

CHAPTER 2

ROOT-INITIAL FAITHFULNESS

2.1 Introduction

Positional asymmetries in feature distribution at the syllabic level are well-known from the work of Steriade (1982), Itô (1986, 1989), Goldsmith (1989, 1990) and Lombardi (1991), among others. Syllable onsets typically permit more, and more marked, segments than do syllable codas. While investigations of syllable-level asymmetries have been numerous and fruitful, phonological asymmetries associated with other structural positions have largely been overlooked.

Root-initial syllables constitute one such case. Phonologically, initial syllables exhibit all of the asymmetrical behaviors typical of “strong licensors”: they permit a wide range of marked segments, trigger directional phonological processes, and resist the application of otherwise regular alternations. In this chapter, I will argue that the phonologically privileged status of root-initial syllables arises from high-ranking initial-syllable faithfulness constraints. Such constraints encompass all three aspects of phonological privilege which are displayed by initial syllables. I begin with a survey of initial syllable privilege effects.

2.2 Initial Syllable Privilege

2.2.1 Psycholinguistic Evidence

One source of evidence for initial-syllable positional privilege may be found in the domain of lexical access and language processing. There is a considerable body of psycholinguistic research which indicates that word-initial material, either spoken or written, plays a key role in lexical access, word recognition and speech production. Some of this evidence is outlined in (1) below. (See Hall 1988, 1992; Hawkins & Cutler 1988 for further examples and discussion of the relevant literature.)

(1) Initiality effects in processing¹

- Utterance-initial portions make better cues for word recognition and lexical retrieval than either final or medial portions (Horowitz *et al.* 1968; Horowitz *et al.* 1969; Nooteboom 1981)
- Initial material is most frequently recalled by subjects in a tip-of-the-tongue state (Brown & McNeill 1966)
- Word onsets are the most effective cues in inducing recall of the target word in tip-of-the-tongue states (Freedman & Landauer 1966)
- Mispronunciations are detected more frequently in initial positions than in later positions (Cole 1973; Cole & Jakimik 1978, 1980)
- Mispronunciations in word onsets are less likely to be fluently replaced in a speech shadowing task than errors in later positions (Marslen-Wilson 1975; Marslen-Wilson & Welsh 1978)

From evidence of this type, Hawkins and Cutler (1988: 299) conclude that the temporal structure of lexical entries is “of paramount importance” in the lexicon. They further “suggest that the pervasiveness of onset salience, expressing itself not only in auditory comprehension but in reading as well, and in parallel effects in speech production, argues that the importance of the temporal structure of words in their mental representation extends beyond the auditory access code.” In this context, the predictions of Nooteboom (1981: 422) take on particular significance: “...lexical items will generally carry more information early in the word than late in the word. In phonological terms one would predict that (i) in the initial position there will be a greater variety of different phonemes and phoneme combinations than in word-final position, and (ii) word initial phonemes will suffer less than word final phonemes from assimilation and coarticulation rules.”

Nooteboom’s predictions appear to be borne out cross-linguistically. There are many examples of phonological behavior which turn on the root-initial/non-initial syllable distinction. I turn to an overview of such examples in §2.2.2.

¹ In the literature cited here, the distinction between word-initial and root-initial is not systematically explored—in many, it is difficult to determine whether only unprefixed forms, or both prefixed and unprefixed words, were used as stimuli. The processing of prefixal morphology is an interesting and complex matter. See Hall (1992) for a useful summary and discussion of the issues.

2.2.2 Phonological Evidence of Positional Privilege

Phonological asymmetries between root-initial and non-initial syllables are well-documented in the descriptive and generative phonological literature. Positional neutralization of vocalic contrasts outside of the root-initial syllable is particularly common in languages which exhibit vowel harmony, and is robustly attested in a variety of languages and language families including Turkic, Tungusic, Mongolian, Finno-Ugric, and Bantu. (Many cases of non-initial vowel neutralization are documented and/or discussed in Trubetzkoy 1939; Bach 1968; Haiman 1972; Ringen 1975; Kiparsky 1981, 1988; Clements & Sezer 1982; Goldsmith 1985; Steriade 1979, 1993c, 1995; Hulst & Weijer 1995, to mention only a few.) In languages that exhibit non-initial neutralization of vowel contrasts, the vowel inventory in non-initial syllables is typically a subset of the full vowel inventory appearing in root-initial syllables. Furthermore, membership in the non-initial inventory is not random: non-initial vowels are generally less marked than, or identical to, the members of the vowel inventory which appear in root-initial syllables.

One language which exhibits this pattern of positional neutralization is Shona, a Bantu language of Zimbabwe. In Shona verbs, vowel height may vary freely in root-initial position, as in (2). However, vowel height in non-initial syllables is severely restricted; non-initial mid vowels may surface only if preceded by an initial mid vowel.

(2) Initial vowel height varies freely

pera	'end'
tsveta	'stick'
sona	'sew'
ipa	'be evil'
iùàa	'come out'
bvuma	'agree'
iata	'hold'
shamba	'wash'

(3) Non-initial height is restricted

tonhor-	‘be cold’	buruk-	‘dismount’
pember-	‘dance for joy’	simuk-	‘stand up’
bover-	‘collapse inwards’	turikir-	‘translate’
		charuk-	‘jump over/across’
		tandanis-	‘chase’

There are no Shona verbs in which mid vowels follow either low or high vowels. Only the peripheral vowels *i*, *u* and *a* are contrastive in non-initial syllables.

Positional restrictions on inventory are not limited to the realm of vowel features. In many languages, consonantal contrasts are confined to root-initial syllables. Representative examples of both vocalic and consonantal positional neutralization are displayed in (4) below.

(4) Root-initial/non-initial inventory asymmetries

Language:	Inventory includes:	Initial s:	Non-initial s:
Tuva (Turkic) (Krueger 1977)	Plain & glottalized vowels	Both plain & glottalized vowels	No glottalized vowels
Turkic family (Comrie 1981; Kaun 1995)	Round & unround vowels	Round & unround vowels	Round vowels only via harmony with a round initial
Hungarian (C. Ringen, personal communication)	High & mid front rounded vowels	High & mid front rounded vowels	Mid front rounded vowels only after front rounded vowels
!Xóó (Bushman) (Traill 1985)	Click & non-click consonants	Click & non-click consonants	No clicks
Tamil (Dravidian) (Christdas 1988; Bosch & Wiltshire 1992)	High, mid & low vowels Round & unround vowels Linked & independent POA in coda position	High, mid & low vowels Round & unround vowels Linked & independent POA in coda position	No mid vowels No round vowels Only linked POA in coda position
Malayalam (Dravidian) (Wiltshire 1992)	Labial, Dorsal & a variety of Coronal consonants	Independent place of articulation in coda position	Place of articulation in coda must be shared by following onset
Dhangar-Kurux (Dravidian) (Gordon 1976)	Oral & nasal vowels Long & short vowels	Oral & nasal vowels Long & short vowels	No nasal vowels No long vowels
Shona (Bantu) (Fortune 1955) (many other Bantu languages exhibit parallel facts)	High, mid & low vowels	High, mid & low vowels	Mid only via harmony with a mid in the initial syllable
Shilluk (Nilotic) (Gilley 1992)	Plain, palatalized & labialized consonants	Plain, palatalized & labialized consonants	No palatalized or labialized consonants
Doyayo (Niger-Congo) (Wiering & Wiering 1994)	Voiceless, voiced & implosive consonants Labiovelar stops (k-p, g-b)	Voiceless, voiced & implosive consonants Labiovelar stops	No implosives (i. à) No labiovelar stops
Bashkir (Turkic) (Poppe 1964)	High, mid & low vowels	High, mid & low vowels	No high vowels

Further examples may be found in many languages of diverse genetic affiliation.

In addition to permitting a wider range of more marked segments, root-initial syllables frequently act as triggers of phonological processes such as vowel harmony, or preferentially fail to undergo an otherwise regular process. Palatal and/or rounding harmony in many Altaic languages can be characterized as spreading triggered by the root-initial syllable. Shona height harmony (and numerous other examples of height harmony in Bantu languages) also falls into this category; harmony is initiated by a segment in the privileged root-initial syllable. The second phenomenon, in which segments in the root-initial syllable fail to undergo a process, is instantiated in Tamil, where codas of initial syllables do not undergo place assimilation, and in Zulu, in which root-initial consonants fail to undergo an otherwise regular process of dissimilation. Further examples of initial syllable resistance can be found in Leti, an Austronesian language, and Korean. Hume (1996) discusses the occurrence of metathesis in the Austronesian language Leti. In Leti, metathesis is a pervasive strategy employed in the satisfaction of a variety of phrase-level prosodic structure constraints. However, while metathesis applies freely to word-final sequences, it never applies in root-initial environments. Finally, Kang (in preparation) (cited in Hume 1996) reports on a process of glide deletion in Seoul Korean which applies at a significantly higher rate in non-initial syllables than in initial syllables.

In this chapter, I will argue that both initially-determined positional neutralization and initially-triggered or -blocked phonological processes result from a high-ranking positional faithfulness constraint, $I_{\text{IDENT}-\sigma_1}(\text{F})$, formulated as in (5).

- (5) $I_{\text{IDENT}-\sigma_1}(\text{F})$
Let β be an output segment in the root-initial syllable, and α its input correspondent.
If β is $[\gamma\text{F}]$, then α must be $[\gamma\text{F}]$.
“An output segment in σ_1 and the input correspondent of that segment must have identical feature specifications.”

This constraint belongs in the same family as the familiar $I_{\text{IDENT}}(\text{F})$ of McCarthy & Prince (1995), and universally dominates it, as shown in (6).

- (6) Universal ranking, initial syllable faithfulness subhierarchy
 $I_{\text{IDENT}-\sigma_1}(\text{F}) \gg I_{\text{IDENT}}(\text{F})$

Non-initial neutralization of contrast arises when some markedness constraint or constraints intervene in the ranking shown in (6). For example, the absence of mid vowels outside of root-initial syllables results from the ranking shown in (7), where the intervening markedness constraint is *M_{ID} (*[-high, -low]).

- (7) Positional limitations on phonemic mid vowels
 IDENT-σ₁(high) » *M_{ID} » IDENT(high)

The ranking of IDENT-σ₁(high) » *M_{ID} will result in the preservation of underlying height contrasts in root-initial syllables. Conversely, the ranking *M_{ID} » IDENT(high) prohibits preservation of input mid vowels outside of the root-initial syllable.

The other two privileged behaviors exhibited by root-initial syllables, triggering of phonological processes and blocking of phonological processes, derive from the same basic pattern of ranking shown in (7). In an OT grammar, phonological processes are manifested when some markedness constraint dominates a faithfulness constraint, thereby forcing an alternation. For example, nasal harmony may result from the ranking of ALIGN(nasal) » IDENT(nasal), place assimilation from the ranking SPREAD(Place) » IDENT(Place) (Padgett 1995b), and so on.

Initial-syllable triggering *and* blocking of phonological processes such as nasal harmony and place assimilation derive from the ranking schema in (8) below, where **M** represents any markedness constraint.

- (8) Initial-syllable triggering and blocking schema
 IDENT-σ₁(F) » **M** » IDENT(F)

The ranking of IDENT-σ₁(F) » **M** renders any element in the root-initial syllable immune to the application of the phonological process characterized by the ranking of **M** » IDENT(F). An example of this type will be presented in §2.3 below.

The remainder of the chapter is organized as follows. In §2.3, I examine the role of IDENT-σ₁(F) in characterizing Shona height harmony. In Shona, contrastive mid vowels occur only in root-initial syllables; elsewhere, they arise predictably through harmony. This pattern

derives from the ranking schema in (8). Section 2.4 provides an analysis of Tamil, a language which exhibits multiple reflexes of high-ranking IDENT- σ_1 (F). In Tamil, as in Shona, mid vowels are limited to root-initial syllables. Furthermore, coda consonants in initial syllables may have an independent place of articulation, those codas of non-initial syllables may not. We will see that high ranking IDENT- σ_1 (F) constraints are again the key to characterizing both the distribution of both vowel height and of coda place of articulation in Tamil. The key findings of the chapter are summarized in §2.5.

2.3 Positional Neutralization and Harmony in Shona

2.3.1 Data and Generalizations

Shona is a Bantu language spoken primarily in Zimbabwe; it belongs in Area S, according to the classification system of Guthrie (1967). The descriptive and generative literature on Shona is extensive, particularly in the realm of tonal phonology. (Notable generative works on Shona tone include Myers 1987 and Odden 1981.) Our focus here will not be on the tonal properties of Shona, but rather on the distribution of vowel height in the verbal system.

The distribution of the feature [high] in Shona verbs is a classic example of positional neutralization accompanied by vowel harmony: the mid vowels *e* and *o* in Shona verbs are contrastive only in root-initial syllables.² They appear in subsequent syllables only when preceded by a mid vowel in root-initial position. A string of height-harmonic Shona vowels is therefore firmly anchored in the root-initial syllable.³

Shona has a three-height vowel system comprised of five surface vowels. The vowels of Shona and the surface feature specifications assumed are shown in (9) below. (Unless otherwise noted, the data and generalizations which follow are drawn from Fortune 1955, who describes

² In the interest of internal consistency, I have adopted the term “root” in the discussion of Shona, rather than “radical”, which is commonly used in the Bantuist literature.

³ The discussion and analysis which follow are restricted to Shona, for largely practical reasons. The same basic pattern of height distribution occurs in many other Bantu languages which have a five-vowel inventory (e.g., Kinyarwanda (Kimenyi 1979), Lamba (Kenstowicz & Kisseberth 1979: 72), and the analysis presented here can be extended to such cases straightforwardly.

the Zezuru dialect of Shona. Tone and vowel length have been omitted throughout; length occurs only in penultimate syllables, as a reflex of stress.)

(9)

	[back]	[round]	[high]	[low]
i	–	–	+	–
u	+	+	+	–
e	–	–	–	–
o	+	+	–	–
a	+	–	–	+

In Shona, as in most languages with triangular vowel systems, the low vowel is inert with respect to vowel harmony; *a* systematically fails to pattern with the [–high] vowels *e* and *o*: The appearance of a root-initial *a* does not permit subsequent mid vowels (indicating that the [–high] specification of *a* is not available for linkage to a subsequent non-low vowel). Furthermore, the distribution of [–high] *a* is free, not restricted to the initial syllable as are the [–high] mid vowels. The relative freedom of the low vowel will emerge from constraint interaction, as shown in §2.3.3 below.⁴

While the distribution of *a* is free in Shona verbs, the occurrence of high and mid vowels is subject to certain limitations. Verb *stems* are composed of a verb *root* and any number of optional derivational *extensions*; verb roots are primarily CVC in shape, but polysyllabic roots are not uncommon. In the initial syllable of a verb stem, there are no restrictions on the occurrence of vowel features. However, in non-initial syllables (whether in the root or in an extension), only [round], [back] and [low] may vary freely. The value of the feature [high] is determined by the height of a preceding vowel: mid vowels may appear non-initially only if preceded by a mid vowel. In order for a string of mid vowels to be licit, the leftmost vowel must appear in a root-initial syllable. (Thus, a sequence *CeCe*, where *C* = any consonant, is not possible if preceded by a root-initial high or low vowel: **CiCeCe*, **CaCeCe*.) High vowels

⁴ No phonological theory of vowel height features that I am aware can adequately explain the widespread failure of low vowels to interact with high or mid vowels in height-sensitive processes. (Rare exceptions include various examples of vowel coalescence (de Haas 1988), Romance metaphony (Calabrese 1988, Hualde 1989); and Woleian raising (Sohn 1971, 1975).) If the low vowels are represented with the same features as vowels of other heights, this asymmetry in behavior is unexpected. The issue of vowel height representation is, however, orthogonal to the characterization of non-initial neutralization. See Clements (1991), Steriade (1995) for relevant discussion of this issue.

may appear non-initially if the vowel of the preceding syllable is either high or low, but never if the preceding vowel is mid. This is summarized for $\# \sigma_1 \sigma_2$ sequences in (10), where $\# \sigma_1$ indicates a root-initial syllable.

(10)

		$\sigma_2 \emptyset$				
		i	u	e	o	a
$\# \sigma_1$	i	v	v			v
	u	v	v			v
	e		v	v		v
	o			v	v	v
	a	v	v			v

Shaded cells in the table indicate non-occurring vowel sequences. Mid vowels may not follow either high or low vowels, while high vowels may not follow mid. This is true both within verb roots and between roots and extensions in derived forms. (The sole exception to this generalization is found in the sequence $\#CeCu$; non-initial round vowels harmonize in height with a preceding vowel only if the vowels agree in rounding. This is manifested in the absence of $\#CeCo$ sequences and the presence of $\#CeCu$, as indicated in (10). I will ignore this gap in the remaining discussion; a full analysis is provided in Beckman 1997)

Data instantiating these distributional generalizations are given in (11)-(16) below. In (11), representative examples of polysyllabic verb roots are provided. (Many of the polysyllabic roots in the language are likely to have been derived from root + extension combinations at an earlier point in the history of the language; such forms appear to have been lexicalized to varying degrees in the synchronic grammar. Others are related to nouns or ideophones. Wherever possible, I have excluded transparently derived roots from the list in (11).) There are no polysyllabic roots which fail to conform to the generalizations shown in (10) above.

(11) Polysyllabic roots exhibit vowel harmony⁵

tonhor-	'be cold'	Fi	chenjer-	'be wise'	M
nonok-	'dally, delay'	Fo7	chember-	'grow old'	M
nonot-	'scold, abuse'	H	verer-	'move stealthily'	M
korokod-	'itch (nostril)'	H	vereng-	'read; count'	M
gobor-	'uproot'	Fo7	pember-	'dance for joy'	H
bover-	'collapse inwards'	H	nyemwerer-	'smile'	Fo7
kobodek-	'become empty'	H			
pofomadz-	'blind (trans.)'	Fo5	zendam-	'lean w/support at side or back'	H
pofomar-	'be blind'	H	chenam-	'bare teeth angrily'	H
chonjomar-	'sit w/buttocks & soles of feet on ground'	H			
fungat-	'embrace'	D	bvinar-	'fade'	H
pfugam-	'kneel'	Fo7	findam-	'tangle (intr.)'	H
ruram-	'be straight,'	Fo7	minaik-	'wriggle'	H
buruk-	'dismount'	Fo7	simuk-	'stand up'	Fo7
dukup-	'to be small'	H	simudz-	'lift'	Fi
kumbir-	'ask for'	M	kwipur-	'uproot'	H
turikir-	'translate'	Fi	svetuk-	'jump'	Fo5
			serenuk-	'water (gums of mouth)'	H
charuk-	'jump over/across'	H	tandanis-	'chase'	Fi
ganhur-	'limit, demarcate'	H	kwazis-	'greet'	Fo7
katuk-	'flicker (flame)'	H			

An exhaustive list of the verbal extensions, both productive and unproductive, is given in (12).

⁵ Data sources are abbreviated as follows: D = Doke (1967), Fi = Fivaz (1970), Fo5 = Fortune (1955), Fo7 = Fortune (1967), H = Hannan (1981), M = Myers (1987). Data are given in the Standard Shona Orthography of Hannan (1981), though phonetic transcription is retained for the implosives and the velar nasal. The correspondence between orthography and pronunciation is generally very close. However, note that sv = labialised alveolar fricative [s^w], tsv = labialised alveolar affricate [ts^w], sh = voiceless palato-alveolar fricative [ʃ], ch = voiceless palato-alveolar affricate [tʃ] and v = voiced bilabial continuant [ʋ] (described as a fricative by Fortune 1955, but as an approximant by Hannan 1981 and Pongweni 1990). Vowel length (which is noncontrastive and appears only in the penultimate syllable, as a reflex of stress) and tone are omitted throughout.

Not all of these sources focus on the Zezuru dialect, but all of the roots cited are found in Zezuru, according to Hannan (1981).

(12) Shona verbal extensions (Doke 1967: 66–67)

-w, -iw/-ew	Passive	
-ir/-er	Applicative	
-ik/-ek	Neuter	
-is/-es, -y	Causative	
-idz/-edz	"	
-is/-es, -isis/-eses	Intensive	
-irir/-erer	Perfective	(from Fortune 1955; Doke says that the perfective does not exist in Shona)
-an	Reciprocal	
-uk/-ok, -uruk/-orok	Reversive	
-ur/-or, -urur/-oror	"	
-aur	Extensive	
-at	Contactive (not productive)	
-am, -ar	Stative (not productive, according to Doke)	

In (13)-(16), I give examples of derived root + extension combinations, taken from Fortune (1955). The (a) forms show surface mid vowels in extensions, while the (b) forms give extensions with surface high vowels. Alternating vowels are italicized.

(13) Root + applicative extension

a.	pera	'end'	per- <i>era</i>	'end in'
	tsveta	'stick'	tsvet- <i>era</i>	'stick to'
	sona	'sew'	son- <i>era</i>	'sew for'
	pona	'give birth'	pon- <i>era</i>	'give birth at'
b.	ipa	'be evil'	ip- <i>ira</i>	'be evil for'
	iata	'hold'	iat- <i>ira</i>	'hold for'
	vava	'itch'	vav- <i>ira</i>	'itch at'
	svetuka	'jump'	svetuk- <i>ira</i>	'jump in'
	pofomadza	'blind'	pofomadz- <i>ira</i>	'blind for'

(14) Root + neuter extension

a.	gona	'be able'	gon- <i>eka</i>	'be feasible'
	verẽga	'count'	verẽg- <i>eka</i>	'be numerable'
	chegeta	'keep'	cheget- <i>eka</i>	'get kept'
b.	kwira	'climb'	kwir- <i>ika</i>	'easy to climb'
	bvisa	'remove'	bvis- <i>ika</i>	'be easily removed'
	tarisa	'look at'	taris- <i>ika</i>	'easy to look at'

(15) Root + perfective suffix

a.	pota	'go round'	pot- <i>erera</i>	'go right round'
	cheka	'cut'	chek- <i>erera</i>	'cut up small'
	seka	'laugh'	sek- <i>erera</i>	'laugh on and on'
b.	pinda	'pass'	pind- <i>irira</i>	'to pass right through'
	iuãa	'come out'	iuã- <i>irira</i>	'to come out well'

(16)	Root + causative suffix			
a.	tonda	'face'	tond- <i>esa</i>	'make to face'
	sho~ga	'adorn self'	sho~g- <i>esa</i>	'make adorn'
	oma	'be dry'	om- <i>esa</i>	'cause to get dry'
b.	bvuma	'agree'	bvum- <i>isa</i>	'make agree'
	shamba	'wash'	shamb- <i>isa</i>	'make wash'
	pamha	'do again'	pamh- <i>isa</i>	'make do again'
	cheyama	'be twisted'	cheyam- <i>isa</i>	'make be twisted'

The data in (11)-(16) demonstrate that high and mid vowels in Shona are not freely distributed in the verbal system. Rather, the height of the root-initial vowel determines the height of any subsequent non-low vowels. If the initial vowel is [-high, +low], following [-low] vowels must share that [-high] specification; if the initial vowel is [+high], only the [+high] vowels *i* and *u* may appear subsequently. Forms such as *ceyamisa* 'make be twisted' and *pofomadzira* 'blind for' demonstrate that the low vowel *a* is opaque to harmony, constituting a barrier to the extension of a multiply-linked [high]. Following a low vowel, no further mid vowels may appear; instead, the typologically less marked high vowels are invariably found. The analysis of these facts is given in section 2.3.2.

2.3.2 Preliminaries: Markedness and Faithfulness Constraints in OT

The distribution of vowel height in Shona, and in many other Bantu languages with comparable harmony systems, is characteristic of positional neutralization. The distinction between high and mid vowels is maintained in root-initial syllables, giving a three-way height contrast, but high and mid vowels are not contrastive outside of the root-initial syllable. This positional restriction on segmental contrastiveness results from the interaction of featural markedness and faithfulness constraints, in the same way that language-wide inventory restrictions arise through markedness/faithfulness interaction (Prince & Smolensky 1993: Chapter 9).

I follow the proposals of Prince & Smolensky (1993) and Smolensky (1993), who argue that universal harmony scales, each of which encodes the relative markedness of all features along a particular dimension such as place of articulation or height, are reflected in the grammar by means of corresponding constraint subhierarchies. Various surveys of vowel

inventory structure (Crothers 1978, Disner 1984) indicate that the presence of mid vowels in an inventory implies the presence of high and low vowels, while the reverse is not true. The universal harmony scale which reflects this implication is given in (17), with the corresponding constraint dominance hierarchy in (18).

- (17) Height markedness: Harmony Scale
High, Low > Mid
- (18) Height markedness: Dominance Hierarchy⁶
*M_{ID} » *H_{IGH}, *L_{OW}

The constraints in (18) are instantiated as in (19)–(21) below.⁷

- (19) *M_{ID}: *[-high, -low]
- (20) *H_{IGH}: *[+high, -low]
- (21) *L_{OW}: *[-high, +low]

In addition to featural markedness constraints, UG includes a set of faithfulness constraints which regulate exactness of input-output identity in vowel height specifications. The faithfulness constraints relevant to the analysis of Shona are divided into two distinct types. The first type is instantiated in the context-free IDENT constraints of (22).

⁶ The relative markedness of high and low vowels is not clear. Jakobson (1941) and Greenberg (1966) both propose an $a > i > u$ implicational hierarchy, with the low vowel implied by the high front vowel. However, Disner (1984) suggests a hierarchy of $\{i, a\} > \{e, o\} > u$, based on the frequency of missing vowels in the 43 defective vowel systems in the UPSID inventory; here there is no implicational relationship between the high front and low vowels. Also, both high and low vowels are found as default segments cross-linguistically. (For example, a is the epenthetic vowel in Axininca Campa (Payne 1981) and Makkan Arabic (Abu-Mansour 1987), while high vowels are epenthetic or default segments in a variety of languages, including Yoruba (Pulleyblank 1988), Zulu (Beckman 1992), Nancowry (Radhakrishnan 1981) and various Arabic dialects (Itô 1989).) Given this indeterminacy, it seems likely that the ranking of *HIGH and *LOW must be subject to cross-linguistic variation.

⁷ For the sake of convenience, I adopt the Chomsky & Halle (1968) features for vowel height. For alternatives, see Clements (1991), Schane (1984), Selkirk (1991a,b). Steriade's (1995) discussion of Bantu height harmony is also relevant; she proposes a perceptual feature [nonperipheral] (supplementary to the articulatory features [high] and [low]) which characterizes mid vowels. [nonperipheral] may be indirectly licensed in non-initial syllables, via multiple linking.

- (22) IDENT(high)
 Let α be an input segment and β its output correspondent.
 If α is [ɣhigh], then β must be [ɣhigh].
 “An input segment and its output correspondent must have identical specifications for the feature [high].”
- IDENT(low)
 Let α be an input segment and β its output correspondent.
 If α is [ɣlow], then β must be [ɣlow].
 “An input segment and its output correspondent must have identical specifications for the feature [low].”

The second type of featural faithfulness constraint is a root-initial faithfulness constraint, as shown in (23). It is the dispersion of height faithfulness according to position which is responsible for the asymmetrical distribution of high and mid vowels in Shona.

- (23) IDENT- σ_1 (high)
 Let β be an output segment in the root-initial syllable, and α its input correspondent.
 If β is [ɣhigh], then α must be [ɣhigh].
 “An output segment in σ_1 and the input correspondent of that segment must have identical specifications for the feature [high].”

Because syllabification is reliably present only in output strings, the constraint is formulated with an output “focus”, in contrast to the context-free constraints of (22). In both cases, however, violations are incurred by any input-output mismatch in feature specifications; IDENT(high) and IDENT- σ_1 (high) are both violated equally by deletion of underlying specifications and by insertion of non-input values. Through interaction with the markedness constraints in (19)-(21), the constraints in (22)–(23) generate the surface patterns of height distribution which are attested in Shona.

2.3.3 Analysis: Positional Neutralization and Harmony

As outlined in Chapter 1, the positional restrictions on phonological inventory which are characteristic of positional neutralization result from the ranking schematized in (24).

- (24) Positional neutralization ranking schema
 IDENT-Position(F) » *F » IDENT(F).

This simple ranking permits the contrastive occurrence of a feature, F, in some prominent position; outside of that position, the ranking of *F above IDENT(F) rules out contrastive

occurrences of F. In Shona, all three vowel heights are contrastive in root-initial syllables, calling for the ranking in (25).

(25) IDENT- σ_1 (high), IDENT(low) » *MID » *HIGH, *LOW

The context-free IDENT(low) is high-ranking because (i) low vowels are free to occur in initial syllables, and (ii) in non-initial syllables, only the low vowel *a* is completely unfettered in its distribution. Low vowels do not raise, and non-low vowels do not lower; IDENT(low) is always satisfied.⁸

High and mid vowels are not distinctive non-initially; instead, they are predictable according to the height of a preceding vowel. Verbs containing a mid vowel in the root-initial syllable consist entirely of mid vowels, while the vowels in verbs whose initial syllable contains a high vowel are uniformly high. There are no verbs of the shape *CiCeC* or *CeCiC* in Shona. Further, if the root-initial syllable contains a low vowel, subsequent vowels may not be mid: **CaCeC*.⁹ These facts, taken together, argue for the ranking in (26).

(26) IDENT- σ_1 (high), IDENT(low) » *MID » *HIGH » IDENT(high)

The correctness of these rankings will be demonstrated in the following sections.

2.3.3.1 Vowel Height in Initial Syllables


I begin by demonstrating that the proposed ranking permits the full range of height contrasts in root-initial syllables. Because IDENT- σ_1 (high) and IDENT(low) dominate all of the featural markedness constraints, height specifications in the initial syllable will never deviate from their input values in order to better satisfy featural markedness constraints. This is shown in

⁸ For the sake of simplicity, I have omitted the positional constraint IDENT- σ_1 (low) throughout the discussion. Under the ranking in (25), positional IDENT- σ_1 (low) can have no visible effect in the grammar.

⁹ The Final Vowels constitute an exception to this generalization: a mid vowel *e* may appear after a low or high vowel *just in case* it is the mood-marking Final Vowel characteristic of Bantu verbal morphology. In Shona, final *-e* marks a number of different moods, including subjunctive, negative habitual and potential. The resistance of the Final Vowels to height harmony may reflect a high-ranking constraint which penalizes the loss of morphological distinctions (see the discussion of MORPHDIS in McCarthy & Prince 1995), or a domain restriction on constraint applicability. I will not attempt to resolve this issue here.


tableaux (27)–(29) below, where only the initial syllable is evaluated against the constraint hierarchy. Tableau (27) shows that mid vowels are permitted in initial syllables.¹⁰

(27) Initial mid vowels are permitted

/cheyam-a/	IDENT- σ_1 (high)	IDENT(low)	*MID	*HIGH	*LOW
a. 			*		
b.	*!			*	
c.		*!			*


IDENT(low) must dominate *MID in order to prevent lowering of an input mid vowel, as in (27c). Note that the lowered output satisfies IDENT- σ_1 (high), as the mid and low vowels are both [-high]. Now we turn to an initial high vowel example in (28).

(28) Initial high vowels are permitted

/bvis-a/	IDENT- σ_1 (high)	IDENT(low)	*MID	*HIGH	*LOW
a.	*!		*		
b. 				*	
c.		*!			*

Here again, the ranking prohibits deviations from underlying height specifications in the initial syllable; the fully faithful (28b) is optimal. Finally, the case of an initial low vowel is illustrated in (29).

(29) Initial low vowels are permitted

/shamb-a/	IDENT- σ_1 (high)	IDENT(low)	*MID	*HIGH	*LOW
a.		*!	*		
b.	*!	*!		*	
c. 					*


¹⁰ I assume that vowel features are organized along the lines suggested in Odden (1991), Clements (1991), and Clements & Hume (1995), with a vowel place node that dominates two dependent class nodes, Color and Aperture. Where relevant to constraint satisfaction, I will explicitly show an Aperture node (Clements 1991, Clements & Hume 1995); otherwise, I omit it in the interest of simplicity.

As expected, the faithful (29c) is optimal. Vowel height ranges freely over high, mid and low in the root-initial syllable, due to high-ranking initial syllable faithfulness.

2.3.3.2 Height in Non-initial Syllables

The ranking displayed in (27)–(29) generates the full range of height contrasts in the initial syllable, but it does not characterize the neutralization of the high-mid contrast in non-initial syllables. The latter arises from the ranking $*M_{ID} \gg *H_{IGH} \gg I_{DENT}(high)$. This ranking, when combined with the higher-ranking faithfulness constraints $I_{DENT}-\sigma_1(high)$ and $I_{DENT}(low)$, will ensure that only low or high vowels may follow an initial syllable containing a low or high vowel. This is illustrated with initial low vowels in (30) and (31), where hypothetical inputs are assumed.

(30) No mid vowels after initial low

/CaCeC/	$I_{DENT}-\sigma_1(high)$	$I_D(low)$	$*M_{ID}$	$*H_{IGH}$	$*L_{OW}$	$I_D(high)$
a.			*!		*	
b.			*!		*	
c. 				*	*	*
d.		*!			**	


The input low-mid sequence is prohibited, whether the low and mid vowels have separate specifications of [–high] (30a) or share a single [–high] (30b). This is due to the marked character of mid vowels. Each of the two candidates fatally violates $*M_{ID}$, by virtue of the [–high, –low] combination instantiated on the second vowel; the parasitism of the mid vowel on the [–high] of initial *a* cannot rescue it from a violation of $*M_{ID}$. This is because $*M_{ID}$ penalizes a feature combination, rather than an individual feature; in each case, the marked combination of [–high, –low] is instantiated. Candidate (30d), in which the non-initial vowel surfaces as low *a*, is also ruled out, in this case by $I_{DENT}(low)$.¹¹ This leaves (30c), in which “default” [+high] is

¹¹ A candidate parallel to (30d), but with a single, multiply-linked VPlace or Aperture node, would fare just as poorly on $I_{DENT}(low)$. In both cases, the input [–low] of the second vowel is changed to [+low] in the output form.

specified on the non-initial vowel, as optimal. Mid vowels may not follow a low vowel; an input mid vowel in this position will be realized as a [+high] vowel. Given an input with a low-high sequence, the candidate (30b) will also be preferred by the grammar. Of the non-low vowels, only those which are [+high] may follow *a*.

A non-initial low vowel is also permitted after an initial low vowel, as shown in (31).

(31) Low vowel licit after initial low

/CaCaC/	I _{DENT} -σ ₁ (high)	I _D (low)	*M _{ID}	*H _{IGH}	*L _{OW}	I _D (high)
a.		*!	*		*	
b.		*!		*	*	*
c.					**!	
d. 					*	
e.					**!	

Any deviation from the input low vowels incurs a fatal violation of I_{DENT}(low), as in candidates (31a,b). A comparison of (31c-e) reveals that multiple-linking of identical specifications under a single Aperture node is preferred to a sequence of independent Aperture nodes. “Vacuous” vowel harmony is optimal, because I_{DENT}(low) is not violated by multiple-linking, and because multiple linking of the Aperture node better satisfies the markedness constraint *L_{OW}. Such markedness constraints, which penalize feature combinations, are best satisfied when only a single token of the feature combination is instantiated in the representation, as in (31d). In such a configuration, there is a single class node which dominates the complex of features under consideration.

The feature-driven character of *F constraint evaluation was pointed out in McCarthy & Prince (1994a), and plays an important role in the Itô & Mester (1994) analysis of Lardil. In Shona, markedness reduction is also achieved via multiple-linking, though the linking in question involves superordinate class nodes, rather than single features such as Coronal or Labial. This is because the markedness constraints which drive multiple-linking are sensitive to the presence of

multiple cooccurring features, and multiple features are organized according to feature class.¹²

To give a unified formal characterization of constraint violation and satisfaction for featural markedness constraints of both the Lardil and Shona types, I propose the principle of Feature-Driven Markedness, as in (32). (See also Beckman 1997.)

(32) Feature-Driven Markedness

Let S denote a set of features $\{\alpha, \beta, \gamma, \dots\}$ and $*S$ a markedness constraint prohibiting the cooccurrence of the members of S .

$*S$ receives one violation-mark for each node N , where

- N dominates all features in S *and*
- there is no node M such that N dominates M and M also dominates all features in S .

For a singleton feature markedness constraint such as $*\text{CORONAL}$ where $S = \{\text{Coronal}\}$, the node N in (32) = Coronal, on the assumption that domination is a reflexive relation (Wall 1972, Bach 1974, Cushing 1978, Johnson 1978, Pullum & Zwicky 1978). One violation-mark for $*\text{CORONAL}$ would therefore be assessed for each occurrence of the feature Coronal in an output form; multiple feature specifications incur multiple violations of markedness constraints, while multiple linkings of a single feature do not. For example, a place-linked nasal+consonant cluster such as *nd* incurs only one violation of $*\text{CORONAL}$; the same cluster, when not place-linked, will incur two $*\text{CORONAL}$ violations.

- (33) a. One $*\text{CORONAL}$ violation b. Two $*\text{CORONAL}$ violations

This is exactly the sense in which place markedness violations are assessed in Itô & Mester (1994) and a host of other recent works, including Alderete *et al.* (1996); Beckman (1995, 1996), Lombardi (1995a,b) and Padgett (1995a,b).


In the case of markedness constraints which evaluate feature combinations, such as $*[-\text{high}, +\text{low}]$, $(*\text{LOW})$, $*[-\text{high}, -\text{low}]$ ($*\text{MID}$), etc., (32) calls for violations to be assessed for

¹² A treatment of Shona which adheres to the Feature Class Theory of Padgett (1995a,b), in which there are no geometric class nodes, will be somewhat different in character. Combinatory featural markedness constraints ($*[F,G]$) cannot be better satisfied by multiple-linking of a superordinate class node (versus multiple linking at the level of the individual features F, G), as there are no superordinate class nodes in FCT. A comparison of the two approaches is orthogonal to the matter at hand.

each discrete node which immediately dominates the relevant feature set. In the case of *LOW, the dominant node in question is the Aperture node. This distinguishes the harmonizing (31d) from the sequence of singly-linked identical vowels in (31c), and from the candidate with multiple Aperture nodes (31e). Feature-driven markedness effectively favors multiple-linking at higher levels of structure, in the case of feature cooccurrence constraints.¹³

With this understanding of featural markedness constraints, we turn to examples in which the initial syllable contains a high vowel. We saw above that the presence of a preceding low vowel will permit only high or low vowels in subsequent syllables. The same is true when the initial vowel is high; the constraint hierarchy permits only high or low vowels following an initial high vowel.

(34) Low vowel licit after initial high

/CiCaC/	IDENT-σ ₁ (high)	ID(low)	*MID	*HIGH	*LOW	ID(high)
a. 				*	*	
b.		*!	*	*		
c.		*!		**		*
d.		*!		*		*

Here, the identity of the input low vowel is protected by high-ranking IDENT(low). Because the constraint dominates *LOW, no change in underlying [+low] specifications is possible, regardless of their position within the word. With an input low vowel in the second syllable, only an output low vowel in that position is possible.

A high vowel is also permitted after a high vowel in the initial syllable. Consider the tableau in (35), where a sequence of input high vowels is examined.

¹³ See also the UNIQUE family of constraints proposed by Benua (1996), discussed in §2.3.4 below. UNIQUE constraints prohibit multiple-linking of phonological elements at various levels of structure from feature to class node. For example, UNIQUE(high) is violated by a multiply-linked [high] specification, while UNIQUE(Aperture) is violated by a shared Aperture node.


(35) High vowel licit after initial high

/CiCiC/	IDENT- σ_1 (high)	ID(low)	*MID	*HIGH	*LOW	ID(high)
a.				**!		
b. ɪ				*		
c.			*!			*
d.		*!			*	*

No deviation from the input high-high sequence is permitted. (35d) is ruled out by the violation of IDENT(low) incurred by the output *a*, and (35c) fatally violates *MID. Because *MID dominates the context-free IDENT(high), mid vowels are generally ruled out, unless protected by IDENT- σ_1 (high). Of the remaining candidates, (35b) is favored by virtue of the single *HIGH violation it incurs. Due to the feature-driven nature of markedness assessment (32), multiple-linking is again favored.

Because IDENT(high) is very low-ranking, the ranking of *MID shown in (35) will rule out full faithfulness to an input high-mid sequence, just as it ruled out (35c) above. This is demonstrated in (36).

(36) Mid vowel illicit after initial high

/CiCeC/	I _{DENT} -σ ₁ (high)	I _D (low)	*M _{ID}	*H _{IGH}	*L _{OW}	I _D (high)
a.				**!		*
b. 				*		*
c.			*!			
d.		*!			*	
e.	*!		*			*


Here, just as in (35), the output candidate with two high vowels which share an Aperture node (36b) is optimal, even though the input here includes a mid vowel. The height of the initial vowel is never subject to change (as in (36e)), due to undominated I_{DENT}-σ₁(high). With a necessarily invariant vowel in the initial syllable, height harmony is forced in subsequent syllables by the ranking of the markedness constraints in the midst of the I_{DENT}(high) subhierarchy.

There are three consequences of the proposed constraint ranking that have been established thus far. First, vowel height in initial syllables is fully contrastive and may vary freely. Second, height in non-initial syllables is limited to high or low when preceded by a low initial vowel. This is a kind of “emergence of the unmarked” effect (McCarthy & Prince 1994a): if the vowels cannot be of identical height (i.e., if the input contains a low-high or low-mid sequence), then only the less marked of the non-low vowels may occur in non-initial position. (Recall that complete identity of height features is prevented in such cases by high-ranking I_{DENT}(low).) Finally, height in non-initial syllables is restricted to high or low when preceded by a high initial vowel. Input mid vowels may not surface in this environment because of the ranking of *M_{ID} » I_{DENT}(high); height harmony is the result.

Now we can turn to the distribution of vowel height following an initial mid vowel. Only mid or low vowels may immediately follow an initial mid vowel; high vowels do not appear in

this position.¹⁴ Thus, we find forms such as *ce~geta* ‘keep’, *sho~gesa* ‘make adorn’, *ponera* ‘give birth at’, *pofomadza* ‘blind’ and *ceyama* ‘be twisted’, but not **ce~gita*, **ponira*, or other comparable examples. It is clear that non-low vowels must agree in height, while the low vowels may occur freely. These restrictions also follow from the constraint hierarchy presented above. The tableau in (37) illustrates the simple case of a low vowel appearing after an initial mid vowel.

(37) Low vowel licit after initial mid

/CeCaC/	IDENT-σ ₁ (high)	I _D (low)	*MID	*HIGH	*LOW	I _D (high)
a. 			*		*	
b.		*!	*			
c.		*!	*	*		*
d.	*!			*	*	*


High-ranking I_{DENT}(low) and I_{DENT}-σ₁(high) combine forces to rule out any unfaithful surface rendering of the input vocalism in this case. The low vowel may not be raised, as in (37b,c), due to undominated I_{DENT}(low); the initial mid vowel cannot be raised because of undominated I_{DENT}-σ₁(high). (The initial vowel cannot be lowered, either, again because of I_{DENT}(low).) The fully faithful (37a) is optimal—low vowels may occur freely after mid vowels.¹⁵

The more interesting case to examine is the prohibition on a high vowel following an initial mid. The constraint ranking established above will correctly generate height harmony, given an input sequence of mid + high. This is illustrated in (38).

¹⁴ With the exception noted above, that round *u* does not harmonize with a preceding *e*. An analysis of this gap is presented in Beckman (1997).

¹⁵ Here, as in (30), the outcome is not affected if the mid and low vowel share only [-high].

(38) Height harmony from a mid + high sequence


/CeCiC/	IDENT- σ_1 (high)	ID(low)	*MID	*HIGH	*LOW	ID(high)
a.		*!	*		*	*
b. 			*			*
c.			*	*!		
d.			**!			*
e.	*!			*		*

Candidates (38a,e) fail on undominated height faithfulness constraints, (38a) because the input high vowel is lowered in the output, thereby violating IDENT(low). (38e) fails because the initial mid vowel surfaces as a high vowel in the output, thus incurring a violation of IDENT- σ_1 (high). This leaves (38b,c,d) as contenders. Candidate (38d) exhibits apparent height harmony, in that the input high vowel has been lowered to mid. However, the existence of two discrete height specifications in this candidate results in a fatal violation of *MID. (38b) and (38c) tie on *MID, but the fully faithful (38c) incurs a fatal violation of *HIGH that (38b) does not suffer. This establishes the crucial ranking *HIGH » IDENT(high).

In order to complete the analysis of the distribution of height following initial mid vowels, we must examine forms such as *pofomadzira* ‘blind for’ and *cheyamisa* ‘make be twisted’. In these words, a high vowel appears in the verbal extensions after the low *a*, although the initial vowel is mid; the pattern *CeCaCe* does not occur. This is a regular property of height distribution in Shona, and is explained in much the same way as the absence of *CaCeC* sequences in general. This is shown in (39).¹⁶

¹⁶ Candidates which incur violations of the No Crossing Constraint (Goldsmith 1976) are not considered; I assume that line crossing is universally ill-formed and therefore not admitted in any candidates.

(39) Low vowels are opaque to harmony

/CeCaCiC/	$I_{D-\sigma_1}(\text{high})$	$I_{D}(\text{low})$	*M _{ID}	*H _{IGH}	*LOW	$I_{D}(\text{high})$
a. 			*	*	*	
b.			**!		*	*
c.		*!	*			*

Either candidate in which the [-high] of the initial mid vowel is multiply-linked to the rightmost vowel fatally violates some high-ranking constraint. In the case of (39c), the relevant constraint is $I_{DENT}(\text{low})$; raising the intervening vowel from low to mid minimizes violations of *M_{ID}, but fails on the higher-ranking faithfulness constraint. The linking in (39b) incurs two violations of *M_{ID}, as there are two distinct instances of [-high, -low], dominated by two Aperture nodes. Candidate (39a), with only one *M_{ID} violation, is optimal; only [+high] non-low vowels may follow *a*. Low vowel opacity results from high-ranking $I_{DENT}(\text{low})$, and from the role of *M_{ID} in limiting the distribution of mid vowels. Sharing only [-high] with a preceding low vowel does not save a mid vowel from fatally violating *M_{ID}.

2.3.4 Conclusions and Implications

The preceding discussion has demonstrated that positional neutralization of height contrasts in Shona verbs arises through the interaction of markedness and faithfulness constraints. The privileged licensing status of the root-initial syllable results from high-ranking $I_{DENT-\sigma_1}(\text{high})$, which forces input-output correspondence in the root-initial position, even for the more marked mid vowels. This is due to the ranking of $I_{DENT-\sigma_1}(\text{high})$ above both of the featural markedness constraints *M_{ID} and *H_{IGH}.

The crucial role of the positional faithfulness constraint $I_{DENT-\sigma_1}(\text{high})$ emerges most clearly when we compare the effects of the proposed ranking on two similar classes of input, shown in (30) and (37). In one case, that of (30), a low-mid sequence (CaCeC) occurs in the input. Such inputs can never surface intact; the non-initial vowel must emerge as a high vowel.

(Thus, the language includes roots such as *charuk-*, *tandanis-* and *ganhur-*, but no comparable forms containing mid vowels: **charok-*, **tandanes-*, **ganhor-*, etc.). By contrast, the opposite ordering of vowels (mid-low) may surface without incident: for example, input /*cheyam-*/ corresponds to output *cheyam-*. Each of the faithful output types, schematically *CaCeC* and *CeCaC*, fares equally well on the markedness constraints **M_{ID}* and **L_{OW}*. It is the *location* of the marked mid vowel which is crucial in differentiating the two forms: a free-standing mid vowel is permitted if and only if it occurs in the root-initial syllable.

Positional faithfulness is crucial to an account of this difference; it cannot be derived by replacing *IDENT-σ₁*(high) with a high-ranking *ALIGN*(high) constraint. To see this, consider the constraint in (40) below, and its application in tableaux (41) and (42). (For the purposes of demonstration, I assume that the remaining constraints and their rankings are fixed.)

- (40) *ALIGN*([high], L, Root, L)¹⁷
 “Every [high] specification must be left-aligned with a root.”

Such a constraint will favor sharing of [-high] between mid and low vowels, regardless of their input position. This derives the correct results in the case of a mid-low input, as in (41).

- (41) [-high] is multiply linked

Input:	<i>ALIGN-L</i> (high)	<i>ID</i> (lo)	<i>*M_{ID}</i>	<i>*H_{IGH}</i>	<i>*L_{OW}</i>	<i>ID</i> (high)
a.	*!		*		*	
b.		*!	*			
c. ☞			*		*	

Candidate (41c), in which [-high] is shared by all output vowels, fares best in this circumstance, as there are no [high] specifications which are not left-aligned. Each of the other plausible output candidates fails on a high-ranking constraint, either *ALIGN-L* or *IDENT*(low).

¹⁷ For representative examples of the use of *ALIGN*(F) constraints in the analysis of harmony phenomena, see Kirchner (1993), Akinlabi (1994, 1995), Pulleyblank (1993, 1994), Ringen & Vago (1995a, b), Beckman (1994b) and Cole & Kisseberth (1995a,b).

I consider only *ALIGN-LEFT* here, as the initial position of the mid vowel is what is at issue.

Now consider a case in which the order of the two input vowels is reversed, as in (42).

(42) Low-mid input sequence

Input:	ALIGN-L(high)	ID(low)	*MID	*HIGH	*LOW	ID(high)
a.	*!		*		*	
b.		*!	*			
c. ●*			*		*	

In this scenario, the constraint hierarchy incorrectly selects candidate (42c). There is no possible ranking of the constraints which can correctly select (41c), but rule out (42c). By contrast, positional faithfulness accounts for the asymmetry, protecting a free-standing mid vowel if and only if it originates in the root-initial syllable.¹⁸

Turning now to inputs containing only mid or high vowels, I have shown that the persistence of initial values of [high] through vowel harmony follows from the ranking of both of the markedness constraints *MID and *HIGH above IDENT(high), and from the feature-driven character of markedness constraint evaluation. Following the principle of Feature-Driven Markedness (32), multiple instances of a node or feature incur more violations than a single instance of a node or feature. In Shona, a single multiply-linked Aperture node dominating some combination of [high] and [low] is more harmonic than two or more individual Aperture nodes dominating the same feature specifications. Thus, feature sharing occurs whenever possible, resulting in uniform height in the output; input *e...i* surfaces as *e...e* (38), while underlying *i...e* surfaces as *i...i* (36).

The markedness constraints themselves, rather than a harmony-favoring constraint such as ALIGN(high) or SHARE(high), favor multiple-linking in Shona. The key role of the markedness constraints in Shona harmony highlights an important point: the absence of feature-sharing in

¹⁸ Positional faithfulness differs from positional licensing in this regard, in that a positional licensing approach favors movement of offending features or segments to privileged positions without regard for their place of origin.

languages which do not exhibit vowel harmony cannot be derived simply by assuming low-ranking ALIGN(F) constraints. Other constraints in the grammar, such as featural markedness constraints, will also favor multiple linking as a means of best satisfaction of the constraint hierarchy; this is the case in Shona. Low-ranking of ALIGN(F) alone cannot guarantee that feature-sharing will be ruled out. Rather, UG must contain a constraint or constraints banning multiple-linking; when such constraints dominate the relevant markedness constraints (such as *LOW, *CORONAL ALIGN(high), etc.), we have a language which does not permit multiple-linking as a means of reducing featural markedness. With the opposite ranking, multiple-linking is allowed, in order to minimize violation of featural markedness or alignment constraints.

Following Benua (1996), I assume that the constraint which penalizes multiple-linking is UNIQUE, shown in (43) below.¹⁹

- (43) UNIQUE
 $\forall x, x$ a feature or class node, x must have a unique segmental anchor y .

In a language such as Shona, which permits multiple linking of features, UNIQUE is dominated by the harmony-driving constraints, as shown in (44) below.

- (44) Dominated UNIQUE permits multiple-linking

/CeCiC/	ID- σ_1 (high)	*MID	*HIGH	*LOW	UNIQUE	ID(high)
a.		*			*	*
b.		*	*!			
c.		**!				*

In candidate (44a), one violation is incurred by each Aperture node which is multiply-linked; because there is one Aperture node which is shared, one violation is assessed. By contrast,

¹⁹ Because a language may prohibit one type of multiple linking, such as the linking of vowel features in vowel harmony, but permit another (e.g., coda place assimilation), different UNIQUE(F) constraints may be required to regulate the linking of different feature classes. This is the approach adopted in Benua (1996), where both UNIQUE(F) and UNIQUE(Class) constraints are proposed.

UNIQUE differs from earlier proposals in which multiple-linking is regulated (e.g. the Multiple Linking Constraint of Selkirk 1991a and the UNIFORM(F) constraint of Kaun 1995), in that UNIQUE is not sensitive to the featural content of the segments to which a feature is linked.

there are no UNIQUE violations in candidates (44b,c). Candidate (44a) is optimal because UNIQUE is dominated by both *MID and *HIGH; multiple linking is optimal.

Conversely, if UNIQUE » *HIGH, multiple linking will be prohibited. Under such a ranking (characteristic of a language other than Shona), candidate (44b), with the unmarked [+high] vowel in the non-privileged position, is optimal. This is shown in (45).

(45) High-ranking UNIQUE prohibits multiple-linking

/CeCiC/	<small>ID-σ₁</small> (high)	<small>*MID</small>	<small>UNIQUE</small>	<small>*HIGH</small>	<small>*LOW</small>	<small>ID</small> (high)
a.		*	*!			*
b. 		*		*		
c.		**!				*

Candidate (45b) is optimal, due to the absence of multiply-linked nodes; (45a) fatally violates UNIQUE. The pattern of vowel height distribution in (45b) is typical of positional neutralization without harmony: a relatively marked element is permitted in a privileged position, such as the initial syllable, but cannot be created in other positions via multiple-linking. Such patterns are common cross-linguistically, and arise from high-ranking markedness constraints, along with high-ranking UNIQUE. One example of such a system, Tamil, will be examined in detail in §2.4. In Tamil, as in Shona, mid vowels are contrastive only in root-initial syllables. However, Tamil does not permit multiple-linking of height features, by virtue of high-ranking UNIQUE.

2.4 Initial Syllable Effects in Tamil

2.4.1 Introduction

Tamil, a South Dravidian language spoken in India and Sri Lanka, illustrates a number of interesting and complex initial-syllable faithfulness effects at the level of features, and at the level of syllable structure. Tamil root-initial syllables differ from their non-initial counterparts in permitting features and/or feature combinations that may not occur non-initially. For example, though high, mid and low short vowels may occur in root-initial syllables, only high and low

vowels may occur non-initially. Similarly, short round vowels are limited to initial syllables; elsewhere, only unrounded vowels occur. Finally, only initial syllable codas may have a place of articulation, one which is Coronal, which is independent from that of the following syllable onset. Codas in non-initial syllables must be homorganic to a following onset.²⁰

I will argue in the following sections that each of these positional restrictions arises from the interaction of a high-ranking IDENT- σ_1 constraint with a variety of markedness constraints, and with the other faithfulness constraints provided in UG. The neutralization of vowel height distinctions, for example, is a result of the ranking IDENT- σ_1 (high) » *MID » IDENT(high), just as in Shona.

The analysis of the initial/non-initial asymmetry in coda point of articulation will demonstrate the interaction of *two* types of positional faithfulness constraints. One is the familiar IDENT- σ_1 (F), and the second is IDENT-ONSET(F). As we saw in Chapter 1, IDENT-ONSET(F) calls for enhanced faithfulness in syllable onsets, positions which are perceptually privileged by virtue of their release (a point originally made, for laryngeal features, in Kingston 1985, 1990).²¹ Much of the acoustic information which signals the presence of contrastive consonantal features such as laryngeal state and place of articulation is carried in the segmental release burst. In coda position, where release bursts are typically absent²², reliable cues to phonological contrast are dramatically reduced. In the positional faithfulness theory of contrast and neutralization which is proposed here, syllable onsets, which are perceptually prominent by virtue of their release burst, are a locus of enhanced faithfulness. Enhanced onset faithfulness, via IDENT-ONSET(F), has two effects. High-ranking IDENT-ONSET(F) permits a broad range of phonological contrasts in onset position, and it renders onsets resistant to many phonological processes. Codas, lacking release,

²⁰ There is an additional asymmetry which is discussed in Chapter 5: Initial syllables may have complex codas, but non-initial syllables are permitted only one coda consonant.

²¹ As noted in Chapter 1, "IDENT-ONSET" is something of a simplification here, as consonants in complex onset clusters often do not have uniform release properties. In many languages, onset consonants are released only if they precede a tautosyllabic sonorant. (See Kingston 1985, 1990 and Lombardi 1991 for discussion.) Although formulation as IDENT-RELEASE may be more precise, I will retain the nomenclature of IDENT-ONSET here, as the further subtleties of the onset vs. release distinction are not relevant in Tamil. (There are no complex onsets in the language.)

²² But see Selkirk (1982) for discussion of French, where coda consonants are released.

are accorded no special faithfulness properties; consequently, codas often display a reduced segmental inventory, relative to onsets, and often undergo assimilation. (See Lombardi 1995a,b; Padgett 1995b; Jun 1995 for recent OT applications of onset faithfulness in the analysis of assimilation and neutralization, and Steriade 1993c for related discussion of segmental release and its relevance to positional neutralization. Early works recognizing the importance of release in phonological representation include McCawley 1967 and Selkirk 1982.)

The specific positional faithfulness constraints which account for the Tamil coda asymmetries are $\text{IDENT-}\sigma_1(\text{Place})$ and $\text{IDENT-ONSET}(\text{Place})$.²³ These constraints favor output maintenance of underlying Place contrasts in onsets, and in root-initial syllables. Through interaction with the place markedness subhierarchy of Prince & Smolensky (1993), and with the syllable markedness constraint NOCODA (favoring open CV syllables), exactly the Tamil pattern of facts is generated. A significant result emerges from this investigation: a distinct Coda Condition on consonantal place of articulation (Itô 1986; Goldsmith 1989, 1991; Itô & Mester 1993, 1994; Lombardi 1995b) is unnecessary. The effects of the Coda Condition arise from the interaction of positional faithfulness, featural markedness and NOCODA .

The remainder of this section is organized as follows. I begin with an overview of the consonant and vowel inventories of the language, and then turn to an analysis of the positional neutralization and positionally-determined allophony in the vowel system in §2.4.3. A positional faithfulness analysis of coda consonants is presented in §2.4.4, and contrasted with markedness-based approaches to coda licensing in §2.4.5.

2.4.2 Language Background

Before considering the details of the Tamil analysis, a few words regarding the language and the data sources are in order. The primary source of data and generalizations for recent work on Tamil phonology is Christdas (1988), who describes her own dialect, spoken in the Kanniyakumari district, at the southern edge of the Indian state of Tamilnadu. Christdas' data

²³ Here I assume that constraints may regulate entire *feature classes*, though nothing crucially hinges on this assumption. See Padgett (1995a,b) for a discussion of feature classes and their role in Optimality Theoretic constraints.

form the basis of the investigation of syllable structure conducted by Schafer (1993), and for a variety of studies conducted by Wiltshire (Bosch & Wiltshire 1992; Wiltshire 1992, 1994, 1995, 1996). Christdas' forms are supplemented in the latter cases by Wiltshire's field notes, in which data are drawn from Tamil speakers native to the central and northern regions of Tamilnadu.

2.4.2.1 Segmental Inventory

Tamil, like many of the languages of India, has an elaborate consonant system in which many places of articulation are contrastive. The underlying consonant inventory, as described by Christdas (1988), is given in (46) below. Geminates (stops and non-rhotic sonorants) may also occur contrastively.

(46) Tamil consonant phonemes²⁴

	<u>Labial</u>	<u>Dental</u>	<u>Alveolar</u>	<u>Retroflex</u>	<u>Palatal</u>	<u>Velar</u>
Stops	p	t̪	t	ʈ	c j	k
Contin.			s	ʂ		
Nasals	m		n	ɳ	ɲ	
Laterals			l	ɭ		
Rhotics			@ r̥	ʀ		
Approx	ä				y	

The surface inventory of segments in Tamil is somewhat more extensive. Although voicing is not contrastive in the language, voiced and partially voiced allophones of the obstruents do appear in surface representation. Additionally, there are palatalized velar sounds (represented here as post-palatal, in accord with Christdas' terminology), and nasals occur predictably at the dental and velar places of articulation. In general, the voiced continuant allophones of the stops appear intervocalically, while the voiced stop allophones occur after a nasal.

²⁴ I have slightly modified the transcription system employed by Christdas; retroflex segments are represented with single characters, rather than with the subdot diacritic. Also, the use of underlining to indicate alveolar place of articulation has been abandoned. The bridge diacritic is used for the dental segments, and three distinct characters are used to represent the three rhotic segments.

(47) Tamil surface consonants

	<u>Labial</u>	<u>Dental</u>	<u>Alv.</u>	<u>Retrofl.</u>	<u>Palatal</u>	<u>Post-Pal.</u>	<u>Velar</u>	<u>Glottal</u>
Stops	p b	tʃ dʒ	t d	ʔ ɻ	c j	kʰ	k g	ɖ
Contin.	ʔ	ʔ	s	ɻ		ç	x	
Nasals	m	nʒ	n	-	ɲ		ŋ	
Laterals			l	ɻ				
Rhotics			@ r~	ʌ				
Approx.	w ä				y			

The vowel system of Tamil is relatively simple; there are five underlying vowel qualities, each of which may be long or short. The relative tenseness of the mid vowels varies with length.²⁵

(48) Tamil vowels

	<u>Front</u>	<u>Back</u>
High:	i, ii	u, uu
Mid:	e, ee	o, oo
Low:		a, aa

In non-initial syllables, short /i/ and /u/ are pronounced as [ɪ] and [ʊ], respectively; short /a/ is realized as [ɛ], described by Christdas (1988: 176) as fronted and non-low.²⁶ The short mid vowels /e/ and /o/ simply do not occur outside of the root-initial syllable. Of the long vowels, apparently only /aa/ occurs with regularity outside the initial syllable (Christdas 1988: 174).

2.4.3 Vowel Features and Positional Faithfulness

2.4.3.1 Introduction

I will begin with an analysis of vowel feature distribution in non-initial syllables, confining the discussion to the short vowel system.²⁷ There are two properties of the short vowel system which are of interest. First, as noted above, short mid vowels are not permitted outside of root-

²⁵ There appears to be a tense/lax variation correlated with length in each of the long/short vowel pairs. Wiltshire (1994, 1995, 1996) consistently transcribes /a/ as [v], /u/ as [U] and /i/ as [ɪ] in initial syllables, and as [ʌ], [ɪ] and [ʊ] elsewhere. Underlying long vowels are transcribed by Wiltshire as short, but tense: /oo/ = [o], /ii/ = [i], etc.

Increased duration is also a property of the phonologically long vowels. Balasubramanian (1980: 463) measured vowel duration for phonologically short and long vowels in a variety of syllable structures. For all of the vowels measured, the long vowel had a duration approximately twice that of the corresponding short vowel.

²⁶ Asher (1985: 218) characterizes /a/ in final syllables as [ʌ], "half-open to open".

²⁷ In the absence of definitive data regarding long vowel distribution, no reliable analysis can be provided.

initial syllables in Christdas' dialect of Tamil; there are no roots which contain a non-initial *e* or *o*. While the words in (49a) are well-formed, there are no Tamil words like those in (49b).

- (49) a. Mid vowels in σ_1 (Christdas 1988:176) b. No mid vowels outside σ_1
- | | | |
|------------------|------------|-------|
| t'@} | 'street' | *tu@' |
| p'@é | 'room' | *pa@' |
| kø}s | 'mosquito' | *kusø |
| pø@ _I | 'fry' | *pi@ø |

Short *e* and *o* are rare or non-existent in the grammatical morphemes, as well, at least in Christdas' dialect.²⁸ This is clearly a categorical restriction: vowels in non-initial syllables must be drawn from the periphery of the vowel height continuum, avoiding the more marked mid vowels *e* and *o*.

In addition to positional neutralization of vowel height, the short vowels also exhibit contextual allophony: vowel variants in non-initial syllables are lax and centralized. The high back vowel, realized as round *u* in initial syllables, is unrounded } in non-initials. Phonemic *i* and *a* are similarly reduced; the various surface realizations of the vowels are shown in (50) below.

(50) Tamil vowel realizations

Initial σ	Non-initial σ
i	I
u	}
a	é
´	—
ø	—

This type of contextual allophony, here linked to the initial/non-initial syllable distinction, is of a different character from the sort of positional neutralization that characterizes the distribution of height features in Tamil. No contrasts are being lost or eliminated; there is simply a contextually determined variation in the realization of the vowels of the high and low vowels. I will return to a

²⁸ Asher (1985) shows a final *e* in many of the case markings where Christdas gives underlying /ay/, surface é. Asher indicates a regional bias toward the speech of the North Arcot District of Tamilnadu, and it is not clear whether the transcriptions reflect phonemic or phonetic forms. Asher indicates that /e/ rarely occurs in word-final position for North Arcot speakers, and is frequently replaced by *a*.

There is one reliable source of non-initial *e*, even in Christdas' forms. Underlying /an/ surfaces as [e~] in phrase-final position, by virtue of a final nasal deletion process. In other dialects, this behavior is paralleled by final /am/, which surfaces as [ø~]. The coronality and labiality of the nasals are apparently absorbed by the preceding vowel under deletion or coalescence, resulting in the otherwise impermissible surface mid vowels.

discussion of this type of allophony in §2.4.3.3 below, after providing an analysis of the positional neutralization of vowel height.

2.4.3.2 Positional Neutralization of Height Contrasts

In Tamil, the absence of contrastive mid vowels in non-initial syllables derives from the interaction of the same faithfulness and markedness constraints which were relevant in Shona. These are repeated in (51) below.

(51) Faithfulness and markedness constraints, Tamil height system

$I_{\text{IDENT}}(\text{high})$

Correspondent segments in output and input have identical values for the feature [high].

$I_{\text{IDENT}}(\text{low})$

Correspondent segments in output and input have identical values for the feature [low].

$I_{\text{IDENT-}\sigma_1}(\text{high})$

A segment in the root-initial syllable in the output and its correspondent in the input must have identical values for the feature [high].

* M_{ID} : *[-high, -low]

* H_{IGH} : *[+high, -low]

* L_{OW} : *[-high, +low]

Through constraint interaction, the constraints in (51) will result in the restricted distribution of mid vowels in Tamil. In this language, just as in Shona, the constraint subhierarchy which is relevant is the positional neutralization subhierarchy schematized in (52). The specific instantiation which accounts for the Tamil facts is given in (53).

(52) Positional neutralization subhierarchy, general schema

$I_{\text{IDENT-Position}}(F) \gg *F \gg I_{\text{IDENT}}(F)$

(53) Positional neutralization subhierarchy, Tamil

$I_{\text{IDENT-}\sigma_1}(\text{high}) \gg *M_{\text{ID}} \gg I_{\text{IDENT}}(\text{high})$

The application of the ranking in (53) will be demonstrated in the following discussion.

The most basic fact to be accounted for is the free distribution of vowel height in root-initial syllables. High, mid and low vowels are all permitted in this position. This indicates that $I_{\text{IDENT-}\sigma_1}(\text{low}), I_{\text{IDENT-}\sigma_1}(\text{high}) \gg *M_{\text{ID}} \gg *H_{\text{IGH}}, *L_{\text{OW}}$; faithfulness to vowel height

specifications in the root-initial syllable takes precedence over markedness considerations.

Examples for each of the three heights are given in tableaux (54)-(56) below.

(54) Initial mid vowels are permitted

/te@ uä/	IDENT- σ_1 (high)	IDENT- σ_1 (low)	*MID	*HIGH	*LOW
a.			*	*	
b.	*!			**	
c.		*!		*	*

Either raising (54b) or lowering (54c) of the input mid vowel will better satisfy the markedness constraint *MID, but at the expense of the high-ranking positional faithfulness constraints. Mid vowels are therefore licit in initial syllables. As tableaux (55) and (56) show, high and low vowels are also licit in this context.

(55) Initial high vowels are licit

/ci@ iy/ 'laugh'	IDENT- σ_1 (high)	IDENT- σ_1 (low)	*MID	*HIGH	*LOW
a.				**	
b.	*!		*	*	
c.	*!	*!		*	*

Here again, the ranking prohibits deviations from underlying height specifications in the initial syllable; the fully faithful (55a) is optimal. Finally, the case of an initial low vowel is illustrated in (56).

(56) Initial low vowels are permitted

/ma@ am/ 'tree'	IDENT- σ_1 (high)	IDENT- σ_1 (low)	*MID	*HIGH	*LOW
a.					**
b.	*!	*!		*	*
c.		*!	*		*

As expected, the faithful (56a) is optimal. No deviations in height are permitted in root-initial syllables, regardless of the input height.

The situation in non-initial syllables is somewhat different. While high and low vowels are permitted in this position, mid vowels are not. This restriction on mid vowel distribution implicates the positional neutralization ranking shown in (57).

(57) $I_{\text{DENT}}\text{-}\sigma_1(\text{high}), I_{\text{DENT}}\text{-}\sigma_1(\text{low}) \gg *M_{\text{ID}} \gg I_{\text{DENT}}(\text{high}), I_{\text{DENT}}(\text{low})$



The freedom of high and low vowels to occur in non-initial syllables derives from the ranking of $I_{\text{DENT}}(\text{high})$ and $I_{\text{DENT}}(\text{low})$ above the markedness constraints $*H_{\text{IGH}}$ and $*L_{\text{OW}}$. These vowels are not positionally restricted in distribution, even following an initial mid vowel. The elaborated constraint subhierarchy in (58) will account for this distribution.

(58) $I_{\text{DENT}}\text{-}\sigma_1(\text{high}), I_{\text{DENT}}\text{-}\sigma_1(\text{low}) \gg *M_{\text{ID}} \gg I_{\text{D}}(\text{high}), I_{\text{D}}(\text{low}) \gg *H_{\text{IGH}}, *L_{\text{OW}}$

In the remainder of this section, I will demonstrate the consequences of (58), beginning with the restriction on mid vowels.

Just as in Shona, mid vowels are not contrastive in non-initial syllables in Tamil. This follows very simply from the ranking of $*M_{\text{ID}}$ above $I_{\text{DENT}}(\text{high})$, as shown in (59) below. (A hypothetical root is considered.)

(59) Non-initial mid vowels are prohibited


/pu@e/	$I_{\text{DENT}}\text{-}\sigma_1(\text{high})$	$I_{\text{DENT}}\text{-}\sigma_1(\text{low})$	$*M_{\text{ID}}$	$I_{\text{D}}(\text{high})$	$I_{\text{D}}(\text{low})$
a.			*!		
b. 				*	
c. 					*

The violation of high-ranking $*M_{\text{ID}}$ in (59a) is fatal. Input mid vowels in non-initial syllables will surface as either high or low, depending upon the relative ranking of the context-free $I_{\text{DENT}}(\text{high})$ and $I_{\text{DENT}}(\text{low})$ constraints. Under such circumstances, the principle of Lexicon Optimization (Prince & Smolensky 1993) favors input representations which do not include mid

vowels in non-initial syllables. In essence, the language learner will never posit inputs like that in (59). An input high or low vowel in the second syllable will always yield a more harmonic input-output mapping for such forms.

In contrast to the mid vowels, high or low vowels are permitted outside of the initial syllable. This is due to the ranking of $I_{\text{IDENT}}(\text{high})$, $I_{\text{IDENT}}(\text{low})$ above the markedness constraints $*\text{HIGH}$, $*\text{LOW}$. The consequences of the full ranking are demonstrated in (60), where the input includes a non-initial high vowel.


(60) Non-initial high vowels are permitted

/munliy/	$I_{\text{IDENT}}\text{-}\sigma_1(\text{high}),$ $I_{\text{IDENT}}\text{-}\sigma_1(\text{low})$	$*\text{MID}$	$I_{\text{D}}(\text{high})$	$I_{\text{D}}(\text{low})$	$*\text{HIGH}$	$*\text{LOW}$
a. 					**	
b.		*!	*		*	
c.			*!	*!	*	*

Any lowering of the input high vowel in the second syllable incurs a fatal constraint violation. Candidate (60b) violates $*\text{MID}$, and (60c) violates both of the context-free faithfulness constraints. There is no motivation from a higher-ranking markedness constraint to deviate from the input height specification; the fully faithful (60a) is optimal.

The behavior of non-initial low vowels is exactly parallel to that of the high vowels, as shown in (61) below.

(61) Non-initial low vowels are permitted

/ma @ am/ 'tree'	$I_{\text{IDENT}}\text{-}\sigma_1(\text{high}),$ $I_{\text{IDENT}}\text{-}\sigma_1(\text{low})$	$*\text{MID}$	$I_{\text{D}}(\text{high})$	$I_{\text{D}}(\text{low})$	$*\text{HIGH}$	$*\text{LOW}$
a. 						**
b.			*!	*!	*	*

c.		*!	*	*
----	--	----	---	---

Here, again, full faithfulness is optimal, as there is no constraint dominating $\text{IDENT}(\text{high})$, $\text{IDENT}(\text{low})$ which would favor an unfaithful output.

Thus far, I have demonstrated that the constraint subhierarchy in (58) will allow high and low vowels to occur in any structural position, due to the ranking $\text{IDENT}(\text{high}), \text{IDENT}(\text{low}) \gg *_{\text{HIGH}}, *_{\text{LOW}}$. Mid vowels are also correctly permitted in initial syllables, but prohibited in non-initial syllables. This follows from the ranking $\text{IDENT}-\sigma_1(\text{high}), \text{IDENT}-\sigma_1(\text{low}) \gg *_{\text{MID}} \gg \text{IDENT}(\text{high}), \text{IDENT}(\text{low})$. However, there is one class of candidates that has not been examined thus far: those in which the height features of a non-initial mid vowel are shared with a mid vowel in the initial syllable, as in (62) below.

(62)

This configuration is not licit in Tamil, though it is well-formed in Shona. Vowel harmony is not possible in Tamil.

The distinction between Shona, which permits height harmony, and Tamil, which does not, lies in the relative ranking of the UNIQUE constraint. In Shona, UNIQUE is dominated by the markedness constraints $*_{\text{MID}}$ and $*_{\text{HIGH}}$, which themselves dominate $\text{IDENT}(\text{high})$; the result (as shown in (38) above) is that feature-sharing is preferred to multiple individual vowel gestures. By contrast, UNIQUE is high-ranking in Tamil. Sharing of vowel features is not tolerated, even if feature-sharing would reduce markedness violations. In tableau (63), I examine a hypothetical input which contains a sequence of mid vowels.

(63) High-ranking $U_{\text{N}}I$ Q U E prohibits multiple-linking

/pe@eya/	*M _{ID}	U _N I _Q U _E	I _D (low)	I _D (high)	*H _I G _H	*L _O W
a. 	*			*	*	*
b.	**!					*
c.	*	*!				*

Candidate (63b), in which there are two independent mid vowels, incurs two violations of *M_{ID}. The remaining candidates, (63a) and (63c), tie on *M_{ID}. However, the candidate which invokes multiple linking, (63c), is ruled out by high-ranking $U_{\text{N}}I$ Q U E.²⁹ Candidate (63a), which displaces an input mid vowel with an output high vowel, is optimal. Vowel harmony is not possible in this grammar.

Tamil, like Shona, is an example of positional neutralization of vowel height. Mid vowels are contrastive in initial syllables, but not in non-initial positions. This basic restriction arises from the positional neutralization subhierarchy given in (64) below.

(64) Positional neutralization of height

$$I_{\text{DENT}}-\sigma_1(\text{high}), I_{\text{DENT}}-\sigma_1(\text{low}) \gg *M_{\text{ID}} \gg I_{\text{DENT}}(\text{high})$$

The two languages differ in whether mid vowels are ever possible in non-initial syllables. In Shona, the ranking of $U_{\text{N}}I$ Q U E below the markedness constraints *M_{ID} and *H_IG_H ensures that multiple-linking is possible, and in fact, required. Conversely, vowel harmony is ruled out in Tamil, due to the ranking of $U_{\text{N}}I$ Q U E \gg *H_IG_H.

2.4.3.3 Contextual Allophony

In the preceding section, I focused on the distribution of mid vowels in non-initial syllables. Before turning to the behavior of coda consonants in Tamil, a few words concerning the contextual allophony of high and low vowels are warranted. As noted in §2.4.3.1 above, the

²⁹ $U_{\text{N}}I$ Q U E must minimally dominate *H_IG_H in order to prohibit multiple linking; it may also dominate *M_{ID}, though there is no evidence which bears directly on this question.

high and low vowels have lax and centralized allophones in non-initial syllables. This is shown in (65) below.

(65) Tamil vowel allophones

<u>Initial σ</u>	<u>Non-initial σ</u>
i	ɪ
u	}
a	é

The Tamil pattern of contextual allophony is similar to other patterns which are quite common crosslinguistically. While some of the contexts by which allophony is determined do overlap with the set of privileged positions, many other determinants of contextual allophony have little or no connection to phonological privilege. In many cases, the conditioning are arguably phonetic, rather than phonological, involving CV or VC coarticulation, low-level variations in duration, etc. A partial list of allophony-determining contexts is given in (66) below.

- (66) Some contextual determinants of vocalic allophony
- Initial/non-initial σ (Tamil)
 - Stressed/unstressed σ
 - Long/short vowel (Hungarian a: vs. ø, e: vs. ɛ)
 - Closed/open σ (Javanese)
 - Preceding or following uvular C
 - Preceding or following pharyngeal C
 - Preceding or following retroflex C (English)

Although the context which determines the Tamil allophony shown in (65) is initial vs. non-initial syllable, this type of variation differs in several respects from the positional neutralization of the mid/non-mid contrast discussed in the preceding section. First and foremost, no phonological contrasts are being neutralized in (65); the high vs. low and front vs. back contrasts are fully maintained. Second, the vowel inventories which occur in initial and non-initial syllables do not stand in the superset/subset relation which is characteristic of positional neutralization. The (non-high) vowels which occur in non-initial syllables are *not* a relatively less marked subset of the vowels in initial syllables. Instead, they are an entirely distinct set of allophones, and arguably a more marked set. It is important to note that the reduced vowel variants which appear non-initially *cannot* appear in initial syllables. There are two different requirements imposed on the surface vowel system of Tamil: first, non-mid vowels in


initial syllables must be peripheral {i, u, a}, and second, subsequent vowels must be non-peripheral {ɪ, ʊ, ɛ}. No mixing of the two sets is permitted.

To see how such a pattern of allophony may be generated, I will assume that the peripheral vowels bear vowel Place features along the lines of Clements (1991), Clements & Hume (1995). Front *i* is Coronal, round *u* Labial and low *a* Pharyngeal. If the non-initial vowels are characterized by loss of Place features, the contextual variants in non-initial syllables can be generated by the ranking in (67), where *Place* is a variable over the three peripheral place features.

- (67) Non-initial syllable allophony
 $\text{IDENT-}\sigma_1(\text{Place}) \gg *P_{\text{PLACE}} \gg \text{IDENT}(\text{Place})$

The application of this ranking is shown in (68).

- (68) Place is prohibited in non-initial syllables

	/te@ uä/	$\text{IDENT-}\sigma_1(\text{Place})$	*P _{PLACE}	$\text{IDENT}(\text{Place})$
a.			*!	
b. 	t'@ }			*

The constraint hierarchy will correctly select the place-less vowel allophones in non-initial syllables, regardless of whether the input vowels bear place or not. This is the pattern characteristic of allophonic alternations in OT; see McCarthy & Prince (1995) and Kirchner (1995) for discussion.

However, when we turn to the initial syllable allophony, a complication arises. Here, $\text{IDENT-}\sigma_1(\text{Place})$ must be dominated by some constraint *forcing* initial syllables to bear place specifications. Not only must the grammar permit vowels to have a place specification in the initial syllable, but it must prohibit placeless vowels in this position.³⁰ From a rich base, the constraint hierarchy must converge on outputs which have Place-ful initial syllables. An input *ɪ*, *ɪ* or *ɛ* which is in the root-initial syllable must acquire a place specification, at the expense of

³⁰ This is true even if the distinction between peripheral and non-peripheral is characterized by some means other than place features. For example, if the reduced vowels involve less articulatory effort (following recent work by Kirchner), the constraint hierarchy must include a constraint requiring more or maximal effort in initial syllables.

IDENT- σ_1 (Place). This, too, is characteristic of an allophonic alternation: surface output is fixed, regardless of the input vowel quality. While the exact character of the Tamil alternation is somewhat unclear, it is instructive, as it demonstrates that positional faithfulness may be overridden by other constraints. Tamil coda consonants provide an additional example in which positional faithfulness may be dominated by other constraints in the hierarchy. It is to this example that I now turn.

2.4.4 Tamil Coda Consonants

2.4.4.1 Introduction

Turning from the relatively simple domain of vowel feature restrictions, I will now consider the distribution of coda consonants in Tamil. As we shall see, the language exhibits two overlapping but distinct patterns of coda behavior which crucially rely positional distinctions. Both patterns involve restrictions on the distribution of place features which are independently attested in other languages.

Outside of the initial syllable, Tamil codas are severely restricted; they must be homorganic to a following onset. (Both geminates and place-linked sonorants are permitted.) Illicit structures are syllabified via epenthesis. This scenario is familiar from Itô (1986, 1989) and Goldsmith (1989, 1990); Japanese and Ponapean are two languages which exhibit this pattern.

Tamil codas are also restricted in initial syllables, but less than in non-initial syllables. In particular, it is possible to have a coronal sonorant in the initial syllable coda; its place of articulation need not be shared with a following onset. This is an example not only of partial positional neutralization, but also of positional resistance to phonological processes: coronal codas in the initial syllable do not undergo place assimilation, though non-coronal segments do. Like the pattern of coda distribution in non-initial syllables, the Tamil initial-syllable facts are independently attested in entire languages. Lardil and Selayarese share this type of syllable structure, with minimally marked segments permitted in coda position.³¹ The interest of Tamil

³¹ Selayarese differs slightly, in that it allows only free-standing \div in coda position. This, too, is arguably a minimally marked segment (see Lombardi 1995b, 1997 for recent discussion).

lies in the fact that it combines two different types of coda restriction, and that the distinction between the two arises from the initial/non-initial dichotomy. As we will see, positional faithfulness theory predicts exactly the Tamil pattern of behavior. Different privileged positions permit varying degrees of marked structure, and varying degrees of resistance to the process of place assimilation. Both facts arise from the interaction of positional faithfulness constraints with independently motivated featural markedness constraints.

Before turning to the details of the analysis, some background information will be helpful. Tamil permits a wide range of possible syllable shapes, ranging from a simple CV to the superheavy CVVCC. (Onsets are required, and are never complex.) There are two facts about initial syllable codas which merit attention in the context of positional faithfulness. First, only initial syllables permit a coda consonant with an independent place of articulation; in subsequent syllables, any coda segment must be homorganic to a following consonant. Examples of simplex codas with an independent place of articulation are shown in (69); *in all cases, the independent coda is a coronal sonorant*.^{32,33}

(69) Independent POA³⁴

³² Balasubramanian (1980) and Wiltshire (1995) list forms in which the initial syllable is closed by a non-coronal obstruent which is not homorganic to a following onset. (Examples: *βvkti* ‘strength’, *bvkt|r* ‘disciple’, *véʔo~* ‘modesty’ (Wiltshire 1995).) These are clearly incompletely assimilated borrowings from Sanskrit. I do not know whether such forms occur in Christdas’ dialect, or how many such forms there may be.

³³ It is not clear whether the palatal *ñ* may appear freely in initial syllable codas; I have not located any forms of this type. The dental nasal appears only in syllable onsets, suggesting that the markedness of the coronals may be stratified, with apical coronals being less marked than laminals. The appearance of free-standing retroflex coronals in the initial syllable coda suggests that, at least for some languages, coronals other than the plain alveolar or dental series may be regulated by the simple *CORONAL constraint (rather than a higher-ranking constraint against complex coronals). (Non-alveolar coronals are also possible in Lardil codas.) Alternatively, these distributional facts may indicate, contra the proposals of Prince & Smolensky (1993), that constraints against complex segments do not always outrank constraints against simplex segments. I will leave this issue for future research.

³⁴ The surface forms shown here and throughout reflect a variety of regular phonological processes tangential to our concerns. These include post-nasal voicing, intervocalic lenition (/k/ Ø [x] or [ç], /t/ Ø [r~], /p/ Ø [ä]) and phrase-final sonorant deletion. For an analysis of the latter, see Wiltshire (1996).

/t5eyääm/	[t5ey.ää]	‘god’	PC: 230
/aa@ääm/	[÷aa@.ää]	‘eagerness’	PC: 231
/maa@kaÄiy/	[maa@.xé.ÄI]	a month	PC: 231
/munIiy/	[mun.ÎI]	‘teacher’	PC: 234
/tunpam/	[tun.bã]	‘sorrow’	PC: 234
/na ⁻ pan/	[n8 a ⁻ .bã]	‘friend’	PC: 234
/anp/	[÷an.b}]	‘love’	PC: 157

Second, initial syllables permit complex codas, as shown in (70); non-initial syllables may have simplex codas only.

(70) Coda clusters in initial syllables (Christdas 1988: 247)

/ayppacy/	[÷ayp.pé.s]	a month
/payt5t5iyam/	[payt5.t5I.yã]	‘madness’
/aykkiyam/	[÷ayk.kI.yã]	‘unity’
/aa@ppaa?am/	[÷aa@p.paa?.?ã]	‘tumult’
/maa@t5t5aa ⁻ ?am/	[maa@t5.t5aa ⁻ .Îã]	place name
/a@t5t5am/	[÷a@t5.t5ã]	‘meaning’
/ääÄkkay/	[ääÄk.ké]	‘life’

Though I will postpone the analysis of these complex codas until Chapter 5, one fact about the data in (70) is relevant to the discussion here. The first consonant in each of the complex codas is a coronal sonorant which is not homorganic to the following coda obstruent.

Outside of the initial syllable, Tamil employs various means of avoiding the syllabification of a coda consonant with an independent place of articulation. If C_1 in a C_1C_2 cluster is a sonorant, place assimilation is the favored strategy by which coda place is avoided. For example, if a nasal segment abuts a non-nasal by virtue of morpheme concatenation or compounding, the nasal assimilates in place of articulation; morpheme-internally, there are no heterorganic nasal+consonant sequences outside of the initial syllable.

(71) Nasal place assimilation

/ma@am + kaÆ/	[ma@é~gé]	‘trees’	PC: 192
/ma@am + t5aan/	[ma@én8d8ã]	‘tree (emphatic)’	"
/pasañ + kaÆ/	[pasé~gé]	‘children’	CW (1995)
/ma@am # kot5t5i/	[ma@é~køt5t5I]	‘woodpecker’	
PC: 193			
/koÆam # t5oo ⁻ ?/	[køÆén8 t5o ⁻ Î]	‘tool for dredging ponds’	PC: 192

Laterals must undergo place assimilation when they precede a coronal obstruent (72).

When the following segment is a non-coronal obstruent, epenthesis occurs (73).³⁵

- (72) Laterals undergo place assimilation (Christdas 1988:319)
- | | | |
|------------------|----------------|---------------------|
| /äayal + t5aan/ | [äayél5d8 äã] | ‘field (emphatic)’ |
| /kappal + t5aan/ | [kappél5d8 äã] | ‘ship (emphatic)’ |
| /pat5il + t5aan/ | [pat5l5d8 äã] | ‘answer (emphatic)’ |
- (73) No assimilation to non-coronal segments (Christdas 1988:319, 331)
- | | | |
|----------------|-------------|-------------------|
| /äayal + kaÆ/ | [äayél}ké] | ‘fields’ |
| /kappal + kaÆ/ | [kappél}ké] | ‘ships’ |
| /pat5il + kk/ | [pat5l}kké] | ‘answer (dative)’ |
| /payi@ + kaÆ/ | [payl@}xé] | ‘crops’ |
| /pot5a@ + kaÆ/ | [pøt5é@}xé] | ‘bushes’ |
| /t5amiÄ + kk/ | [t5amrÄ}kk} | ‘Tamil (dative)’ |

Epenthesis is also obligatory when rhotics concatenate with other consonants; they never assimilate, even to coronals, and generally cannot participate in linked structures (Christdas 1988: 265).

Finally, underlying obstruent+obstruent clusters are resolved via epenthesis; assimilation or segmental deletion are not possible. Some examples are given in (74).

- (74) Epenthesis in obstruent + obstruent clusters
- | | | | |
|-----------------|----------------|------------------|---------|
| /kaat5 + kaÆ/ | [kaad8 }xé] | ‘ears’ | PC: 289 |
| /kaat5 + kk/ | [kaad8 }kk} | ‘ear (dative)’ | |
| /kamp + kaÆ/ | [kamb}xé] | ‘sticks’ | PC: 289 |
| /kamp + kk/ | [kamb}kk} | ‘stick (dative)’ | |
| /pan8 t5 + kaÆ/ | [pan8 d 8 }xé] | ‘balls’ | PC: 289 |
| /pan8 t5 + kk/ | [pan8 d 8 }kk} | ‘ball (dative)’ | |
| /kayat + kaÆ/ | [kayér~}xé] | ‘ropes’ | PC: 302 |
| /kayat + kk/ | [kayétt}kk} | ‘rope (dative)’ | |
| /kat5ap + kaÆ/ | [kad8éä }xé] | ‘doors’ | PC: 306 |
| /kat5ap + kk/ | [kad8 éä}kk} | ‘door (dative)’ | |

There are no morpheme-internal clusters of obstruents which are not geminates.

³⁵ Unfortunately, Christdas provides few data which demonstrate the result of concatenating a nasal+sonorant or lateral+sonorant sequence. (C₁C₂ sequences, whether hetero- or tautosyllabic, must generally be of falling sonority, so such sonorant+sonorant combinations are not likely to syllabify as clusters in most cases.) Interestingly, an *initial* syllable ending in a lateral may precede an onset ä (all examples include the nominalizing suffix -äiy; Christdas 1988: 240): *kaläiy* ‘education’, *keæäiy* ‘question’, *tooläiy* ‘defeat’. There are also two examples in which a stem-final lateral takes on the nasality of a following nasal: /uæÆ-may/ Ø [u⁻ may] ‘truth’, /nall-may/ Ø [nanmay] ‘goodness’. On the basis of such limited data, no conclusive analysis can be generated.

For convenience, the strategies employed in resolving illicit C_1C_2 sequences are summarized in (75) below.

(75) Summary: Syllabifying illicit consonant clusters

C_1	C_2	Result	Example
Nasal	Obstr.	Place assimilation	/ma@am+kaÆ/ Ø ma@é̃ gé
Lateral	Coronal obstr.	Place assimilation	/äayal+t5aan/ Ø äayél5d8 äã
Lateral	Non-coronal obstr.	Epenthesis	/äayal+kaÆ/ Ø äayél} ké
Rhotic	Any consonant	Epenthesis	/payi@+t5aan/ Ø payi@ }d8 äã
Any obstr.	Any consonant	Epenthesis	/kaat5+kaÆ/ Ø kaad8 }xé

With the distributional facts firmly in hand, we can turn to an analysis of the coda asymmetries shown above. There are two basic properties of Tamil syllable structure that must be accounted for. In initial syllables, only Coronal, the least marked place, is permissible in coda position. In non-initial syllables, all places are prohibited. This dual division of initial versus non-initial, and of Coronal versus non-Coronal, is captured by the interaction of positional faithfulness with the Place markedness subhierarchy (Prince & Smolensky 1993). The restriction on non-initial codas results from the ranking in (76); no place of articulation, no matter how marked, is permitted in the coda here:

(76) Ranking for Tamil non-initial codas

IDENT-ONSET(PLACE) » *DORSAL, *LABIAL » *CORONAL » IDENT(PLACE)

Offending segments must assimilate, or be syllabified in onset position (via epenthesis). Overlaid on this positional neutralization ranking is the initial syllable constraint IDENT- σ_1 (PLACE), dominating *CORONAL. This ranking, shown in (77), permits free-standing Coronals in just this privileged position.

(77) Ranking for all Tamil coda asymmetries

ID-ONSET(PLACE) » *DORSAL, *LABIAL » IDENT- σ_1 (PLACE) » *CORONAL » IDENT(PLACE)

In the next section, echoing the discussion of onset/coda asymmetries in Chapter 1, I will show that the behavior of codas in non-initial syllables arises from the basic ranking IDENT-ONSET(PLACE) » *DORSAL, *LABIAL » *CORONAL » IDENT(PLACE). Then, in Section 2.4.4.3,

I will demonstrate that the initial syllable behavior is captured by the simple addition of the positional faithfulness constraint $I_{\text{DENT}}-\sigma_1(\text{Place})$, as shown in (77).

2.4.4.2 Non-initial Syllables

As the data in §2.4.4.1 demonstrate, non-initial syllables display a pattern of behavior typically attributed to the Coda Condition, a constraint forbidding coda place of articulation (Itô 1986, 1989; Goldsmith 1989, 1990; Itô & Mester 1993, 1994): consonants may not appear in a syllable coda unless they are linked to a following onset. Thus, while the range of Place contrasts permitted in syllable onset position is broad, encompassing six points of articulation, the range of Place contrasts in coda position is maximally restricted. No contrasts are permitted in non-initial codas. Coda place of articulation is predictable on the basis of the following onset consonant.

This is a pattern of positional neutralization, exactly parallel to the distribution of vowel height in Shona and Tamil. In a privileged position (here, the syllable onset), the full set of consonantal places is permitted; outside the privileged position, the value of Place is always determined by linking to the protected place features of the onset. The same basic pattern of constraint ranking that generated Shona vowel harmony will account for place-linking in Tamil codas. This basic pattern is outlined in (78) below.

(78) Neutralization schema
 $I_{\text{DENT}}\text{-Position}(\text{F}) \gg \mathbf{M} \gg I_{\text{DENT}}(\text{F})$

In Shona, height harmony triggered by the initial syllable results from the ranking of $I_{\text{DENT}}-\sigma_1(\text{high}) \gg *M_{\text{ID}}, *H_{\text{IGH}} \gg I_{\text{DENT}}(\text{high})$, where $\mathbf{M} = *M_{\text{ID}}, *H_{\text{IGH}}$. In Tamil, the relevant faithfulness constraints are $I_{\text{DENT}}\text{-ONSET}(\text{Place})$ and $I_{\text{DENT}}(\text{Place})$, as shown in (79).³⁶

(79) $I_{\text{DENT}}\text{-ONSET}(\text{Place})$
 A segment in the onset of a syllable and its input correspondent must have identical Place specifications.
 $I_{\text{DENT}}(\text{Place})$
 Correspondent segments have identical Place specifications.

³⁶ Here I again adopt the proposal of Padgett (1995a, b), that constraints may refer to feature classes (though I retain the geometric organization of feature classes). *Place* ranges over all of the consonantal place features.

The markedness constraint **M** of (78) is instantiated in Tamil by Prince & Smolensky's (1993) Place markedness subhierarchy, which assesses the relative markedness of consonantal place of articulation. The positional neutralization subhierarchy for Tamil is thus as in (80). (For the sake of brevity, I use *PLACE as a convenient shorthand for the Place markedness subhierarchy of *LABIAL *DORSAL » *CORONAL. Nothing in the analysis of non-initial syllables crucially hinges on this decision.)

- (80) Positional neutralization of Place in Tamil, non-initial σ
 IDENT-ONSET(Place) » *PLACE » IDENT(Place)

Place-linking triggered by an onset consonant follows from the constraint ranking shown in (80). Coda consonants assimilate to the place of a following onset consonant because *PLACE » IDENT(Place); reduction of output place specifications is more harmonic than complete faithfulness to input values. By contrast, onsets trigger spreading (rather than undergoing it) because of the ranking IDENT-ONSET(place) » *PLACE. Faithfulness to onset place specifications is paramount, and takes precedence over the imperative to minimize place specifications in the output.

To illustrate the effects of (80), we turn now to the behavior of nasals in non-initial codas. Nasal + obstruent clusters which span non-initial syllables are always homorganic. This is true of both root-internal and derived clusters; examples of derived clusters are repeated in (81) below.

- (81) Nasal place assimilation
- | | | | |
|--------------------|-----------------|---------------------------|-----------|
| /ma@ am + kaÆ/ | [ma@é~gé] | 'trees' | PC: 192 |
| /ma@ am + t5aan/ | [ma@én8d8ã] | 'tree (emphatic)' | " |
| /pasañ + kaÆ/ | [pašé~gé] | 'children' | CW (1995) |
| /ma@ am # kot5t5i/ | [ma@é~køt5t5i] | 'woodpecker' | |
| PC: 193 | | | |
| /koÆam # t5oo~ ʔ/ | [køÆén8 t5o~ Î] | 'tool for dredging ponds' | PC: 192 |

In each case, the stem-final nasal has assimilated to the place of the following onset consonant.

One basic point is foregrounded by the data above: NOCODA, which favors open CV syllables, must be dominated by MAX, the anti-deletion constraint. Segments are not simply

deleted in order to avoid a NoCODA violation; closed syllables occur quite regularly. This is shown in (82).

(82) $\text{MAX} \gg \text{NoCODA}$

	/pasan δ + ka \AA /	MAX	NoCODA
a. $\text{\textcircled{a}}$	pa.sé̃.gé		*
b.	pa.sé.xé	*!	

The actually occurring (82a) incurs a violation of NoCODA , but this violation is rendered irrelevant by the dominant MAX . The opposite ranking would favor uniformly open syllables, effectively ruling out all coda consonants.

The pair of candidates in (82) provides evidence for an additional ranking: $\text{MAX} \gg \text{IDENT(Place)}$. Place assimilation is preferred to segmental deletion.

(83) $\text{MAX} \gg \text{IDENT(Place)}$

	/pasan δ + ka \AA /	MAX	IDENT(Place)
a. $\text{\textcircled{a}}$	pa.sé̃.gé		*
b.	pa.sé.xé	*!	

The actual surface form violates IDENT(Place) , a constraint which is satisfied by candidate (83b). The IDENT(Place) violation does not matter, however, due to high-ranking MAX ; (83a) is optimal.

I have so far established that MAX is high-ranking, preventing segmental deletion; I will henceforth omit MAX -violating candidates from consideration. But why is (83a), *pa.sé̃.gé*, preferred to a candidate *pa.sén δ .gé*, which satisfies both MAX and IDENT(Place) ? Some constraint or constraints, dominating IDENT(Place) , must favor place assimilation. The relevant set of constraints can be found in the place markedness subhierarchy of Prince & Smolensky (1993):

(84) Place markedness subhierarchy³⁷
 $*\text{DORSAL} \ * \text{LABIAL} \gg \ * \text{CORONAL}$

³⁷ Prince & Smolensky (1993) do not impose a ranking on $*\text{LABIAL}$ and $*\text{DORSAL}$, and there is no evidence in the phonology of Tamil coda syllabification to suggest any relative ranking. Consequently, I leave the constraints unranked throughout; nothing crucial hinges on this decision.

The ranking in (84) is arguably universal, and favors Coronal over the more marked Labial and Dorsal articulations. The effects of this ranking frequently emerge in situations of epenthesis, where coronal consonants are more common than either labial or velar segments.³⁸ Reflexes of place markedness are also apparent when the subhierarchy is sandwiched in between two distinct faithfulness constraints, such as $M_{AX_{IO}}$ and $M_{AX_{BR}}$ in cases of reduplication³⁹, or (as in Tamil), between $I_{DENT-ONSET}(Place)$ and $I_{DENT}(Place)$. In the latter case, the ranking $I_{DENT-ONSET}(Place) \gg *DORSAL \gg *LABIAL \gg *CORONAL \gg I_{DENT}(Place)$ accounts for the mutability of coda consonants (and the invariance of onset consonants).

Proceeding in step-wise fashion, let us begin at the bottom of the Tamil constraint subhierarchy. The dominance of the place markedness constraints over $I_{DENT}(Place)$ will favor place-sharing between coda and onset (just as the ranking of $*M_{ID}$ and $*H_{IGH}$ over $I_{DENT}(high)$ favors height-sharing in Shona). Consider the candidates in tableau (85) below. (Hereafter, $*P_{LACE}$ violations will be indicated segmentally, to aid in reading the tableaux.)

(85) $*P_{LACE} \gg I_{DENT}(Place)$

/pasan8 + kaE/	*LAB	*DORS	*COR	$I_{DENT}(Place)$
a. $\text{pa.sé}^{\sim}.\text{gé}$	p	$\sim g$	s	*
b. $\text{pa.sén}8.\text{gé}$	p	g	s, n8 !	

Each independent place specification receives one violation mark for the relevant $*P_{LACE}$ constraint, according to the principle of Feature-Driven Markedness (see (32) above). Therefore, the independent Coronal place of articulation of the coda consonant in the fully faithful (85b) incurs a fatal violation of $*C_{ORONAL}$. The place assimilation in (85a) avoids this violation, by reducing the Coronal, Dorsal sequence of input /n8 -k/ to a single output Dorsal specification. The $I_{DENT}(Place)$ violation which results from place assimilation is irrelevant, due to the subordination of this constraint to the place markedness subhierarchy.

³⁸ Lombardi (1995b,1997) argues that (84) should be amended to include lowest-ranking $*P_{HARYNGEAL}$. One fact that such an amendment can capture is the preponderance of epenthetic = cross-linguistically. Pharyngeal, being the least-marked place of articulation, is the epenthetic segment *par excellence*.

³⁹ See Alderete *et al.* (1996) for the application of this idea to reduplicative segmentism in Tübatulabal and Nancowry.

As (85) shows, the ranking of *DORSAL, *LABIAL » *CORONAL » IDENT(Place) favors assimilation, rather than a faithful output rendering of all input places. However, the ranking in (85) does not successfully select between the actual surface form (85a) and another possible alternative, *pa.sén8 .d8 é*. In this candidate, place assimilation results in removal of an offending *DORSAL violation, in favor of a less-marked Coronal cluster. Such a candidate would be favored by the constraint subhierarchy of (85), but it is not the actually occurring form.

The forms in question, *pa.sé̃.gé* (85a) and *pa.sén8 .d8 é* both exhibit nasal place assimilation, but they differ in the *direction* of assimilation. In the actual Tamil form, *pa.sé̃.gé* a *coda* consonant assimilates to the following onset; in the unattested *pa.sén8 .d8 é*, the *onset* assimilates to the preceding coda. It is the subordination of the onset's place features to those of the preceding coda in *pa.sén8 .d8 é* which is fatal to such a candidate. Padgett (1995b) reminds us that place assimilations typically proceed from onset to coda; the features of the released segment are preferentially maintained in output forms. In the theory of positional faithfulness developed here, this finding can be incorporated naturally: onset features are preserved, by virtue of high-ranking IDENT-ONSET(Place). As Padgett (1995b) observes, the direction of spreading, from onset to coda, is a natural consequence of the faithfulness asymmetry between onsets and codas, and need not be stipulated independently.

IDENT-ONSET(Place), ranked above the place markedness subhierarchy, accounts for the optimality of (85a) (as well as the non-optimality of a maximally unmarked candidate such as *ta.sén8 .d8 é*, which contains only Coronal consonants). This is shown in (86) below.

(86) IDENT-ONSET(Place) » *PLACE » IDENT(Place)

/pasan8 + kaÆ/	ID-ONSET(Place)	*LAB	*DORS	*COR	IDENT(Place)
a. pa.sé̃.gé		p	g̃	s	*
b. <i>pa.sén8 .d8 é</i>	*!	p		s, n8d8	*
c. <i>ta.sén8 .d8 é</i>	**!			t, s, n8d8	**

High-ranking IDENT-ONSET prevents wholesale changes in onset place of articulation, initiated in the interest of minimizing markedness, as in (86c). More to the point, it also prevents the

coda-to-onset assimilation of (86b). The ranking in (86) has the result that *only* coda segments may undergo assimilation, as in (86a). It should be clear from the preceding discussion that the ranking in (86) will compel place-sharing for any nasal+obstruent cluster, regardless of the nasal's input place specification.

The ranking of IDENT-ONSET(Place) » *PLACE ensures that onset place specifications are not lost in order to satisfy the imperative for minimal markedness. Optimality Theory, with its focus on free ranking permutation, predicts that the opposite ranking is possible: *PLACE » IDENT-ONSET(Place). However, this ranking seems not to be attested; there is no language in which onset contrasts are neutralized to glottal stop or a minimally marked coronal consonant, though this is the pattern predicted by such a ranking. Speakers of such a language would presumably be at a considerable communicative disadvantage. In light of such extra-grammatical considerations, I assume that the ranking IDENT-ONSET(Place) » *PLACE is fixed in UG.

Harkening back to the earlier discussion of prohibitions on multiple-linking, I pause now to consider the relative ranking of UNIQUE in the grammar of Tamil as a whole. This constraint militates against multiply-linked features in autosegmental representation. The vowel height features in Tamil are not permitted to be multiply linked; there is no height harmony or feature sharing in the vowel system of this language. As I argued above, UNIQUE must dominate the height markedness constraints *HIGH and *LOW, in order to prohibit multiple linking of an mid vowel to subsequent syllables. However, in the consonant system, multiple linking of place features is permitted. UNIQUE is violated in order to achieve better satisfaction of the *PLACE constraints, indicating that *LABIAL, *DORSAL » *CORONAL » UNIQUE.

(87) *PLACE » UNIQUE


/pasaŋ + kaɛ/	IDENT-ONSET(Place)	*LAB	*DORS	*COR	UNIQUE	IDENT(Place)
a. pa.sé.gé		p	g	s	*	*
b. pa.séŋ.xé		p	x	s, nŋ !		*

UNIQUE must be dominated by *CORONAL, and by transitivity of ranking, *LABIAL and *DORSAL, in order to ensure that (87a) is optimal. The vowel height markedness constraints

*HIGH and *LOW are ranked below UNIQUE in the constraint hierarchy; the result being permissible multiple linking of consonantal place features, but not of the vowel height features.

Two questions remain to be answered before we move on to the treatment of non-nasal segments: What is the relative ranking of MAX and the place markedness subhierarchy, and where does the anti-epenthesis constraint DEP fit into the ranking developed thus far? Just as MAX must dominate NOCODA (82), MAX must also dominate the *PLACE constraints; the opposite ranking would favor segmental deletion as a means of achieving minimal markedness.



(88) MAX » *PLACE

/pasan8 + kaE/	MAX	*LAB	*DORS	*COR	IDENT(Place)
a.  pa.sé.gé		p	g	s	*
b. pa.sé.xé	n8 !	p	x	s	

The reverse ranking, *PLACE » MAX, favors (88b), and even more radically reduced candidates.

The answer to the second question cannot be determined by examining nasal codas. Comparing a hypothetical candidate such as *pa.sé.n8 }.xé*, where epenthesis occurs, with the actual output form (88a), there is no valid ranking argument to be drawn. The epenthesis candidate incurs two constraint violations that the real form does not. This is shown in (89), where DEP is arbitrarily displayed in the ranking.

(89) No ranking of DEP and *PLACE

/pasan8 + kaE/	DEP	*LAB	*DORS	*COR	IDENT(Place)
a.  pa.sé.gé		p	g	s	*
b. pa.sé.n8 }.xé	*	p	x	s, 	

Even if DEP were dominated by the place markedness subhierarchy, the additional *CORONAL violation incurred by (89b) would be fatal. In order to determine the ranking of DEP, we must turn our attention to the behavior of lateral and obstruent segments.

Recall that the laterals assimilate to following coronal obstruents, but not to other places of articulation. This selective assimilation can be attributed to high-ranking feature cooccurrence constraints. In Tamil, as in most languages of the world, non-coronal laterals are not

permitted.⁴⁰ This restriction on the inventory of segments can be enforced by the constraints LATCOR and IDENT(lateral) in (90) below.

- (90) LATCOR
 [lateral] Ø [Coronal]
 “Lateral segments must be Coronal.”⁴¹
- IDENT(lateral)
 An input segment and its output correspondent must agree in their specification of the feature [lateral].

LATCOR and IDENT(lateral) must dominate all of the place faithfulness constraints in order to ensure that an input velar lateral is mapped on to an output coronal lateral, as in (91). (“L” represents a velar lateral.)

- (91) LATCOR, IDENT(lateral) » IDENT-ONSET(Place) » IDENT(Place)

/l̥a/	LATCOR	IDENT(lateral)	IDENT-ONSET(Place)	IDENT-(Place)
a. l̥a	*!			
b. la			*	*
c. ~a		*!		

LATCOR must dominate IDENT-ONSET(Place), and by transitivity of ranking, the place markedness subhierarchy. This will prevent place assimilation to a non-coronal obstruent, as shown in (92) below for the input /äaɣal + kaɛ/, ‘fields’. High-ranking IDENT-ONSET will rule out assimilation of the obstruent to the lateral.

- (92) Assimilation to a non-Coronal is prohibited

/äaɣal + kaɛ/	LATCOR	ID(lat)	ID-ONS(Place)	*LAB, *DORS	*COR	ID(Place)
a. äa.yél.gé				ä, g	y, l	
b. äa.yéL.gé	*!			ä, Lg	y,	*
c. äa.yél.dé			*!	ä	y, ld,	*
d. äa.yé~.gé		*!		ä, ~g	y	*

Each of candidates (92b-d) is ruled out by a high-ranking constraint, leaving (92a) as the optimal form. However, (92a) is not the actually occurring surface form in this case. Rather, epenthesis occurs, yielding äa.yé.l}.xé. This candidate and (92a) fare equally well with respect

⁴⁰ Contrastive velar laterals have been reported for a handful of languages in New Guinea (Melpa, Mid-Waghi, Kanite and Yagaría), Africa (Kotoko) and North America (Comox) (Ladefoged & Maddieson 1996).

⁴¹ Dickey (1996) argues that laterals are complex [Coronal, Dorsal] sounds, rather than [lateral] segments. It is unclear how the effects of the implicational constraint in (90) can be captured in such a theory.

to the place markedness subhierarchy, but differ with respect to two other constraints:

NOCODA and DEP. The relevant violations are shown in the chart in (93) below.

(93) NOCODA is relevant in selecting the optimal candidate

Candidate	*DORS	*LAB	*COR	NOCODA	DEP
äa.yél.ǵ	g	ä	y, l	*	
äa.yé.l}.xé	x	ä	y, l		*

The two candidates tie on each of the *PLACE constraints, making these constraints irrelevant to the choice of the optimal candidate. This leaves NOCODA and DEP, and here there is a clear ranking argument to be made here: NOCODA » DEP. When high-ranking LATCOR and IDENT-ONSET(Place) conspire to prevent place assimilation, as in the case at hand, epenthesis is the result. Insertion of non-underlying material is tolerated in order to achieve less marked syllable structure. However, the relative ranking of NOCODA and DEP with respect to the place markedness subhierarchy cannot be determined.

The preceding discussion has demonstrated that epenthesis is preferred when place assimilation cannot occur. However, the constraint hierarchy in (92) does allow for place assimilation when a sequence of lateral+coronal obstruent occurs in the input. This case will also provide an argument for the ranking of NOCODA with respect to the place markedness subhierarchy: NOCODA must be dominated by *CORONAL, and by transitivity of ranking, by *LABIAL and *DORSAL. The reduction of place markedness via multiple linking takes precedence over the achievement of open syllables. Because epenthesis does not reduce place markedness, it is dispreferred when place assimilation is possible, *even though the anti-epenthesis constraint DEP is ranked below NOCODA*. This is shown in (94) below.

(94) Assimilation to a Coronal obstruent is required

/äayal + t5aan/	LATCOR	ID-ONS	*LAB, *DORS	*COR	NOCODA	DEP	ID(Place)
a. äa.yél5.d8 äã			ä	y, l5d8	*		
b. äa.yé.l}.d8 äã			ä	y, l, d8 !		*	

Candidate (94b) fares better on NOCODA than (94a), but worse on *CORONAL. The optimality of (94a) indicates that *CORONAL » NOCODA.

Thus far, the analysis has accounted for the behavior of nasals and laterals which are followed by obstruents in the input. (The rhotics and the sonorants *ä* and *y* never assimilate to a following obstruent, probably due to a combination of restrictions on place/stricture and syllable contact interactions. See Padgett 1991 for relevant discussion.) The following ranking relationships have been established:

(95) Interim ranking summary

Now we turn our attention to C_1C_2 sequences in which the segments are of equal or falling sonority; that is, sequences of two obstruents, two sonorants, or an obstruent followed by a sonorant. Such sequences can never be syllabified as coda and onset, regardless of their place of articulation; even homorganic clusters such as *nl*, *ʔæ*, etc. cannot be successfully syllabified. Christdas (1988) attributes this gap in the inventory of coda-onset sequences to the Syllable Contact Law (Hooper 1976, Murray & Vennemann 1983, Clements 1990). A formulation is provided in (96) below.

(96) SYLLABLE CONTACT LAW (SCL)

In a sequence $VC_1.C_2V$, the sonority value of $C_1 =$ the sonority value of C_2

A full formulation of SCL in within Optimality Theory would take us far beyond the scope of this dissertation.⁴² For the purposes of expediency, I will adopt (96), with the additional provision that sequences of consonantal root nodes are the relevant units over which SCL is evaluated. Gemimates, which are underlyingly moraic consonants with a single root node, vacuously satisfy SCL.⁴³ (I assume that *Gen* admits only one basic geminate structure, the single-root representation. No “pseudogeminates” like (97) are possible. To my knowledge, there are no theories of geminate structure which allow both single-root and two-root gemimates to coexist.)

(97) Impermissible pseudogeminate

⁴² The interested reader is referred to the pre-OT work of Clements (1990), and to Prince & Smolensky (1993) for related proposals and discussion.

⁴³ The single-root theory of gemimates accounts for their unexceptional behavior with respect to SCL. But see Selkirk (1990) for an alternative view of geminate structure which assumes two root nodes.

In Tamil, *SCL* is never violated; the constraint must enter the realm of the high-ranking, along with *MAX*, *LATCOR* and *IDENT*(lateral). Crucially, *SCL* dominates both the **PLACE* subhierarchy and *DEP*, and is dominated by *MAX*. Such a ranking will force epenthesis, rather than deletion, as a means of satisfying *SCL*, even at the expense of the **PLACE* constraints. This will account for data such as those in (98), repeated from (74) above.

- (98) Epenthesis in obstruent + obstruent clusters
- | | | | |
|-----------------|----------------|------------------|---------|
| /kaat5 + kaÆ/ | [kaad8 }xé] | ‘ears’ | PC: 289 |
| /kaat5 + kk/ | [kaad8 }kk] | ‘ear (dative)’ | |
| /kamp + kaÆ/ | [kamb }xé] | ‘sticks’ | PC: 289 |
| /kamp + kk/ | [kamb }kk] | ‘stick (dative)’ | |
| /pan8 t5 + kaÆ/ | [pan8 d 8 }xé] | ‘balls’ | PC: 289 |
| /pan8 t5 + kk/ | [pan8 d 8 }kk] | ‘ball (dative)’ | |
| /kat5ap + kaÆ/ | [kad8éä }xé] | ‘doors’ | PC: 306 |
| /kat5ap + kk/ | [kad8 éä }kk] | ‘door (dative)’ | |

The occurrence of epenthesis in this context is required by the constraint ranking illustrated in tableau (99) below.

- (99) Epenthesis in obstruent+obstruent sequences

/kat5ap+kaÆ/	MAX	SCL	ID-ONS	*LAB, *DORS	*COR	NOCOD A	DEP	ID(Place)
a. ka ka.d8é.ä }xé				k, ä, x	d8		*	
b. ka.d8ép.ké		*!		k, p, k	d8	*		
c. ka.d8 é.xé	*!			k, x	d8			

SCL correctly favors (99a) over the candidates in (99b,c). This comparison is not very interesting, however, because (99b) would lose to (99a) on the basis of NoCODA, even if SCL were low-ranking. The more interesting comparison is between (99a) and another candidate, *ka.d8 ék.ké*. In this candidate, underlying /k/ has been geminated via deletion of the input /p/, as shown in (100) below.

- (100) Derived geminate

The derived geminate structure in (100) is a poor candidate because it violates MAX, a constraint that is otherwise respected in the language. (It also neutralizes a distinction between geminate and singleton consonants. While such alternations do occur in Tamil, they are restricted to a small number of morphological contexts; the weight distinction is not subject to phonological neutralization.) Consider the array of candidates in (101) below, where (101b) = (100).

(101) Gemination and deletion are non-optimal

/kat5ap+kaÆ/	MAX	SCL	ID-ONS	*LAB, *DORS	*COR	NOCODA	DEP	ID(Place)
a. ka ka.d8é.ä}.xé				k, ä, x	d8		*	
b. ka.d8ék.ké	*!			k, kk	d8	*		
c. ka.d8 é.xé	*!			k, k	d8			
d. ka.d8 ép.ké		*!		k, p, k	d8	*		

Comparing candidates (101b,c), it is clear that (101c) would be favored if segmental deletion were a possible means of resolving SCL violations. The failure of both (101b) and (101c), and the success of (101a), confirms the ranking of MAX and SCL above the place markedness subhierarchy.

The final case to be considered is that of an input sonorant+sonorant sequence. Such sequences are resolved via epenthesis, just as obstruent+obstruent clusters are; this is due to high-ranking SCL. A hypothetical example is examined in (102) below.

(102) Hypothetical: sonorant + sonorant cluster

/kat5am+laÆ/	MAX	SCL	ID-ONS	*LAB, *DORS	*COR	NOCODA	DEP	ID(Place)
a. ka ka.d8é.m}.lé				k,m	d8 ,l		*	
b. ka.d8 én.lé		*!		k	d8 ,nl	*		*
c. ka.d8 é.lé	*!			k	d8 ,l			
d. ka.d8 ém.lé		*!		k, m	d8 ,l	*		

This example shows clearly that SCL must dominate the place markedness subhierarchy. The opposite ranking, with *LABIAL, *DORSAL » SCL, would favor candidate (102b), in which the coda nasal assimilates to the following sonorant. Such sequences of sonorants do not occur in Tamil.

To sum up the results of this section, I have shown that the prohibition on independent place specifications in coda position results from the asymmetry between onset and coda faithfulness, which are separately assessed via IDENT-ONSET(Place) and IDENT(Place). Place assimilation derives from the ranking of the place markedness subhierarchy above IDENT(Place). *PLACE » IDENT(Place) yields place assimilation when possible; that is, when neither LATCOR nor SCL is violated. The high-ranking positional faithfulness constraint

$\text{IDENT-ONSET(Place)}$ favors maintenance of contrastive information in onset position, meaning that codas are the targets (rather than the triggers) of place assimilation in such circumstances. Finally, under domination of MAX , the ranking $*\text{PLACE} \gg \text{DEP}$ will result in epenthesis when assimilation is blocked. The final ranking summary for non-initial syllables is shown in (103) below.

(103) Final ranking summary

This set of constraints, crucially incorporating the positional faithfulness constraint, $\text{IDENT-ONSET(Place)}$, is responsible for the patterns of coda assimilation and epenthesis which characterize non-initial syllables in Tamil. Minimization of place markedness is paramount—wherever possible, place assimilation occurs. In the event that assimilation is impossible, epenthesis occurs, resulting in less marked CV syllables. In the next section, I will show that the positional faithfulness constraint $\text{IDENT-}\sigma_1(\text{Place})$ interacts with the system in (103) to generate the independent Coronal place which is permitted in the coda of a root-initial syllable.

2.4.4.3 Initial Syllable Codas

In the preceding section, I established that the distribution of coda place features in non-initial syllables results from a prototypical positional neutralization ranking, as shown in (104).

(104) Positional neutralization of place distinctions, Tamil non-initial codas
 $\text{IDENT-ONSET(Place)} \gg *DORSAL \ *LABIAL \gg *CORONAL \gg \text{IDENT(Place)}$

Now we turn to initial syllable codas, whose behavior will be unified, via constraint ranking, with that of codas in non-initial syllables. Like non-initial syllables, root-initial syllables in Tamil display an asymmetry in the segmental inventory permitted in onset and coda position. In initial syllables, some, but not all, places of articulation may occur independently in codas; in particular, free-standing coronal sonorants may occur in this position. As we have seen, codas in non-initial syllables are restricted to consonants which are homorganic to a following onset. The onset/coda and initial/non-initial asymmetries are summarized in (105) below.

(105) Two levels of distributional asymmetry in Tamil

Initial σ		Non-initial σ	
Onset	Coda	Onset	Coda
• All consonants	• C homorganic to following onset • Coronal sonorant	• All consonants	• C homorganic to following onset

The coda inventory in root-initial syllables is a more marked superset of the coda inventory in non-initial syllables: initial syllable codas may include an independent coronal place. This is literally more marked, as the coronal consonant in question will incur an additional *CORONAL violation not assessed to a coda which shares its place with the following onset.

This type of markedness asymmetry, with more marked elements being permitted in a privileged position, but not elsewhere, is a familiar diagnostic of positional neutralization. The Tamil pattern, involving an overlap of onset/coda and initial/non-initial asymmetries, is more complex than others we have examined thus far. However, this pattern is exactly what is predicted by positional faithfulness theory: high-ranking IDENT- σ_1 (Place), dominating some markedness constraint, leads to the occurrence of more marked structure in root-initial syllables. Specifically, IDENT- σ_1 (Place) fits into the ranking of (104) as shown in (106) below.

(106) Initial syllable faithfulness

ID-ONSET(Place) » *DORS, *LAB » **IDENT- σ_1 (Place)** » *CORONAL » ID(Place)

In the remainder of this section, I will demonstrate the application of the ranking in (106).

Representative examples of initial syllable codas are repeated in (107). Coda segments which bear an independent coronal place of articulation appear in boldface.

(107) Coda clusters in initial syllables (Christdas 1988: 247)

/ayppaciɣ/	[÷aɣp.pé.sɪ]	a month
/payt5t5iyam/	[paɣt5.t5 $\underline{1}$.yã]	'madness'
/aykkiyam/	[÷aɣk.k $\underline{1}$.yã]	'unity'
/aa@ppaaʔam/	[÷aa@p.paaʔ.ʔã]	'tumult'
/maa@t5t5aaʔam/	[maa@t5.t5aaʔ.Ĵã]	place name
/a@t5t5am/	[÷a@t5.t5ã]	'meaning'
/äaaÄkkay/	[äaaÄk.ké]	'life'

(108) Independent POA

/t5eyääm/	[t5ey.ää]	‘god’	PC: 230
/aa@ äam/	[÷aa@.ää]	‘eagerness’	PC: 231
/maa@kaÄiy/	[maa@.xé.ÄI]	a month	PC: 231
/munÍiy/	[mun.ÍI]	‘teacher’	PC: 234
/tunpam/	[tun.bã]	‘sorrow’	PC: 234
/na ⁻ pan/	[n8 a ⁻ .bã]	‘friend’	PC: 234
/anp/	[÷an.b }	‘love’	PC: 157

The positional neutralization subhierarchy given in (106) is exactly what is needed to generate both the basic pattern of non-initial codas, illustrated in §2.3.4.2, and the more intricate facts of the root-initial syllables. Initial syllable codas are able to resist coda assimilation, while non-initial codas may not. This disparity calls for the initial-syllable faithfulness constraint shown in (109) below.

(109) IDENT- σ_1 (Place)

Segments in the initial syllable of the output and their input correspondents must have identical Place specifications.

Through constraint ranking, IDENT- σ_1 (Place) is able to provide a straightforward explanation of two asymmetries in Tamil. First, the separability of IDENT- σ_1 (Place) and the context-free IDENT(Place) permits various markedness constraints, such as *CORONAL, to intervene in the ranking. This yields different levels of markedness in the two syllabic domains, initial and non-initial, with initial syllables permitting more marked structure than non-initials.

In addition, the intervention of IDENT- σ_1 (Place) in the midst of the place markedness subhierarchy accounts for the Coronal restriction on initial syllable codas: *LABIAL *DORSAL » IDENT- σ_1 (Place) » *CORONAL. Labial and dorsal codas are prohibited in initial syllables, just as they are in subsequent positions. Codas which bear the minimally marked coronal place, however, are permitted, due to the ranking IDENT- σ_1 (Place) » *CORONAL. The expansion of the initial syllable coda inventory to include only coronal is exactly what we expect, given a fixed universal ranking of place markedness in which coronal occupies the bottom rung. The effects of this ranking are shown in (110) and (111) below.

Through domination of *CORONAL, (109) will permit free-standing coronal place in the coda of a root-initial syllable. This is demonstrated in (110). (Recall that the Syllable Contact Law requires codas to be higher in sonority than following onset consonants, meaning that free-standing coronal obstruents will not be possible, even in initial syllables. The SCL is not shown in the following tableaux.)

(110) Coronal place is permitted

/tunpam/	ID-ONS	*LAB	*DORS	IDENT- σ_1 (Place)	*COR	ID(Place)
a. $\text{tun.b}\tilde{\text{a}}$		b			t, n	
b. $\text{tum.b}\tilde{\text{a}}$		mb		*!	t	*

The initial syllable identity constraint correctly rules out candidate (110b), in which coda assimilation occurs. Because $\text{ID}_{\text{ENT-}\sigma_1}(\text{Place}) \gg *_{\text{CORONAL}}$, faithfulness to the input coronal specification takes precedence over markedness reduction. Independent coronal in the coda is preferred to assimilation.⁴⁴

Now consider the case of a non-coronal coda consonant, shown in (111). The positional faithfulness hierarchy of (110) will correctly require place assimilation in such a case.

(111) Labial or dorsal place is prohibited

/mam-ka/	ID-ONSET	*LAB	*DORS	ID- σ_1 (Place)	*COR	ID(Place)
a. $\text{mam.g}\tilde{\text{e}}$		m,m!	g			
b. $\text{m}\tilde{\text{a}}.\text{g}\tilde{\text{e}}$		m	$\tilde{\text{g}}$	*		*

Although place assimilation in candidate (111b) incurs a violation of $\text{ID}_{\text{ENT-}\sigma_1}(\text{Place})$, the violation is irrelevant, due to the ranking $*_{\text{LABIAL}}, *_{\text{DORSAL}} \gg \text{ID}_{\text{ENT-}\sigma_1}(\text{Place})$. Labial and dorsal segments are not possible codas in the initial syllable.

I have shown in the discussion above that a number of complex interactions among syllabification, place of articulation and positional prominence in Tamil are captured via constraint ranking. The various positional effects and the constraint rankings which generate them are summarized in (112) below.

⁴⁴ The candidate $\text{tu.m}\tilde{\text{a}}.\tilde{\text{a}}\tilde{\text{a}}$, with epenthesis into the root, is not shown here. By the ranking $\text{NOCODA} \gg \text{DEP}$ established in the preceding section, such a candidate should be favored over the actual surface form, $\text{tun.b}\tilde{\text{a}}$. For discussion of these candidates and the relevant constraint which favors $\text{tun.b}\tilde{\text{a}}$, see Chapter 5.

(112) Summary: Positional effects in Tamil syllabification

a. Coda in non-initial σ shares place with a following onset:

*LAB, *DOR » *COR » ID(Place)

b. Coda in σ_1 can have independent coronal place:

IDENT- σ_1 (Place) » *COR

c. Coda in σ_1 shares Lab/Dor with following onset:

*LAB, *DOR » ID- σ_1 (Place) » *COR » ID(Place)

d. Codas (not onsets) undergo assimilation:

ID-ONSET(Place) » *LAB, *DOR » *COR » ID(Place)

Each of these effects is predicted by Positional Faithfulness Theory; separate constraints which assess faithfulness in privileged positions may be ranked above various markedness constraints, yielding a pattern of marked segments in privileged positions, but not elsewhere.

In the following section, I will consider an alternative approach to positional asymmetries in markedness. This is the familiar positional licensing analysis of coda place restrictions, which employs the Coda Condition of Itô (1986, 1989). We will see that the Coda Condition is redundant in a theory which includes Prince & Smolensky's place markedness subhierarchy. Furthermore, the Coda Condition alone cannot characterize positional effects such as the preference for onset-to-coda spreading in place assimilation. Positional faithfulness constraints are required to provide a full account of common patterns of onset/coda interaction.

2.4.4.4 Analytic Alternatives: Positional Licensing

As an alternative to positional faithfulness theory, we may consider a positional licensing analysis of onset/coda asymmetries. As discussed in Chapter 1, the positional licensing view of weak coda licensing, embodied in the work of Itô (1986, 1989), Goldsmith (1989, 1990), Lombardi (1991), Wiltshire (1992), Bosch & Wiltshire (1992), and Itô & Mester (1993, 1994), assumes that place specifications are prohibited or severely restricted in coda position. There are two basic implementations of positional licensing theory. The first, proposed in Itô (1986, 1989), is a negative constraint which prohibits coda place specifications. This is the Coda Condition shown in (113).

(113) Coda Condition (CODACOND)

In Itô's (1986, 1989) application of the Coda Condition, a feature which is linked to both coda and onset is exempt from the constraint, by virtue of Hayes' (1986b) Linking Constraint. Later formulations derive this effect by formulating the Coda Condition as a feature-to-syllable alignment constraint, where the onset affiliation of the multiply-linked place specification satisfies a requirement for alignment of consonantal place features at the left edge of a syllable (Itô & Mester 1994).

The well-formedness of such linked configurations is granted without special machinery by the Prosodic Licensing approach to positional asymmetries, developed in Goldsmith (1989, 1990), Wiltshire (1992) and Bosch & Wiltshire (1992). (See also the positive licensing formulation of laryngeal constraints in Lombardi 1991, explored in Chapter 1.) Prosodic Licensing theory characterizes onset/coda asymmetries in licensing by means of syllable templates which incorporate positive licensing statements. In languages such as Tamil, in which codas may not bear an independent place specification, the coda position in the syllable template is endowed with only limited licensing capabilities. The onset, by contrast, licenses a full range of features. A typical syllable template for such a language is shown in (114) below.

(114) Weak coda licensing, Prosodic Licensing theory


In this theory, a feature need only be licensed, through association, by *some* element in the prosodic structure; the feature need not be licensed by *every* segment to which it is associated. Association to an onset is sufficient to license a place specification which is shared with a preceding coda, though the coda itself cannot license place features.

Abstracting away from the various formal differences between the negative licensing of the Coda Condition and the positive statements of Prosodic Licensing theory, the core notion in both approaches is the same: certain marked features, such as place of articulation, are not licensed in coda position. My chief concern here is with an OT implementation of positional markedness, whether the relevant constraints are formulated in positive or negative terms. Having explored the positive formulation of positional licensing in the discussion of Catalan

voicing in Chapter 1, I will examine the negative, CODA_{COND} approach in subsequent discussion. However, the flaws encountered by the negative, CODA_{COND} formulation are also found in a positive licensing analysis, as we have seen. Licensing theory alone cannot account for the pervasive onset-to-coda direction of spreading in place assimilation contexts; it requires only that a place feature be associated to some onset position. The origin of the place feature in question is irrelevant in licensing theory; either progressive or regressive assimilation results in a well-formed structure. By contrast, positional faithfulness constraints predict that spreading will proceed from onset to coda, because the features of the onset are preferentially maintained. Directionality follows from positional faithfulness, but must be stipulated in licensing theory.

Assuming an OT formulation of CODA_{COND} in the spirit of Itô (1986, 1989), in which multiply-linked place specifications satisfy CODA_{COND}, let us consider the role of CODA_{COND} in the grammar of Tamil. I will first focus on the distribution of place features in non-initial syllables. Recall that Tamil non-initial syllables may not have independent place features; nasal codas assimilate to a following onset in order to avoid an independent coda place of articulation. This suggests that CODA_{COND} » IDENT(Place). Furthermore, the fact that assimilation is preferred to either epenthesis or deletion in Tamil indicates that MAX, DEP » IDENT(Place). Consider the tableau in (115).

(115) Preliminary ranking: MAX, DEP, CODA_{COND} » IDENT(Place)

/pasanɳ + kaɛ/	MAX	DEP	CODA _{COND}	IDENT(Place)
a.  pa.sé̃.gé				*
b. pa.sé.xé	nɳ			
c. pa.sénɳ.gé			nɳ	
d. pa.sé.nɳ }.xé		}		

CODA_{COND} is successful in distinguishing among the candidates in (115).

However, there is an additional candidate with place assimilation which must be considered, as shown in (116).

(116) Onset assimilation is favored by the grammar

/pasan δ + ka E /	MAX	DEP	CODACOND	IDENT(Place)
a. $\text{pa.s}\acute{\text{e}}\text{.g}\acute{\text{e}}$				*
b. $\text{pa.s}\acute{\text{e}}\text{n}\delta\text{.d}\delta\acute{\text{e}}$				*

The CODACOND grammar has no means of choosing between the actual surface form (116a), and the alternative (116b), in which the onset /k/ has assimilated to the coda's place of articulation. Furthermore, if we consider place markedness, (116b) is arguably optimal, as it contains a Coronal cluster, rather than a more marked dorsal. If the burden of evaluation is placed squarely on the shoulders of the place markedness subhierarchy, the results will be disastrous for the language as a whole. This is because the markedness subhierarchy will favor the least marked configuration in every case, with no regard for direction of spreading. In order to prevent such an outcome, the features of the onset must take precedence over the features of the coda—we need IDENT-ONSET(Place). Thus, even if CODACOND is available in the grammar, positional faithfulness is absolutely essential in deriving the correct outputs. Any positional markedness approach which denies licensing of place in codas cannot account for the directionality of assimilation in cases like Tamil without adopting the positional faithfulness constraint IDENT-ONSET(Place).⁴⁵

2.5 Conclusions

Root-initial syllables have a privileged status in human language processing; they play a key role in lexical access, speech production and lexical storage. Being salient in this way, root-initial syllables are equipped to convey a wide range of marked features and segments. In this chapter, I have argued that this perceptual salience is exploited directly in the phonological component of the grammar, by means of positional faithfulness constraints which assess input-output faithfulness in root-initial syllables.

Three predictions arise from the addition of IDENT- σ_1 constraints to the grammar. First, root-initial syllables should exhibit a larger and more marked inventory of segments than non-

⁴⁵ Related arguments are also advanced in Padgett (1995b).

initial syllables. Separately rankable $\text{IDENT-}\sigma_1$ and IDENT constraints will permit the intervention of inventory-defining featural markedness constraints, as schematized in (117).

(117) $\text{IDENT-}\sigma_1(\text{F}) \gg *F \gg \text{IDENT}(\text{F})$

This is the subhierarchy which is characteristic of positional neutralization, and, as we have seen, there are numerous examples which instantiate this ranking. The distribution of vowel height in Shona and Tamil arises from just this ranking; other examples of initially-determined positional neutralization are listed in (5) above.

The second prediction of root-initial positional faithfulness is that root-initial syllables will trigger phonological processes. This, too, arises from the separability of $\text{IDENT-}\sigma_1$ and IDENT in the constraint hierarchy. Phonological processes such as assimilation and dissimilation arise when a markedness constraint such as $*M_{\text{ID}}$, $*L_{\text{ABIAL}}$ or $\text{ALIGN}(\text{F})$ dominates a conflicting faithfulness constraint. For example, height harmony in Shona derives from the ranking in (118).

(118) Shona height harmony
 $*M_{\text{ID}} \gg *H_{\text{IGH}} \gg \text{IDENT}(\text{high})$

Faithfulness is subordinated to the higher-ranking markedness constraints. In this system, spreading is triggered by the root-initial syllable, due to high-ranking $\text{IDENT-}\sigma_1(\text{high})$:

(119) $\text{IDENT-}\sigma_1(\text{high}) \gg *M_{\text{ID}} \gg *H_{\text{IGH}} \gg \text{IDENT}(\text{high})$

Initial syllables are immune to spreading; in fact they trigger vowel harmony, determining the height of subsequent vowels.

Finally, positional faithfulness constraints predict that segments in the privileged positions will exhibit resistance to the application of phonological processes. Once again, through dominance of the constraint subhierarchy which generates some phonological alternation, positional faithfulness constraints will render prominent positions immune to change. This is demonstrated for root-initial syllables in the Shona height harmony system, and also in Zulu, where root-initial labials fail to undergo labial palatalization. Tamil presents an example of positional resistance at two levels. Syllable onsets in Tamil fail to undergo place assimilation (by virtue of high-ranking IDENT-ONSET), though codas do not. Furthermore, the codas of root-

initial syllables do not assimilate to following onsets, though codas in non-initial syllables do. This derives from high-ranking IDENT- σ_1 (Place).

In the preceding sections, I have shown that the predictions of Positional Faithfulness Theory are robustly borne out in a variety of languages and language families. The distribution of marked segments and the behavior of root-initial syllables with respect to phonological processes stand as strong evidence in support of IDENT- σ_1 constraints. Furthermore, alternative analyses which attempt to characterize positional faithfulness phenomena in terms of positional markedness or licensing constraints cannot rise to the occasion. Such approaches must incorporate positional faithfulness constraints; this was demonstrated in the CODA COND analysis of Tamil presented in §2.4.4.4. The work of the Coda Condition, a positional markedness constraint, is accomplished independently by the place markedness subhierarchy of Prince & Smolensky (1993). In addition, IDENT-ONSET(Place) is required to explain the invariant coda-to-onset direction of assimilation in Tamil and numerous other languages. In subsequent chapters, I will adduce further evidence in support of Positional Faithfulness Theory, showing that both stressed syllables and roots are positions of enhanced faithfulness. In each case, we will see that only positional faithfulness can account for the patterns of behavior attested in the world's languages.