENT constraints do exist, do they pose any threat to the empirical generalizations made in this and the other chapters in this Part?

The answer is “no”, and follows primarily from the fact that faithfulness constraints can only refer to marked feature values in the present theory. A constraint such as OI-IDENT[af] effectively prevents an input segment’s f-value from becoming α. Since α is always a marked value in the present theory, OI-IDENT constraints will always militate against features taking on a marked value. For example, OI-IDENT[K] prevents segments from becoming dorsals: it blocks /anka/ → [apk] (but not /ap/ → [ant]). So, OI-IDENT constraints in the present theory effectively prevent outputs from becoming more marked, playing a similar role to markedness constraints.

Importantly, the present theory does not allow IDENT constraints that refer to unmarked values. For example, there can be no constraint OI-IDENT[T]. This constraint effectively prevents segments from taking on the less marked coronal feature: e.g. /apt/ → *[ant]. The constraint OI-IDENT[T] has undesirable effects for both neutralization and assimilation. For example, it can produce neutralization to more marked elements, as shown in tableau (128).

(128)

<table>
<thead>
<tr>
<th>/anka/</th>
<th>OI-IDENT[T]</th>
<th>*(K)</th>
<th>IO-IDENT[K]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) akm</td>
<td><img src="output.png" alt="output" /></td>
<td><img src="output.png" alt="output" /></td>
<td><img src="output.png" alt="output" /></td>
</tr>
<tr>
<td>(b) apkm</td>
<td><img src="output.png" alt="output" /></td>
<td><img src="output.png" alt="output" /></td>
<td><img src="output.png" alt="output" /></td>
</tr>
<tr>
<td>(c) am</td>
<td><img src="output.png" alt="output" /></td>
<td><img src="output.png" alt="output" /></td>
<td><img src="output.png" alt="output" /></td>
</tr>
</tbody>
</table>

OI-IDENT[T] effectively prevents neutralization to the least marked element [i], forcing segments to neutralize to the next least marked segment – [p]. As discussed in ch.6 §6.6.1, this type of neutralization is unattested.

In contrast, a constraint like OI-IDENT[K] has no pathological effects. It can prevent neutralization to more marked segments (i.e. /ap/ → [ak]) – a result which is highly desirable.

While OI-IDENT constraints are not clearly undesirable, the need for their existence is still controversial. Pater (1996, 1999) and Gnanadesikan (1997) provide relevant arguments.

However, there is some reason to be cautious: OI-IDENT constraints predict effects that run counter to the predictions for triggering elements identified in §7.5.4. These effects follow from the fact that OI constraints can set a threshold on the markedness produced by assimilation (much like RM theories – see §7.7.2). For example, OI-IDENT[K] can prevent assimilation to dorsals: /anka/ → [apk] is violated by this constraint. In a language where OI-IDENT(K) outranks all marked-cluster constraints, then, assimilation will only take place if the result produces labials or coronals. In other words, only labials and coronals will trigger assimilation.

(129)

<table>
<thead>
<tr>
<th>/ankampa/</th>
<th>OI-IDENT[K]</th>
<th>*(KPT)</th>
<th>IO-IDENT[KPT]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) ankampa</td>
<td><img src="output.png" alt="output" /></td>
<td><img src="output.png" alt="output" /></td>
<td><img src="output.png" alt="output" /></td>
</tr>
<tr>
<td>(b) apkampa</td>
<td><img src="output.png" alt="output" /></td>
<td><img src="output.png" alt="output" /></td>
<td><img src="output.png" alt="output" /></td>
</tr>
<tr>
<td>(c) ankampa</td>
<td><img src="output.png" alt="output" /></td>
<td><img src="output.png" alt="output" /></td>
<td><img src="output.png" alt="output" /></td>
</tr>
</tbody>
</table>

If OI-IDENT[KP] were ranked in the same position, it would prevent segments from assimilating to labials and dorsals.

The problem with these results is that there seems to be an implicational relationship in assimilation triggers: if x forces y to assimilate, then all z that are more marked than x also force y to assimilate (see (86)). So, if labials force preceding segments to assimilate, then so do dorsals. With OI-IDENT[K] ranked appropriately high, this generalization is reversed: labials trigger assimilation in this language while dorsals do not.

Therefore, the existence of marked-OI-faithfulness constraints may introduce undesirable effects into the typology of assimilation patterns. Further typological research into triggering effects will reveal whether this is a well-founded concern. For the moment, I merely identify it as a point of concern.

7.8 Summary and empirical implications

This chapter had two aims. One was to show that constraints that preserve only marked elements – marked-faithfulness constraints – are necessary. The other was to show that all other faithfulness constraints are unnecessary. Sections 7.2-7.3 were devoted to the first aim, and sections 7.4-7.7 argued for the second proposal.

• **The need for marked-faithfulness**

Evidence that marked-faithfulness constraints are essential was provided by systems in which only unmarked elements undergo assimilation. For example, only coronals undergo assimilation in Catalan: /som bəus/ → /som bəus/, cf /som docils/, /tiŋ pa/.

This pattern was argued to result from the blocking effect of the marked-faithfulness constraints. Because marked-faithfulness constraints can preserve more marked elements without preserving less marked ones, they can prevent the marked dorsals and labials from assimilating. The ranking is provided for the hypothetical form /ankanpa/ in tableau (130),

(130)

<table>
<thead>
<tr>
<th>/ankanpa/</th>
<th>IDENT[KP]</th>
<th>*(KPT)</th>
<th>IDENT[KPT]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) ankanpa</td>
<td><img src="output.png" alt="output" /></td>
<td><img src="output.png" alt="output" /></td>
<td><img src="output.png" alt="output" /></td>
</tr>
<tr>
<td>(b) apkanpa</td>
<td><img src="output.png" alt="output" /></td>
<td><img src="output.png" alt="output" /></td>
<td><img src="output.png" alt="output" /></td>
</tr>
<tr>
<td>(c) apkanpa</td>
<td><img src="output.png" alt="output" /></td>
<td><img src="output.png" alt="output" /></td>
<td><img src="output.png" alt="output" /></td>
</tr>
</tbody>
</table>
The faithful candidate (a) has too many heterorganic clusters [nk mk] – so violating *(KPT)\,(KPT)\,twice – compared with the winning form (b). In contrast, the fully assimilated candidate (c) is fatally unfaithful to an underlying labial specification: /m/ is converted into [n] on the surface. In this way, IDENT[KP] blocks assimilation of marked elements, but places no restrictions on less marked elements so allowing candidate (b), with assimilation of the coronal, to win.

Section 7.3 was devoted to showing why no alternative analyses of 'unmarked-undersgoer' systems could work.

- **No need for other faithfulness constraints**
  Sections 7.4-7.6 were devoted to showing that only marked-faithfulness constraints are necessary. Specifically, there is no need for constraints like IDENT[T] or IDENT[PT]; these both preserve less marked elements without preserving more marked ones.

A challenge for this proposal appears in systems in which only marked elements undergo assimilation: the opposite of Catalan. For example, /tf/ fails to assimilate in Sri Lankan Portuguese Creole (/tʃiŋ-pʊŋ/ → *[ʃiŋpʊŋ]), while labials and dorsals do (e.g. /mʌŋ-ki/ → *[maŋkil], /nɪŋ-ki/ → *[nuŋkɪl]).

The sections argued that the failure of coronals to assimilate in SLP Creole is due to the fact that they are preserved above all other elements; such an analysis would require the unmarked-faithfulness constraint IDENT[T]. Instead, coronals do not undergo assimilation in SLP Creole because they are already adequately unmarked. This idea was formally expressed in a set of constraints that mitigate against heterorganic clusters. The most important characteristic of this constraint is that they assigned different types of cluster different violations. The net result is that clusters with more marked components are more marked than those with less marked components. This was used to explain why labials and dorsals undergo assimilation in SLP Creole: the faithful clusters [mk] and [np] are too marked, violating the constraint *(KPT)\,(KPT). In contrast, the heterorganic cluster [np] is relatively less marked – it does not violate *(KPT)\,(KPT).

At this point, the Marked-Cluster constraints had been shown to provide an alternative to the unmarked-faithfulness constraints, but no reason had been given that one approach was necessarily more desirable than the other.

Accordingly, sections 7.5 and 7.6 were devoted to showing why the Marked-Cluster constraints are independently necessary. Section 7.5 dealt with systems in which only a subset of elements triggers heterorganicity-avoidance. Section 7.6 focused on languages with medial PoA neutralization and no final neutralization. The Marked-Cluster constraints were argued to be essential in accounting for these cases.

So, sections 7.5 and 7.6 showed that the Marked-Cluster constraints are independently necessary. There is therefore no need for the unmarked-faithfulness constraints, a conclusion also made in chapter 6.

- **Eliminating unmarked-faithfulness**
  It would be ideal if unmarked-faithfulness constraints could be shown to make undesirable typological predictions, rather than simply be redundant. However, there are few effects that are not subsumed by markedness constraints. Of the cases considered so far, one difference identified relates to multiple-method systems. With a constraint IDENT[T], there could be a system in which coronal+C clusters are eliminated by epenthesis, while non-coronals assimilate: /an+ka\rightarrow*[apka], /am+kа\rightarrow*[anka]; this system is the opposite to Ponapean's. In this system, IDENT[T] would prevent coronals from assimilating, so forcing the less desirable method of epenthesis to apply. Without a constraint that specifically preserves coronals, there is no way to produce such a system. More generally, in all multiple-method systems in which assimilation is employed, the present theory predicts that the least marked undergos should assimilate; this prediction only holds if there are no unmarked-faithfulness constraints.

Unfortunately, the rarity of multiple-method systems precludes any conclusion about the validity of the prediction made by the present theory. Pending future discoveries in this area (or lack of them), it can be provisionally concluded that unmarked-faithfulness constraints are unnecessary, and that they should therefore be eliminated from the theory.

### 7.8.1 Implications for markedness

At first glance, the typological results of this chapter may seem to render any notion of markedness irrelevant to assimilation. After all, almost every imaginable set of PoAs can be undergos of assimilation (or heterorganicity-avoidance in general), as shown in Table 7.16. For the sake of brevity only two languages at most are given for each language type. The sections indicated contain other examples.

<table>
<thead>
<tr>
<th>Language</th>
<th>K</th>
<th>P</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diola Fogny (J.Sapir 1965)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Sri Lankan Portuguese Creole (§7.4.1), Nunggubuyu (§7.4.4)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Harar Oromo (§7.4.3.2)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>NBA Inuktitut (§7.2.1), (Korean – §7.5.2)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Catalan (§7.2.1), Yanghu (§7.2.2)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Guim/Kwini (see below)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Chukchi, Uradhi (§7.4.3.1)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Southern Sierra Miwok (§7.6.2.2)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

A check ✓ in a column indicates that segments with the underlying PoA indicated (K=dorsal, P=labial, T=coronal) undergo assimilation. Shaded boxes indicate that segments with the underlying PoA indicated do not undergo assimilation. As shown, every possible system is attested. Glottals were left out of the table because they are rarely available for assimilation (for incidental reasons – they are often excluded in the relevant positions – see ch.6). Section 7.2.2 provides relevant discussion.

The only system in the typology not discussed in the text is Gunin (McGregor 1993). In this language, both coronal and dorsals can appear in heterorganic clusters [nb nd nq tŋ], but labials cannot: *[nnd nq]. This system is a combination of NBA Inuktitut,
with IDENT{K} preserving dorsals, and SLP Creole, where *(KP){KPT} only motivates assimilation of marked categories.

Although it seems that undergoers tell us nothing about markedness – since every imaginable system is attested – the preceding sections have argued that there are two distinct types of language in the table. One comes about by having marked-faithfulness constraints outrank all anti-heterorganic constraints (e.g. Catalan, N.B.A.Inuktitut). The other type owes its existence to the form of the cluster-markedness constraints (e.g. SLP Creole and Chukchi). Languages such as Harar Oromo and Gunn owe their structure to a mixture of both conditions. In short, although every option in the table above is filled, the formal apparatus for the different types of language is far from unified – some systems depend on marked-faithfulness constraints while others rely on the form of the cluster-markedness constraints.

- Triggers

In contrast to the undergoer typology, the theory proposed in this chapter predicts that only marked elements can trigger heterorganicity-avoidance, agreeing with observations by Mohanan (1993:75,76) and Jun (1995:71,78). For example, only labials and dorsals trigger deletion in heterorganic clusters in Attic Greek, and only dorsals trigger assimilation in Korean. I have found no language in which only coronals are triggers (i.e. /apta/ → [ata], /apka/ → [apka]). This prediction follows from the nature of the markedness constraints: the cluster-constraints all favour clusters with less marked elements over clusters with more marked elements. For example, [kp] harmonically bounds [pt] in terms of the cluster constraints, as does [tk] for [tp]. Since only the most marked clusters can be avoided through markedness constraints, there is no system in which only [Ct] clusters are avoided – such a system would require a markedness constraint that only targeted coronals.

The present theory also predicts that there is no relation between which elements trigger assimilation and which ones undergo it. The languages examined in previous sections indicate that this prediction is borne out. Coronals undergo deletion in Attic Greek, but they do not trigger it; dorsals trigger assimilation in Catalan, but they do not undergo it. The lack of a relation between undergoers and triggers ultimately derives from the form of the cluster-constraints. One can conceive of the markedness constraints as essentially having the form *(undergoers)|triggers], given systems in which the leftmost element undergoes the process and the rightmost one triggers it. The independence of the two sets follows from the fact that there is a constraint for every combination of possible PoA sets. In short, undergoers are affected by both markedness and faithfulness, while triggers are only affected by markedness. Therein lie the differences in their markedness behaviour.

- Voice

While the focus of this section has been on place of articulation, the present theory extends to other scales as well (e.g. the obstructant voicing scale – sec.3.1.3, 5.3). The prediction of the present theory is that blocking effects analogous to those found with PoA assimilation should be found with other scales. For the voice scale this is borne out: the marked [+voice] value does not assimilate in some languages (sec.3.1.3).224 There are also cases of voice assimilation in which only [+voice] assimilates, analogous to SLP Creole’s assimilation of dorsals and labials only (sec.5.3). This fact suggests that the markedness approach to PoA assimilation presented in §2 can and should be generalized to other scales.

7.8.2 Extending the theory: Where to go from here

The primary aim of this chapter was to provide evidence for marked faithfulness constraints. So, constraints were only proposed and examined insofar as they were relevant to this goal. The most significant of these were the constraints proposed for dealing with heterorganic consonant clusters – the Marked-Cluster constraints. These constraints raise questions that are outside the scope of this chapter’s aims. Several major ones will be discussed here.

The marked-Cluster constraints used in this chapter do not mention constituency. So, *(KPT){KPT} bans heterorganic clusters in all positions, whether they be heterosyllabic or tautosyllabic. Since this issue was not particularly relevant to the point of this chapter, it was not addressed above. I also did not discuss differences depending on manner of articulation: in some languages heterorganic stop clusters are tolerated, while nasals must be homorganic (Jun 1995:77) (but see sec.6.2.1).

It is possible that the Marked-Cluster constraints need to be enhanced or increased to deal with these issues. However, an alternative is that the form of markedness constraints is adequate, and that constituency-related effects result from the form of faithfulness constraints. If faithfulness constraints require preservation of onset elements, for example, they could block assimilation in onsets while allowing codas to assimilate. Thus, heterosyllabic clusters would not assimilate while tautosyllabic ones would, obviating the need for separate hetero- and tautosyllabic versions of the markedness constraints. This issue is left to further research. The only concern of this chapter is that there are markedness constraints that favour certain heterorganic clusters over others.

7.8.3 Harmony and marked-faithfulness

The focus of this chapter has been on PoA assimilation, with frequent mention of voice assimilation. Only brief mention of the predictions of the present theory for other types of assimilation and harmony systems is given here (for recent work on harmony within OT, see Kam 1997, Baković 1999, Walker 2000).

The marked-faithfulness constraints predict that marked elements may be exempt from processes that harmonize other features (e.g. [nasal], [ATR], [round], [back]). For 224 Lombardi (1995) proposes that there are differences between PoA and voice in terms of possible methods of avoidance, deriving the differences partly from representational distinctions and partly from faithfulness constraint differences. In her approach, there is no feature [+voice], and MAX constraints apply to voicing while IDENT applies to PoA. While the too-many-methods problem is certainly significant, it may be the case that there are other non-representational solutions. For example, Wilson (2000) has presented a proposal that restricts possible methods of avoiding violations without appealing to representational differences.
example, one may expect to find a system with rounding harmony in which the marked [+round] vowels are exempt from harmonizing with [+round] vowels, but the unmarked [-round] vowels must harmonize with the [+round] vowels. For example, /poti/ would surface as [poti], but /pito/ would surface as [pito], not *[pite]. The net effect of such a system is that the marked [+round] feature seems to be the only one that harmonizes. Such ‘marked only’ harmony systems are common – even more common perhaps than systems in which both feature values harmonize (nasal harmony – Walker 2000, rounding harmony – Kaun 1997 and references cited therein, ATR harmony – Casali 2002 and references cited therein). For binary scales, such as [+round] -[round], systems in which marked elements are exempt from harmony are effectively the same as those in which only marked feature values propagate. This prediction follows from the present theory – from the fact that faithfulness constraints always preserve the marked elements.

The present theory makes no direct predictions about systems in which only unmarked values are exempt from harmony, or – similarly – in which only unmarked feature values propagate. In the present theory, such systems must be produced through the action of markedness constraints: faithfulness constraints cannot be used to exempt unmarked values alone. For example, I have argued that the SLP Creole system – in which only dorsals and labials undergo assimilation – comes about because the anti-heterorganic constraints specifically target marked elements; faithfulness constraints have nothing to do with the fact that coronals fail to assimilate.

So, since unmarked-undergoer systems do exist in voice and PoA assimilation, should we expect them to appear for other harmony systems? For example, should there be rounding harmony systems in which only [+round] vowels harmonize, while [-round] ones are exempt? In such a system, /poti/ would surface unchanged as [poti], while /pito/ would surface as [pito].

The marked-faithfulness theory makes no predictions either way about the existence of such systems. In the marked-faithfulness theory, such systems do not come about through the action of faithfulness constraints, but through markedness constraints. Since the theory is about faithfulness constraints, then, predictions about such systems rests on a theory of harmony-triggering markedness constraints – a theory that is not within the scope of this chapter’s aims.

Nevertheless, two relevant sets of markedness constraints have been proposed in this chapter – one for PoA and one for [voice]. The form of the constraints allows for systems in which only unmarked elements are exempt from agreement. However, this does not imply that the form of all harmony-assimilation-triggering constraints should be the same. For example, there may be no constraint *[±round][±round], so precluding the existence of rounding harmony systems in which only marked elements agree in rounding. Certainly, such systems are at least rare, and perhaps unattested – but accounting for this fact is not the aim of the present approach.

In short, the marked faithfulness theory predicts that for all scales – and therefore all assimilation and harmony systems – there may be systems in which only unmarked elements are undergoers. This chapter has shown the prediction to be borne out in PoA and voice assimilation; there are relevant cases for ATR, [round], and [nasal] harmony as well.
CHAPTER 8

FAITHFULNESS AND CONFLATION:

COALESCENCE

8.1 Introduction

As discussed in chapter 5, the faithfulness constraints proposed in this Part have two core properties. One has been discussed at length in the preceding two chapters: the constraints can preserve marked features without preserving less marked ones. The other core property is the focus of this chapter: the faithfulness constraints’ stringent form.

As an example, the PoA faithfulness constraints are IDENT[K], IDENT[KP], IDENT[KPT], and IDENT[KPT']. They are in a stringency relation because every constraint preserves either a subset or superset of the feature values that every other constraint preserves. Quasi-tableau (1) graphically illustrates this point.

(1) Stringent form of faithfulness constraints

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>/k/ → [p] or [t] or [ʔ]</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>/p/ → [k] or [t] or [ʔ]</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>/t/ → [k] or [p] or [ʔ]</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>/t'/ → [k] or [p] or [t]</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

A stringent theory of faithfulness contrasts with one in which constraints refer to individual points on a scale: e.g. \[[K] = \[KP] = \[KPT] = \[KPT']\].

Chapter 3 showed that evidence for stringent markedness constraints is found in a phenomenon called ‘category conflation’ – where a grammar ignores markedness distinctions between categories for the purposes of some process. This chapter identifies an analogous phenomenon for faithfulness: ‘faithfulness conflation’ is when unfaithfulness to two different scale categories is treated in the same way. To clarify, the previous chapters have shown that some languages assign greater importance to marked categories in terms of faithfulness: this explains why labials are exempt assimilation in Catalan, while coronals are not (ch.7§7.2). In contrast, this chapter shows that faithfulness distinctions can be collapsed, with languages treating unfaithfulness to labials and coronals as equally significant.

8.2 Coalescence

The empirical focus of this chapter is coalescence. ‘Coalescence’ refers to the situation where two or more input segments fuse to form a single output segment; in the most transparent type of coalescence, the output preserves features of both input segments.

An example is consonant coalescence in the Indic language Pāli: e.g. /labʰ+tʰ/ → [ladʰ], ‘take {gerund}’ (§8.4, Fahs 1985). The input consonants /bʰ/ and /tʰ/ fuse to form a geminate in the output: [dʰ]. That coalescence has taken place rather than deletion is shown by the featural content of the output: [dʰ] retains the voicing and aspiration of the input /bʰ/, but has the Place of Articulation (PoA) of the input /tʰ/.

In Optimality Theory, coalescence describes a situation where two or more input segments correspond to a single output segment (McCarthy 1995, 2000b, Lamontagne & Rice 1995, Pater 1996, 1999, Ganadesan 1995). In other words, both /bʰ/ and /tʰ/ of /labʰ+tʰ/ correspond to [dʰ]. This type of multiple correspondence violates the constraint UNIFORMITY, given in (3) (McCarthy & Prince 1995).

(2) UNIFORMITY  For all output segments x, x has only one input correspondent.

Coalescence in Pāli is motivated by a ban on certain types of coda consonant, called CODACOND here (see §8.4 for details). To produce coalescence, CODACOND must outrank UNIFORMITY, as shown in (3). The subscript numerals indicate correspondence relations.

(3) \(/labʰ+tʰ/\) \(\rightarrow\) CODACOND UNIFORMITY

| (a) labʰ+tʰ | * |
| (b) ladʰ | * |

Coalescence of featurally distinct segments inevitably results in featural unfaithfulness. For example, /bʰ/ is specified as a labial while /tʰ/ is a coronal. Because a surface segment cannot be both labial and coronal at the same time, Pāli is forced to choose whether the coalesced output is one or the other. Whichever option it chooses – whether /bʰ-/tʰ/ coalesce to form [dʰ] or *[tʰ] – PoA-unfaithfulness is inevitable. In constraint terms, the coalescence of /bʰ-/tʰ/ will inevitably result in a violation of IDENT[KPT].

8.3 The marked survivor

The ‘inevitable violation’ issue raises two questions for Pāli. One is why the marked value of [voice] – i.e. [+voice] – survives in the output: i.e. /bʰ-/tʰ/ → [dʰ], *[tʰ].

Because IDENT is inevitably violated by coalescence of featurally non-identical elements, IDENT can block coalescence of all but featurally identical elements. See de Lacy (1998) and Keer (1999) for discussion and applications.
Another is why the unmarked PoA value ‘coronal’ survives: i.e. /bh-t/ → [d^2^] *{[b^2^]}. Both issues will be discussed in turn.

Preservation of the marked value of [voice] receives the same account as in previous chapters: [+voice] survives because marked values excite greater preservation. Thus, the output [d^2^] is as faithful as possible to its input in terms of the feature [voice].

Table (4) illustrates the formal implementation of this point. IDENT[+voice] is crucial: it favours the candidate that preserves the marked [+voice] value.

(4) Preservation of the marked

<table>
<thead>
<tr>
<th>/lab^1^-t-lad^2^-ab^2^</th>
<th>CODACOND</th>
<th>IDENT[+voice]</th>
<th>*[+voice]</th>
<th>UNIFORMITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) lab^1^-t-lad^2^-ab^2^</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) lat^1^-t-lab^2^-ab^2^</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>#* (c) lad^1^-t-lab^2^-ab^2^</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

The tableau shows that the marked [+voice] value is retained because the marked-faithfulness constraint IDENT[+voice] preserves marked elements alone. Candidate (b) fails to retain the [+voice] value of its input correspondent /bh/, so violating IDENT[+voice].

The table also identifies a conflict between the faithfulness constraint IDENT[+voice] and the markedness constraint *[+voice]. It is therefore crucial that IDENT[+voice] outrank *[+voice]: the opposite ranking would favour the candidate with a voiceless output segment. The nature of this conflict will prove to be crucial in accounting for the appearance of the unmarked PoA value.

- The unmarked survivor

In contrast to [voice] preservation, the unmarked PoA value [coronal] survives in Pali coalescence: /lab^1^-t-lab^2^-ab^2^ → [lad^2^-ab^2^]. The fact that the unmarked PoA value (i.e. coronal) survives in coalescence cannot be ascribed to faithfulness. As shown for [voice], faithfulness constraints prefer preservation of the marked value, so a ranking of the PoA faithfulness constraints analogous to the ranking in (4) would produce an output that preserves the marked labial specification.

Instead, markedness constraints must be responsible for the survival of [coronal]. In terms of the PoA-markedness constraints, the constraint *[KP] favours [lad^2^-ab^2^] over *[lab^2^-ab^2^]. *[KP] must outrank all faithfulness constraints that preserve labials without also preserving coronals. Table (5) illustrates this point.

(5) Unmarked survivor ranking I

<table>
<thead>
<tr>
<th>/lab^1^-t-lad^2^-ab^2^</th>
<th>CODACOND</th>
<th>*[KP]</th>
<th>IDENT[KP]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) lab^1^-t-lad^2^-ab^2^</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) lab^2^-t-lad^2^-ab^2^</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>#* (c) lad^1^-t-lad^2^-ab^2^</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

It is essential that both candidates (a) and (b) violate IDENT[KP] equally. Because they are equally faithful at this point, the markedness constraint *[KP] can emerge to assign the crucial violation.

In other words, the mappings /bh-t/→/[d^2^] and /bh-t/→/*[b^2^] are conflated by IDENT[KP] – they are treated the same, so allowing a lower-ranked constraint to make the crucial determination. The stringent form of the faithfulness constraints is crucial to producing this conflation. A set of non-stringent constraints is unable to produce this result, predicting that the marked value will always win in coalescence; this point is discussed in detail in §8.2.3.

- Organization

Three basic types of coalescence are predicted by employing stringent constraints. The sections of this chapter are arranged around these three types.
8.2 The marked survivor: Attic Greek

This section has two aims. One is to introduce the ranking needed to produce coalescence (after McCarthy 1995, 2000b, Lamontagne & Rice 1995, Pater 1996, and others). The other aim is to show how faithfulness constraints can be used to preserve the marked value in coalescence, so accounting for one of the three types of coalescence (i.e. ‘marked-coalescence’) identified in the introduction.


Section 8.2.1 describes the relevant facts.

An analysis is provided in §8.2.2.

Section 8.2.3 discusses alternatives. In particular, theories that do not make distinctions between PoA values in faithfulness constraints are examined.

Section 8.2.4 discusses the typological predictions of the theory for other scales.

A summary is provided in §8.2.5.

In one type, the marked feature value survives. Section 8.2 presents an analysis of a relevant case in Attic Greek, where vowel coalescence retains the marked [+round] feature (Sommerstein 1973:55, Lejeune 1972:260-3, de Haas 1988). This section also introduces the ranking needed for coalescence.

The type that is of most interest here – because it illustrates faithfulness conflation – is one in which the unmarked feature survives. Sections 8.3 and 8.4 provide analyses of cases of this type. Section 8.3 focuses on consonantal features, namely [+voice] and [−continuant] in Chipewyan (Li 1946, Causley 1997). The other case is Swedish (Hellberg 1974, Sigurd 1965, and Lombardi 1999). Swedish does not involve coalescence, but rather bi-directional voice assimilation, in which [+voice] always survives. The ranking needed for Swedish is akin to the one needed for coalescence, and so it also demonstrates the need for stringent faithfulness constraints.

The third type is a mixture of the other two types. Such ‘hybrid’ systems emerge with multi-valued scales. For example, a full analysis of Pāli shows that the unmarked value survives in the competition between a labial and coronal, but the marked value wins in the competition between a dorsal and a coronal. Sections 8.4 and 8.5 discuss hybrid cases, both found in Pāli. Section 8.4 examines the preservation of Place of Articulation while Section 8.5 focuses on the fate of scenery in Pāli coalescence (Hupkauser & Aissen 1974, Fahn 1985).

Section 8.7 presents a summary of the findings of this chapter.
Supporting data is provided in tables (10) and (11) (compiled from Liddell & Scott 1996). The roots listed in the leftmost column combine with the suffixes in (9).

(9) Suffixes

<table>
<thead>
<tr>
<th>Suffixes</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>/-e-tel/</td>
<td>2pl. present active indicative</td>
</tr>
<tr>
<td>/-o-men/</td>
<td>1pl. present active indicative</td>
</tr>
<tr>
<td>/-e/</td>
<td>infinitive</td>
</tr>
<tr>
<td>/-e-tel/</td>
<td>2pl. present subjunctive</td>
</tr>
<tr>
<td>/-o-sal/</td>
<td>present participle</td>
</tr>
<tr>
<td>/-e-men/</td>
<td>1pl. present subjunctive</td>
</tr>
</tbody>
</table>

Evidence that the suffixes have the form stated in (9) comes from verbs with consonant-final stems or high-vowel final stems. These do not undergo contractions in morphone concatenation: e.g. /krin/ 'judge': [krinete], [krinomen], [krine].

(10) Attic Greek: V+ round vowels

<table>
<thead>
<tr>
<th>Root</th>
<th>/-e-tel/</th>
<th>/-e/</th>
<th>/-e-tel/</th>
</tr>
</thead>
<tbody>
<tr>
<td>/p/</td>
<td>/p/</td>
<td>/p/</td>
<td>/p/</td>
</tr>
<tr>
<td>/t/</td>
<td>/t/</td>
<td>/t/</td>
<td>/t/</td>
</tr>
<tr>
<td>/m/</td>
<td>/m/</td>
<td>/m/</td>
<td>/m/</td>
</tr>
<tr>
<td>/s/</td>
<td>/s/</td>
<td>/s/</td>
<td>/s/</td>
</tr>
<tr>
<td>/N/</td>
<td>/N/</td>
<td>/N/</td>
<td>/N/</td>
</tr>
</tbody>
</table>

Data relevant for V+a combinations is /kera+al-/ [kera] 'prize', and /aida+al-/ [aida] 'shame [acc. sg.]'.

- Why coalescence?

The majority of vowel-cluster simplifications show that Attic Greek vowel-cluster simplification involves coalescence rather than deletion. For example, /aza/ results in the output [za] (e.g. /peza+omen/ → [peza+omen] 'we are hungry'); the output retains the roundness of the input /a/ but the ATR value of the input /za/. The same can be seen in the combinations /o+al-/ [o], /i+al-/ [ii], /e+al-/ [e], and /a+al-/ [a].

The examples also show that 'direction' does not matter: the output is always [+round] and low regardless of whether the leftmost or rightmost consonant has the relevant value in the input. For example, both /a+ol/ and /o+al/ coalesce to form [a]: e.g. /tigma+omen/ → [tigma+omen], /aida+al-/ [aida].

- Deletion and coalescence

An important point must be made about the difference between the traditional notion of coalescence and its use here, using the formalism of Correspondence theory (McCarthy & Prince 1995). A number of the vowel-cluster simplifications are not coalescence in the traditional sense: e.g. /aza+er/ → [za]. The output [za] does not retain any vestiges of /za/ – so – strictly speaking – is not coalescence in the traditional sense.

However, /aza+er/ → [za] is still coalescence in terms of the formal apparatus used here. The reason that there is no vestige of /za/ in the output is because the two vowels differ only in one feature – [ATR]. The coalesced output always chooses [+ATR] over [±ATR], as shown by /aza+er/ → [za]. So, the output of /aza+er/ coalescence will be [±ATR] – i.e. [a].

In short, /e/’s features are entirely obscured in the output – a seemingly 'vacuous' coalescence. Even so, they are obscured for obvious reasons, and there is no reason to think that /a/ and /e/ do not fuse into a single output element: [a].

This point raises a general issue, though: how do we know that /aza+er/ → [za] – and all such cases where one of the input segments is entirely obscured in the output – does not simply involve deletion?

A preliminary point is that nothing in Correspondence theory bans coalescence of /a/ to [a]. More specifically, no constraint forces deletion just when the coalesced output would be vacuous. Thus, vacuous coalescence is formally possible.
Furthermore, in some situations vacuous coalescence may be required by the constraint ranking. For example, because /a+e/-→[ə] clearly involves coalescence, MAX must outrank UNIFORMITY (see the following analysis for discussion). Because coalescence is preferred over deletion in this competition, /a+e/-→[ə] may necessarily involve coalescence as well.

Whether /a+e/-→[ə] does indeed involve coalescence depends on the blocking effect of higher-ranked constraints. If a constraint incidentally prevents coalescence in the /a+e/-→[ə] situation, a candidate with deletion may win instead. For example, if coalescence of /a+e/-→[ə] to [ə] would result in a loss of some feature [i], IDENT[if] could block coalescence, allowing deletion instead (see de Lacy 1999b, Keer 1999 for discussion of IDENT’s blocking effect in coalescence). However, IDENT[if] must not block coalescence of /a+e/-→[ə].

In this particular case, it is difficult to see what feature f is: the only feature /e/ loses in /a+e/-→[ə] is [+ATR], and this is also lost in /a+o/-→[ə] coalescence. Thus – in this particular case – the constraints and ranking may dictate that /a+e/-→[ə] is formally coalescence rather than deletion. More generally, once the || MAX » UNIFORMITY || ranking is established – i.e. once one case can be shown to be coalescence – deletion cannot simply be assumed to take place in analogous vacuous coalescences in the same grammar.

A final caveat is that the cases in this chapter are considered coalescence rather than the result of an opaque process of assimilation followed by deletion. For example, the Attic Greek coalescence could be argued to involve the steps: (i) roundness assimilation: /a+e/-→[ə] followed by (ii) deletion [ə]. Evidence that an opaque analysis produces the wrong results or is irrelevant to the points made will be given for each case where appropriate.

Other dialects
Attic is far from unique among Greek dialects. Lupas (1972), Lejeune (1972:260ff), and Bubenik (1983:67ff) discuss a number of other dialects with the same or similar restrictions (see Kaisse 1977 for Modern Greek). In contrast Aetolian, Boeotian, and Cretan have no or less coalescence (Bubenik 1983:67ff).

The markedness of [+round]
The analysis presented in the following section focuses on the feature [+round]. The feature [+round] is the marked value of [round], so Attic Greek vowel coalescence is a case where the marked value survives – i.e. 'marked coalescence'.

Evidence that [+round] is marked independent of its context comes from vowel inventories. Some languages lack round vowels (e.g. Kabardian – Choi 1992a; Marshallese – Bender 1968, Choi 1992b; Margi – Maddieson 1987).230 As shown in ch.6, the least marked element can never be eliminated in a binary scale. The fact that no language lacks [−round] vowels therefore shows that [+round] is the less marked of the two roundness values (see ch.8 §4.1.4).

The point could be raised that the markedness of roundness depends on backness: [+round] is preferred with back vowels, but [−round] with front or central vowels. However, the markedness of [+round] can be seen in back vowel inventories as well: while there are languages with back round vowels and no back unround vowels (e.g. Maori), there are also languages with back unround vowels ([i] and [u] and back round vowels of the same height (e.g. Koqiva – Ebert 1996, and many other Dravidian languages). In contrast, if a language has a front round vowel, it also has a front unround vowel of the same height: i.e. no language has [y] without [i].

These facts follow if (i) [+round] is generally more marked than [−round] and (ii) there is a markedness constraint that bans unround back vowels: *[−back,+round]. If *[−back,+round] outranks *+round, the language will contain round back vowels and unround front vowels. The opposite ranking will produce a language with unround front and back vowels. No ranking will produce a ranking with only round front vowels. In short, the proposal is that [+round] is more marked than [−round], with a contextual markedness constraint *[+back,+round] obscuring this fact for back vowels.

8.2.2 Analysis
For the roundness scale | +round | −round |, the present theory predicts that there are two roundness-referring faithfulness constraints, listed in (12).

(12) IDENT[+round]  If x is [+round] then x is [+round]
IDENT[−round]  If x is [−round] then x is [−round]

One constraint preserves only the marked [+round] feature; the other preserves both values of [round]. As explained in ch.5-7, the theory does not allow a constraint that preserves only the unmarked feature – i.e. IDENT[−round].

The scale also produces two markedness constraints: *[+round] and *[−round]. The former bans round vowels, and the latter is violated by both round and unround vowels. Given full specification, all vowels will violate *[−round].231

The following sections will show how the roundness constraints affect the result of coalescence in Attic Greek. The first two sections identify the ranking needed to motivate coalescence and avoid other outcomes. Section 8.2.2.3 shows how the marked value is preserved. Section 8.2.2.4 discusses preservation of other features. §§8.2.2.5 discusses lack of a directional effect. §8.2.2.6 summarizes the ranking.

230 Despite the fact that *[−round] is violated by all vowels, this does not necessarily mean that *[−round] will be unnecessary or redundant (or more precisely, that *[−round] makes no division in the candidate set). *[−round] is effectively a general ban on vowels.

231
8.2.2.1 Motivating coalescence

The aim of this and the following section is to present the ranking responsible for coalescence. The coalescence ranking has previously been identified in McCarthy (1995, 2000b), Lamontagne & Rice (1994, 1995), Pater (1995), Gnanadesikan (1995), and developed further in later work (de Lacy 1999b, Keer 1999, Struijke 2001).

Avoidance of vowel clusters in Attic Greek is motivated by ONSET. This constraint penalizes heterosyllabic vowel clusters because the second vowel appears in an onsetless syllable. For example, ONSET is violated by *[ti.mau.o.med1], so forcing coalescence of the /aʊ/ cluster.

ONSET conflicts with the constraint UNIFORMITY, defined in (2). This constraint bans output segments with more than one input correspondent, which effectively bans coalescence (McCarthy & Prince 1995). Tableau (13) shows that ONSET must outrank UNIFORMITY.

(13) Attic Greek I: Trigering coalescence

<table>
<thead>
<tr>
<th>/t̠i.mau.o.med1</th>
<th>ONSET</th>
<th>UNIFORMITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) t̠i.mau.o.med1</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>(b) t̠i.mau.o.med1</td>
<td>✗</td>
<td>*</td>
</tr>
</tbody>
</table>

As shown in the tableau, coalescence in (b) avoids the onsetless syllable that dooms (a).

The next step is to show why other outcomes – deletion, epenthesis, and resyllabification – are not employed instead of coalescence.

8.2.2.2 Avoiding deletion, epenthesis, and neutralization

The hiatus in *[t̠i.mau.o.med1] is not avoided by deletion or epenthesis; MAX and DEP must therefore (at least) outrank UNIFORMITY.

(14) Attic Greek II: Avoiding other outcomes

<table>
<thead>
<tr>
<th>/t̠i.mau.o.med1</th>
<th>ONSET</th>
<th>MAX</th>
<th>DEP</th>
<th>UNIFORMITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) t̠i.mau.o.med1</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>(b) t̠i.mau.o.med1</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>*</td>
</tr>
<tr>
<td>(c) t̠i.mau.o.med1</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>(d) t̠i.mau.o.med1</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>*</td>
</tr>
</tbody>
</table>

In fact, a further ranking can be established based on data such as [aʊbu] ‘to lead’, and [e.pi.or.kos] ‘perjured’. In these cases, onsetless syllables are tolerated – they are not eliminated through deletion or epenthesis, so MAX and DEP must outrank ONSET. Why [lo] in [e.pi.or.kos] is not eliminated through coalescence will be discussed presently.

The onsetless syllable in *[t̠i.mau.o.med1] could be avoided by syllabifying the [a] and [o] into the same nucleus: i.e. *[t̠i.mau.med1]. However, this method of hiatus-
In summary, every alternative in Attic Greek is blocked – deletion, epenthesis, neutralization, and diphthong formation. The least costly way to resolve hiatus is therefore coalescence.

8.2.2.3 Preserving the marked value

All cases of hiatus involving a round vowel result in a round vowel in the output; the only time a non-round vowel appears is when neither of the input segments are round (e.g. /pemnau/ → /pemnau/).

Since [+round] is more marked than [-round], it is impossible to appeal to a markedness constraint to prefer round coalesced vowels over unround vowels. Therefore, some faithfulness constraint that preserves roundness must be active. The markedness theory provides the constraint IDENT[+round] – this constraint requires that input round vowels remain round in the output; it makes no demands on unround vowels.

IDENT[+round] must outrank all markedness constraints that favour [-round] vowels over [+round] ones – i.e. [*][+round]. Tableau (17) illustrates this point.

\[
\begin{array}{c|c|c}
\text{Input} & \text{IDENT[+round]} & \text{*}[+round] \\
\hline
\text{a} & \text{IDENT[+round]} & \text{*}[+round] \\
\text{b} & \text{IDENT[+round]} & \text{*}[+round] \\
\text{c} & \text{IDENT[+round]} & \text{*}[+round] \\
\end{array}
\]

Candidates (a) and (b) both avoid an onset violation by coalescing the vowels. However, (a) fails to retain the input [+round] specification of /a/, so fatally violating IDENT[+round]. The tableau shows that the ranking || IDENT[+round] » *+round || is essential – the opposite ranking would favour (a) over (b).

The ranking of the markedness constraint *[-round] is also indeterminable. Since *[-round] does not favour [+round] vowels over [-round] ones, it is not crucially ranked with respect to IDENT[+round] in Attic coalescence.\(^{233}\)

- Generalization

In short, the crucial ranking for preserving the marked feature in Attic Greek is that IDENT[+round] outranks all markedness constraints that ban round vowels. Generally speaking, to preserve a marked value mF rather than an unmarked value mF in coalescence, some faithfulness constraint that preserves mF but not mF must outrank all markedness constraints that favour mF over mF.\(^{233}\)

8.2.2.4 IDENT[+round] as a blocking constraint

Now that the ranking for IDENT[+round] has been established, the ranking for IDENT[+round] can be identified.

At first glance, it may seem that there is no way to determine the ranking of IDENT[+round]. IDENT[+round] is equally violated by both output candidates in coalescence. For example, from /tζma1-0:men/ both */[tζma1-0:men] and *[tζma1-0:men] incur equal violations of IDENT[+round]; the latter for the loss of [+round] in /a/→/a/ and the former for the loss of [+round] in /a/→/a/ This equal violation seems to make the constraint inactive.

However, IDENT[+round] does have a significant effect: it is violated by candidates with coalescence. IDENT[+round] is not violated by candidates with epenthesis *[tζma1-0:men], deletion *[tζma1-0:men], neutralization *[tζma1-0:men], and inaction *[tζma1-0:men] – all of these candidates preserve the [+round] specifications of the /a/ and /o/.

In being violated by coalesced forms, IDENT[+round] is like UNIFORMITY. More precisely, IDENT[+round] is violated by candidates that are unavoidably unfaithful through coalescence.

For further discussion of this point, see Pater (1995). This property of IDENT constraints has been used to block coalescence of non-identical elements, by de Lacy (1999b) for morphological haplology, and by Keer (1999) for geminates.

To prevent IDENT[+round] from blocking coalescence, it must be dominated by MAX, DEP, ONSET, and IDENT[+high], as shown in tableau (18).

### Tableau (18): Attic Greek V: IDENT can block coalescence

<table>
<thead>
<tr>
<th>Input</th>
<th>ONSET</th>
<th>MAX</th>
<th>DEP</th>
<th>IDENT[±ATR]</th>
<th>IDENT[±high]</th>
<th>IDENT[+round]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) tζma1-0:men</td>
<td>*1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>IDENT[+round]</td>
</tr>
<tr>
<td>(b) tζma1-0:men</td>
<td>*1</td>
<td></td>
<td></td>
<td>IDENT[+high]</td>
<td>IDENT[+round]</td>
<td></td>
</tr>
<tr>
<td>(c) tζma1-0:men</td>
<td></td>
<td></td>
<td></td>
<td>IDENT[+high]</td>
<td>IDENT[+round]</td>
<td></td>
</tr>
<tr>
<td>(d) tζma1-0:men</td>
<td></td>
<td></td>
<td></td>
<td>IDENT[+high]</td>
<td>IDENT[+round]</td>
<td></td>
</tr>
<tr>
<td>(e) tζma1-0:men</td>
<td></td>
<td></td>
<td></td>
<td>IDENT[+high]</td>
<td>IDENT[+round]</td>
<td></td>
</tr>
</tbody>
</table>

The ranked needed for IDENT[+round] is also needed for every feature for which the coalesced output is unavoidably unfaithful. For example, *[tζma1-0:men] is also unfaithfully unfaithful to ATR: it does not preserve /a/’s [+ATR] feature; its competitor *-[tζma1-0:men] does not preserve /a/’s [-ATR] feature. The same is true for *[tζma1-u:men] is unfaithful to /al’s [+low] specification. Therefore, IDENT[±ATR] and IDENT[±low] must be ranked in the same way as IDENT[+round]. This point will be raised in the other cases discussed in this chapter, since it is an essential part of the coalescence ranking. The most extensive – and complex – discussion in this chapter can be found in §8.3.2.5, for coalescence in Chipewyan. Note that IDENT[±high] was used in this way in tableau (16) to block coalescence of a high and non-high vowel.\(^{234}\)

\(^{233}\) Because *[-round] is violated by all vowels, MAX must outrank it otherwise all vowels would be deleted.

\(^{234}\) Because IDENT[+round] is used in this way in tableau (16) to block coalescence of a high and non-high vowel.
8.2.2.5 Preserving other features: ATR, height, and length

This section discusses height, quantity, and their effect on the output of Attic Greek coalescence.

- **height and [ATR]**

  The traditional description of coalescence is that if either of the input vowels is low, the output vowel is also low. Following the analysis of similar cases by Casali (1997a,b), the relevant phonological feature is [ATR]: [e o i] are [+ATR] while [e o i u] are all [+ATR].

  Preservation of [−ATR] is shown by /tima + omen/ → [timɔmen], where the input vowels are [−ATR] and [+ATR] respectively, but the output vowel is [ε] is [−ATR]. The form /pʰile + omen/ → [pʰile] ‘I love’ shows that there is no directional effect – the input vowels are [+ATR] and [−ATR] respectively, but the output is still [−ATR].

  The retention of the [−ATR] specification receives the same treatment as preservation of [+round]. If a constraint that preserves [−ATR] outranks all markedness constraints against low vowels, the winning form will have a low vowel.234

<table>
<thead>
<tr>
<th>(19) Attic Greek VI: Preserving [-ATR]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
</tr>
<tr>
<td>(a) tigma + omen</td>
</tr>
<tr>
<td>(b) tīmā + omen</td>
</tr>
<tr>
<td>(c) tīmā + men</td>
</tr>
<tr>
<td>(d) tīmā + omen</td>
</tr>
</tbody>
</table>

  This is not quite the end of the story for height preservation, though. Coalescence of /a/i/ with an unround vowel produces [a]: tīma-see/o → [timɔe]. The ranking established so far will not decide between the competitors [tīmɔe] and *[tīmɔe] since both contain low vowels.

  There are two ways to achieve the right result. A faithfulness constraint like IDENT[+low] can favour [a] over [e] ([(e] is taken to be [−high, −low, −ATR]). A markedness constraint can also be used to favour [a] over [e]. As in ch.3, a constraint banning low sonority syllable heads can be invoked – [−low] ksi [−gamma]. The choice of analysis is immaterial to the main point here, so the ramifications of the two approaches will not be explored here. However, it is important that – whatever constraint is employed – it must

234 This analysis assumes that [−ATR] vowels are marked. There are no clear implications as to which ATR value is preserved in coalescence (cf de Haas 1998:81, Casali 1997a,b). In Attic Greek, the lowest height possible wins (restricted by the requirement that the vowel be [round]); the same is true in Modern Greek, Rotuman, Korean, Japanese, and Tunic. In contrast, in Tshitsahha Nootka the highest height wins: a combination of a high vowel and /a/ yields a (+ATR) high vowel (Stonham 1999: 64); the same is true of Dakota (h) and Mohawk (Hopkins 1987). In contrast, Sanskrit chooses a compromise height /a/i+→ [e], /a/i+→ [e].

235 Coalescence of moras must also be banned. Cases like this one raise issues about Richness of the Base; since we cannot guarantee that input vowels will have moras, how can we use MAX-μ to ensure a long vowel in the output? One way is to ensure that only vowels with moras are retained in the output. If the constraint DEP-μ – banning insertion of moras – outranks MAX, moraless input vowels will be deleted in the output. Thus, only candidates with vowels that had input moras will be relevant. An alternative is an opaque analysis: all vowels are assigned moras, then coalescence takes place.

236 All moras could be preserved by coalescing to form a trimoraic segment (i.e. *[timaːmen]). However, trimoraic syllables are banned in the language generally.

be ranked below IDENT[+round]. The opposite ranking would favour *[timaːmen] over [timɔmen] (a ranking found in Modern Greek – Kaisse 1977).

• **Length**

  The other input property retained in Attic Greek is vowel length. Even identical vowels do not coalesce into a single output vowel; they end up as a long vowel: /pʰile + etel/ → [pʰilete]. An account of this fact refers to the constraint MAX-μ, which requires input moras to be retained in the output (McCarthy 1995, 2000b; Morén 1999).235

  With MAX-μ outranking constraints against complex nuclei, input moraic content will be retained.

  However, there is one further crucial ranking involving MAX-μ. The form /tima+ɔ/ → [timɔ] ‘estimate (1sg)’ shows that ONSET outranks MAX-μ; the opposite ranking would block coalescence:

  (20) Attic Greek VII: Preserving moraic content

<table>
<thead>
<tr>
<th>Input</th>
<th>ONSET</th>
<th>MAX-μ</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) tima ɔ</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>(b) tīmā ɔ</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>(c) tīmā men</td>
<td>✗</td>
<td>✗</td>
</tr>
</tbody>
</table>

  Both ONSET-satisfying candidates (b) and (c) violate MAX-μ: there are three moras in the input, but only two in (b) and one in (c). Since (b) incurs fewer violations than (c), it wins. However, if MAX-μ outranked ONSET, coalescence would be blocked and the faithful form (a) would win.236

8.2.2.6 Lack of direction

The final ranking issue to be addressed in this analysis relates to the fact that direction and morphological affiliation are irrelevant to roundness preservation in Attic. Regardless of whether the round vowel is first or second in the input, or whether it is in a root or affix, the output vowel is always round: compare /mistrio+ete/ → [misto+ete] and /pʰile+omen/ → [pʰile+omen]. Therefore, any constraint that favours the [round] value of segments depending on input position or morphological affiliation must be dominated by IDENT[+round].
In the present instance, the most relevant constraint is root-IDENT[±round], which preserves the roundness of input root segments (after McCarthy & Prince 1994, Beckman 1998). The relevant ranking is provided in (21).

(21) Attic Greek VIII: Eliminating directional effects

<table>
<thead>
<tr>
<th>Constraint</th>
<th>+[round]</th>
<th>-[round]</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) pʰlé2n</td>
<td>IDENT[+round]</td>
<td>*!</td>
</tr>
<tr>
<td>b) pʰlō2n</td>
<td>root-IDENT[±round]</td>
<td>*</td>
</tr>
</tbody>
</table>

As the tableau shows, it is crucial that IDENT[+round] dominate root-IDENT[±round], otherwise the roundness value of the root segment will always win.

8.2.2.7 Ranking summary

The essential parts of the Attic Greek ranking are represented in Figure 8.1.

Figure 8.1: Attic Greek vowel coalescence ranking

- (a) MAX DEF IDENT[±high]
- (b) IDENT[+round]

The diagram shows that the ranking that motivates coalescence (a) and the ones that determine the output quality (b) are relatively independent. IDENT[+round] could almost be ranked above or below any of the constraints in (a) and have the same effect. The only condition is that no markedness constraint that favours [+round] vowels over [-round] ones outrank IDENT[±round].

The ranking in (a) expresses the fact that all constraints that ban coalescence – UNIFORMITY and IDENT[+round] (also IDENT[±ATR] and IDENT[±low]) – are rendered inactive by constraints that (i) ban some surface configuration (ONSET), and (ii) block every other possible outcome (MAX, DEF, IDENT[±high]).

• Other cases

This subsection concludes by identifying other cases that are similar to the one found in Attic Greek. The same pattern of [+round] preservation is found in several other cases of vowel coalescence. Languages in which [+round] is preserved include Tsishiaath Nootka (Stonham 1999), Pali (Geiger 1943), and Tunica (Haas 1946).

However, it is worth pointing out that [+round] does not always take precedence in vowel coalescence, nor is it predicted to do so. In Modern Greek, for example, preservation of [+low] overrules faithfulness to [round] (Koutsoudas 1962, Sanders 1974, Kaisse 1977).

While any non-low vowel [i e o u] plus a round vowel yields a round vowel, any vowel combination with the [+low] vowel [a] produces [a]. In this case, IDENT[+low] outranks IDENT[+round], producing the [+low, -round] vowel [a]; the language bans [+low, +round] vowels (i.e. [e o]). Furthermore, §8.4 will discuss cases where the coalesced output retains the [+round] specification.

8.2.3 Alternatives

The facts of coalescence in Attic Greek rule out a number of alternative theories of faithfulness constraints. In particular, theories that either have no faithfulness constraint that specifically preserves marked elements (IDENT[+round] in the present case), or rank all faithfulness constraints that preserve unmarked values above all those that preserve marked values (i.e. IDENT[±round] > IDENT[+round]) cannot account for the Attic Greek system.

Pater (1995) shows that it is impossible to retain the marked value in coalescence without a faithfulness constraint that preserves only marked values. Since no markedness constraint favours the marked feature value over the unmarked one, and no faithfulness specifically preserves the marked value, the coalesced output with the unmarked value will harmonically ban the competitor with the marked value.

To illustrate, consider a theory that has only one faithfulness constraint; the constraint preserves both values of [round] – IDENT[±round] (cf Prince 1998 for Place of Articulation). No faithfulness constraint will favour the mapping /ο1ε2/→[ο1,2] over /ο1ε2/→[ε1,2]. IDENT[±round] assigns the same violations to both. No markedness constraint favours [o] over [ε]: neither *[+round] nor *±[round] favours [o] over [ε], and *+[round] favours [ε] over [o]. Since no markedness favours [ε] over [o], the coalesced unround vowel [ε1,2] is a therefore a harmonic bound for the coalesced [ο1,2].

(22) Failed Theory I: no marked-faithfulness constraint

<table>
<thead>
<tr>
<th>Constraint</th>
<th>+[round]</th>
<th>*+[round]</th>
<th>*±[round]</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) pʰlé2n</td>
<td>IDENT[±round]</td>
<td>*</td>
<td>*[+round]</td>
</tr>
<tr>
<td>b) pʰlō2n</td>
<td>IDENT[±round]</td>
<td>*</td>
<td>*[±round]</td>
</tr>
</tbody>
</table>

This result not only rules out theories that have only one faithfulness constraint IDENT[±round], but theories in which faithfulness to the unmarked is always dominant: e.g. in the fixed ranking IDENT[±round] > IDENT[+round], and with the stringent constraints IDENT[±round], IDENT[±round]. With both these theories, there is no ranking in which /ο1ε2/→[ε1,2] is favoured over /ο1ε2/→[ε1,2]; no faithfulness constraint favours the former mapping, and no markedness constraint favours [o] over [ε]. Of course, these theories have already been shown to be inadequate for neutralization in ch.6 and assimilation in ch.7; this case drives another nail into the coffin.
8.2.4 Marked survivors elsewhere

The aim of this section is typological: it identifies cases that are analogous to Attic Greek’s coalescence, but differ in terms of the marked feature they preserve, showing that the analysis presented above generalizes to other scales.

- Nasality

Dakota is akin to Attic Greek in that the [+round] specification of coalesced vowels persists in coalescence (Shaw 1980:34, 82). In addition, the marked feature [+nasal] also survives.237

(24) Dakota coalescence: [+nasal] preservation

<table>
<thead>
<tr>
<th>Dakota</th>
<th>Opaque analysis of coalescence</th>
</tr>
</thead>
<tbody>
<tr>
<td>( /\text{t}\text{a}^{+}\text{at}[\text{pr}]/ \rightarrow [\text{t}\text{a}\text{t}\text{pr}] )</td>
<td></td>
</tr>
<tr>
<td>( /\text{t}\text{a}^{+}\text{at}[\text{pr}]/ \rightarrow [\text{t}\text{a}\text{t}\text{pr}] )</td>
<td></td>
</tr>
<tr>
<td>( /\text{t}\text{a}^{+}\text{at}[\text{pr}]/ \rightarrow [\text{t}\text{a}\text{t}\text{pr}] )</td>
<td></td>
</tr>
<tr>
<td>( /\text{t}\text{a}^{+}\text{at}[\text{pr}]/ \rightarrow [\text{t}\text{a}\text{t}\text{pr}] )</td>
<td></td>
</tr>
</tbody>
</table>

That the feature [+nasal] is marked for vowels is clear from inventory facts: all languages with nasal vowels have oral vowels, but not vice-versa.

In Dakota, then, IDENT[+nasal] must outrank all constraints against nasal vowels: i.e. *[+nasal]/V. The result is preservation of nasality. Tableau (25) illustrates this ranking and its effect.

(25) Dakota [+nasal] preservation

<table>
<thead>
<tr>
<th>Dakota</th>
<th>Opaque analysis of coalescence</th>
</tr>
</thead>
<tbody>
<tr>
<td>( /\text{t}\text{a}^{+}\text{at}[\text{pr}]/ \rightarrow [\text{t}\text{a}\text{t}\text{pr}] )</td>
<td></td>
</tr>
<tr>
<td>( /\text{t}\text{a}^{+}\text{at}[\text{pr}]/ \rightarrow [\text{t}\text{a}\text{t}\text{pr}] )</td>
<td></td>
</tr>
<tr>
<td>( /\text{t}\text{a}^{+}\text{at}[\text{pr}]/ \rightarrow [\text{t}\text{a}\text{t}\text{pr}] )</td>
<td></td>
</tr>
</tbody>
</table>

As a side-note, discussed further below, Dakota contrasts with Attic Greek in preserving [=low] rather than [+low]. For example, \( /\text{a}/ \) is realized as \( [\text{a}] \) in Attic Greek. A similar fact is seen in coalescence of nasal consonants with obstruents. In Indonesian, for example, coalescence of a prefix nasal and a voiceless stop results in retention of all features of the root consonant, except for the [+nasal] feature of the prefix consonant: \( /\text{m}\text{n}\text{n}^{+}\text{pilih}/ \rightarrow [\text{m}\text{n}\text{nilih}] \), *[m\text{n}pilih]; \( /\text{m}\text{n}\text{n}^{+}\text{kash}/ \rightarrow [\text{m}\text{n}\text{pash}] \) ‘to give’ (Lapolla 1981:110, see Pater 1995 for an analysis).

237 The fact that /\text{a}/ and mid vowels surface to form a nasalized high vowel follows from a general ban on nasalized mid vowels in the language. The height preserved in Dakota is [=low].
The formal expression of markedness – ch.8

IDENT[liquid] must outrank all markedness constraints that favour non-liquids over liquids.

(28) **High sonority preservation in Harar Oromo**

<table>
<thead>
<tr>
<th></th>
<th>SONDIST</th>
<th>IDENT[liquid]</th>
<th>*-Δσ,liquid</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>barar</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>(b)</td>
<td>barar</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>(c)</td>
<td>barar</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>(d)</td>
<td>barar</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

The tableau shows that faithfulness constraints will favour the most marked element. It is crucial that the faithfulness constraint outranks its markedness counterpart *-Δσ,liquid otherwise liquids will be penalized in favour of nasals, producing (c) as the output.

It is impossible to determine the influence of faithfulness constraints on glides in this language; no relevant examples are provided. The fact that /t/ wins over /l/ in /ol+rafe/ → [orafe] may not indicate a sonority difference, but rather defaulting to the [t]; there is no corresponding /l+raf/ case to decide the issue. A similar case is found in the Australian language Bardi (Metcalfe 1975, Bowern 2001). Harar Oromo contrasts with Pali, discussed in §8.4.

8.2.5 **Summary**

This section has shown that a theory with marked-faithfulness constraints correctly predicts that the most marked features may be retained in coalescence. The most marked value \( mf \) will emerge in coalescence if the faithfulness constraint that exclusively preserves \( mf \) (i.e. IDENT[mf]) outranks all markedness constraints that ban \( mf \) (\( * \{mf\} \)). The following tableau schematizes this ranking, with \( mf \) the marked value of feature \( f \) and \( [af] \) the unmarked value.

(29) **Marked-Coalescence Ranking**

<table>
<thead>
<tr>
<th></th>
<th>IDENT[mf]</th>
<th>( * {mf} )</th>
<th>IDENT[mf, mf]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>( mf )</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>(b)</td>
<td>( mf )</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

In summary, the marked-coalescence pattern is found for many different scales, not just for roundness. The following section summarizes the rankings identified in this section.

Paul de Lucy

- **Sonority**

  In Harar Oromo, a syllable contact restriction bans adjacent sonorants \( [j w r l n] \) (Owens 1985:22). Adjacent sonorants in the input coalesce to form a geminate in the output. The most sonorous input segment wins.

(26) **Gemination in Harar Oromo**

(a) /\( lr, l \) + \( n/ \) → /\( r, r \)\n
/\( l, g + n/ \) → /\( l, g e \) \( 'we watched'\)
/\( barar+ne/ \) → /\( barar \) \( 'we flew'\)
/\( m\o\+ny/ \) → /\( m\o\\) \( 'fat-nom'\)

(b) /\( n + (r,l), w/ \) → /\( r, l, g, w/ \)

/\( h, m + raf/ \) → /\( h, raf \) \( 'you don't lie down'\)
/\( h, m + l, g, s/ \) → /\( h, l, g, s \) \( 'we don't observe'\)
/\( h, m + w, g, s/ \) → /\( h, w, g, s \) \( 'he doesn't bake'\)
/\( h, m + j, a, s / \) → /\( h, j, a, s \) \( 'he doesn't think'\)

(c) /\( l + t / \) → /\( t \)\n
/\( o + raf/ \) → /\( o+raf \) \( 'he slept up'\)

Gemination in Harar Oromo is a case of coalescence rather than deletion. Other geminations show retention of elements of both input segments: e.g. /\( m, k + t, s + e / \) → /\( m, k, s + e \) \( 'you turned'\) (p.22).

The output in Harar Oromo can be ascribed to the action of faithfulness constraints: it is most harmonic to preserve the most sonorous – and highly marked – element. This result is achieved by ranking all relevant faithfulness constraints over all markedness ones. The constraint IDENT[liquid] is relevant here.

(27) **IDENT[liquid]**

“If \( x \) is equally or more sonorous than a liquid, then \( x' \) has the same sonority value as \( x \), where \( x' \) is the correspondent of \( x \).”
Candidate (b) violates IDENT[mf] because it fails to keep the underlying marked feature specification; this leaves candidate (a). The constraints IDENT[mf, uf] – which preserves both marked and unmarked values of f – and *[mf, uf] – which bans both marked and unmarked values of f – are included to show that their ranking is irrelevant in this type of coalescence. Since IDENT[mf, uf] preserves both feature specifications equally it cannot distinguish between the two candidates. Similarly, a markedness constraint like *[mf, uf] is irrelevant – such a constraint does not favour one feature value over the other, so has no effect on the outcome.

More concretely, the analysis of Attic Greek showed that the ranking || IDENT[+round] > *[+round] || resulted in preservation of roundness. The ranking of IDENT[+round] and *[+round] was indeterminate in relation to these other constraints.

As illustrated in §8.2.A, the same principle applies to many other scales: nasality in Dakota, [anterior] in Catalan, and the sonority scale in Harar Oromo. Further examples will appear in the following case studies.

8.3 The unmarked survivor

The aim of this section is to demonstrate the need for stringently formulated faithfulness constraints. The empirical focus is the voicing scale [+voice]–voice]. Cases in which the unmarked [+voice] feature survive are shown to require faithfulness constraints that preserve both values of [voice] equally, hence in a stringency relation with the marked-faithfulness constraint IDENT[+voice] (from ch.7).

Section 8.3.1 presents an analysis of bi-directional [+voice] assimilation in Swedish, based on data from Sigurd (1965) and Hellberg (1974). The analysis owes a significant debt to Lombardi’s (1999) analysis and Baković’s (1999) insights, though it is cast in terms of the present theory. The claim made in this analysis – and in all analyses in ‘unmarked coalescence’ cases – is that the unmarked value wins due to the action of markedness constraints against the marked value – i.e. *[+voice] in this case. It is then argued that only a faithfulness constraint that preserves both values of [voice] – IDENT[±voice] – must outrank *[+voice] in order to prevent voice neutralization generally.

Section 8.3.2 presents an analysis of coalescence in the Athapaskan language Chipewyan (Fort Chipewyan dialect – Li 1946). Chipewyan has several coalescence patterns, one of which is the famous Athapaskan d-effect. As in Swedish, the unmarked [+voice] value survives in coalescence, as does the feature [‐continuant].

This same argument is provided for vowel features in §8.4.

8.3.1 Bi-directional assimilation in Swedish

This section shows that bi-directional assimilation poses the same issues as coalescence. In bi-directional assimilation, the featural content of the output is not determined by the rightmost or leftmost element. Instead, a single value dominates. In Swedish, the value is [+voice]: underlying clusters with an underlying voiceless segment surface as voiceless. This pattern differs from Attic Greek’s in that the unmarked value survives. This fact is shown to require voice-referring faithfulness constraints in a stringency relation.

Section 8.3.1.1 describes the relevant facts, followed by an analysis in §8.3.1.2. Section 8.3.1.3 discusses the central point of this analysis: that the unmarked feature value can only survive in bi-directional assimilation and coalescence if there is faithfulness conflation. Faithfulness conflation is argued to require stringently formulated constraints. Section 8.3.1.4 discusses alternative theories.

### Table 8.3: Swedish consonants

<table>
<thead>
<tr>
<th>Type</th>
<th>Labial</th>
<th>Alveolar</th>
<th>(Alveo-)Palatal</th>
<th>Velar</th>
<th>Glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stops</td>
<td>p</td>
<td>t</td>
<td>tʃ</td>
<td>k</td>
<td></td>
</tr>
<tr>
<td>Fricatives</td>
<td>b</td>
<td>d</td>
<td>dʒ</td>
<td>ɡ</td>
<td>h</td>
</tr>
<tr>
<td>Nasals</td>
<td>m</td>
<td>n</td>
<td>sibilants</td>
<td>n</td>
<td></td>
</tr>
<tr>
<td>Liquids</td>
<td>ː</td>
<td>r</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The Swedish syllable has optional onsets and codas; both constituents may contain between one and three consonants. There is no voicing neutralization in codas; both voiced and voiceless obstruents can appear in this position: e.g. tub ‘tube’, kap ‘cape’, hed ‘heath’, bit ‘piece’, rgy ‘cloth’, bak ‘back’; riy ‘fox’, kuf ‘odd’.

- **Voice assimilation**

In general, then if one of the input segments is [+voice], the output feature is [-voice].

Swedish contrasts with Attic Greek in that the marked input feature is not preserved in assimilation. Therefore, the opposite ranking must hold: whereas a faithfulness constraint that preserved only marked elements (i.e., [+round]) outranked all markedness

There is little controversy that [+voice] is the unmarked voicing feature for obstruents. This point is discussed in chapter 7. Therefore, the issue that arises in Swedish voice assimilation is why the unmarked [+voice] value emerges while the marked [+voice] value is eliminated.

8.3.1.2 Analysis

The following analysis will show that the constraint IDENT [+voice] is needed to adequately account for Swedish bi-directional voicing assimilation. The crucial aspect of this constraint is that it ‘conflates’ unfaithfulness: it assigns the same violations to [+voice→-voice] as to [+voice→+voice] mappings.

Swedish voice assimilation has been analyzed in Optimality Theory by Lombardi (1999), Bakovic (1999a,b, 1999b), and Wilson (2003:132f). The following analysis owes a great deal to Lombardi's proposals, and for the most part is a straightforward recasting of the analysis in Lombardi (1999) in terms of the present theory. The differences will be commented on where necessary.

Bakovic (1999a,b) presents a significantly different approach to the issue presented here; this theory is discussed in ch.7.7.7, so it will not be discussed further here. For a critique of the proposals in Wilson (2000), see McCarthy (2002b).

- Motivating assimilation

In obstruent voicing, [+voice] segments are more marked than [-voice] ones. Therefore, the present theory provides two faithfulness constraints. One exclusively preserves the marked value – IDENT [+voice], and the other preserves both values – IDENT [+voice], IDENT [-voice].

A full theory of the markedness constraints that trigger assimilation has been presented in chapter 7:7.2.3.1, the relevant assimilation-inducing constraints will be called ASSIM [+voice] here to save the reader the trouble of referring back to that chapter.

In order for ASSIM [+voice] to motivate assimilation of voiced segments, ASSIM [+voice] must outrank all constraints that preserve voiced segments – i.e., IDENT [+voice] and IDENT [-voice]; the opposite ranking would prevent voiced segments from undergoing assimilation. This general ranking was established in ch.7.

As shown by the pair /hås-d/→/hus/ and /hås-d/→/hus/ the output of assimilation is not directionally conditioned: in other words, neither the rightmost nor the leftmost segment consistently determines the voicing of the output.

The pair /hås-d/→/hass/ and /hås-d/→/hus/ provide evidence that morphological affixation does not matter: the voicing of the affix segment persists in [s], while the root's value wins in [k]. In general, then if one of the input segments is [+voice], the output will be voiceless.

### (30) Swedish obstruent voice assimilation

<table>
<thead>
<tr>
<th>Root</th>
<th>Gloss</th>
<th>Assimilated Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>t[gb]</td>
<td>t’ub ‘tube’</td>
<td>t’ub ‘tube + genitive’</td>
</tr>
<tr>
<td>r[kt]</td>
<td>r’od ‘red’</td>
<td>r’od ‘red (neuter)’</td>
</tr>
<tr>
<td>[gud]</td>
<td>g’ud ‘good’</td>
<td>g’ud ‘good (genitive)’</td>
</tr>
<tr>
<td>s[pr]</td>
<td>s’priel ‘brittle’</td>
<td>s’priel ‘brittle (neuter)’</td>
</tr>
<tr>
<td>t[s]</td>
<td>t’id ‘time’</td>
<td>t’id ‘time+genitive’</td>
</tr>
<tr>
<td>k[kl]</td>
<td>kl’ida ‘to dress’</td>
<td>kl’idas ‘to dress’</td>
</tr>
<tr>
<td>[f[t]s]</td>
<td>f’tida ‘food’</td>
<td>f’tida ‘food’</td>
</tr>
<tr>
<td>s[kuk]</td>
<td>sk’og ‘forest’</td>
<td>sk’ogs ‘forest (genitive)’</td>
</tr>
<tr>
<td>l[łs]</td>
<td>l’ög ‘high’</td>
<td>l’ög ‘high (language)’</td>
</tr>
<tr>
<td>v[łk]</td>
<td>v’ig ‘to marry’</td>
<td>v’iges ‘marriage’</td>
</tr>
<tr>
<td>d[łg]</td>
<td>d’ag ‘day’</td>
<td>d’ag ‘daylight’</td>
</tr>
<tr>
<td>s[ygl]</td>
<td>s’trgy ‘naughty’</td>
<td>s’trgy ‘naughty (neuter)’</td>
</tr>
<tr>
<td>b[yg]</td>
<td>b’ygg ‘build’</td>
<td>b’ygg ‘build (supine)’</td>
</tr>
<tr>
<td>h[a]v</td>
<td>h’av ‘sea’</td>
<td>h’av ‘sea + adv. suffix’</td>
</tr>
<tr>
<td>r[av]</td>
<td>r’av ‘fox’</td>
<td>r’av ‘fox + genitive’</td>
</tr>
<tr>
<td>s[trav]</td>
<td>s’tra’vrough’</td>
<td>s’tra’vrough (neuter)</td>
</tr>
</tbody>
</table>

### (c) +v[d]→+v[d]

<table>
<thead>
<tr>
<th>Root</th>
<th>Gloss</th>
<th>Assimilated Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>h[ægl]</td>
<td>h’and-bok ‘handbook’</td>
<td>h’and-bok ‘handbook’</td>
</tr>
<tr>
<td>s[yl]s-v[ęg]</td>
<td>syl’svässt ‘south-west’</td>
<td>syl’svässt ‘south-west’</td>
</tr>
<tr>
<td>s[ęg]</td>
<td>s’ega ‘to own’</td>
<td>s’ega ‘to own’</td>
</tr>
<tr>
<td>v[a]v</td>
<td>v’av ‘to weave’</td>
<td>v’av ‘to weave’</td>
</tr>
<tr>
<td>b[yg]</td>
<td>b’ygg ‘build’</td>
<td>b’ygg ‘build’</td>
</tr>
</tbody>
</table>

### (31) Swedish I assimilation

<table>
<thead>
<tr>
<th>Root</th>
<th>ASSIM [+voice]</th>
<th>IDENT [+voice]</th>
<th>IDENT [-voice]</th>
</tr>
</thead>
<tbody>
<tr>
<td>/hås-d/</td>
<td>a</td>
<td>a</td>
<td></td>
</tr>
<tr>
<td>/hås-d/</td>
<td>a</td>
<td>a</td>
<td>a</td>
</tr>
</tbody>
</table>
constraints against that feature (*[+round]) in Attic, the relevant markedness constraint in Swedish (*[+voice]) must outrank all faithfulness constraints that preserve that feature (IDENT+[voice]).

Tableau (32) illustrates this ranking.

(32) Swedish II: Elimination of the marked

<table>
<thead>
<tr>
<th>/æt-\dy/</th>
<th>ASSIM[voice]</th>
<th>*[+voice]</th>
<th>IDENT+[voice]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) æt-k \dy</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) æt-k \dy</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(c) æt-k \dy</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The crucial competition is between (b) and (c): (c) loses because it contains more voiced segments than (b). Thus, *[+voice] must outrank IDENT+[voice]; the opposite ranking would favour preservation of the marked value, with the undesirable result that (c) would win.

Tableau (33) is an elaboration on the ranking in (32). It shows that onset-faithfulness constraints must also be ranked below *[+voice].

(33) Swedish II: onset-faithfulness

|------------|--------------|-----------|---------------------|---------------------|
| (a) æt-k \dy | * | | * | *
| (b) æt-k \dy | | | * | *
| (c) æt-k \dy | | | | *

- Faithfulness conflation

A further ranking is needed. Some faithfulness constraint that preserves [+voice] must outrank *[+voice], otherwise [+voice] would be eliminated in all contexts: e.g. /æt-\dy/ would emerge as *[ækt].

The only faithfulness constraint left in the present theory is IDENT+[voice]; its effect is shown in the following tableau. A ranking analogous to [[IDENT+[voice]] → *[+voice]] was proposed by Lombardi (1999:285ff).

(34) Swedish III: avoidance of neutralization

<table>
<thead>
<tr>
<th>/æt-\dy/</th>
<th>IDENT+[voice]</th>
<th>*[+voice]</th>
<th>IDENT+[voice]</th>
</tr>
</thead>
</table>
| (a) æt-k \dy | * | * | *
| (b) æt-k \dy | * | * | *

The constraint IDENT+[voice] plays a crucial part. It prevents gratuitous elimination of [+voice], as in candidate (b). The opposite ranking would produce a language with wholesale elimination of *[+voice].

Notably, no faithfulness constraint except for IDENT+[voice] can be brought to the aid of *[ækt] here. As Lombardi (1999) shows, all constraints that favour a directional bias must be ranked below *[+voice]. This was demonstrated in tableau (33) for onset-faithfulness constraints. Tableau (35) makes the same point for root-controlled faithfulness constraints.

(35) Swedish IV: irrelevance of root-faithfulness

|----------|--------------|-----------|--------------------|--------------------|
| (a) strævt | * | * | * | *
| (b) stræft | | | * | * |
| (c) stræv-d | | | * | * |

So, the resulting ranking for Swedish voice constraints is anti-Paninian (Prince 1997 et seq.). The ranking has a general faithfulness constraint outranking a more specific one: i.e. [[IDENT+[voice]] → *[+voice] → IDENT+[voice]]]. The form of the constraint IDENT+[voice] is crucial in this analysis as it allows faithfulness conflation while maintaining contrast. This point will be fully developed in the next section.

8.3.1.3 Faithfulness conflation

The Swedish facts can be produced by the present theory because the marked-faithfulness constraints allow faithfulness conflation. The following tableau will be used to elucidate this point.

(36) Swedish V: Faithfulness conflation

|----------|--------------|--------------|-----------|---------------|
| (a) vik-k \dy | * | * | * | *
| (b) vik-k \dy | | * | * | *
| (c) vik-k \dy | | * | * | *

The reason that the markedness constraint *[+voice] emerges to make the crucial decision between (b) and (c) is because the mappings /vik-k\dy/→*[vik-k\dy] and /vik-\dy/→*[vik-k\dy] are conflated in faithfulness terms. Unfaithfulness to an input *[+voice]
specification incurs the same violations of active constraints as unfaithfulness to an input [+voice] specification. More concretely, the mappings incur equal violations of all relevant active faithfulness constraints – i.e. IDENT[±voice].

Because the active faithfulness constraint fails to distinguish the two different mappings, the lower-ranked markedness constraint can emerge to make the crucial decision. This is analogous to markedness conflation, discussed in chapters 3 and 4: two markedness categories are conflated if they incur the same violations of active markedness constraints.

To elucidate this point, suppose that IDENT[±voice] outranked *[±voice]. This ranking would fail to produce Swedish: it would favour candidate (c) over candidate (b). A key point is that IDENT[±voice] must be active: if it were ranked below *[±voice], all voicing contrasts would be eliminated.

Therefore, there are two requirements on all active voice-faithfulness constraints in Swedish: (i) they must preserve the voicing contrast and (ii) they must allow faithfulness conflation. The only way to deal with both these conditions is to have a faithfulness constraint that preserves both values of [voice] at once, thereby assigning equal violations to candidates that differ in either value of [voice]. In short, the constraint IDENT[±voice] is indispensible.

8.3.1.4 Alternatives: Non-stringent theories

This section considers theories with non-stringent faithfulness constraints: constraints that refer to a single feature value.

Suppose that there were a set of non-stringent faithfulness constraints in a fixed ranking: || IDENT[±f] » IDENT[±a] ||. This approach cannot deal with the Swedish facts: it offers no way to both preserve the voicing contrast and allow [+voice] to survive. Retention of the voicing contrast requires the ranking || IDENT[±voice] = *[±voice] ||. However, emergence of *[±voice] requires the ranking || *[±voice] » IDENT[±voice] ||. Thus, the fixed ranking approach produces a ranking paradox.

To explore non-stringent solutions further, one could propose that the ranking || IDENT[±voice] » IDENT[±voice] || held in Swedish. While this would account for the facts in this case, it predicts that unmarked features may be the specific focus of preservation; chapter 7 shows this proposal to be problematic.

A final non-stringent approach – that IDENT[±voice] is the only voice-faithfulness constraint – has already been shown to be inadequate (ch.7.2.3.1).

A final comment about the Swedish facts is that it shows that faithfulness constraints must be able to mention unmarked features. With only a constraint IDENT[±voice], [+voice] is predicted to always win in assimilation and coalescence (see chapter 7§7.5 and Wetzels & Mascaró 2001:214ff for discussion).

8.3.2 Voicing and continuancy in Chipewyan

The aim of this section is to show that the ranking for Swedish bi-directional assimilation can produce the same result for coalescence, with the result that the unmarked [+voice] value survives. Moreover, the language discussed here – Chipewyan – also shows that the unmarked value for [continuant] can also survive.

The difference between this example and Swedish is primarily in complexity. Many different features are in conflict in Chipewyan coalescence: [voice], [continuant], [strident], [anterior], [lateral], [distributed], and major Place of Articulation. So, Chipewyan’s complexity provides a good test for the approach to coalescence and feature preservation advocated here.

A number of Athapaskan languages employ coalescence to eliminate certain consonant clusters. The most famous coalescence case involves the classifier /t/ – the famous Athapaskan d-effect (e.g. Navajo; McDonough 1990, Sekani; Hargus 1988:97ff; Slave; Rice 1987, 1989; general: Howren 1971, Rice 1987, Lamontagne & Rice 1994, 1995).

This section focuses on two types of coalescence in the Athapaskan language Chipewyan, one of which is the d-effect; the other relates to coalescence of laterals (Li 1946). This section presents a unified analysis of both coalescence types, showing how both preserve the unmarked feature in the output.

Two generalizations hold of all the coalescence outputs: (i) if either of the inputs is [+voice], the output is [+voice] and (ii) if either of the inputs is a stop, the output will be a stop or affricate. The following table summarizes relevant data from Li (1946). More complete data is provided in the following sections.

(37) Chipewyan coalescence in brief

<table>
<thead>
<tr>
<th>Type</th>
<th>Source</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) voiced + voiceless</td>
<td>[θ]-[n] → [θ-n]</td>
<td>‘start to hunt 2 dual’ (p.414)</td>
</tr>
<tr>
<td>(b) voiced + voiceless</td>
<td>[θ]-[n] → [θ-n]</td>
<td>‘he is exhausted’ (415)</td>
</tr>
<tr>
<td>(c) stop + C</td>
<td>[θ]-[n] → [θ-n]</td>
<td>‘I came back’ (412)</td>
</tr>
<tr>
<td>(d) stop + C</td>
<td>[θ]-[n] → [θ-n]</td>
<td>‘to handle grain-like’ (409)</td>
</tr>
<tr>
<td>(e) stop + C</td>
<td>[θ]-[n] → [θ-n]</td>
<td>‘to be, act, do’ (409)</td>
</tr>
<tr>
<td>(f) stop + C</td>
<td>[θ]-[n] → [θ-n]</td>
<td>‘several persons go’ (409)</td>
</tr>
<tr>
<td>(g) stop + C</td>
<td>[θ]-[n] → [θ-n]</td>
<td>‘we (dual) have woken up’ (414)</td>
</tr>
<tr>
<td>(h) stop + C</td>
<td>[θ]-[n] → [θ-n]</td>
<td>‘you (dual) eat’ (413)</td>
</tr>
</tbody>
</table>

The majority of the data in (37) shows that Chipewyan cluster simplification involves coalescence rather than deletion. For example, coalescence of /θ/ produces an
output that retains the voicing of the /θ/ and laterality of the /t/. i.e. [t] (37a). Similarly, coalescence of a stop and fricative results in an affricate (as in /θɔˈɡ/-[tʃ] and /θɔˈɡ/-[tθ]). The reported simplification /θ+t produces [k], a segment which preserves the manner of articulation of the /θ/ and place of articulation of the /t/.

This section shows that Chipewyan requires the same type of ranking as Swedish: in other words, a general faithfulness constraint must outrank a more specific one. The difference is that the case involves both [voice] and [continuant].

Section 8.3.2.1 presents background facts on Chipewyan phonology and a description of the coalescence data. Sections 8.3.2.2 presents an analysis of lateral coalescence, and §8.3.2.3 provides an analysis of /t/-coalescence (i.e. the /θ/-effect).

### 8.3.2.1 Description

Table 8.4 lists the consonants found in Chipewyan. Several facts prove to be important in consonant coalescence: (i) there are three types of stop: unaspirated, aspirated, and glottalized, (ii) there are a variety of affricates, including interdental [ts], dental [ts], palatal [tʃ], and lateral [tl], and (iii) there is a voiceless lateral fricative [θ], which will prove to be significant in the alternations discussed below.241

<table>
<thead>
<tr>
<th>Stop &amp; Affricates</th>
<th>Labial</th>
<th>Coronal</th>
<th>Dorsal</th>
<th>Glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td>p</td>
<td>tθ</td>
<td>t</td>
<td>t</td>
<td>?</td>
</tr>
<tr>
<td>tθ</td>
<td>tθ'</td>
<td>t'</td>
<td>tθ'</td>
<td>?</td>
</tr>
<tr>
<td>/θ</td>
<td>tθ'</td>
<td>t'</td>
<td>tθ'</td>
<td>?</td>
</tr>
<tr>
<td>t</td>
<td>tθ'</td>
<td>t'</td>
<td>tθ'</td>
<td>?</td>
</tr>
<tr>
<td>/θ</td>
<td>tθ'</td>
<td>t'</td>
<td>tθ'</td>
<td>?</td>
</tr>
</tbody>
</table>

Table 8.4: Chipewyan Consonants

Chipewyan syllables have the shape (C)V(zC). Codas cannot be stops or affricates. They are also restricted to coronal or glottal POA, with the exception of [θ]. In other words, codas are one of [θ Q] s z ʃ ɹ n h l r (Li 1946:401).

Of largely incidental relevance is the fact that stem-initial fricatives are not contrivasive in voicing. They are voiceless word-initially and after voiceless fricatives, but voiced elsewhere. By Richness of the Base, both voiced and voiceless stem-initial fricatives must be considered in input forms. Unless directly relevant, the data below has input voiced stem-initial fricatives.

241 Jakobson & Waugh (1979:141-2) observe that Chipewyan /t/ is produced with strong velarization. This fact will be ignored here. Some support for their observation is that pre-Chipewyan *t has become [k] in certain modern Chipewyan dialects (see ch.6 §6.3.1).

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### 8.3.2.2 Lateral Coalescence

The formal expression of markedness – ch.8

- **Coalescence**
  - Coalescence most often takes place in the set of prefixes that precedes the verb root. The closest set of prefixes, which Li (p.410) calls the ‘conjunctive prefixes’, has the order [modals + aspectual + pronominal subject + classifiers + verb root]. The consonants of these prefixes coalesce when their preservation would violate the syllable restrictions identified above.
  - Coalescence happens often because many of the conjunctive prefixes consist of a single consonant or terminate in a consonant. For example, the classifiers are /l/, /l/, and /θ/, and the pronominal subject morphemes are /l/ (1sg.), /l/ (2sg.), /l/ (1mon-sg.), and /l/ (2mon-sg.) (Li 1946: 411-2); one of the aspect prefixes is /θ/; other aspect prefixes end in a vowel. All modal prefixes end in a vowel. Epenthesis is used to eliminate consonant clusters in other positions, as discussed in ch.4.
  - A unified analysis of all the consonant coalescences in Chipewyan will be presented in the following sections. However, it will prove useful to classify them into two types for descriptive purposes. All coalescences involve one of the classifiers /l/, /l/, and /θ/. So, ‘lateral coalescence’ will be used to refer to coalescence involving the lateral classifiers /l/ and /θ/. The term ‘stop coalescence’ will be used to refer to coalescence involving the classifier /t/, called the /θ/-effect after the orthographic symbol used for this consonant.

<table>
<thead>
<tr>
<th>Stop &amp; Affricates</th>
<th>Labial</th>
<th>Coronal</th>
<th>Dorsal</th>
<th>Glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td>p</td>
<td>tθ</td>
<td>t</td>
<td>t</td>
<td>?</td>
</tr>
<tr>
<td>tθ</td>
<td>tθ'</td>
<td>t'</td>
<td>tθ'</td>
<td>?</td>
</tr>
<tr>
<td>/θ</td>
<td>tθ'</td>
<td>t'</td>
<td>tθ'</td>
<td>?</td>
</tr>
<tr>
<td>t</td>
<td>tθ'</td>
<td>t'</td>
<td>tθ'</td>
<td>?</td>
</tr>
<tr>
<td>/θ</td>
<td>tθ'</td>
<td>t'</td>
<td>tθ'</td>
<td>?</td>
</tr>
</tbody>
</table>

Table 8.5: Lateral Coalescence in Chipewyan

The outputs of lateral coalescence are summarized in Table 8.5 and of stop coalescence in Table 8.6. Supporting data is provided at the end of this section (i.e. §8.3.2.1).

The top row in Table 8.5 lists all possible coda consonants (/θ ɔ s z ʃ ɹ n h l r) except for /θ ɔ s/ which did not appear in the data, and /θ/, which coalesces with the preceding vowel (e.g. /θp/ → /θθp/). Gaps indicate combinations for which there is no mention in Li (1946). The top row in Table 8.6 lists all stem-initial consonants for which there is data. The category ‘stop/affricate’ refers to all stops and affricates; the result of their coalescence with /θ/ is the same stop or affricate.

<table>
<thead>
<tr>
<th>Stop &amp; Affricates</th>
<th>Labial</th>
<th>Coronal</th>
<th>Dorsal</th>
<th>Glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td>p</td>
<td>tθ</td>
<td>t</td>
<td>t</td>
<td>?</td>
</tr>
<tr>
<td>tθ</td>
<td>tθ'</td>
<td>t'</td>
<td>tθ'</td>
<td>?</td>
</tr>
<tr>
<td>/θ</td>
<td>tθ'</td>
<td>t'</td>
<td>tθ'</td>
<td>?</td>
</tr>
<tr>
<td>t</td>
<td>tθ'</td>
<td>t'</td>
<td>tθ'</td>
<td>?</td>
</tr>
<tr>
<td>/θ</td>
<td>tθ'</td>
<td>t'</td>
<td>tθ'</td>
<td>?</td>
</tr>
</tbody>
</table>

Table 8.6: /θ/-coalescence in Chipewyan

That these cases involve coalescence rather than deletion is evinced by the pairs /θ+ ∈/={1}, /θ/ ∈/={1}, and virtually all of the stop coalescence cases, where /θ/ plus another
consonant fuse to form an affricate, or – in the case of /t+x/ – a stop that preserves the marked PoA.

Several generalizations hold of the output of both lateral and stop coalescence. They are summarized in (38).

(38) The output of Chipewyan stop coalescence
(a) If an input segment is [−voice], the output is [−voice]
(b) If an input segment is [−continuant], the output is [−continuant]
(c) Preserve aspiration and glottalization
(d) Preserve marked (labial, dorsal) places of articulation.
(e) Preserve the following features in order of importance:
[+strident] > [+lateral] > [−anterior] > [−distributed]

The primary focus of the following analysis is (38a) and (38b).

As an example of (38a), coalescence of /θ+l/ produces the voiceless [θ]: e.g. /θeθ-θhu-/ → [θehθ] ‘he is exhausted’ (p.415). Similarly, coalescence of /h+l/ produces voiceless [h]: e.g. /heθ-θhu-/ → [heθθ] ‘we started to hunt’ (p.414). Finally, coalescence of /t+l/ produces the voiceless affricate [θ].

(38b) states that coalescence involving a stop will produce a stop. This is clearest in the coalescence /t+x/, which produces [k]. In this case, the output preserves the [−continuant] feature of the input /t/. After Clements’ (1999) proposal that affricates are strident stops, combinations of /l/ and fricatives also show that [−continuant] survives since the output is an affricate – i.e. [−continuant].

To allow us to proceed to the analysis without further ado, (38c) and (38d) will be discussed when they become relevant.

• Data

The data in (39) and (40) is from Li (1946); numbers in brackets refer to page numbers in this work. All coalescences reported above are described by Li, though there are some missing combinations, noted below.

39) Lateral coalescence data\[33] (relevant clusters are underlined)
(a) /C+L/ →
/θ+l/ → [θeθθ] ‘make it [perf,3sg.]’ (414)
/t+l/ → [θθθ] ‘I am doing so’ (418)

(b) /C+L/ →
/θ+l/ → [θeθθ] ‘be handling gran-like object’ (409)
/t+l/ → [θθθ] ‘several persons go-progressive’ (409)

(40) Stop coalescence data
/h+t/ → [θ] ‘you (dual) eat’ (413)
/h+t/ → [θθ] ‘several persons go’ (409)

no data

/h+t/ → [θθ] ‘to start hunt’

/h+t/ → [θθθ] ‘go to sleep’ (409)
/h+t/ → [θθθ] ‘to start hunt 2 dual’ (414)

Evidence that the /l/ and /θ/ morphemes are underlyingly [l] and [θ] comes from forms without contraction: e.g. /θeθ-θhu-/ → [θeθθ] ‘to make it (imperf, 3sg.)’, /θa-θeθ-θnu-/ → [θaθθθ] ‘to make it [perf 1]’ (414).

33 Compare with Hare /θeθ-θx-/ → [θeθθθ] ‘it is cut’, /θaθ-θeθ-θx-/ → [θaθθθθ] ‘she hangs him/herself’.
8.3.2.2 Lateral coalescence: Survival of [+voice]

Lateral coalescence is triggered by a ban on complex margins: *COMPLEX. As shown for Attic Greek, coalescence comes about when *COMPLEX outranks UNIFORMITY; deletion and epenthesis are blocked by MAX and DEP respectively. The example in tableau (41) is /θl-yl-]/ → [θλl]/ ‘he is exhausted’.

<table>
<thead>
<tr>
<th>Input</th>
<th>+complex</th>
<th>Max</th>
<th>Dep</th>
<th>Uniformity</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>[θl-yl]</td>
<td>#!</td>
<td></td>
<td>!</td>
</tr>
<tr>
<td>(b)</td>
<td>[θl-yl]</td>
<td>#!</td>
<td></td>
<td>!</td>
</tr>
<tr>
<td>(c)</td>
<td>[θl-yl]</td>
<td>!</td>
<td></td>
<td>!</td>
</tr>
<tr>
<td>(d)</td>
<td>[θl-yl]</td>
<td></td>
<td></td>
<td>!</td>
</tr>
</tbody>
</table>

Input tri-consonantal clusters in which the middle element is a lateral [l] are resolved as coalescing the first two consonants in the output. For example, /θl-yl]/ is realized as [θλl]/, with the leftmost input consonants /θl/ coalescing to produce [θ]; the rightmost two consonants do not coalesce: *[θλl]/ is *[θlλl]/.

To account for the fact that the first two consonants coalesce rather than the second two, a constraint that bans coalescence in onsets is employed. This constraint is a straightforward extension of Beckman’s (1998) theory of positional faithfulness:

(42) on-set-uniformity If x is in an onset, x has only one input correspondent.

The constraint on-set-uniformity places a stronger requirement on onsets than other elements: onset consonants cannot be coalesced segments. With onset-uniformity, the only viable coalesced output from a tri-consonantal input is one in which the coalesced output segment is in the coda. Tableau (43) illustrates this point.

<table>
<thead>
<tr>
<th>Input</th>
<th>+complex</th>
<th>On-set-uniformity</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>[θl-yl]</td>
<td>#!</td>
</tr>
<tr>
<td>(b)</td>
<td>[θl-yl]</td>
<td>!</td>
</tr>
<tr>
<td>(c)</td>
<td>[θl-yl]</td>
<td>#!</td>
</tr>
<tr>
<td>(d)</td>
<td>[θl-yl]</td>
<td></td>
</tr>
</tbody>
</table>

The analysis of stop coalescence below will show that *COMPLEX outranks on-set-uniformity.

Tri-consonantal clusters with stops as the medial consonant behave differently – the stop coalesces with the following consonant. An explanation for this difference will be provided in the next section.229

229 Causley (1997) proposes that two coalescences take place in the derivation ḥp-ah-l-ː/[hul-ː]/: the lateral feature of /l/ coalesces with /h/ to produce [h], and the [+voice] feature of the /l/ coalesces with the
ranked markedness constraint *[+voice] to emerge, favouring the candidate with the unmarked [+continuant] feature over the one with [+voice].

• Preservation of [lateral] and [strident]

The preservation of [lateral] and [strident] contrasts with [voice] in that the marked values of these latter features are retained. Almost all coalescences involving a lateral result in a lateral: e.g. /huh-1-zəʔ/ → [huhə], *[huhə]; /θ-θ-i-y/ → [θi], *[θi].

The ranking responsible for retention of [+lateral] is schematically the same as that used for [+round] preservation in Attic Greek: IDENT[+lateral] dominates *[+lateral]. Through this ranking, the marked feature will be preserved, as shown in tableau (46).

\[
\begin{array}{|c|c|c|}
\hline
\text{Candidate} & \text{IDENT[+lateral]} & \text{*[+lateral]} \\
\hline
(a) & \checkmark & \checkmark \\
(b) & \checkmark & \\
\hline
\end{array}
\]

An interesting point relates to stridency. In combinations of the strident /s/ and lateral, the output is strident: e.g. /thu-1-ςθ/ → [thuθ] ‘I am doing so’ (p.418), /θ-θ-i-ςθ/ → [θiθ] ‘to start hunting’ (p.414). It is clear that preservation of stridency takes preference over preservation of [+lateral]. This can be formally expressed by having IDENT[+strident] outrank IDENT[+lateral], as in tableau (47).

\[
\begin{array}{|c|c|c|}
\hline
\text{Candidate} & \text{IDENT[+strident]} & \text{IDENT[+lateral]} \\
\hline
(a) & \checkmark & \checkmark \\
(b) & \checkmark & \\
\hline
\end{array}
\]

Preservation of stridency will also play a role in stop coalescence, to which we now turn.

8.3.2.3 Stop coalescence: Survival of [+continuant]

Stops are banned in Chipewyan codas, so all /t/C clusters must be eliminated in the output form.245 An interesting aspect of stop coalescence is that /t/ always coalesces with the following consonant in tri-consonantal clusters, rather than with the preceding one: e.g. /θ-θ-θ-θ/ → /θθθθ/ ‘he went home’ (419). This contrasts with lateral coalescence, in which the lateral coalesces with the preceding consonant.

245 Evidence that the classifier is /θ/ comes from combinations with /θ/, where the result is /θ/. Rice (1987) has proposed that the /θ/ classifier consists of the feature [+continuant] alone, with its other features being filled in as defaults. However, under present assumptions (i.e. that glottals are less marked than coronals), nothing would prevent the output from being just /θ/, which is also [+continuant].
output is always glottalized or aspirated. This also shows up in the coalescence of /t+ɬ/, which results in a glottalized [t’]. Assuming that [ɬ] is inherently glottalized, this result is expected. Thus, as for the marked features above, a faithfulness constraint that preserves [spread glottis] and [constricted glottis] can be invoked.

- **Major PoA**
  Finally, coalescence of /t/ with /s,ʃ/ yields a [k]. The fact that /t+$\theta$/ does not result in a *{t} or *{t}s shows that Chipewyan preserves the marked PoA in coalescence. This generalization is supported by the fact that coalescence with any non-coronal stop or affricate results in the same stop or affricate: e.g. /s+t/-$\theta$/k/ → [xatar-θkai] ‘it is white spotted’ (417). In this coalescence, the dorsal PoA of the /k/ survives, obscuring any vestige of the underlying /t/. Again, a faithfulness constraint that preserves marked feature values – IDENT[K] – can be invoked; this constraint must outrank all antagonistic markedness constraints (i.e. *{K}, *(KP)).

### 8.3.2.5 Putting the rankings together

So far, two sets of rankings have been developed independently. One set produces coalescence. The other determines which features are preserved in the output. To help clarify, the rankings in (Figure 8.2.a) trigger coalescence and those in (Figure 8.2.b) result in the survival of the [-continuant] and [+voice] features. There is also another set of rankings, involving stridency, [lateral], [anterior], [distributed], and major PoA; these will be discussed below.

![Figure 8.2: Interim Chipewyan coalescence ranking](image)

(49) Chipewyan VII: directional effects in stop coalescence

<table>
<thead>
<tr>
<th>Segments</th>
<th>CODACOND</th>
<th>*{continuant}</th>
<th>onset-UNIFORMITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>/t+ɬ/</td>
<td></td>
<td>*(t')</td>
<td></td>
</tr>
<tr>
<td>/t+$\theta$/</td>
<td></td>
<td>*(t+$\theta$)</td>
<td></td>
</tr>
<tr>
<td>/t/</td>
<td></td>
<td>*(t)</td>
<td></td>
</tr>
</tbody>
</table>

Candidate (a) coalesces the leftmost segment to form a [-continuant] affricate: /θ+t/→-[θ]. While doing so minimizes violations of *{t}[-continuant], it fatally violates the ban on stops and affricates in codas.

Candidate (b) avoids violating the coda condition by failing to preserve /t/’s [-continuant] feature. However, doing so results in three continuants on the surface [θ ð ɬ]. In contrast, candidate (c) minimizes continuants by coalescing the stop with the following consonant and preserving the [-continuant] feature.

### 8.3.2.4 The other features

This section focuses on the other features preserved in Chipewyan coalescence: minor and major place of articulation, stridency, and secondary articulations. For these features, the marked value is always preserved.

- **Minor PoA**
  Coalescence of the alveolar /t/ and interdental /θ/ results in an interdental fricative [θ], not an alveolar affricate [ts] or plain alveolar stop [t]. Similarly, coalescence of /t/ with an alveo-palatal /ʃ/ produces an alveo-palatal [ʃʃ], not an alveolar [ts] or [t].
  
  These facts follow in much the same way as preservation of [+lateral] – by a ranking that preserves the marked values [+distributed] (for /θʃ/) and [+anterior] (for /ʃʃ/). If IDENT[+distributed] and IDENT[+anterior] outrank *{distributed} and *(anterior), both values will be preserved, so blocking the plain [ʃ] and [ʃ].
  
  Importantly, both these constraints must be ranked below IDENT[+lateral]. This can be seen in the coalescence /θ+t/-[ʃ], which results in a lateral [ʃ], not an interdental *(θ)[t], and /ʃʃ/, which also results in the voiceless lateral.
  
  Finally, /t+/[ʃʃ] results in the affricate [ts], not a plain stop. This can be explained by invoking IDENT[+strident], which preserves the stridency of /ʃʃ/, resulting in a strident stop – i.e. an affricate, after Clements (1999).
  
  To summarize, several marked feature values are preserved in Chipewyan coalescence. The interesting fact is that there is an order of preference: [+strident] is preserved over all other features, then [+lateral], and finally – if possible – [+anterior] and [+distributed].

- **Aspiration and glottalization**
  A similar point can be made for the secondary articulations of aspiration and glottalization. In combinations of /t/ with glottalized or aspirated stops and affricates, the
The general point here is that coalescence of segments that disagree in some feature results in unavoidable unfaithfulness to f (Pater 1995). Therefore, coalescence can be blocked by IDENT constraints that refer to this feature. For extensive discussion of this point and its relation to gemination, see Keer (1999); the same point is made for morphological haplology in de Lacy (1999b).

In Chipewyan, a further ranking can be established for IDENT+[voice], relating to onset-UNIFORMITY. Input /θs1.l2.z3/ can be coalesced so as to avoid violations of IDENT+[voice] altogether: i.e. *[θs1.l2.z3]. By coalescing the /θ/ and /z3/, the [+voice] of the /θ/ is lost. This satisfies IDENT+[voice], unlike the actual winner /θs1.l2.z3/. The problem with the losing form is that it violates onset-UNIFORMITY, as shown in tableau (51).

![Diagram](image)

The point about IDENT constraints blocking coalescence also holds for the faithfulness constraints that relate to stridency, [lateral], [distributed], [anterior], and so on.

To summarize the preceding sections, these constraints are arrayed in the ranking in Figure 8.3.

![Diagram](image)

The formal expression of markedness – ch. 8

- IDENT blocks coalescence II

The point about IDENT constraints blocking coalescence also holds for the faithfulness constraints that relate to stridency, [lateral], [distributed], [anterior], and so on. To summarize the preceding sections, these constraints are arrayed in the ranking in Figure 8.3.

![Diagram](image)

The diagram in Figure 8.4 is provided primarily to assure the reader that all the rankings proposed so far are compatible. The rankings in Figure 8.3 are left aside; as explained above, they are incorporated into Figure 8.4 by having the *complex, CODACOND, MAX, and DEP all outrank IDENT+[lateral].

![Diagram](image)

The general point here is that coalescence of segments that disagree in some feature results in unavoidable unfaithfulness to f (Pater 1995). Therefore, coalescence can be blocked by IDENT constraints that refer to this feature. For extensive discussion of this point and its relation to gemination, see Keer (1999); the same point is made for morphological haplology in de Lacy (1999b).

In Chipewyan, a further ranking can be established for IDENT+[voice], relating to onset-UNIFORMITY. Input /θs1.l2.z3/ can be coalesced so as to avoid violations of IDENT+[voice] altogether: i.e. *[θs1.l2.z3]. By coalescing the /θ/ and /z3/, the [+voice] of the /θ/ is lost. This satisfies IDENT+[voice], unlike the actual winner /θs1.l2.z3/. The problem with the losing form is that it violates onset-UNIFORMITY, as shown in tableau (51).

![Diagram](image)

The same problem does not arise for the relation between IDENT+[continuant] and onset-UNIFORMITY. Problems could only arise in a tri-consonantal cluster consisting of a stop+/θ/ or a continuant. In this case, /θ/ would coalesce with the preceding stop rather than the following fricative to minimize violations of IDENT+[continuant]. However, no stops are permitted in Chipewyan codas. The only [−continuant] element is /n/, which coalesces with a preceding vowel: e.g. /θn+s3i/ → [θs3i] ‘you made it’ (p. 414). Therefore, the previously established ranking || IDENT+[continuant] = onset-UNIFORMITY || has no undesirable effects.
8.3.2.6 Alternatives

This section considers an alternative analysis: that coalescence in Chipewyan involves a complex set of opaque processes.

In a rule-based analysis, underlying /θ+l/ would first undergo voicing assimilation: →[θl], followed by deletion →[θ]. Thus, there is no ‘real’ coalescence in Chipewyan: only an opaque assimilation process.

As pointed out for Attic Greek, the problem with an opaque approach is that opaque processes necessarily have transparent surface effects as well. By invoking voice assimilation for /θ0l/ →[θ], one predicts that voice assimilation should occur in non-opaque contexts, too.

To some small extent, this is true: there is progressive voicing assimilation from segments to fricatives: e.g. [θl-χaθ] ‘I shake it’ cf [θθl-χaθ] ‘you (pl.) shake it’; [θθl-χaθ] ‘it is being hooked’ cf [θθl-χaθ] ‘hook it!’ (411). This fits in with the proposed opaque process whereby /l/ becomes voiceless after the voiceless fricative /θ/.

However, the putative opaque assimilation is not the same as the progressive voicing otherwise seen in Chipewyan. The opaque assimilation is not progressive: it is bi-directional [-voice] assimilation. This can be seen from the pair /θl+/→[θ]. Unlike non-opaque cases, the [θ] does not voice after the /l/, cf /θθl+/→[θθl] ‘he started to hunt’ (414). In short, the opaque assimilation process is not the same that is seen elsewhere in the language: the opaque assimilation would have to be a bi-directional [-voice] assimilation (like Swedish). Since bi-directional assimilation is not seen in transparent environments, the putative opaque process cannot exist.

8.3.3 Unmarked vowel features

The preceding two cases have focused on the features [voice] and [continuant]. §8.4 and §8.4 present cases of unmarked coalescence involving Place of Articulation, sonority, and [anterior]. This section shows that the unmarked value of vowel-related features can also survive in coalescence, standing in contrast to Attic Greek.

The case discussed here involves preservation of the feature [+back] in the informal register of Japanese men’s speech.246

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246 1 thank Makoto Kadowaki, Takahito Shinya, and Mariko Sugahara for their native speaker judgments. The generalizations presented here are from my own work. See Newman (1997) for a more limited description (of the [oi]-[ei] alternation). Also see Rice & Causley (1998) and Causley (1999b:139-140) for alternative analyses.
That the vowel cluster simplifications involve coalescence and not deletion is seen in /oso1i2/ → [ose2], where the output [e] retains the [-back, +round] value of the /o/ and height of the /i/.

The result of the coalescences seen in [o(e.i)]→[e] contrasts markedly with coalescence in Attic Greek. Neither the marked [+round] nor [+back] feature of input /o/ are retained – instead, the unmarked [-round, +back] features of the input /i/ and /o/ are preserved in the output.

Motivating coalescence

The coalescing clusters all consist of a high sonority segment [a o e] followed by a front vowel [i e]. All such clusters – if realized faithfully – would form a diphthong, while all clusters do not. So, coalescence in JMIR can be seen as motivated by the desire to avoid diphthongs; heterosyllabic clusters therefore avoid coalescence.

- [-back] survival

In the coalescence /oso1i2/ → [ose2], /i/’s [+back] feature survives while /o/’s [+back] feature does not. Like [-round], [+back] feature is the unmarked value of [back]. This is therefore a case of unmarked coalescence.

For [-back] to survive, *[+back] must outrank IDENT[+back], as shown in tableau (53).

(53) JMIR I: unmarked coalescence ranking, part 1

<table>
<thead>
<tr>
<th>/oso1i2/</th>
<th>*[+back]</th>
<th>IDENT[+back]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) ose2</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td># (b) ose2</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

By retaining the marked [+back] value in coalescence, (a) fatally violates *[+back]; it incurs two violations to (b)’s one.

The second part to the ranking involves IDENT[+back]. This constraint must outrank *[+back], otherwise /o/ would neutralize to a front vowel in all environments.

(54) JMIR II: unmarked coalescence ranking, part 2

<table>
<thead>
<tr>
<th>/oso1i2/</th>
<th>IDENT[+back]</th>
<th>*[+back]</th>
<th>IDENT[+back]</th>
</tr>
</thead>
<tbody>
<tr>
<td># (a) ose2</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) ose2</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

Tableau (54) shows that IDENT[+back] is crucial: it prevents the word-initial /o/ from neutralizing to [e].

- Roundness

Unlike Attic Greek, [+round] does not survive in JMIR coalescence. There are two possible analyses of this fact for JMIR. One is that this is again an example of unmarked coalescence: the unmarked [-round] feature emerges through the ranking || IDENT [+round] > *[+round] = IDENT [+round]].

The other alternative is that JMIR coalescence is structure-preserving. To explain, if /o/ coalesce to form a [+back] vowel but retain the [+round] feature, the output would be [a] – a vowel that is banned in the language generally. To formally implement this approach, *[+back] must outrank IDENT [+round], as shown in tableau (55).

(55) JMIR III: structure preservation

<table>
<thead>
<tr>
<th>/oso1i2/</th>
<th>⊗</th>
<th>*[+back]</th>
<th>IDENT [+round]</th>
</tr>
</thead>
<tbody>
<tr>
<td># (a) ose2</td>
<td>⊗</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) ose2</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

Candidate (c) minimally violates *[+back] and preserves IDENT [+round]. However, it does so at the expense of creating a segment that is banned in the language – i.e. it is non-structure-preserving (Kiparsky 1982). In contrast, candidates (a) and (b) are structure-preserving, having only vowels that are allowed elsewhere in the language. Candidate (a) minimizes back vowels, and so wins.

Summary

In short, coalescence in Japanese men’s informal register is a case where the unmarked value of a vowel-related feature – [back] – survives. This contrasts with the preservation of the marked [+round] in Attic Greek.

247 Other languages that only allow diphthongs consisting of a non-high vowel followed by a front vowel are Dumi (van Driem 1993), Usdu (Rog 1988:18), and Wari’ (Everett & Kern 1997).

8.3.4 Summary
The case studies in this section have illustrated the ranking schema that allows unmarked features to emerge in coalescence. With the constraint ranking that causes coalescence, the schema in (56) is essential in ensuring that the unmarked value of feature f – i.e. uf – survives in the coalesced output.

(56) Unmarked survival ranking
\[ \text{IDENT}[mf, uf] \rightarrow \text{IDENT}[mf] \]

Again, mf is the marked feature value in relation to uf, as in the oppositions [+voice] to [−voice], [dorsal] to [coronal], [dorsal] to [labial], and so on. The schema states that some markedness constraint that favours the unmarked value over the marked one (i.e. *mf) must outrank all faithfulness constraints that preserve the marked value without preserving the unmarked one (i.e. IDENT[mf]). As tableau (57) shows, the result is that the unmarked feature uf survives.

(57) Unmarked survival, schematically

<table>
<thead>
<tr>
<th>mf, uf</th>
<th>IDENT[mf, uf]</th>
<th>*[mf]</th>
<th>IDENT[mf]</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>b</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

Two crucial properties allow the result above. One is that there is a faithfulness constraint that preserves the least marked element: uf. If there were no such constraint – i.e. if there were only IDENT[mf] – it would be impossible for the unmarked feature to emerge in coalescence and bi-directional assimilation. In such a system, IDENT[mf] would have to outrank *mf otherwise mf would be neutralized in all positions. However, if IDENT[mf] were so ranked, the marked feature would always be favoured in coalescence.

The second property is that there is a faithfulness constraint that preserves both the marked and unmarked feature. Excluding the non-strictenent theory that \[ \text{IDENT}[uf] \rightarrow \text{IDENT}[mf] \] (see ch.7), the only way to give both (a) and (b) equal violations of active faithfulness constraints is if the active faithfulness constraint preserved both mf and uf equally. The result is that the faithfulness constraints are in a subset-superset relation: IDENT[mf,uf] incurs a subset of the violations that IDENT[mf] does.

---
248 The difference between Japanese, Korean, and Rotuman is that the latter two cases are non-structure-preserving. In other words, coalescence produces vowels that are not otherwise allowed: e.g. Korean [pːo]/→[pː], [tː], Rotuman [hːo]/→[hː], [hː]. (cf Japanese [tːo]/→[tː], [tː]) The issue of structure-preservation in coalescence is not directly relevant to the aims of this chapter, so I will not discuss it further here. See McCarthy (1985, 2000b) for a relevant discussion of Rotuman coalescence.
Syllables can be onsetless word-initially, but medial onsetless syllables do not seem to occur. Rimes can contain (i) a long vowel, (ii) a short vowel+consonant, or (iii) a nasalized vowel. Word-final consonants are banned. Onset clusters can have two members if (i) the first member is [s] or (ii) the second member is a glide.

Heterosyllabic consonant clusters must be either geminates or homorganic nasal+stop clusters. Clusters of sonorants + [h] also occur; these are considered aspirated sonorants here. Examples of the latter three types are given in (58); examples of geminates are presented in the following sections. Examples marked (Gxx) are from Geiger (1943), with xx as page numbers.

(58) **Consonant clusters in Pathi**

(a) [nasal+stop] clusters

- [vamh'ati] ‘shames’ (G103)
- [rundhati] ‘encloses’ (G103)
- [ananjita] ‘infinity’ (G101)
- [karphag] ‘doubt’ (G101)

(b) [(nasal, glide) + h]

- [amblanat] ‘with the stone’ (G93)
- [paritu] ‘question’ (G92)
- [pubshitu] ‘forenoon’ (G92)
- [sait] ‘that which is to be endured’ (G92)

Of the geminates, only [vx] cannot occur; when it would come about through assimilation, it appears as [h][x] (Geiger p.94). More generally, [v] is classed as a glide here because its behaviour is distinctly glide-like. Not only does it behave as highly sonorous in assimilation, it classes with liquids and glides for other processes (Geiger p.60).

- **Coalescence**

  The following description and analysis is only concerned with synchronic alternations; unlike most previous analyses, the diachronic change from Sanskrit to Pathi will not be discussed, although it follows (approximately) the same lines as the synchronic alternations. The generalizations proposed in this section are from my analysis of alternations reported in Pals (1985).

Pathi syllable restrictions force many consonant clusters to simplify. The usual method of cluster-avoidance is coalescence to form a geminate: e.g. /khunam+j2+jati/ \→ \[kh\^nj2-at\] ‘dig’. However, if gemination would create an illicit output sequence, there is simply coalescence: e.g. /sa\^1+i2-vog\^2/ \→ \[si\^1\^1-vo\^2\] ‘go’, \*[si\^1\^2-va]. The cases discussed below clearly involve coalescence. For example, /nj/ coalesces to form [x], an output that preserves the nasality of the /n/ and PoA of the /j/. Similarly, /h\^1-h\^2/ coalesces to form [\^h\^2], a form that preserves the voicing and aspiration of the /h/ and the PoA of the /h/.

This section focuses solely on the PoA of the output of coalescence. For discussion of other features, see §8.5.

Coalescence takes place between a stem-final consonant and a following suffix’s consonant, or between adjacent suffix consonants. For example, the root-final /bh/ coalesces with the alveo-palatal /p/ and alveolar /s/ to form an aspirated geminate palatal [c^2s] in /labh\^1-t\^2-s/ \→ \[lac\^2m\]. There are restrictions on possible consonants in Pathi suffixes: in effect, only coronals [t c s \^j n] are found in a position where coalescence takes place. After T. Hall (1997) and a number of others, I adopt the view that [c] and [j] are coronals.

- **Generalizations**

  Generalizations about the PoA of the output of coalescence are identified in (59).

(59) **The PoA of Pathi coalescence**

(a) if the inputs are dorsal and coronal, the output is dorsal (see (60)).
(b) if the inputs are labial and coronal, the output is coronal (see (61)).
(c) if the inputs are (alveo-)palatal and alveolar, the output is alveolar (see (62)).

In other words, there is a precedence scale of [dorsal \→ alveolar \→ (alveo-)palatal] for PoA, with the highest element on the scale surviving in any competition.

The PoA preferences in coalescence do not refer to ‘direction’ or morphological affiliation. The PoA of the rightmost (or leftmost) input consonant does not win in all situations: compare /la\^1-t\^2-s/ \→ \[lag\^2\] with /la\^1\^2-t\^2-s/ \→ \[lad\^2\]. Nor is it the case that the PoA of the root consonant wins in all situations (as shown by the same two examples).

Further generalizations about the persistence of aspiration and retroflexion are made in §8.5.
The formal expression of markedness – ch.8

8.4.2 Analysis

The following analysis starts by identifying the basic ranking needed for coalescence in Pili. Section 8.4.2.2 shows how the marked element can be preserved, while sections 8.4.2.3–8.4.2.4 show how unmarked values can be preserved in the same grammar.

8.4.2.1 Motivating coalescence

Two conditions motivate gemination in Pili. One bans heterorganic clusters. The other condition is that singleton codas can only contain nasals, so allowing homorganic NC clusters; geminates escape this prohibition (after Ito 1986). For discussion of how to effect these prohibitions, see ch.7. For present purposes, the effect of these conditions will be referred to as the constraint CODACOND.

In the standard way, CODACOND, MAX, and DEP, must outrank UNIFORMITY to produce coalescence.

In addition, as explained in previous sections, all IDENT constraints that preserve features that are unavoidable eliminated in coalescence must be ranked below CODACOND, MAX, and DEP as well. These IDENT constraints preserve [voice], [sonority], and all PoAs except for dorsal (which always survives). For example, IDENT[voice], IDENT[KP], and IDENT[KPT] must be ranked at the same level as UNIFORMITY above, otherwise the output [lad'ja], which is unfaithful to h't's [‑voice] and h't/h't's labial specification, would be eliminated by the IDENT constraints just mentioned. Since PoA is the focus of this section, rankings involving these IDENT constraints will only be discussed when directly relevant.
8.4.2.2 Preserving the marked

In terms of coalescence of a dorsal and coronal, Pāli is a ‘marked coalescence’ system: the marked value dorsal survives. This fact can be explained by the method used for Attic Greek: some faithfulness constraint that preserves dorsals but not coronals (IDENT[K], IDENT[KP]) must outrank all markedness constraints that favour coronals over dorsals (*[K], *[KP]). The faithfulness constraint IDENT[K] is chosen here, for reasons that will become apparent in the next subsection.

\[ \begin{array}{c|c|c|c} \text{Pāli II: marked preservation} \\
/\text{sak}_1^2-\text{t}_1^3-\text{a}^2/ & \text{IDENT}[\text{K}] & *_{\text{[K]}} & *_{\text{[KP]}} \\
\hline
\text{a} & \text{sak}_1^2-\text{t}_1^3-\text{a}^2 & *_{\text{[K]}} & *_{\text{[KP]}} \\
\text{b} & \text{sak}_1^2-\text{t}_1^3-\text{a}^2 & *_{\text{[K]}} & *_{\text{[KP]}} \\
\end{array} \]

Candidate (a) wins because – unlike (b) – it preserves the marked feature [dorsal]. As a side-note, coalescence with underlying stridents [s s] produces an aspirated output. For an account of this fact, see §8.5.

8.4.2.3 Preserving the unmarked I: Coronal

In contrast with dorsal+coronal coalescence, the unmarked value emerges in coalescence of a labial and coronal: e.g. /lab^2-ta/ → [lad^2a] ‘take [participle]’. Analogous to Swedish and Chipewyan, no faithfulness constraint favours preservation of coronals over labials – quite the opposite in fact. Therefore, markedness constraints must be responsible for favouring the output [lad^2a] over *[lab^2a]. Specifically, the constraint *{KP} favours the former over the latter.

\[ *_{\text{[KP]}} \text{ must outrank all faithfulness constraints that preserve labials without preserving coronals – i.e. IDENT(KP). This ranking is shown in tableau (65).} \]

\[ \begin{array}{c|c|c|c} \text{Pāli III: unmarked survival, part 1} \\
/\text{lab}_1^3-\text{t}_1^3-\text{a}^2/ & *_{\text{[KP]}} & \text{IDENT}[\text{KP}] \\
\hline
\text{a} & \text{lab}_1^3-\text{t}_1^3-\text{a}^2 & *_{\text{[KP]}} & \text{IDENT}[\text{KP}] \\
\text{b} & \text{lab}_1^3-\text{t}_1^3-\text{a}^2 & *_{\text{[KP]}} & \text{IDENT}[\text{KP}] \\
\end{array} \]

However, some constraint must prevent labials from neutralizing in all positions. More concretely, some faithfulness constraint must prevent /t/ from neutralizing to [d] in [lad^2a] ‘tie [participle]’ (i.e. *[lad^2a]). Moreover, the faithfulness constraint cannot favour preservation of labials over coronals, otherwise the result in (65) would be undone. The only faithfulness constraint that can do this job, then is that one that preserves labials and coronals equally – i.e. IDENT[KPT]. This is illustrated with /lab^3-ta2–i–lad^2-a2/.

\[ \begin{array}{c|c|c|c} \text{Candidate (c) is eliminated by IDENT[KPT] because it eliminates labials altogether, even when coalescence is not at issue: the candidate incurs one violation of this constraint for [d^2]'s unfaithfulness to /bh/’s labial specification and one for [d^2]'s unfaithfulness to [b^2]’s labial specification. It is crucial that candidates (a) and (b) are assigned the same violations of IDENT[KPT].} \]

\begin{itemize}
\item \textbf{Fixed Ranking theories}
\item \text{Figure 8.5 summarizes the rankings of PoA constraints determined so far. Figure 8.5: Major Place of Articulation in Pāli coalescence: Rating.}
\item \text{The ranking shows how both marked and unmarked features can survive in the same grammar. By ranking IDENT[K] over all markedness constraints, dorsals are ensured survival. By ranking *{KP} over all constraints that preserve labials without preserving coronals, coronals are assured survival when dorsals are not available. This system shows why faithfulness theories with a universally fixed ranking – even those with stringent constraints – are inadequate. A theory with a fixed ranking such as \text{IDENT[K] = IDENT[P] = IDENT[T]} \text{ implies that the most marked feature will always survive in coalescence. However, this is only partially true for Pāli. In coalescence of labials with coronals, the theory will incorrectly favour labials by the action of IDENT[P].} \end{itemize}
Markedness constraints that favour coronals over labials cannot be invoked: if +{P} or +{KP} outranked IDENT{P}, the result would be neutralization of labials in every position. A theory with the opposite fixed ranking || IDENT{K} = IDENT{KP} = IDENT{KPT} || faces the reverse problem: it predicts that the unmarked feature will always survive. Because preservation of dorsals is less faithful than preservation of coronals, no markedness constraint favours dorsals over coronals, the competition between dorsals and coronals can only produce labials.

It is not just Fixed Ranking theories with non-stringent constraints that fail to account for Pitk. Theories with stringent constraints in a fixed ranking do equally badly. For example, a theory with the fixed ranking || IDENT{K} = IDENT{KP} = IDENT{KPT} || – it cannot deal with the output of labial+coronal coalescence. Because coronals survive in this case, some markedness constraint that bans labials must outrank IDENT{KP}, as established above. However, no higher-ranked faithfulness constraint preserves neutralization, resulting in labial neutralization in every position.

The opposite problem arises for a fixed ranking || IDENT{KPT} = IDENT{KP} = IDENT{K} ||. Because dorsals survive in competition with coronals, some faithfulness constraint that preserves dorsals and not coronals – IDENT{K}, IDENT{KP} – must outrank +{K} and +{KP}. This results in a problem for labial+coronal coalescence because the labial-eliminating constraint – +{KP} – is already ranked below all faithfulness constraints that preserve labials, so predicting that labials will win.

As a final note, the Pitk system does not rule out a theory with freely rankable non-stringent constraints. In such a system, the ranking || IDENT{K} = IDENT{T} = IDENT{P} || would produce the right results. See ch.5§5.3 for arguments against such a theory.

- A comment on direction

One might point out that the examples of labial+coronal coalescence all involve the order labial+coronal, never (coronal)+labial. Sequences of (coronal)+labial/ never occur in Pitk because there are no labial-initial affixes.249

Therefore, one alternative is that this coalescence simply involves survival of the onset’s PoA feature, rather than survival of the least marked feature.

Evidence against this proposal is found in a small class of roots that coalesce to form a singleton, not a geminate. For example, /hat-ta/ coalesces to form /hat-a/ ‘take’ (170), not /hat-ta/. Notably, /jam-ta/ ‘hold back’ forms /jat-a/, not */jap-ta* (also /dov-ta/ ‘clean’ → /dota/, */dopa*). Appealing to preservation of the onset’s PoA does not resolve the tie between /jat-a/, and */jap-ta* – both are equally unfaithful since /jat-a/ fails to preserve the PoA of the input /t/. Thus, one would have to appeal to a markedness constraint to resolve the tie in favour of the coronal in any case.

Finally, in coalescence of (dorsal)+coronal, the leftmost PoA wins, not the rightmost. Thus, although direct evidence that (coronal)+labial/ clusters would coalesce to form a (coronal) is lacking for incidental reasons, viable alternatives to the claim that labial+coronal coalescence aims to yield the least marked value are not at all obvious.

8.4.2.4 Preserving the unmarked II: Alveolars

The final PoA-related issue is competition between alveo-palatals and coronals. The proposal that [c] and [g] are non-strident alveo-palatals is adopted here (Clements 1976, 1999, Halle & Stevens 1979, Hume 1982, T Hall 1997). After Clements (1999), [c] and [g] are [−anterior, +distributed, −strident], compared with [t] which are [−anterior, +distributed, +strident]. In short, the issue discussed in this section is the preservation of [anterior] values.

Coalescence of a [−anterior] segment with a [−anterior] one results in a [−anterior]: e.g. /vac-ta/ → /vat-pa/, */vac-pa* → /sat-a/ → /sata/250

There is no doubt that of the two features, [−anterior] is the less marked. Every language in the ones listed in ch.6 that has a [−anterior] coronal also has a [−anterior] coronal, regardless of the manner of articulation. For example, there is no language with a [c] but no [t] or [g]).

Therefore, survival of [−anterior] must be implemented by the same ranking as survival of coronal PoA: || IDENT{anterior} = +{anterior} = IDENT{anterior} ||.

Tableau (67) shows how the candidate with [+anterior] [t2], to come be the output: it beats candidate (a) in markedness, by minimizing [−anterior] segments.

The ranking of || IDENT{anterior} = +{anterior} || is essential for the same reasons as identified for || IDENT{KPT} = +{KP} || above – it prevents contrast in (anterior) from being neutralized in all environments. It also prevents the output of labial+alveo-palatal coalescence from being an alveolar, as shown in tableau (68).

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249 Exceptions are the first person [m] for verbs, and the accusative [m]. However, the 2nd person [m] is always separated from the root by a vowel, so coalescence never takes place. Some C-final nouns with accusative [m] coalesce to form an m (e.g. sotas-m/ → /sotam/), but it seems that in such cases the overriding goal is to realize the accusative morpheme (i.e. *[sotas]).

250 The behaviour of true palatals in coalescence differs from alveo-palatals. For example, /kha-ti/ ‘dig {pass-3p.sg.}’, /kha-nti/ ‘dig, pass-3p.sg’. /khan-ti/ ‘dig, pass-3p.sg’. /j/ is palatal, as opposed to the alveo-palatals [c] and [g]. The output of /j/ is the alveo-palatal [g] because this is the sound that is most like a true palatal.
8.4 Summary

In summary, Fili presents a hybrid system: where a marked scale value survives in one particular case of coalescence, but the least marked value survives otherwise. The analysis showed that the Fili facts can be produced by amalgamating the schemas for marked and unmarked coalescence identified in the analysis of Attic Greek, Swedish, and Chipewyan.

- Other hybrid systems

The present theory predicts a number of other hybrid systems for PoA. A number of these predictions are borne out in recent work on coalescence in child language. For example, Gnanadesikan’s (1995) analysis of her child Gitanjali’s speech shows a hybrid system in terms of PoA preservation. Relevant data is presented in (69). The data in the left column is the adult form, the rightmost column is Gitanjali’s form.

---

(68) Paul de Lacy

<table>
<thead>
<tr>
<th></th>
<th>(\text{Labial} + \text{Coronal})</th>
<th>(\text{Labial})</th>
<th>(\text{Coronal})</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>(\text{Labial} + \text{Coronal})</td>
<td>(\text{Labial})</td>
<td>(\text{Coronal})</td>
</tr>
<tr>
<td>(b)</td>
<td>(\text{Labial} + \text{Coronal})</td>
<td>(\text{Labial})</td>
<td>(\text{Coronal})</td>
</tr>
</tbody>
</table>

It is worth pointing out that this ranking contrasts with the one needed for Chipewyan. In §8.3.2.4, it was noted that \([\text{-anterior}]\) survived in coalescence with a \([\text{POA}]\): i.e. \(\text{Labial} + \text{Coronal}\) to \([\text{Labial} + \text{POA}]\) ‘he went home’ (Li 1946: 419). The same is true of coalescence in Catalan (§8.2.4): /ba\(\text{r}\)/ \(\to\) /ba\(\text{ru}\)/ ‘low zero’. In these cases, the ranking \([\text{POA}] > [\text{POA}']\) holds.

- Apparent exceptions

This section concludes by noting that there are some exceptions to the claim that coalescence of alveolars and alveo-palatals yield alveo-palatales.

However, one class of these cases involves combinations of a nasal plus a palatal: e.g. /han\(\text{c}\)/ \(\to\) /ha\(\text{ca}\)/ ‘kill [absolutive],’ /k\(\text{c}\)an\(\text{a}\)-\(\text{t}\)/ \(\to\) /k\(\text{ga}\)\(\text{pat}\)/ ‘he was killed’. In some situations, the nasal assimilates to the following alveo-palatal, rather than geminates: /han\(\text{g}\)\(\text{a}\)-\(\text{t}\)/ \(\to\) /ha\(\text{pat}\)/ ‘kill [future-3p.sg.]’. The behaviour of \(\text{t}\)/ may relate to the fact that nasals assimilate far more freely than other segments; this may be formally implemented by having nasal PoA features subject to less preservation than obstruents’, accounting for the fact that the obstruct’s PoA wins in coalescence.

The other class of exceptions relates to combinations of /\(\text{d}\)/ and an alveo-palatal, which typically results in an alveo-palatal: e.g. /\(\text{b}\)\(\text{n}\)\(\text{d}\)-\(\text{t}\)/ \(\to\) /\(\text{b}\)\(\text{pat}\)/ ‘track [future-3p.sg.]’, /\(\text{c}\)\(\text{u}\)-\(\text{a}\)-\(\text{t}\)/ \(\to\) /\(\text{c}\)\(\text{u}\)\(\text{pat}\)/ ‘push’. However, /\(\text{d}\)/ is generally the least robust of all consonants in Fili, not only for PoA preservation, but for seniority preservation as well. The exceptional behaviour of /\(\text{d}\)/ is discussed further in §8.5.

---

(69) Gitanjali’s coalescence

(a) /Labial + Coronal\(\to\) /Labial\[

\(\text{Labial}\) | \(\text{Coronal}\) |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>/(\text{sn})(\text{m})/</td>
<td>/(\text{f})/</td>
</tr>
<tr>
<td>/(\text{s})(\text{w})(\text{t})/</td>
<td>/(\text{g})/</td>
</tr>
<tr>
<td>/(\text{t})(\text{w})/</td>
<td>/(\text{t})/</td>
</tr>
<tr>
<td>/(\text{\textit{t}})/</td>
<td>/(\text{\textit{p}})/</td>
</tr>
</tbody>
</table>

(b) /Dorsal + Coronal\(\to\) /Dorsal\[

\(\text{Dorsal}\) | \(\text{Coronal}\) |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>/(\text{g})(\text{a})/</td>
<td>/(\text{d})/</td>
</tr>
<tr>
<td>/(\text{s})(\text{k})/</td>
<td>/(\text{s})/</td>
</tr>
<tr>
<td>/(\text{k})/</td>
<td>/(\text{\textit{p}})/</td>
</tr>
</tbody>
</table>

(c) /Dorsal + Labial\(\to\) /Labial\[

\(\text{Dorsal}\) | \(\text{Labial}\) |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>/(\text{kwaj})/</td>
<td>/(\text{p})/</td>
</tr>
<tr>
<td>/(\text{skwiz})/</td>
<td>/(\text{b})/</td>
</tr>
</tbody>
</table>

This is coalescence rather than deletion, as shown by forms like /\(\text{\textit{f}}\)\(\text{w}\)/ smell: the /\(\text{f}\)/ retains the continuant of /\(\text{\textit{f}}\)/ and PoA of the /\(\text{w}\)/.

The data may seem to show a case of marked-coalescence: in competition with coronals, the marked PoA (dorsal, labial) wins, in contrast to Fili. However, as argued in ch.7, dorsals are more marked than labials. Therefore, the fact that labial-dorsal coalescence yields a labial is a case where the least marked element survives: e.g. /\(\text{k}\)\(\text{waj}\)/ \(\to\) /\(\text{p}\)/. A similar pattern is reported by Pater & Barlow (2002).

This hybrid system can be analysed in the same way as Fili. Preservation of the marked values dorsal and labial in coalescence with coronals is implemented by ranking \([\text{IDEN}+\text{KP}]\) over both \([\text{K}]\) and \([\text{KP}]\). Preservation of the less marked labial in combination with the more marked dorsal is implemented by the ranking \([\text{IDEN}+\text{KP}]\) over \([\text{K}]\) and \([\text{KP}]\). Both incur equal violations of \([\text{IDEN}+\text{KP}]\), so allowing \([\text{K}]\) to decisively favour /\(\text{p}\)/ over /\(\text{k}\)/.

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(70) Gitanjali I

<table>
<thead>
<tr>
<th></th>
<th>/(\text{\textit{t}})/</th>
<th>/(\text{\textit{p}})/</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>k(\text{\textit{a}})/</td>
<td>/(\text{\textit{a}})/</td>
</tr>
<tr>
<td>(b)</td>
<td>p(\text{\textit{a}})/</td>
<td>/(\text{\textit{a}})/</td>
</tr>
</tbody>
</table>

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21 One might point out that this could be a marked coalescence system if it were assumed that labials are more marked than dorsals. However, there are several reasons to think this is not the case in child language (and adult language – see ch.6, ch.7). For example, dorsals can trigger consonant harmony in child language without labials also doing so, but the opposite situation – with labial triggers and not dorsal triggers – has not been reported. Similarly, some children delete dorsals without deleting labials, but there is no reported system in which labials are deleted without dorsals also being eliminated. For relevant work, see Pater (1997), Pater & Werle (2001), Pater & Barlow (2002, to appear).
transitive nature of ranking and the form of the constraints in the present theory, only transitively consistent systems can be produced.

8.5 Hybrid systems II; Sonority in Pāli

This section completes the analysis of Pāli coalescence started in §8.4. Like PoA in Pāli, sonority preservation is a hybrid system; in the majority of coalescences, the least marked sonority value survives, but in a few competitions, the most marked wins. This system is of interest primarily for its complexity, as for Chippewa. Pāli sonority preservation provides a good testing ground for the adequacy of the stringency theory.

Pāli gemination has been the subject of many descriptions and analyses (Geiger 1943, Hankamer & Aissen 1974, Murray 1982, Weitzels & Hermans 1985, Cho 1999). As discussed in §8.4, syllable structure requirements eliminate many types of input clusters. Usually the method of elimination is gemination, as in /daːtəpələ → [dəpələ] ‘see+ (gerund)’. The focus of the previous section was preservation of Place of Articulation. The concern of this section is sonority.

Hankamer & Aissen (1974) propose that the coalesced segment’s sonority is the same as that of the lowest sonority input segment. For example, since stops are less sonorous than fricatives, the result of /kʰtʰ/ coalescence is the stop [kʰ] rather than a fricative [ʂ].

The description presented below both extends and (largely) validates Hankamer & Aissen’s proposal. However, exceptions to the sonority generalization are identified. Most notably, coalescence of a voiced stop and a voiceless stop yield the more sonorous voiced stop: e.g. /labʰ/ → [bʰ] ‘hab’. This fact makes Pāli’s system a ‘hybrid’ coalescence one, rather than one in which the unmarked value always survives.

For a discussion of the basic phonology of Pāli, see §§8.4.1.

Section 8.5.1 describes the sonority of coalesced outputs.

Section 8.5.2 provides an analysis of sonority preservation.

Section 8.5.3 completes the analysis of Pāli by examining preservation of other features, including aspiration and retroflexion, and showing how they relate to preservation of sonority and PoA.

Section 8.5.4 discusses alternative approaches.

Section 8.5.5 presents a summary.

8.5.1 Description

Table 8.9 summarizes the outcome of coalescence in terms of sonority. The leftmost column lists the first member of the input cluster, and the top row the second member. Due to restrictions on affixes, the second member is always a coronal, so the actual segments that occur are listed rather than their feature classes.
Grayed-out cells are not attested in the data. Superscript * stands for aspiration.

### Table 8.5.2: Pāṭī consonant coalescence: The sonority of the output

<table>
<thead>
<tr>
<th>C1 + C2</th>
<th>[t, c]</th>
<th>[s]</th>
<th>[n]</th>
<th>[j]</th>
</tr>
</thead>
<tbody>
<tr>
<td>-vd stop</td>
<td>-vd stop</td>
<td>-vd stop</td>
<td>-vd stop</td>
<td>-vd stop</td>
</tr>
<tr>
<td>-vd stop</td>
<td>-vd stop</td>
<td>-vd stop</td>
<td>-vd stop</td>
<td>-vd stop</td>
</tr>
<tr>
<td>-fricatives</td>
<td>-vd stop</td>
<td>fricative</td>
<td>s+nasal</td>
<td>fricative</td>
</tr>
<tr>
<td>nasal</td>
<td>-vd stop</td>
<td>nasal</td>
<td>nasal</td>
<td>nasal</td>
</tr>
<tr>
<td>nasal</td>
<td>-vd stop</td>
<td>nasal</td>
<td>nasal</td>
<td>nasal</td>
</tr>
<tr>
<td>fricative</td>
<td>-vd stop</td>
<td>nasal</td>
<td>nasal</td>
<td>nasal</td>
</tr>
<tr>
<td>glide</td>
<td>-vd stop</td>
<td>glide+h</td>
<td>glide+h</td>
<td>glide+h</td>
</tr>
</tbody>
</table>

The table shows that in almost all cases where the consonants coalesce, the output element has the same sonority as the least sonorous input element. The relevant parts of the consonant sonority scale are provided in (73), from ch.3 and ch.4.

(73) Consonant sonority scale

| glottal | glide | liquid | nasal | fricative | voice stop | voiceless stop |

The most important exception to the generalization above is the coalescence of voiced and voiceless stops. The outcome of this coalescence is the more sonorous voiced stop, contrary to the expected outcome: e.g. /hubə-tu/ → [hubən], *[lutən]. This difference shows that Pāṭī coalescence is a hybrid system in terms of coalescence.

The table indicates that not all consonant clusters are eliminated through coalescence. Input clusters consisting of an /h/ or liquid followed by a glide are eliminated through metathesis: e.g. /kar-ja-ti/ → [kijrat] ‘maked{passive+3p.sg.pres.}’. This outcome will be discussed in §8.5.3.

The other exception involves clusters that can surface faithfully without violating syllable restrictions. For example, clusters consisting of [s]+nasal are acceptable on the surface, so underlying clusters of this type do not coalesce: /las-mu/ → [asmi], *[asq] ‘I am’. The same is true for certain combinations of nasals and stops.

### Data

A great deal of data is needed to provide adequate support for table 8.9’s generalizations. So, for ease of exposition, the data has been placed at the end of this section, in §8.5.5. The following analysis will discuss relevant data when appropriate.

#### 8.5.2 Analysis

There have been several formal analyses of Pāṭī coalescence (Hankamer & Aissen 1974, Murray 1982, Wetzels & Hermans 1985, Cho 1999). The analysis presented above has followed Hankamer & Aissen in invoking the sonority scale as the guiding factor behind the preservation of the output. One difference between previous analysis and the present one will be that the account of gemination here will not rely on opacity. However, the primary aim of the following analysis is to provide an account for why the least marked sonority level survives in coalescence in the majority of cases, but why one particular fusion – involving voiced stops and voiceless stops – results in the most marked sonority value surviving.

The motivation for coalescence in Pāṭī has already been discussed in detail in §8.4.2.1. The relevant tableau is repeated here. The constraint CODACOND stands for the set of constraints that bans all but homorganic nasals and the first half of geminates in codas. The tableau shows the coalescence /vas-tum/ → [vatəm] ‘to live’. Note that coalescence of stops and fricatives produces an aspirated stop.

(74) Pāṭī stop-fricative coalescence

<table>
<thead>
<tr>
<th>[vas-tum]</th>
<th>CODACOND</th>
<th>MAX</th>
<th>DEP</th>
<th>UNIFORMITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) vas-tum</td>
<td>*1</td>
<td>*1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) vas-tum</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) vas-tum</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(d) vas-tum</td>
<td></td>
<td></td>
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</tbody>
</table>

Section 8.5.2.1 discusses why the lowest sonority value is preserved in coalescence: i.e. why /vas-tum/ produces [vatəm] rather than *[vatəm].

Section 8.5.2.2 deals with coalescence involving voiced stops.

Section 8.5.2.3 discusses the survival of other features.

#### 8.5.2.1 The unmarked survivor: Stops

As established in ch.3 (also see ch.8, Prince & Smolensky 1993), low sonority is less marked than high sonority in margins. Therefore, Pāṭī presents a case where the less marked value emerges in coalescence (cf Harar Oromo – section 8.2.4). To account for the emergence of the least marked element, the ‘unmarked coalescence’ schema will be employed: [[IDENT(|f, m|) → *1 → IDENT(|m|)].

To take one pair of segments, /stop+fricative/ and /fricative+stop/ clusters produce a coalesced output with the sonority of a stop: e.g. /dag-i-ba/ → [dagəba], /sak-i-ti/ → [sakəti] ‘be able to (aorist+3p.sg.)’.

It could be pointed out that high sonority is desirable in codas, and that preservation of low sonority may therefore be preservation of the marked value in codas. However, this will not account for cases where segments coalesce but do not form a geminate. See §8.5.2.4 for discussion.
In the present instance, \( mf \) is the sonority value ‘fricative’, and \( st \) is the sonority value ‘stop’. For stops to survive in coalescence, a markedness constraint that favours them over fricatives – i.e., \( *-\Delta_{st}[\text{fricative}] \) – must outrank all faithfulness constraints that preserve fricatives: i.e. \( IDENT2[\text{fricative}] \) here. As a reminder, the constraint \( *-\Delta_{st}[\text{fricative}] \) bans all segments that are equally or more sonorous than a fricative in syllable margins (i.e. the non-DTE of syllables).

<table>
<thead>
<tr>
<th>(75)</th>
<th>Pitt VIII: The least sonorous wins, part 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>( /dag_1_\text{a}b_2/ )</td>
<td>( *-\Delta_{st}[\text{fricative}] ) ( IDENT2[\text{fricative}] )</td>
</tr>
<tr>
<td>(a) ( da_1_\text{a}b_2a )</td>
<td>*</td>
</tr>
<tr>
<td>(b) ( da_1_\text{a}b_2\text{a} )</td>
<td>* *</td>
</tr>
</tbody>
</table>

Candidate (b) violates \( *-\Delta_{st}[\text{fricative}] \) because it has a fricative \( [s] \) in a syllable margin. Candidate (a) violates \( IDENT2[\text{fricative}] \) because it fails to retain the sonority value of the \( [s] \) in the coalesced output \( [t\text{h}] \).

- Faithfulness condition

The second ranking needed for unmarked coalescence involves a faithfulness constraint that preserves both stops and fricatives, so allowing coalesfication of the mappings. In the present competition, this constraint is \( IDENT2[\text{stop}] \). \( IDENT2[\text{stop}] \) must outrank \( *-\Delta_{st}[\text{fricative}] \) otherwise (at least) fricatives will be neutralized in margins. This ranking is illustrated in (76).

<table>
<thead>
<tr>
<th>(76)</th>
<th>Pitt VIII: The least sonorous wins, part 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>( /\text{a}k_1_\text{a}b_2/ )</td>
<td>( IDENT2[\text{stop}] ) ( *-\Delta_{st}[\text{fricative}] ) ( IDENT2[\text{fricative}] )</td>
</tr>
<tr>
<td>(a) ( sa_1_\text{a}b_2a )</td>
<td>*</td>
</tr>
<tr>
<td>(b) ( sa_1_\text{a}b_2\text{a} )</td>
<td>* *</td>
</tr>
<tr>
<td>(c) ( \text{cak}_1_\text{a}b_2 )</td>
<td>* * *</td>
</tr>
</tbody>
</table>

The need for the ranking \( *-\Delta_{st}[\text{fricative}] \) \( IDENT2[\text{fricative}] \) is shown by the competition between (b) and (c). Candidate (b) fatally violates the markedness constraint \( *-\Delta_{st}[\text{fricative}] \); since all faithfulness constraints that would save the fricative are ranked lower than the markedness constraint, they are inactive in this competition. So, (c) wins because it fares better on markedness.

The competition between (c) and (d) shows why \( IDENT2[\text{stop}] \) must outrank \( *-\Delta_{st}[\text{fricative}] \). Without this constraint, there would be wholesale neutralization to stops: \( /s/ \) would emerge as the stop \( [t\text{h}] \) in all environments, not just in coalescence. So, candidate (d) fails because the initial /s/ gratuitously neutralizes to \( [t\text{h}] \), so incurring an extra violation of \( IDENT2[\text{stop}] \).

As discussed for Attic Greek and Chipewyan, CODACOND, MAX, and DEF must all outrank \( IDENT2[\text{stop}] \) otherwise coalescence would be blocked.

As a final comment on this competition, the fact that /\text{fricative}+\text{stop}/ and /\text{stop}+\text{fricative}/ clusters yield the same result – a stop – shows that all faithfulness constraints that impose a directional bias on the outcome are ranked below \( *-\Delta_{st}[\text{fricative}] \). The following tableau illustrates this point with the constraint \( IDENT2[\text{fricative}] \) – this constraint preserves input fricatives (and more sonorous elements) if they are affiliated to a root.

The ranking identified above only accounts for one of the results of coalescence. The next section deals with the other types of coalescence in Pitt.

8.5.2.2 The other unmarked survivors

The ranking identified above deals with the outcome of the coalescence stops and fricatives. Because almost all other coalescences are resolved in the same way – through preservation of the least sonorous element – they are all amenable to the same explanation.

The ranking identified for stops and fricatives is \( IDENT2[\text{stop}] \) \( IDENT2[\text{fricative}] \). This ranking can be generalized to every pair of sonority levels. The result is the ranking in Figure 8.7.

The formal expression of markedness – ch.8

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Figure 8.7: Pitt Ranking 1: IDENT constraints

CODACOND MAX DEP

\( IDENT2[\text{stop}] \)

\( IDENT2[\text{fricative}] \) \( IDENT2[\text{nasal}] \) \( IDENT2[\text{liquid}] \) \( IDENT2[\text{glide}] \)

\( IDENT2[\text{stop}] \) must outrank \( *-\Delta_{st}[\text{stop}] \) otherwise all segments would be neutralized to stops.

The need for the rankings above relates to the schema for unmarked coalescence: \( IDENT[\text{mf, af}] \) > \( IDENT[\text{mf}] \). The novelty with Pitt is that it refers to a multi-valued scale rather than a binary scale. However, the schema can be equally applied to multi-valued scales.

Starting with the competition between stops and other consonants, the output form in Pitt always has the sonority of a stop. In terms of the schema, then, af refers to the ‘stop’ category, and mf refers to a more sonorous category: i.e. one of {fricative, nasal, liquid, glide}. Therefore, the schema dictates that: (1) some faithfulness constraint that preserves all sonorities be topmost (i.e. \( IDENT2[\text{stop}] \)), (2) for every non-stop category c, there is a markedness constraint M that favours stops over c and (3) M outranks all faithfulness constraints that favour preservation of c without preserving stops.

For the competition between stops and fricatives, then, \( *-\Delta_{st}[\text{fricative}] \) must outrank \( IDENT2[\text{fricative}] \). The only markedness constraint that favours stops over
The ranking in (77) will not contradict any of the other rankings established so far. Analogously, for the competition fricatives and nasals, *-Δ Oc2nasal must outrank IDENT2nasal. Again, *-Δ Oc2nasal is the only markedness constraint that favours fricatives over nasals, and IDENT2nasal is the only relevant faithfulness constraint that preserves nasals without preserving fricatives.

For nasals and liquid, the ranking is || *-Δ Oc2liquid = IDENT2liquid ||, and for liquids vs glides || *-Δ Oc2glide = IDENT2glide ||.

No other rankings are necessary. As an example, since the competition between stops and liquids yields stops, some markedness constraint against liquids must outrank all faithfulness constraints that preserve them to the exclusion of stops; conversely, there can be no faithfulness constraint F that favours liquids over stops such that F outranks all markedness constraints that favour stops over liquids. With the rankings so far established, there is no such ranking. F can be any of IDENT2fricative, IDENT2nasal, and IDENT2liquid, but in each case, the faithfulness constraint is outranked by a markedness constraint that favours stops over liquids: i.e. *-Δ Oc2fricative, *-Δ Oc2nasal, *-Δ Oc2liquid. Therefore, the liquid will never emerge from a /stop+liquid/ input cluster.

However, one pair does not fit into the general ranking above: coalescence of voiced and voiceless stops yields the more sonorous voiced stops, contrary to the other outcomes.

8.5.2.3 Voiced stops

Most /voiceless stop+voiceless stop/ input clusters coalesce to form voiced stops: e.g. /rad2-ta/ → [rad2a] ‘be successful’/hūb-ta/ → [hu2a]. This outcome is the reverse of all other coalescences in sonority terms: the more sonorous element wins.

The marked coalescence ranking identified for Attic Greek must be employed to deal with the competition between voiced and voiceless stops. This ranking requires some faithfulness constraint that preserves voiced stops but not voiceless ones (IDENT2{+vd stop}) to outrank all markedness constraints that favour voiceless stops over voiced ones (*-Δ Oc2{+vd stop}). Tableau (77) shows how this ranking produces the right result.

(77) Pāli VIII: the marked wins

\[
\begin{array}{c|c|c}
\text{Input} & \text{Ident} & \text{ranking} \\
\hline
\text{hūb-ta} & \text{IDENT2{+vd stop}} & *-Δ Oc2{+vd stop} \\
(a) \text{lutu1-}\text{h} & \text{IDENT2{+vd stop}} & *-Δ Oc2{+vd stop} \\
#(b) \text{hūb1-}\text{h} & \text{IDENT2{+vd stop}} & *-Δ Oc2{+vd stop} \\
\end{array}
\]

Candidate (b) beats (a) because (a) fails to preserve the sonority value ‘voiced stop’ of the input hūb-ta.

- Relation to other rankings
The ranking in (77) will not contradict any of the other rankings established so far.

The most relevant ranking relates to the competition between voiceless stops and fricatives: /sak1-{fric}/ → [sak2]. This coalescence shows that *-Δ Oc2fricative outranks all constraints that preserve fricatives without also preserving stops. The only two constraints that do this are IDENT2{fricative} and IDENT2{voiced stop}. This in no way contradicts the ranking in (77): since *-Δ Oc2{fricative} does not favour *[lutu1-2a] over *[lutu1-3a], it can outrank IDENT2{+vd stop}. This ranking is shown in tableau (78).

(78) Pāli IX: integrated rankings

<table>
<thead>
<tr>
<th>Input</th>
<th>*-Δ Oc2{fric}</th>
<th>IDENT2{fric}</th>
<th>IDENT2{+vd stop}</th>
</tr>
</thead>
<tbody>
<tr>
<td>/sak1-\text{h}</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*(a) sak2-\text{\text{h}}</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*(b) sak2-\text{\text{\text{h}}}</td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Ranking summary
The rankings identified in (77) and (78) can be straightforwardly amalgamated into the constraint hierarchy, as shown in Figure 8.8.

Figure 8.8: Pāli Ranking II

The summary shows that the majority of coalescences in Pāli are of the ‘unmarked’ sort. By having markedness constraints dominate their correspondent faithfulness constraints, the output will always chose the candidate with the least marked (i.e. lowest) sonority value. The difference is with voiced stops, for which the ranking is reversed. As shown in bold, the faithfulness constraint for voiced stops and greater outranks the corresponding markedness constraint. This ensures that the marked value will survive in just this competition.

- A note on exceptions
The generalization above holds of all voiced stops except for the plain coronal /d/; e.g. /cʰd-tum/ → [cʰtum] ‘crack’. This contrasts with the behaviour of aspirated /d'/: e.g. /bʰd-tum/ → [bʰtum], *[bʰtum], /bʰd-ta/ → [bʰd'a]. Coalescence of /d+n/ unexpectedly yields the more sonorous output [n2]: e.g. /nud-n/ → [n2a] ‘knock’.

253 There is also one example involving /f/: /hūb-n/ → [hūb2] ‘drink’. A lack of further examples makes it impossible to determine whether this is a pattern.
8.5.2.4 The survival of other features

The aim of this section is to provide an account of the other features that persist in Pāli coalescence—aspiration and retroflexion, and to explain why metathesis takes place in limited environments rather than coalescence.

• Aspiration

If one of the input segments is an aspirated stop, /h/, /g/, /j/ or /d/, the output is also aspirated. This point is illustrated in (79).

(79) Aspiration Preservation in Pāli

(a) stop+C

/ labh3-tum/ → / [ladg2um] 'take+infin.' (191)
/rad3-ta/ → / [radz2a] 'resut+participle' (170)

(b) +C

/vas-ta/ → / [vut2a] 'live+participle' (170)
/sst-ta/ → / [szt2a] 'leave+participle' (17)
/ltg-ta/ → / [ltj2a] 'wish+participle' (170)

(c) C→

/sak-f-ta/ → / [szk2a] 'be able+aorist+3p.sg.' (158)
/labh3-f-tum/ → / [zac2tm] 'take+aorist+1p.sg.' (158)
/kad3-f-ta-ti/ → / [zez2atz] 'crack+futur+3p.sg.' (148)

(d) +C

/duh-ta/ → / [dudz2a] 'milk+participle' (170)
/snhd-ta/ → / [sinid2a] 'love+participle' (170)

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The same analysis for aspiration preservation as used in Chipewyan is given here (§8.3.2.4); a faithfulness constraint that preserves [+spread glottis] outranks all markedness constraints that favour plain stops over aspirates. The proposal that voiceless fricatives are specified as [+spread glottis] is adopted here (Kingston 1990, Vaux 1998), so accounting for the fact that their coalescence yields an aspirated stop.

(80) Pāli: Aspiration Preservation

<table>
<thead>
<tr>
<th>/nas-ta/</th>
<th>IDENT[+spread glottis]</th>
<th>[+spread glottis]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) vat2-ta</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) vat2-ta</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

It is impossible to tell whether sonority-preservation or aspiration-preservation is more important in Pāli. Data that would determine this issue would involve an input cluster consisting of an aspirate and a consonant that is (i) less sonorous and (ii) unable to bear aspiration. However, for purely incidental reasons such clusters never arise. There is no consonant that is less sonorous than an aspirated stop, so all /stop+C/ clusters are irrelevant. The only consonants less sonorous than fricatives are stops, and all stops have an aspirated counterpart, so /h+v/C clusters are irrelevant.

The only remaining relevant cluster is /h+v/C, where C is a glide, liquid, or nasal. Since there are no aspirated counterparts of glides, liquids, or nasals, the result ought to show whether sonority or aspiration is more important. For example, if /h+v/ → [r], then preservation of sonority trumps aspiration; if aspiration-preservation is more significant, the result should be [h]. Unfortunately, there are very few such clusters. There are no /h+v/ clusters due to the lack of suffixes starting with /v/. Input /h+glide/ clusters usually surface as [glide+h]. There are one or two exceptions. For example, /kat-ha-m/ → [kahagim] ‘make+full+1p.sg.’ and /haq-hi-t/ → [haghit] ‘name+full+3p.sg.’. However, the /h/ here is a marginal alternant of /g/, so it may be that the /g/ has debuccalized to [h] opaquely. This leaves /h+nasal/ clusters. Unfortunately, I have been unable to find any systematic examples of such clusters – /h/-final verbs seem to be defective for the most part, and the crucial morphological contexts are missing.

• Retroflexion

Input clusters of a retroflex consonant plus a stop always produce a retroflex consonant on the surface. Representative examples are given in (81).

(81) Preservation of retroflexion

/dag-taab/ → / [dag2tab] ‘see [gerund]’
/cf /vag-taab/ → / [vat2tab] ‘live [gerund]’
/dag-taab/ → / [dag2tac] ‘see [absolutive]’
/kag-na/ → / [kagi] ‘scatter’
/ig-ta/ → / [it2a] ‘wish’

254 Other roots with this pattern are /zak3 ‘cover’, /pad3 ‘go’, and /sda3 ‘cook’.

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Since Pāli does not allow retroflex fricatives or liquids on the surface, /dąg/ and /k sæ/ are realized with non-retroflex consonants in other environments: e.g. /dąg-jā-ti/ → [dəjati] ‘see (causative)’, /dąg-sæ-am/ → [aːdæsam] {aorist 1.p.sg.}; /k sæ-am/ → [kəsam] {2p.sg.pres.indic.}

Since retroflexion is a marked feature, the ‘marked coalescence’ ranking must be used here: a retroflexion-preserving faithfulness constraint must outrank all markedness constraints against retroflex stops. The interesting difference in this ranking is that constraints against retroflex continuants (i.e. *+h, *+d) must outrank all retroflex-preserving faithfulness constraints, otherwise they would survive in the output. Tableau (82) shows the ranking for retroflex-preservation in coalescence; tableau (83) shows how retroflexion in continuants is otherwise neutralized. The relevant retroflex feature is taken to be [+back] here (after Chomsky & Halle 1968, E.Pulleyblank 1989).

(82) Pāli X VI. preservation of retroflexion

|  /dąg-jæ-tæ|  |  /k sæ-am|  |
|----------------|-----------------|-----------------|
| (a) dəjati | *+h | IDENT[+back] | *+d |
| (b) dəjati | * | IDENT[+back] | *+d |

Tableaux (82) and (83) also give some indication as to the relative ranking of the retroflex-preserving faithfulness constraint and the sonority faithfulness constraints. Underlying segments do not change their sonority in the output in order to preserve retroflexion. For example, /dąg-jā-ti/ does not surface as [dəqʰətə] even though doing so would preserve the input retroflex feature. So, it is clear that sonority preservation requirements outweigh retroflex-preservation. In terms of the constraints discussed, this means that IDENT[2:fricative] must outrank IDENT[retroflex].

(83) Pāli X VI. retroflexion again

|  /dąg-jæ-tæ|  |  /k sæ-am|  |
|----------------|-----------------|-----------------|
| (a) dəjati | *+h | IDENT[+back] | *+d |
| (b) dəjati | * | IDENT[+back] | *+d |

There is no way to determine the relative ranking of the PoA-faithfulness constraints and retroflex-faithfulness constraints. The crucial data would involve a /k+-retroflex/ input feature. Unfortunately, no suffixes begin with a retroflex consonant.

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* Metathesis and faithfulness

In all the cases where coalescence does not take place – i.e. the cluster surfaces faithfully – the cluster does not violate any syllable restriction. For example, since [+C] onsets are permitted, /s+-nasal/ clusters are realized faithfully: /as-mu/ → [asni] ‘+1.p.sg.’, *[aːp] (139). Codas permit geminates and nasals homorganic to a following stop, so underlying nasal+stop clusters surface faithfully: /kʰan-tum/ → [kʰan-tum] ‘dig+inf.1’, *[kʰatum] (191); *[pam-tv] → [pam-tv] ‘go+absolutive’ (183)

Another situation where adjacent consonants do not coalesce is with [b+glide] clusters; /h+glide/ clusters metathesize to form an acceptable output sequence: e.g. /dąh-jæ-ti/ → [dəḥæti] ‘burn+passive+3p.sg.’ (201). Metathesis is also used with /{liquid,glide}+/ clusters. Input /{glide,liquid}+/ clusters surface as a [j+glide] output sequence, with [j] often realized as lengthening of the preceding vowel: e.g. /bʰəqəjæ-tæ → [bʰəqʰətə]/[bʰəqæti] ‘carry+passive+3p.sg.’ (201). Metathesis is only allowed with glides and /h/, though. Other sequences do not allow metathesis: so /stop+nasal/ clusters are realized as stops, not *[nasal+stop] (e.g. /daqʰənæ → [laŋŋa] ‘hang up+participle’, *[laŋŋa] (167).

Restricting metathesis to high sonority elements is expected. In a number of languages, only high sonority elements undergo metathesis (Hume 1997, Carpenter 2001, Bleivins & Garrett 2001). After Carpenter (2001), there is more faithfulness to adjacency relations between low-sonority elements: LINEARITY[+nasal] specifically preserves linear precedence relations between elements that are less sonorous than liquids. This constraint is in a stringency relation with the more general LINEARITY (from McCarthy & Prince 1995, slightly adapted below).

(85) (a) LINEARITY[+nasal] If x or y are equally or less sonorous than a nasal, and x precedes y, then it is not the case that y precedes x.
(b) LINEARITY If x precedes y, then it is not the case that y precedes x.

Since all outcomes except metathesis are blocked – including deletion, epenthesis, and coalescence, the constraints MAX, DEP, and UNIFORMITY must outrank LINEARITY, as shown in tableau (86).

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To ensure that coalescence takes place in every other combination, though, LINEARITY > nasal must outrank UNIFORMITY.

8.5.4 Data
The data given below is based on my construal of Fula morphology and phonology, as determined from alternations presented by Fahs (1985), and from analysis by Geiger (1943). Accordingly, this section starts by laying out the reasons for the claims about the underlying forms made below.

- /d/, /j/, and /ŋ/
  Coalescence facts provide a good deal of evidence for segments that otherwise undergo absolute neutralization in output forms. For example, Fula only allows surface [s], not [ʃ] or [tʃ]. However, there is clear evidence that some forms that have [s] on the surface are underlingly /ʃ/ or /tʃ/. One near minimal pair is [sis] ‘leave’ and [sis] ‘wish’: the former must be underlyingly /sis/ and the latter /ʃis/ to explain why sis+ta is realized as [sɪʃa] with a plain stop [tʃ], while is+s+ta is realized as [tʃa] with a retroflex.

- /t/ and /k/
  The same is true for an underlying /t/ vs /k/ contrast neutralized to [ɾ]. Two relevant roots are har ‘name’ and d’ar ‘keep’: the former produces a retroflex in combination with /t/ [participle], while the latter does not: [haɾa] cf [d’ara]; therefore har is /haɾ/ while d’ar is /d’ɾa/.

- The ghost segment
  A more extreme case of underlying contrast is that roots differ as to whether they have a final underlying mora (or ‘ghost segment’). This difference emerges in combination with suffixes, as shown in the following pairs: /hɔp+ta/ → [hɔpʃa] ‘watch’ (170) cf [hɔp+ta+ʃ] → [hɔpʃatʃa] ‘he will take’; /s+i+ʃ+ta/ → [ʃis+i+ʃa] ‘split’. In both these cases, the output consonant is palatal despite the fact that – on the surface – the future and aorist otherwise show up as [ɾ]: e.g. /har+ʃ+ta/ → [hɑʃatʃa] ‘name’ [3p.sg.fut.1].

<table>
<thead>
<tr>
<th>7</th>
<th>7</th>
</tr>
</thead>
</table>
| 4 | 3 | 8.5.4 Data

<table>
<thead>
<tr>
<th>/b’ag+na/</th>
<th>CODACOND</th>
<th>LINEARITY</th>
<th>UNIFORMITY</th>
<th>LINEARITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) b’ap+a</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(b) b’ap+ja</td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(c) b’ag+aj</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

Candidate (b) violates LINEARITY > nasal because a segment with the same or less sonority than a nasal – i.e. /tu/ – metathesizes in the output. In contrast, /tʃ+/→[ʃj] does not violate LINEARITY > nasal – neither segment has the same or less sonority than a nasal, so the constraint does not apply.

Notably, the coalesced candidate (c) does not violate LINEARITY. LINEARITY is only violated when there is a reversal of precedence relations, so /x/y/→[x,y] does not violate the constraint. So, the correct output in tableau (9) wins.

As shown in previous studies, the further ranking [ LINEARITY > nasal = UNIFORMITY ] is needed to produce coalescence in /b’ag+na/→[b’ag+na]. This leaves us with the triggering ranking: [ CODACOND, MAX, DEP = LINEARITY > nasal = UNIFORMITY = LINEARITY ].

8.5.3 Summary
This section has presented a rather complex case of a hybrid coalescence system. For the most part, the unmarked value of sonority survives in Fula coalescence. However, in some cases – between voiced and voiceless stops – the marked value is preserved.

The Fula pattern is not unique. Child language provides a number of similar systems. For example, Pater (2001) provides a detailed analysis of a child’s (Julia) coalescence patterns. To summarize, a consonant cluster will be generally reduced to the least sonorous of the two: i.e. /stop+liquid/ → [stop], /fricative+stop/ → [stop], /fricative+liquid/ → [fricative], and so on. However, there is one difference: /s+nasal/ clusters are realized as nasals, not as [ʃ]. This contrasts with a similar pattern reported by Gnanadesikan (1995), where /t/ is realized as [ʃ] in Gitanjali’s speech.

Julia’s pattern is akin to Fula’s, although the majority of coalescence outputs preserve the least marked sonority value, there is a reversal in one case. The Fula ranking can therefore be straightforwardly adapted to account for Julia’s pattern: IDENT2nasal must outrank ∗-Δ≥2[nasal].

8.5.4 Data
The data given below is based on my construal of Fula morphology and phonology, as determined from alternations presented by Fahs (1985), and from analysis by Geiger (1943).
• The data

The underlying forms in the data below are based on the comments above. Evidence for the underlying final consonants in C-final forms come from V-initial suffixes. Output forms are from Fähn (1985). For ease of reference, the table of Pāṭi consonants is repeated from §8.4.1. Absolutely neutralized consonants are included as well – they are in lightly shaded cells. [v] is classed as a glide rather than a fricative – see ch.6 for discussion.

<table>
<thead>
<tr>
<th>Table 8.10: Pāṭi underlying consonants</th>
</tr>
</thead>
<tbody>
<tr>
<td>-vd</td>
</tr>
<tr>
<td>aspirated</td>
</tr>
<tr>
<td>stops</td>
</tr>
<tr>
<td>p</td>
</tr>
<tr>
<td>pʰ</td>
</tr>
<tr>
<td>h</td>
</tr>
<tr>
<td>fricatives</td>
</tr>
<tr>
<td>s</td>
</tr>
<tr>
<td>nasals</td>
</tr>
<tr>
<td>m</td>
</tr>
<tr>
<td>liquids</td>
</tr>
<tr>
<td>ɾ</td>
</tr>
<tr>
<td>glides</td>
</tr>
<tr>
<td>v</td>
</tr>
</tbody>
</table>

The formal expression of markedness – ch.8

(89) Glide+N

/s/ → [t] /dʰ/ → [dʰ]‘ov-ta/ → [dʰ]‘otu’ – [dʰ]‘otiva’ ‘clean (infin.)’

(90) Nasal+N

* most of the following examples use /n/ (participle)

/ṅ/ → [ŋ] /kñ-na/ → [kñ]‘kna’ ‘scatter’

(91) Glide+N

• the following examples use /}$/ (passive) + /}' (3pers.sg.)

/hj/ → [hj] /qñ-h-ja-ti/ → [qñ]‘hati’ ‘burn’

(92) Nasal+N

• most of the following examples use /}$/ (future) or /}$/ (aorist)

/tʃ/ → [tʃ] /hañ-tʃ-ja-ti/ → [hañ]‘tʃati’ ‘kill’

(93) Fricatives+N

/pl/ → [pl] /b/p-la-ta/ → [b]‘pa’ ‘break’

255 Evidence that the passive is underlyingly /ja/ comes from vowel-final roots: e.g. /kʰa-ja-ti/ → [kʰa]‘gati’ ‘proclaim’ (2011).

256 Proof for the form of the root: /qñ-h-asti/ → /qñhati/ (present indicative 3p.sg.). All other underlying roots listed below have similar justification; their underlying form can also be seen by comparing their behaviour in different coalescence patterns.
(94) /X+stop/<

<table>
<thead>
<tr>
<th>Stem</th>
<th>Root</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>/aj/</td>
<td>/t/</td>
<td>'milk'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/s/</td>
<td>'tie'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/t/</td>
<td>'clean'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/v/</td>
<td>'make'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/c/</td>
<td>'make'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/a/</td>
<td>'bust'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/t/</td>
<td>'dug'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/s/</td>
<td>'kill'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/n/</td>
<td>'go'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/n/</td>
<td>'go'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/c/</td>
<td>'go'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/s/</td>
<td>'see'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/t/</td>
<td>'live'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/s/</td>
<td>'sleep'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/d/</td>
<td>'throw'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/d/</td>
<td>'take'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/d/</td>
<td>'take'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/d/</td>
<td>'crack'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/d/</td>
<td>'crack'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/d/</td>
<td>'bore through'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/d/</td>
<td>'speak'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/d/</td>
<td>'enjoy'</td>
</tr>
</tbody>
</table>

(95) /voiceless stop+X/<

<table>
<thead>
<tr>
<th>Stem</th>
<th>Root</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>/aj/</td>
<td>/t/</td>
<td>'scrawl'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/c/</td>
<td>'marry'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/s/</td>
<td>'able'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/v/</td>
<td>'turn'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/c/</td>
<td>'throw'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/s/</td>
<td>'speak'</td>
</tr>
<tr>
<td>/aj/</td>
<td>/n/</td>
<td>'free'</td>
</tr>
</tbody>
</table>

8.6 Summary

The aim of this chapter was to show that stringently formulated faithfulness constraints are necessary. In other words, for every pair of faithfulness constraints F₁,F₂ that refer to the same scale, F₁ preserves a subset of the elements that F₂ preserves or vice-versa. With the additional proviso that the marked element is always preserved, for a pair of a scale \( \alpha, \beta \), there are therefore two faithfulness constraints IDENT(\( \alpha \)) and IDENT(\( \alpha, \beta \)); there can be no faithfulness constraint IDENT(\( \beta \)).

**Faithfulness conflation**

These proposals predict that ‘faithfulness conflation’ may occur. In other words, two mappings from the same input may incur the same violations of active faithfulness constraints. This fact turns out to be crucial in accounting for certain cases in which...
featural unfaithfulness is forced, or more precisely where an IDENT constraint for some feature is inevitably violated by the winning form. This occurs in both coalescence and bi-directional assimilation. For example, coalescence of /b+d/ in PaI (8.4.5) inevitably results in unfaithfulness to Place of Articulation: the output [d] ignores b’s labial specification, and output [b] ignores t’s coronal value.

To generalize, for a mapping /x/y/ → [z₁,z₂], where x and y have different values for some feature f, the present theory predicts two possible outcomes. The examples focus on Place of Articulation. m f refers to a marked value of feature f, and u f refers to a relatively less marked value.

(97) Outcomes of coalescence
(a) The marked feature survives (e.g. /b+d/ → [b])
   \[ \text{IDENT}[mf] \rightarrow *{mf} \] 
(b) The unmarked feature survives (e.g. /b+d/ → [d])
   \[ \text{IDENT}[mf, uf] \rightarrow *{mf} \times \text{IDENT}[mf] \]

Cases where the unmarked value survives in the output of coalescence show the need for stringent faithfulness constraints. If the unmarked value of a feature f appears in the output, some markedness constraint against the marked value *mf must outrank all faithfulness constraints that preserve marked values. For the coalescence /b+d/ → [d], where the unmarked coronal PoA survives, this means that *{KP} must outrank IDENT[KP].

However, in order for mf to contrast with uf, some faithfulness constraint F must outrank *{KP} and output [d] ignores /t/’s coronal value. Therefore, F must both preserve mf yet not favour mf over uf. The only way to satisfy these requirements is if F preserves both mf and uf equally, as shown in the tableau below.

(98) Table 8.11: Coalescence typology

<table>
<thead>
<tr>
<th>Feature</th>
<th>Marked Wins</th>
<th>Unmarked Wins</th>
</tr>
</thead>
<tbody>
<tr>
<td>[-anterior]</td>
<td>Catalan (8.2.4)</td>
<td>PaI (8.4.2.4)</td>
</tr>
<tr>
<td>[back]</td>
<td>Chipewyan (8.3.2.4)</td>
<td>Taos (Trager 1946)</td>
</tr>
<tr>
<td>[constr glottis]</td>
<td>Chipewyan (8.3.2.4)</td>
<td>Japanese men’s speech (8.3.3)</td>
</tr>
<tr>
<td>[nasal]</td>
<td>Dakota, Indonesian (8.2.4)</td>
<td>PaI (8.5)</td>
</tr>
<tr>
<td>[round]</td>
<td>Greek (8.2.1)</td>
<td>PaI (8.5)</td>
</tr>
<tr>
<td>[sonority]</td>
<td>Harar Oromo (8.2.4)</td>
<td>Chipewyan (8.3.5)</td>
</tr>
<tr>
<td>[spread glottis]</td>
<td>Chipewyan (8.3.5)</td>
<td>PaI (8.5)</td>
</tr>
<tr>
<td>Major PoA</td>
<td>PaI (dorsal-coronal) (8.4)</td>
<td>PaI (coronal-labial) (8.4)</td>
</tr>
</tbody>
</table>

As the table shows, there are some gaps in the typology. I have found no clear case where [+back] wins in coalescence. This gap may be because [back] and [round] are so closely associated, so it is often difficult to tell whether the output preserves the input’s [back] or [round] feature. However, cases like Korean and the analogous Rotuman (Churchward 1940, McCarthy 1995, 2000b) show that the two features are separable. Another gap relates to nasality: a clear case where the unmarked [nasal] value persisted would involve a coalescence such as /i + õ/ → [e], or /m+p/ → [b].
CHAPTER 9
SUMMARY AND IMPLICATIONS

9.1 Introduction
This chapter has two goals. The first is to discuss how the aims of this dissertation have been met (§9.2). The second is to re-evaluate the notion of markedness in the light of the results of the preceding chapters (§9.3).

9.2 Aims
This dissertation started with an informal statement of two leading ideas, repeated in (1).

(1) Leading Ideas
(a) Markedness relations between categories may be ignored, but never reversed.
(b) The more marked an element is, the greater the pressure to preserve it.

Evidence for (1a) was shown to come from systems in which different sonority categories are treated the same for stress purposes (ch.3, ch.4). For example, stress placement in Gujarati is sensitive to sonority distinctions: stress deviates from its default penultimate position if doing so will allow it to fall on a highly sonorous low vowel: e.g. [tād̪e] ‘recently’, [stār] ‘movie theatre’ (ch.3§3.2). However, while stress favours low vowels over all other types, it treats mid and high vowels in exactly the same way; stress does not avoid a penultimate vowel for a mid vowel (e.g. [tɒʊkɾ̥o] ‘girls’, *[tɒʊkɾ̥o]), or avoid a mid vowel for a high vowel (e.g. [tʃum̥st̥e] → [tʃhum̥st̥e] ‘74’, *[tʃım̥st̥e]). In other words, the sonority categories ‘mid peripheral vowel’ and ‘high peripheral vowel’ are conflated for stress purposes in Gujarati. This contrasts with a stress system like Nepanasan’s, where stress avoids the default penultimate position if it contains a high vowel: ([kɒm̥to] ‘carries’, *[kɒnt̥pa], cf Gujarati [tɒ̱ʊkɾ̥o]).

Evidence for (1b) was shown to come from processes for which marked elements are exempt. For example, chapter 6 provided examples from neutralization in languages like Yampfu (Rutgers 1998). In Yampfu, a general process of Place of Articulation neutralization in syllable codas forces /t/ to surface as a glottal stop: /namə/ → /nəmə/ ‘daughter-in-law’, cf [namə̠d̪-a] [instrumental], /sət̥-nə/ → /sən̥a/ ‘to hit’, cf [sət̥-a] ‘hit-past’. However, the more marked PoA values ‘labial’ and ‘dorsal’ are exempt from this attrition: e.g. [kʰap] ‘language’, *[kʰaʔ], [kʰe̠p-]-[a]- ‘to stick’; [aʔik] ‘bendy’, [kʰek-]-[a]- ‘scrape one’s throat’. In other words, greater preservation is afforded to the marked PoA values in Yampfu, preventing them from undergoing an otherwise general process.

Further evidence for (1b) comes from assimilation (ch.7). While coronals assimilate in Catalan, labials and dorsals do not: /son ʃɔks/ → /son ʃɔks/ ‘they are few’. cf /son dɔs/ → /son dɔs/ ‘we are two’, [atʃ ŋʊ̃tu] ‘stupid year’, [atʃ pɾeʃa] ‘I am in a hurry’. Again, the marked elements are preserved, exempting them from an otherwise general process.

Evidence for both (1a) and (1b) was argued to be found in coalescence (ch.8). In Pili, for example, adjacent consonants had to fuse to form geminates. When dorsals and coronals fused, the output element retained the more marked dorsal feature: /hak-ʃu/ → *[hak-ʃu], *[sak-ʃu] ‘be able to {aorist+3p.sg.}. This shows that there is greater pressure to preserve the marked element in this competition, so providing evidence for (1b).

In contrast, the fusing of labials and coronals in Pili produces a segment with the less marked coronal Place of Articulation: e.g. /hak-ʃu/ → *[hak-ʃu] ‘long for (participle)’, *[hak-ʃu]. Chapter 8 argued that the coronal PoA survives because labials and coronals are equally important in terms of preservation in Pili. So, unlike dorsals, the output of /h-ʃ/ could be either a labial *[b-ʃ] or coronal *[d-ʃ] and the preservation requirements of the language would be met. In this sense, the mappings /h-ʃ/ → *[b-ʃ] and /h-ʃ/ → *[d-ʃ] are conflated; they are treated in exactly the same way in Pili. Because survival of either the labial or coronal PoA is countenanced, the choice between the two falls to markedness constraints; accordingly, the least marked (coronal) PoA is favoured.

Now that evidence for the leading ideas has been reviewed informally, I will turn to a discussion of how the leading ideas are formally implemented. Since a detailed summary of the theoretical proposals has been provided at the end of each previous chapter, the aim of the following subsections is to provide a brief synopsis of the theoretical proposals as they relate to the leading ideas in (1). See the cross-references provided below for more detailed discussion.

9.2.1 Markedness constraints
Scale-referring markedness constraints have two tasks: (i) to formally encode hierarchical relations between scale elements and (ii) to allow category conflation. Chapter 3 argued that both (i) and (ii) could be achieved if constraints refer stringently to hierarchical relations between scale elements and (ii) to allow category conflation. The formal expression of markedness – ch.9
The constraints implement the hierarchy expressed by the scale in (2). More precisely, the constraints prevent reversal of the scale in (2). For example, low vowels are more desirable than mid vowels for stress purposes in Gujarati, as discussed above. This was implemented by ranking the constraint *Δv[ða:u,e,o] above the constraint that requires penult stress (ALIGNFTR) in ch.3.

However, mid vowels can never attract stress away from low vowels. For this to happen, there would have to be some constraint that assigned a violation to stressed low vowels but not to stressed mid vowels. As shown in quasi-tableau (5), there is no such constraint. While there is a constraint that favours [a] over [æ] (i.e. *Δv[ða:u,e,o]), there is no constraint that does the opposite.

Because [æ] incurs a proper subset of the violations of [a], the ranking of the constraints will make no difference to the relative markedness of [e] and [æ] – the former can never be preferred over the latter in terms of these constraints. However, there are constraints that treat the two categories – i.e. mid and low vowels – in the same way. This is crucial for the competition between mid and high vowels in Gujarati. As discussed above, the two categories are conflated for stress purposes. This follows if all constraints that distinguish the two – i.e. *Δv[ða:u] – are ‘inactive’ for stress, which in this case means ‘ranked below ALIGNFTR’. This situation is illustrated in tableau (6).

The only constraint that favours stressed mid vowels over stressed high vowels is *Δv[ða:u]. Because it is ranked below ALIGNFTR, its violations are inconsequential in determining the winner for stress.

In this ranking, it is crucial that *Δv[ða:u,e,o] assigns exactly the same violations to both (a) and (b). This is how conflation is formally implemented – through the assignment of equal violations. By doing so, *Δv[ða:u,e,o] makes no decision between the two candidates; this allows ALIGNFTR to make the crucial decision, favouring the candidate with stress in the default position. Chapter 3 provided an in-depth discussion of why stringent form is crucial in producing conflation.

- **Structural elements**
  - The other major markedness-related theoretical proposal is that certain scales can combine with structural elements to form constraints. For example, the constraints in (3) are combined with the structural element ‘stressed syllable’. This was argued to be only one of many possible structural elements. In fact, scales like the sonority hierarchy were argued to combine with both heads and non-heads of all prosodic levels.
  - Detailed arguments for this proposal were provided in chapter 4.

**9.2.2 Faithfulness constraints**

Faithfulness constraints must (i) encode the proposal that more marked elements can be subject to greater preservation and (ii) allow for faithfulness conflation. Chapters 6-8 argued that both (i) and (ii) could be achieved if faithfulness constraints referred to contiguous sets of scale elements and always preserved the most marked element. For example, the faithfulness constraints for the Place of Articulation scale in (7) are provided in (8).

(7) Place of Articulation scale

(8) Place of Articulation (PoA) faithfulness constraints:

- x corresponds to x’
  - IDENT[dorsal] If x is dorsal, then x’ has the same PoA as x.
  - IDENT[dors,lab] If x is dorsal or labial, then x’ has the same PoA as x.
  - IDENT[dors,lab,cor] If x is dorsal, labial, or coronal, then x’ has the same PoA as x.
  - IDENT[dors,lab,cor,gl] If x has any PoA, then x’ has the same PoA as x.

The example of Pāli coalescence mentioned in the previous section will be used to illustrate the two major properties of the ‘marked-faithfulness’ constraints in (8).

- **Marked-faithfulness**
  - When dorsals and coronals coalesce in Pāli, the result is a dorsal: e.g. sak+śū → {sakśū}, *{sahśū}). This illustrates the proposal that more marked elements can be subject to greater preservation. In constraint terms, the dorsal+coronal coalescence shows that there is a faithfulness constraint that preserves dorsals but not coronals, as shown in tableau (9).
neutrality of labials in the output (i.e., /labh\textsuperscript{2}-tabh\textsuperscript{2}/ → *[lubh\textsuperscript{2}-tabh\textsuperscript{2}]). Yet because IDENT(dors, lab, cor) treats the candidates’ unfaithfulness as being equally severe, it allows the lower-ranked markedness constraints to determine the output of coalescence.

<table>
<thead>
<tr>
<th>/sak\textsuperscript{2}-tat\textsuperscript{2}/</th>
<th>IDENT(dors, lab, cor)</th>
<th>*{dorsal}</th>
<th>IDENT(dors, lab)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) sak\textsuperscript{2}-tat\textsuperscript{2}</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(b) sat\textsuperscript{2}-tat\textsuperscript{2}</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

The competition between (a) and (b) shows that it is crucial for both candidates to incur the same violations of IDENT(dors, lab, cor) – doing so allows the lower-ranked markedness constraint *{dors, lab} to favour the candidate with a coronal coalesced segment over the one (a) with the more marked labial segment.

The competition between (b) and (c) shows that the ranking of IDENT(dors, lab, cor) with respect to *{dors, lab} is crucial; the opposite ranking would result in neutralization of labials in all positions.

Finally, the ranking shows that it is crucial that all constraints that preserve labials and not coronals (IDENT(dors, lab)) must be inactive. If IDENT(dors, lab) outranked *{dors, lab}, candidate (a) would win.

In short, it is crucial that some faithfulness constraint preserve marked elements without preserving unmarked ones, but it is also crucial that there are faithfulness constraints that preserve all elements equally.

This concludes the synopsis of the theoretical proposals in this dissertation. I now move on to considering the implications of this dissertation for the notion of markedness.

9.3 The status of markedness

The preceding chapters have shown that certain diagnostics that have been standardly used to determine markedness relations are invalid.

For example, since the Prague School theorists it has been standard to use inclusion in segmental inventories to determine relative markedness: if \( x \) is in some inventory but \( y \) is not, then \( y \) is more marked than \( x \). However, chapter 6 showed that this diagnostic gives almost no insight into markedness relations because almost all possible gaps in inventories are attested. This point is illustrated for voiceless stops in Table 9.1, repeated from ch.6§7.7.

Cf.

Faithfulness conflation

However, there is a way for the least marked element to survive. A relevant case is the competition between labial and coronal PoA in Pšk, as in /labh\textsuperscript{2}-tabh\textsuperscript{2}/ → *[lubh\textsuperscript{2}-tabh\textsuperscript{2}].

The reason that the output is coronal relates to faithfulness conflation. In effect, the marked-faithfulness constraints allow different types of unfaithfulness to be assigned equal importance. In Pšk, unfaithfulness to a labial is accorded the same status as unfaithfulness to a coronal. This allows markedness constraints to make the crucial decision.

The constraint IDENT(dors, lab, cor) allows unfaithfulness to labials and coronals to be conflated. This constraint must outrank *{dors, lab} in order to prevent wholesale
Gapped inventories are those that contain a marked element but lack a less marked element. Harmonically complete inventories are those that have a contiguous set of elements including the least marked type: i.e. for PoA in voiceless stops, [p t k].

As an example, chapter 6 distinguished between harmonically complete and gapped inventories. To put this in slightly different terms, there are asymmetries in the grammar, but none in the superficial observations about phenomena. The same point was made for undergoers of assimilation. While it has been claimed that only marked elements can be exempt from assimilation (Mohanan 1993, Jun 1995), only coronals do not undergo assimilation in Sri Lankan Portuguese Creole: /s‘in-pa/ → [s‘aŋ̩po], ‘bell {dative sg.}. *[s‘in-po]; cf /m‘oŋ-k-i/ → [m‘aŋk-i] ‘hand (verbal noun)’ (ch.7§7.4.2.1). Chapter 7 showed that any set of segments could be exempt from undergoing PoA assimilation.

Similarly, chapter 8 showed that any feature value – marked or unmarked – can survive in coalescence. Chapter 4§4.4 showed that epenthetic vowels can have any sonority (i.e. [ɔ i e ə]). At this point, one may wonder whether the notion of markedness has any validity at all, considering that these traditional diagnostics have been shown to be uninformative. The following subsections discuss this concern. Section 9.3.1 discusses why the phenomena mentioned above do not show surface asymmetries. Section 9.3.2 identifies phenomena that still exhibit asymmetric behaviour, so providing valid diagnostics for markedness relations.

### 9.3.1 Covert asymmetry

While there are no surface asymmetries in terms of inventories, undergoers of assimilation, and the output of coalescence, this dissertation has argued that this fact is an incidental result of the proposal that marked values can be exempt from undergoing certain processes. To put this in slightly different terms, there are asymmetries in the grammar, but none in the superficial observations about phenomena.

As an example, chapter 6 distinguished between harmonically complete and gapped inventories. Harmonically complete inventories are those that have a contiguous set of elements including the least marked type: i.e. for PoA in voiceless stops, [p t k], [t], and [ʔ]. Gapped inventories are those that contain a marked element but lack a less marked element: i.e. [k t ʔ], [k p ʔ], [k ʔ], [p ʔ]. When the results of these two inventory types are combined, almost every imaginable inventory is attested. However, I have argued that the two types are produced through entirely different ways.

Harmonically complete inventories are produced by the effect of markedness constraints. Markedness constraints militate against highly marked elements, so may effectively eliminate all but the less marked segments in an inventory.

In contrast, gapped inventories are primarily produced through the effect of marked-faithfulness constraints. For example, a gapped inventory like [k p ʔ] occurs because a constraint that prevents marked elements from being eliminated – IDENT[KP] – prevents these elements from undergoing an otherwise general neutralization process.

So, there is an asymmetry in terms of inventories, but it is 'covert' – i.e. not obvious on the surface. The asymmetry relates to how the different types of inventory come about, one primarily through the influence of markedness constraints, and the other through the blocking effect of marked-faithfulness constraints.

In short, the lack of asymmetry in inventories is a coincidental result of the proposal that marked elements can be subject to greater preservation than unmarked ones. This proposal allows gapped inventories to exist, with the surface effect that almost any inventory is attested.

* Coalescence and assimilation undergoers

The same 'covert asymmetry' explains the lack of surface asymmetries for coalescence and the undergoers of assimilation.

As discussed in chapter 7, coalescence systems can be broadly divided into two types: those in which the unmarked feature survives (as in PaH ɣu ɣ → [📆]) and those in which the marked feature survives (as in /k-ɾʃ-tʃ/ → [kʃ]). The former type is produced primarily by the influence of markedness constraints – markedness constraints favour less marked elements over more marked ones, so ensuring that the least marked feature survives. The type in which the marked feature survives relies on the influence of marked-faithfulness constraints, which demand that marked features persist in the output.

An analogous 'covert asymmetry' accounts for the different types of assimilation systems, discussed in chapter 7. Those like Sri Lankan Portuguese Creole, where only marked elements assimilate, come about through the action of markedness constraints: the markedness constraints seek to eliminate highly marked clusters, but allow less marked ones (i.e. those with coronals, in this case) to survive. In contrast, systems like Catalan’s, where marked elements are exempt from assimilation, rely on the existence of marked-faithfulness constraints: the greater preservation afforded to marked elements prevents them from assimilating in this language.

So, although there is no overt difference between inventory types, coalescence patterns, and assimilation systems, an asymmetry lurks beneath the surface: some systems come about through minimization of markedness, while others come about through preservation of marked elements.

For arguments that covert asymmetries exist, see the chapters cited.
9.3.2 Overt asymmetry

The previous section has argued that lack of surface asymmetry for some phenomena comes about through the preservation of marked elements. This proposal predicts that surface asymmetries should be visible in phenomena for which preservation is irrelevant.

- **Sonority-driven stress**
  
  For example, faithfulness is irrelevant to sonority-driven stress. More concretely, in the candidates from input /patal, [pita] and [pitá], both incur the same faithfulness violations; therefore, markedness alone is relevant in determining the winner. So, a phenomenon like this is predicted to behave asymmetrically – since markedness constraints determine the output, processes can only promote unmarked elements. Accordingly, there are systems in which less marked (i.e. more sonorous) stressed vowels are preferred over more marked (=less sonorous) ones, but there are none in which more marked stressed vowels are preferred over less marked ones. Concretely, while there are languages in which highly sonorous vowels attract stress away from lower sonority ones, there is no language where the opposite is true, where high vowels attract stress away from [a], for example.

- **Epenthetic PoA**
  
  Faithfulness is also irrelevant in determining the PoA of epenthetic elements. Epenthetic segments do not have corresponding input elements, so the proposal that marked values are subject to greater preservation will have no effect on their form. So, the PoA of epenthetic elements can only reflect markedness concerns. As shown in ch.§5.3, the result is that epenthetic consonants can only have the unmarked PoA values ‘glottal’ or ‘coronal’; they are never labials or coronals (also see ch.6§6.6, ch.4§4.4).

- **Output of neutralization**
  
  The same is true for the output of neutralization. For example, [k] is banned in Standard Malay codas (ch.§6.2). It can therefore neutralize to [p], [t], or [ʔ]. Importantly, faithfulness is irrelevant to the choice of output: [p], [t], and [ʔ] are all equally unfaithful to /k/. Therefore, only markedness constraints are relevant in choosing the winning form. As argued in ch.6, only [ʔ] and [t] are ever produced by neutralization. Again, this asymmetry follows from the fact that the marked-faithfulness constraints are irrelevant in this situation.

- **Output of Deletion**
  
  An analogous point holds for deletion, in a subtler way. The proposal that more marked elements can be subject to greater preservation than less marked ones only applies to feature-changing processes, not segment-deleting ones. More concretely, the constraint IDENT[KP] cannot prevent /k/ and /p/ from deleting. As shown in ch.6§6.4.2, this means that the marked-faithfulness constraints are effectively irrelevant in determining which elements undergo deletion. The net result is that if an element x undergoes deletion, then all more marked elements also delete. Again, because marked-faithfulness is irrelevant, deletion provides a clear indication of markedness asymmetries.

  - **Triggers of assimilation**
    
    The final major markedness diagnostic discussed here again relates to assimilation, but this time to the elements that trigger it. For example, dorsals in Korean force the preceding element to assimilate to them: /kamki/ → [kaŋk], /han-kaŋ/ → [han-kaŋ]. In contrast, the less marked labials and coronals do not trigger assimilation: e.g. [p̩ap̩ota], *[p̩am̩ota], *[sun̩ta], *[sun̩ta].

    Again, faithfulness has no relevance for assimilation triggers. This can be seen by comparing the candidates from /kam-ki/ → *[k̩am-k̩i] and those from /sun̩ta/ → [sun̩ta] and *[sun̩ta]. The only faithfulness difference between the candidates relates to the element that (potentially) undergoes assimilation – the coda nasal /n/. The triggering element – /k/ and /h/ respectively – do not undergo any featural change, so faithfulness is irrelevant for them. Accordingly, markedness constraints alone can determine which elements trigger assimilation. As argued in ch.6, the overall aim is to eliminate heterorganic clusters with highly marked elements, explaining why the most marked element – dorsal – triggers assimilation while the less marked elements do not. Since markedness is the sole factor that determines which elements trigger assimilation, the present theory predicts that if x triggers assimilation, so will all elements that are more marked than x (also see Mohanan 1993). For a detailed discussion of this point, see ch.7§7.5.

9.4 Summary

To summarize, the proposals in this dissertation in no way eliminate the need for a concept of markedness. However, they do offer a significantly different perspective on where markedness asymmetries may be found. For a number of phenomena, asymmetries will not be evident on the surface. Even so, all phenomena are predicted to at least show ‘covert asymmetries’, whereby some systems are produced through markedness reduction, while others are due to the preservation of marked elements. Finally, phenomena for which faithfulness is irrelevant are predicted to exhibit overt markedness asymmetries.

9.5 Closing remarks

I wish to conclude this dissertation by identifying (i) a few areas to which the proposals herein could potentially apply and (ii) issues that were not addressed.

While the entire focus of this dissertation has been on phonological scales, the proposals and results discussed herein could (and should) apply to morphological and syntactic scales. For example, one could expect to find a syntactic equivalent of conflation for phenomena involving the Person/Animacy hierarchy (Silverstein 1976, Dixon 1979, Aissen 1999, Woolford 1999). In fact, there is a hint that syntactic-scale conflation exists: some work recognizes a distinction between 1st and 2nd person in the Person hierarchy, while others group the two categories together (calling it ‘local’ – see Aissen 1999 for
relevant discussion). It is less easy to see how the faithfulness proposals – ‘marked preservation’ and stringent form – will apply to syntactic scales given the few feature-changing operations in syntactic phenomena (cf neutralization and assimilation in phonology). In short, the parallels with syntax are issues that require careful attention.

Some scale-related issues were not addressed in this dissertation. One is the combination of scales with other scales. For example, is it possible for two scales like those for PoA and voice to combine, forming constraints such as \( *[+vd]/[dorsal], *[+vd]/[dorsal,labial], \) and so on? Some attention has already been given to this issue from the viewpoint of local conjunction (Smolensky 1993). However, local conjunction alone predicts a vast number of scale-scale combinations; such combinations – if necessary – may be more limited.

Another unaddressed issue relates to ‘distance’ constraints, especially for sonority. Certain phenomena seem to refer to the degree of difference in the sonority of adjacent elements, as in syllable-contact restrictions (Hooper 1976, Murray & Vennemann 1983; Vennemann 1988, Gouskova 2002) and onset cluster conditions (Selkirk 1984 and many others). Some of these conditions may be explained solely by the constraints proposed here – i.e. by constraints that do not mention degree of difference.\(^{257}\) However, it is likely that some constraints must explicitly refer to clusters of elements, as proposed in Baertsch (1998), Morell (1999), Davis (1998), and Gouskova (2002). Exactly how conflation applies for such ‘distance’ effects is an issue that remains to be explicitly explored.

In conclusion, by no means has this dissertation provided solutions for every aspect of scale-reference. While it has presented proposals for many of the core aspects of scale-reference, a number of issues remain to be explored or re-evaluated in light of the issues raised herein.

\(^{257}\) I have argued this point for a case that involves apparent reference to degree of difference in tone height of different syllables elsewhere (de Lacy 2002b).
The formal expression of markedness – Appendices

Comments on specific inventory types are given in Appendices 3-5. Appendix 3 deals with harmonically complete inventories, Appendix 4 with gapped inventories, and Appendix 5 with disharmonic ones. Only harmonically complete and gapped inventories are listed here. Disharmonic inventories (i.e. [KP], [K], [P]) are discussed in Appendix 5.

- **Liquids and glides**

Liquids are unrevealing due to the extreme rarity of non-coronal liquids (Walsh & Dickey 1997). Consequently, if a language has a liquid, it always has a coronal. The same can be said for affricates: [pʃ] and [ks] are extremely rare, while their voiced counterparts are even rarer. In contrast, the coronal affricates [ts] and [tf] are common, so much so that I have found no language with affricates that does not have a coronal [ts] or [tf]. While this generalization supports the current hypothesis, it is again unrevealing given the lack of a reasonable sample of non-coronal affricates.

Glides present a rather unique situation in that the glide [w] classes with both the labials and dorsals in the same language and cross-linguistically (Ohala & Lorentz 1977). Moreover, there is no true alveolar coronal: [j] always acts like a palatal (T.Hall 1997:21). Nevertheless, there are languages with only contrastive [j] and with both contrastive [j] and [w]. Nunggubuyu only allows [j] in codas, but both [w] and [j] in onsets (Heath 1984:19).

(1) **Voiceless stops: Harmonically complete inventories without Glottal Elimination**

<table>
<thead>
<tr>
<th>k</th>
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<th>t</th>
<th>?</th>
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<th>Onset Inventory</th>
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<tbody>
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<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Chiracahua Apache [k p t ʔ]ONS</td>
<td>-</td>
</tr>
<tr>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
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</tr>
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<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Apalai Carib [k p t ʔ]CONS</td>
<td>-</td>
</tr>
<tr>
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<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Fore [k p t ʔ]CONS</td>
<td>-</td>
</tr>
<tr>
<td>✔</td>
<td>✔</td>
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<td>✔</td>
<td>Kashaya [q k p t ʔ]CONS</td>
<td>-</td>
</tr>
<tr>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Kalatang Malay [k p t ʔ]CONS</td>
<td>-</td>
</tr>
<tr>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Nantong Chinese [k p t ʔ]CONS</td>
<td>-</td>
</tr>
<tr>
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<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Gadup [k p t ʔ]CONS</td>
<td>-</td>
</tr>
<tr>
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<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Menomini [tʃ ʔ]~[k p t ʔ]CONS</td>
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</tr>
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<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Chickasaw</td>
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</tr>
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<td>✔</td>
<td>✔</td>
<td>✔</td>
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<td>✔</td>
<td>Arekuna Carib [k p t ʔ]CONS</td>
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</tr>
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<td>✔</td>
<td>Pendau [k p t ʔ]CONS</td>
<td>-</td>
</tr>
</tbody>
</table>

- **Glides present a rather unique situation in that the glide [w] classes with both the labials and dorsals in the same language and cross-linguistically (Ohala & Lorentz 1977). Moreover, there is no true alveolar coronal: [j] always acts like a palatal (T.Hall 1997:21). Nevertheless, there are languages with only contrastive [j] and with both contrastive [j] and [w]. Nunggubuyu only allows [j] in codas, but both [w] and [j] in onsets (Heath 1984:19).**

(2) **Voiceless stops: Harmonically complete inventories with Glottal Elimination**

<table>
<thead>
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<th>k</th>
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<th>?</th>
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<th>Onset Inventory</th>
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<td>✔</td>
<td>✔</td>
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<td>-</td>
</tr>
<tr>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Taiwanese secret language reduplicants</td>
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</tr>
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<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Uradhi</td>
<td>-</td>
</tr>
<tr>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Kiowa (Formal) [k p t ʔ]CONS</td>
<td>-</td>
</tr>
<tr>
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<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Vanimo Berber (Imdlawn Tashlihyy) [q qʰ k kʰ]</td>
<td>-</td>
</tr>
<tr>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Yuma [q k p t]~[q qʰ k p t]CONS</td>
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</tr>
<tr>
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<td>✔</td>
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<td>✔</td>
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(3) **Voiceless stops: Gapped inventories**

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<th>Coda Inventory</th>
<th>Onset Inventory</th>
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<td>✔</td>
<td>✔</td>
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<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Yampfu [k p t ʔ]</td>
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</tr>
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<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Refugee Tibetan [k p t ʔ]</td>
<td>-</td>
</tr>
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<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Chaoyang [k p t ʔ]CONS</td>
<td>-</td>
</tr>
<tr>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Nanibqara [k p t ʔ]</td>
<td>-</td>
</tr>
<tr>
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<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Nganasan codas [k p t ʔ]CONS</td>
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</tr>
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<td>✔</td>
<td>✔</td>
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<td>-</td>
</tr>
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<td>Wichita [kʰ tʃ tʃ]</td>
<td>-</td>
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<td>✔</td>
<td>✔</td>
<td>Nganasan [p t k ʔ b d ʔ]CONS</td>
<td>-</td>
</tr>
<tr>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Tzukou</td>
<td>-</td>
</tr>
</tbody>
</table>

Appendices 3-5 with disharmonic ones.

2 A rather remarkable case that attests to [w]’s dual nature is found in Nunggubuyu (Heath 1984). In this language there are two types of underlying /w/. One lenites to [b] in stem-initial position, and the other to [g] (p.14ff).

3 Heath uses ‘b’, ‘d’, ‘g’ to stand for voiceless unaspirated stops [p t k]. All are allowed in onsets. [p] is only allowed in codas in a small number of interjections.
The formal expression of markedness – Appendices

(4) **Voiced stops: Harmonically complete inventories**

<table>
<thead>
<tr>
<th>g</th>
<th>b</th>
<th>d</th>
<th>Onset Inventory</th>
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<td>Diyari</td>
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<td>✓</td>
<td></td>
<td>Nambiquara</td>
</tr>
<tr>
<td>✓  ✓</td>
<td></td>
<td>✓</td>
<td>Sioux Valley (Santee)</td>
</tr>
<tr>
<td></td>
<td>✓</td>
<td>✓</td>
<td>Xavanté Macro-Jé</td>
</tr>
<tr>
<td>✓  ✓</td>
<td>✓</td>
<td>✓</td>
<td>Juruna</td>
</tr>
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<td>✓</td>
<td>✓</td>
<td>Nhandá</td>
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<td>✓</td>
<td>✓</td>
<td>Catalan</td>
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<td>✓  ✓</td>
<td>✓</td>
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(5) **Voiced stops: Gapped inventories**

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<td>Wapishana</td>
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<td>✓</td>
<td>✓</td>
<td>Ayutla Mixtec</td>
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(6) **Voiced fricatives: Harmonically complete inventories without Glottal Elimination**

<table>
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<th>x</th>
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<td>✓</td>
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<td>✓</td>
<td>✓</td>
<td>Fox [h]–[s h]</td>
<td>Kapingamaranghi [h]</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Chiricahua Apache [s h]–[s ʃ x h]</td>
<td>Bororó Macro-Jé</td>
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<td>Chipewyan [ʃ h]–[ʃ s h]</td>
<td>Gujarati [s ŋ h]</td>
</tr>
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<td>Chamicuro [ʃ s h]</td>
<td>Tunica [s ŋ h]</td>
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<td>✓</td>
<td>✓</td>
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<td>Kipeú Macro-Jé</td>
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<td>Abau</td>
<td>Kshlaya [s ŋ h]</td>
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<td>Egyptian Arabic [ʃ s h]</td>
<td>Somali</td>
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(7) **Voiceless fricatives: Harmonically complete inventories with Glottal Elimination**

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<td>✓</td>
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<td>Teton [x ŋ h]</td>
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<td>✓</td>
<td>✓</td>
<td>Sentedi [s ŋ h]</td>
<td>Sentani [x ŋ h]</td>
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<td>✓</td>
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<td>Sentedi</td>
<td>Mataco-Noctenes [x s ŋ h]</td>
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<td>✓</td>
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(8) **Voiceless fricatives: Gapped inventories**

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<th>Onset Inventory</th>
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<td>Lakkia [x f ŋ h]</td>
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<td>Teton [x ŋ h]</td>
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<td>Sentani [x ŋ h]</td>
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<td>Sui</td>
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<td>✓</td>
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<td>✓</td>
<td>✓</td>
<td>Sentedi</td>
<td>Mataco-Noctenes [x s ŋ h]</td>
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<td>✓</td>
<td>✓</td>
<td>Apatani</td>
<td>Sentedi</td>
</tr>
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</table>

4 ([h] appears PrWd-initially (e.g. [ri{h b}lɛi] ‘rehabilitate’) and in stressed syllable onsets ([vi{h kj}l] ‘vehicular’), but not elsewhere (cf [vi{h kl}] ‘vehicle’).
## The formal expression of markedness – Appendices

### Voiced fricatives

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<td>Gujarati (‘innovating’ dialects)</td>
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<td></td>
<td></td>
<td>Yuma [v ň]</td>
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<td>Hungarian [v z ȷ]</td>
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<td></td>
<td></td>
<td>Carijona Carib [β z]</td>
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<td>Sioux Valley (Santee) [γ ň ȷ]</td>
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<td>Chiracahua Apache [γ z ȷ]</td>
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### Nasals: Harmonically complete inventories without Glottal Elimination

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<td>&quot;N&quot;</td>
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<td>&quot;m&quot;</td>
<td>&quot;N&quot;</td>
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<td>&quot;m&quot;</td>
<td>&quot;N&quot;</td>
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<td>&quot;-n&quot;</td>
<td>&quot;m&quot;</td>
<td>&quot;N&quot;</td>
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<td>&quot;-n&quot;</td>
<td>&quot;m&quot;</td>
<td>&quot;N&quot;</td>
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<td>Arabela</td>
<td>&quot;-n&quot;</td>
<td>&quot;m&quot;</td>
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<td>Piro</td>
<td>&quot;-n&quot;</td>
<td>&quot;m&quot;</td>
<td>&quot;N&quot;</td>
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---

1. Coda [m n] are permitted before a homorganic consonant. e.g. [junda].
2. Avoidance of onset glottals could account for the lack of relevant examples. The only cases listed here have [ŋ], not [ŋ] as their only onsets.
4. The fact that [N] and [ŋ] have the same phonetic realization makes it difficult to determine cases where they contrast phonologically.
(11) **Nasals: Harmonically complete inventories with Glottal Elimination**

<table>
<thead>
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<td>Nambiquara [m in loans]</td>
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<td>Konkani</td>
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<td>✓</td>
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(12) **Nasals: Gapped inventories**

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<td>✓</td>
<td>Cayapa [η m n η]</td>
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(13) **Glides: inventories**

Note: [G] is the velar glide

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<td>✓</td>
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9 The rarity of onset [η] is probably responsible for the lack of examples with onset [η m n] and coda [m n].
10 Word-initial [η] is banned, but can appear in medial onsets.
Appendix B: Language References

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<td>Athapaskan</td>
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<td>Tibeto-Burman</td>
<td>Abraham 1985</td>
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<td>Semitic</td>
<td>Broselow 1976, Gadalla 2000</td>
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<td>Arawakan</td>
<td>Aikhenvald 1999</td>
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<td>Voorhoeve 1985, Foley 1986:60</td>
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<td>Attic Greek</td>
<td>Indo-European</td>
<td>Bubenik 1983:78</td>
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<td>Ayutla</td>
<td>Mixtecan</td>
<td>Pankratz &amp; Pike 1967</td>
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<td>Sino-Tibetan</td>
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<td>Dell &amp; Elmedlaoui 1988</td>
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<td>Boazi</td>
<td>Trans-New Guinea</td>
<td>Foley 1986:61</td>
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<td>Bora</td>
<td>Witotoan</td>
<td>Thiesen 1996</td>
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<td>Giannelli &amp; Savosa 1979, Kurchner 1998:ch:7</td>
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<td>Fore</td>
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Fuzhou                    | Sino-Tibetan  | Yip 1982:646                                                              |
Gadsup                    | Trans-New Guinea | Foley 1986:61                                                            |
Gilbertese                | Oceanic       | Blevins & Harrison 1994                                                  |
Golin                     | Trans-New Guinea | Bunn & Bunn 1970                                                          |
Gujarati                  | Indo-Iranian  | Cardona 1965, Mistry 1997                                                 |
Haida                     | Na-Dene       | Sapir 1923                                                                |
Harar Oromo               | Ethiopic      | Owens 1985                                                                |
Hawaiian                  | Polynesian    | Pauk & Elbert 1979                                                        |
Hixkaryana               | Carib         | Derbyshire 1985                                                           |
Hopi (Toreva)             | Uto-Aztecan   | Whorf 1946                                                                |
Hullaga Quechua          | Quechuan      | Weber 1989:459                                                            |
Hungarian                 | Uralic        | Abondolo 1998b                                                            |
Japanese, Kagoshima       | -             | Kaneko & Kawahara 2002                                                    |
Jicarilla                 | Athapaskan    | Haas 1968                                                                 |
Kannada                   | Dravadian     | Sridhar 1990                                                              |
Kashaya                   | Hakan         | Buckley 1994                                                              |
Khatti                    | Uralic        | Abondolo 1998c                                                            |
Koawa                     | Athapaskan    | Watkins 1984                                                              |
Koawa-Apache             | Athapaskan    | Haas 1968                                                                 |
Kwara`ae                  | -             | Solh 1980                                                                 |
Kut                       | -             | Winfield 1928                                                             |
Kovaja                    | Dravadian     | Eibert 1996                                                               |
Lipan                     | Athapaskan    | Haas 1968                                                                 |
Luangua                   | Polynesian    | Salmond 1974                                                              |
Macro-Je                  | Trans-New Guinea | Rodrigues 1999b                                                          |
Makassarese               | Malayo-Polynesian | Aronoff et al. 1987                                                      |
Malay (Kalantan)          | Malayo-Polynesian | Teoh 1988, Trigo 1988                                                    |
Maltese                   | Semitic       | Borg & Azzopardi-Alexander 1997                                           |
Mani                      | Uralic        | Keresztes 1998                                                            |
Maori                     | Polynesian    | Bauer 1993                                                                |
Masset Hasda              | Na-Dene       | Enrico 1991                                                               |
Mayu                      | Nilo-Saharan  | Breen 1981                                                                |
Menomini                  | Algonquian    | Bloomfield 1962                                                           |
Misanla Totonac           | Polynesian    | Mackay 1994, 1999                                                        |
Makurap                   | -             | Rodrigues 1999a:112ff                                                    |
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<td>Quick 2000§2.4.1</td>
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<td>Shaw 1980:17</td>
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<td>Rice 1989</td>
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<td>Tzutuqil</td>
<td>Dayley 1985:38</td>
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<td>Uradhi</td>
<td>Pama-Nyungan, Hale 1976, Crowley 1983</td>
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<td>Vanimo</td>
<td>Ross 1980:78f</td>
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<td>Walmatjari</td>
<td>Hudson 1958</td>
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<td>Wayana</td>
<td>Carib, Jackson 1972</td>
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<td>Wichita</td>
<td>Caddoan, Garvin 1950</td>
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<td>Yanfau</td>
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