3

The Controversy over Geminates and Syllable Weight

Stuart Davis

3.1. Introduction

One of the major areas of research in syllable phonology is syllable weight: specifically, what types of syllables can function as heavy and how weight is represented. The moraic view of the syllable is a widely accepted approach for encoding syllable weight. Within this approach, it is generally agreed that a short vowel constitutes a single mora while a long vowel is bimoraic. With respect to consonants, however, there is a controversy over whether the difference between a single consonant and a geminate (long) consonant is one of inherent weight or of featural or other type of representation. On the one hand, Hayes (1989) posits the moraic theory of geminates whereby a geminate consonant is underlyingly moraic but a single consonant is not. On the other hand, Selkirk (1990) posits the two-root node theory of geminates whereby a geminate consonant is represented underlyingly as a consonant linked to two root nodes while a single consonant is linked to only one root node. In an earlier view of geminates, developed in Clements and Keyser (1983) and Hayes (1986), a geminate is represented as a consonant linked to two skeletal slots, but a nongeminate is represented as a consonant linked to a single skeletal slot. These three views are illustrated in (1)–(3), respectively. (The following abbreviations are used: UR = underlying representation, μ = mora, c = consonant, RN = root node, X = skeletal slot.)

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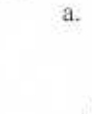
(1) Moraic theory of geminates (Hayes 1989)
a. Geminate in UR

(geminate)
b. Single consonant in UR

(singleton)

(2) Two-root node theory of geminates (Selkirk 1990)
a.

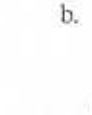


(geminate)
b.

(singleton)

(3) Two-skeletal position theory of geminates (Clements and Keyser 1983, Hayes 1986)
a.

(geminate)
b.



(singleton)

Within Optimality Theory (OT), the theoretical framework assumed in this chapter, the controversy over geminates continues. Baker (1997), adopting the two-root node theory in (2), argues for the nonmoraicity of geminates based on the stress pattern of the Australian language Ngalakan. Hume et al. (1997), adopting the theory in (3), argue against the moraicity of geminates based on the patterning of initial geminates of the Austronesian language Leti. In this chapter I focus my attention on the patterning of geminates in Sinhala, an Indic language of Sri Lanka. I argue that an optimality-theoretic analysis of Sinhala strongly supports the view of geminates as being underlyingly moraic. The analysis of Sinhala that I will present in section 3.2 not only argues for the moraic nature of gemi-

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3.2. Sinhala

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3.2.1 Data

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nates but also helps to solve an interesting controversy in the Sinhala phonological literature regarding whether the singular of the Sinhala inanimate noun is derived from the plural (e.g., Feinstein 1979, Rosenthall 1988, Steriade 1993) or the plural derived from the singular (e.g., Pyatt 1993). The optimality-theoretic analysis shows that the plural does not involve an affix or a process; rather the difference between the singular and the plural is determined strictly by the phonology (i.e., the constraint ranking). In section 3.3 I consider the evidence put forth by researchers like Baker (1997), Hume et al. (1997), and others who argue against the moraic view of geminates. I contend that the specific evidence cited either does not argue against geminates being underlyingly moraic in an optimality-theoretic grammar, or, in the case of Leti, points to the extraprosodicity of an edge element. Section 3.4 concludes the chapter.

3.2. Sinhala

In this section I present an optimality-theoretic analysis of the Sinhala inanimate plural that provides strong evidence for the underlying moraic nature of geminate consonants. In section 3.2.1 I present and discuss the relevant data. In 3.2.2 I detail the optimality-theoretic analysis that crucially assumes the moraic character of geminates. Here I point out that the analysis offers a solution to the controversy regarding whether the singular is derived from the plural (e.g., Feinstein 1979, Rosenthall 1988, Steriade 1993) or whether the plural is derived from the singular (e.g., Pyatt 1993, Davis 1999a). In section 3.2.3 I provide additional evidence for the underlying nature of Sinhala geminates based on the pattern of genitive allomorphy. I then show that the analysis of the Sinhala genitive is problematic given either the two-root node theory of geminates in (2) or the skeletal theory of geminates in (3).

3.2.1 Data

A common pattern of inanimate plurals found in Sinhala is shown by the data in (4) and (5). The singular noun must always occur with some suffix (e.g., definite suffix, genitive suffix, etc.), whereas plurals can occur without such suffixes. (The sources for the Sinhala data include Feinstein 1977, 1979, Reynolds 1980, Pyatt 1993, Steriade 1993, Letterman 1994).

(4)

Singular noun (def.)	Plural	Gloss
a. mal-ə	mal	'flower'
b. mænik-ə	mænik	'gem'
c. pot-ə	pot	'book'
d. dawas-ə	dawas	'day'
e. ræ	ræ	'dark, night'
f. olu-(w)ə	olu	'head'
g. kaasi-(y)ə	kaasi	'coin'
h. toppi-(y)ə	toppi	'hat'
i. ispaasu-(w)ə	ispaasu	'peace, rest'
j. igænniim-ə	igænniiŋ	'teaching'
k. bim-ə	biŋ	'ground'
l. amb-ə [a.mbə]	aŋ	'mango'
m. kand-ə [ka.ndə]	kaŋ	'trunk'

(5)

Singular noun	Plural	Gloss
a. mull-ə	mulu	'corner'
b. pætt-ə	pæti	'area'
c. awurudd-ə	awurudu	'year'
d. baDəginn-ə	baDəgini	'hunger'
e. watt-ə	watu	'estate'
f. kæll-ə	kæli	'piece'
g. wæss-ə	wæsi	'rain'
h. ginn-ə	gini	'fire'
i. redd-ə	redi	'cloth'
j. pott-ə	potu	'core'
k. bell-ə	beli	'neck'
l. and-ə [an.də]	a.ndu	'fence'
m. kand-ə [kan.də]	ka.ndu	'hill'

In the data in (4) the inanimate plural can be seen as consisting of just the bare noun root, as evidenced by (4a)–(4i); the glide shown in parentheses in (4f)–(4i) predictably occurs in hiatus. In (4j)–(4m) the word-final nasal is realized as [ŋ], reflecting a general condition on word-final nasals in the language; that is, any final nasal must be velar (Reynolds 1980: 4). The nasals in (4l)–(4m) are traditionally viewed as being single prenasalized segments that could be transcribed as /ᵐb/ and /ⁿd/, respectively. As seen in the data, they too are realized as the velar nasal in the plural. Thus, the plural in (4) is the bare noun root; any word-final nasal is realized as velar in conformity with the phonotactics of the language.

In (5) it does not appear that the plural consists of the bare noun root. In (5a)–(5k) the noun roots all end in a geminate consonant, as evidenced

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Given this discussion,
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by the singular forms. The plurals of these end in a high vowel with the root-final consonant degeminated. The apparent difference in the plural formation from (4) can be viewed as reflecting an undominated constraint in Sinhala against the surface appearance of word-final geminates. Consequently, the plural form cannot surface as the bare noun root as in (4). What occurs in (5), then, is degemination plus epenthesis. If we view a geminate as being underlyingly moraic, the occurrence of epenthesis in (5) can simply be viewed as an effect of moraic faithfulness. For example, the noun root /mull/ in (5a) would have two moras, one contributed by the vowel and one by the geminate. Its plural form, [mulu], likewise has two moras. The evidence for epenthesis in (5), as opposed to saying that the final vowel reflects a plural affix, is that the quality of the word-final high vowel is completely predictable. If the preceding vowel is back, the high vowel is [u]. If the preceding vowel is front, then it is [i]. This, plus the fact that the forms in (4) do not have an additional final high vowel in the plural, argues for the epenthetic nature of the final vowel in (5). Thus, in (5) the input to the plural is the bare noun root. Degemination and epenthesis are phonological effects.

The data in (5l)–(5m) look different from the other data in (5) but can be viewed the same way. The prenasal consonant in (5l)–(5m) can be considered as underlyingly moraic. In the plural the prenasal demoraifies, and epenthesis occurs just as in the other data in (5). The evidence that the prenasal of the root is moraic in (5l)–(5m) comes from the syllabification shown for the singular, especially in comparison with (4l)–(4m); the nasals in (5l)–(5m) stand in coda position. Moreover, Steriade (1993) specifically proposes that Sinhala data like those in (5l)–(5m) have a nasal closure that is moraic, while those in (4l)–(4m) are nonmoraic. Her evidence comes from the spectrographic work on Sinhala by Ladefoged and Maddieson (1996), which examined examples similar to (4) and (5). Ladefoged and Maddieson show that nasal closures on singular words like those in (5l)–(5m) are at least twice as long as the nasal closures in (4l)–(4m). Given this difference, the data in the former are indeed exactly like the rest of the data in (5). The final consonant in the plural degeminates (or, rather, demoraifies), but its mora is preserved through epenthesis. Since the final prenasal is not moraic in (4l)–(4m), the final consonant becomes a velar nasal in the plural, exactly as in (4j)–(4k).

Given this discussion, we can conclude that there is no affix marking the Sinhala inanimate plural. The precise surface form of the plural in (4) and (5) is determined by the phonology. The input to the plural would just be the noun root. I show the specific input forms in (6) for the first and last examples in (4) and (5).

(6) Input structure

μ
|
a. mal (4a)

μμ
||
b. mul (5a)

μ
|
c. ka^{n}d (4m)

μμ
||
d. ka^{n}d (5m)

Having established the nature of the input structures for the plural, we can now consider an optimality-theoretic analysis.

3.2.2 Optimality-Theoretic Analysis

In this section I present the relevant constraints that are needed for the optimality-theoretic analysis of the Sinhala inanimate plural and consider the tableaux of the forms reflected by the input structure in (6). I show that the analysis is unproblematic given the view that geminate consonants are underlyingly moraic.

In analyzing the Sinhala plural data in (4) and (5), I need to make reference to the constraints shown in (7).

(7) Constraints
- a. *GEM# – Geminates are disallowed in word-final position.
- b. FAITH-μ – Moras in the input and output correspond (i.e., no mora deletion or insertion).
- c. *V: – Long vowels are prohibited.
- d. DEP[Root Node] – A root node in the output must have a correspondent in the input (i.e., no epenthesis).
- e. DEP[±back] – The feature [±back] in the output must have a correspondent in the input.

The constraint in (7a) disallows word-final geminates and is inviolable in Sinhala. It is very common for languages that have geminates to prohibit them in word-final position. Such languages include Biblical Hebrew, Japanese, Italian, and Trukese. The constraint in (7b) is a constraint on moraic faithfulness requiring input and output moras to correspond. This militates against the insertion or deletion of moras. Faithfulness constraints of this type are posited by McCarthy and Prince (1995) and Rosenthall (1997). (7b) is a

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(8) /mal/ – [mal] 'flow

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μ | ☞ a. mal	
μ μ | | b. ma lu	

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high-ranking constraint in this analysis and seems reflective of the phonology as a whole since phenomena like vowel deletion that eliminate a mora or insertion processes that add moras appear to be quite rare in Sinhala phonology. Moreover, as seen by the data item in (5f), long vowels do not shorten in closed syllables in Sinhala, thus suggesting that moraic faithfulness is indeed high ranking. The constraint in (7c) is not inviolable in Sinhala as seen by data with long vowels, such as in (4e), (4g), and (5f). However, it plays an important role in our analysis of the plural in (5) so as to rule out candidates with long vowels, such as the hypothetical [muul] for the plural of (5a). The constraint in (7d) is a low-ranking constraint that militates against the occurrence of epenthesis. The constraint in (7e), which does not seem to be crucially ranked, prohibits the insertion of a [±back] feature. Its effect can be seen in (5) where the inserted vowel takes on the backness value of the preceding vowel. (That is, the epenthetic vowel in (5) shares the [back] feature with the preceding vowel.)

In (8), I show the tableau for the plural form of (4a) where the input form of the plural is the noun root. I discuss the arguments for the constraint ranking as they arise after each tableau.

(8) /mal/ – [mal] 'flowers' (4a)

/mal/	Faith-μ	*Gem#	*V:	Dep[Root Node]	Dep[±back]
☞ a. mal					
b. ma lu	*!			*	

The actual output in (8a) is faithful to the input. It does not violate any relevant constraint. Any other candidate, such as that in (8b), would incur a violation of some faithfulness constraint. A tableau like that in (8) accounts for most of the plural forms for data like those in (4). The tableau in (8) does not provide evidence for the specific ranking of the constraints since the winning candidate does not violate any of the relevant constraints.

In (9), we show the tableau for the plural form of (5a). As in (8), the input form consists of the noun root; the final geminate is viewed as being under-

lyingly moraic. (In the moraic representation of the input and the various candidates in the tableaux I include a subscript for each mora so as to make clear whether moraic faithfulness is being respected.)

(9) /mu l/ – [mulu] 'corner' (4a)

/mu l/	FAITH-μ	*GEM#	*V:	DEP[Root Node]	DEP[±back]
a. mu l [mull]		*!			
b. mul	*!				
c. m u l [muul]			*!		
d. mu l u [mullu]	*!			*	
☞ e. mu l u				*	
f. mul i				*	*!

The tableau in (9) is quite revealing of how the phonology alone determines the nature of the plural form. The input in (9) is like that shown in (8). It is just the noun root. However, in (9) the root ends in a moraic (geminate) consonant. Hence, the faithful candidate in (9a) cannot surface since it has a fatal violation of *GEM#. One possibility is simply to degeminate the final consonant, as reflected by the candidate in (9b). Such a candidate is phonotactically good, as can be seen by its resemblance to (8a). However, the candidate fatally violates the moraic faithfulness constraint and so fails

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(10) a. *GEM# >> DEP
b. FAITH-μ >> DEP
c. *V: >> DEP

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b. IDENT-PLACE –

The constraint in (11a)
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to surface. Thus the constraints *Gem# and Faith-μ must each outrank Dep[Root Node] (i.e., avoid epenthesis), which is the constraint violated by the winning candidate in (9e). Candidate (9c) is a realistic possibility because it avoids violating moraic faithfulness by preserving the mora as part of a long vowel. Moreover, a candidate like (9c) is phonotactically possible in Sinhala given that the language has long vowels in closed syllables (as in (5f) and words like [haal] 'uncooked rice'). That candidate (9c) fails to surface as the plural constitutes a ranking argument for the constraint *V: being higher ranked than Dep[Root Node]. Candidate (9d) is also phonotactically permissible, but it is ruled out because it has one more mora than the input form and thus fatally violates the moraic faithfulness constraint. The choice then is between candidates (9e) and (9f). Both respect moraic faithfulness in that they do not add or subtract moras from the input. They both violate low-ranking Dep[Root Node] in that they have an inserted vowel. However, candidate (9f) is eliminated because of its violation of Dep[±back] in that the feature [–back] is added. Candidate (9e) does not violate this constraint since it acquires its backness feature from the preceding vowel. Thus we see from the tableau in (9) how the phonology alone determines the form of the plural, given the noun root as the input.

The constraint rankings that emerge from tableau in (9) are given in (10).

(10) a. *Gem# >> Dep[Root Node] (Evidence: comparison of (9a) with (9e))
b. Faith-μ >> Dep[Root Node] (Evidence: comparison of (9b) with (9e))
c. *V:>> Dep[Root Node] (Evidence: comparison of (9c) with (9e))

While a specific argument regarding the relative ranking of Faith-μ and *V: does not emerge from the tableau in (9), the fact that long vowels do not shorten even when in closed syllables (as in (5f)) provides evidence for the ranking of Faith-μ over *V:. I am unaware of any evidence that indicates the relative ranking of Faith-μ and *Gem#. Based on (9) and (10), both are high ranking.

Finally, as mentioned previously, the constraint Dep[±back] is not critically ranked with respect to the other constraints. I place it with Dep[Root Node] in the tableaux for clarity.

In dealing with data containing word-final nasal consonants ((4j)–(4m)), we need to make reference to two other constraints:

(11) a. Final-ŋ – Word-final nasals must be velar.
b. Ident-Place – Place features in the input and output are identical.

The constraint in (11a) requiring word-final nasals to be velar is high ranking in Sinhala since all word final nasals are velar. Trigo (1988) notes that the

phenomena of word-final nasals being velar is not uncommon cross-linguistically and may be reflective of the glidelike character of a coda nasal that is not followed by a homorganic consonant. The constraint in (11b) is lower ranked than (11a) and would be violated any time a word-final nasal changes its place of articulation to become a velar, as in the plural forms of (4j)–(4m).

The tableau for the data item in (4m), where the input has a final nasal, is shown in (12).

μ μ
| |

(12) /kand/ – [kaŋ] 'trunks' (4m)

μ /kand/	Final-ŋ	Faith-μ	*Gem#	*V:	Ident-Place	Dep [Root Node]	Dep [±back]
μ ☞ a. kaŋ					*		
μ μ b. ka.ndu		*!			*		
μ c. kand	*!						

The plural for the form in (4m) is accounted for unproblematically. The faithful candidate in (12c) would violate the undominated constraint, requiring final nasals to be velar. (Recall from the discussion in the previous section that all nasal-plus-stop sequences in Sinhala are viewed as prenasalized stops.) The candidate in (12b) violates moraic faithfulness. Thus (12a), with a final velar nasal, surfaces as the actual plural even though it violates Ident-Place. (The exact ranking of Ident-Place is not crucial other than that it must be ranked lower than Final-ŋ.)

In (13) is the tableau for the data item in (5m) where the input has a final prenasal that is moraic.

μ_i μ_j μ_i μ_j
| | | |

(13) /ka nd/ – [ka.ndu] 'l

μ_i μ_j /ka nd/	Final
a. μ_i μ_j ka nd [ka nd]	*!
b. μ_i ka ŋ	
c. $\mu_i\mu_j$ ka ŋ [kaaŋ]	
d. μ_i μ_j μ_k ka n.du [kan.du]	
☞ e. μ_i μ_j ka.ndu	
f. μ_i μ_j ka.nd i	

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μi μj μi μj
| | | |

(13) /ka nd/ – [ka.ndu] 'hills' (5m)

μi μj | | /ka nd/	Final-ŋ	Faith-μ	*Gem#	*V:	Ident-Place	Dep [Root Node]	Dep [±back]
a. μi μj | | ka nd [ka nd]	*!		*				
b. μi | ka ŋ		*!			*		
c. μiμj \/ ka ŋ [kaaŋ]				*!	*		
d. μi μj μk | | | ka n.du [kan.du]		*!				*	
☞ e. μi μj | | ka.ndu						*	
f. μi μj | | ka.nd i						*	*!

The evaluation of the candidates for the plural form of (5m) is quite revealing. The faithful candidate in (13a) is ruled out because it would violate both the constraint against word-final geminates and the constraint requiring final nasals to be velar. The candidate in (13b) is ruled out because of its violation of moraic faithfulness. The candidate in (13c) fatally violates the constraint against long vowels. The candidate in (13d) violates the constraint on moraic faithfulness by adding an extra mora. The choice, then, is between candidates (13e) and (13f), both of which violate low-ranking Dep[Root Node] because of the final epenthetic vowel. However, since (13f) incurs an additional violation of Dep[±back], (13e) surfaces as the winner. Again, we see that the plural output is determined strictly by the phonology, given that the input is just the noun root. Crucial for the analysis is that the Sinhala geminate

consonants are underlyingly moraic. On this analysis, the only difference between the underlying prenasal consonant in (4m) and (5m) is that the one in (5m) is moraic whereas the one in (4m) is not. That is, they are exactly like the rest of the data in (4) and (5), where the roots in (5) end in moraic consonants while those in (4) do not.

As for the singular forms, their input would consist of the noun root plus a suffix, such as the definite suffix, the genitive suffix, and so on. The constraint ranking that we have established results in the correct singular output. The tableaux in (14) and (15) show the singular forms of (4a) and (5a), respectively.

(14) /mal + ə/ – [malə] 'the flower' (4a)

/mal + ə/	Faith-μ	*Gem#	*V:	Dep[Root Node]	Dep[±back]
☞ a. malə					
b. mall ə	*!				

(15) /mul + ə/ – [mullə] 'the corner' (5a)

/mul + ə/	Faith-μ	*Gem#	*V:	Dep[Root Node]	Dep[±back]
☞ a. mull ə					
b. mul ə	*!				

The optimality-theoretic analysis presented in this section helps to solve a controversy regarding the proper analysis of the inanimate plural. As I point out in section 3.2, in the optimality-theoretic analysis of the Sinhala inanimate plural there is no affixation or plural process. The precise shape of the plural is determined by the phonology, that is, the constraint ranking with the

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In previous research, P
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In the analysis of Fein
(1988), it is proposed that
Feinstein posits that all th
underlying representatio
[beli] in (5k) are shown i
to be /a/ underlyingly by
data in (4) and (5).)

(16) Singular noun Pl
a. /mulw-a/ /m
b. /bely-a/ /b

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Davis (1999a) has of
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input consisting of just the noun root. However, this has not been the view of previous research on the Sinhala inanimate plural, none of which is done in OT. On the one hand, researchers like Pyatt (1993) and Davis (1999a), following the description of Fairbanks et al. (1968), have analyzed the plural as being based on the singular. On the other hand, Feinstein (1977, 1979) has maintained that the singular form is actually derived from the plural. Feinstein's analysis has been adopted in more recent discussion on Sinhala by such researchers as Rosenthall (1988), Steriade (1993), and Letterman (1994). Rosenthall (1988: 280) in particular refers to the definite morpheme as the singular morpheme. The optimality-theoretic analysis argues against both of these positions.

In previous research, Pyatt (1993) and Davis (1999a) posit similar analyses of the Sinhala inanimate plural whereby the plural is formed from the singular by a delinking process in which the root-final consonant degeminates (or demoraifies), with a final vowel being subsequently inserted whose backness value agrees with that of the last root vowel. On this view, the inanimate plural has an input requirement that the final consonant be geminate. But the optimality-theoretic analysis that I have offered in this section shows that the degemination is not part of a special plural process but rather is just a consequence of the normal phonology (i.e., the constraint ranking).

In the analysis of Feinstein (1977, 1979), which is adopted by Rosenthall (1988), it is proposed that the singular form is actually derived from the plural. Feinstein posits that all the nominal roots in (5) end in a glide, /w/ or /y/. The underlying representation for [mullə] and [mulu] in (5a) and for [bellə] and [beli] in (5k) are shown in (16a) and (16b), respectively. (The suffix is argued to be /a/ underlyingly by Feinstein though it surfaces as [ə] as seen from the data in (4) and (5).)

(16)	Singular noun	Plural	Gloss
	a. /mulw-a/	/mulw/	'corner'
	b. /bely-a/	/bely/	'neck'

The suffix that appears in (16) is referred to by Rosenthall (1988) as a singular suffix, though traditionally it is considered to be a definite marker (and it cannot co-occur with plurals). The suffix is viewed in (16) as being attached to a noun root to make it singular. Feinstein posits rules of glide assimilation and vocalization to account for the surface forms of the singular and plural, respectively.

Davis (1999a) has offered a number of criticisms of this type of analysis where the singular is derived based on the plural. Two of them center on the positing of a root-final glide. First, the glide actually never surfaces in any of the allomorphs. Thus, the underlying forms in (16) are quite abstract. Second, and probably a more significant criticism is that the nature of the

root-final glide posited in the underlying form, as exemplified in (16a) and (16b), is completely predictable. It is /w/ if the preceding vowel is back, and it is /y/ if the preceding vowel is front. That the nature of the underlying glide as a /w/ or /y/ is completely predictable in Feinstein's research seriously calls into question the validity of his analysis, given that one would not expect redundant information of this type to be part of the underlying representation. Consequently, I maintain that the optimality-theoretic analysis offers a new insight into the problem of the Sinhala inanimate plural by showing that there is no special process or morphology associated with the inanimate singular-plural pairs in (4) and (5). The output forms are just determined by the phonology (i.e., the constraint ranking) given the noun root as the input.

3.2.3 Genitive Allomorphy and the Nonmoraic View of Geminates

In this section I provide additional evidence for the underlying moraic nature of Sinhala geminates based on the pattern of genitive allomorphy. I then show that the analysis of the Sinhala genitive is problematic given either the two-root node theory of geminates in (2) or the skeletal theory of geminates in (3).

In Sinhala, the genitive suffix has two allomorphs, [-e] and [-ee]. In (17), we see examples of words that take the allomorph [-e], and in (18) are examples with the allomorph [-ee].

(17) Sinhala genitive allomorph [-e]

	Noun roots	Genitive	Gloss	Syllabification
a.	mudal-	mudəl-e	'the fund's'	mu.də.le
b.	paar-	paar-e	'the street's'	paa.re
c.	pawl-	pawl-e	'the family's'	paw.le
d.	pætt-	pætt-e	'the side's'	pæt.te
e.	pott-	pott-e	'the core's'	pot.te
f.	and-	and-e	'the fence's'	an.de
g.	kand-	kand-e	'the hill's'	kan.de

(18) Sinhala genitive allomorph [-ee]

	Noun roots	Genitive	Gloss	Syllabification
a.	mal-	mal-ee	'the flower's'	ma.lee
b.	pot-	pot-ee	'the book's'	po.tee
c.	amb-	amb-ee	'the mango's'	a.mbee
d.	kand-	kand-ee	'the trunk's'	ka.ndee

The generalization regarding the allomorphy pattern shown in (17) and (18) is relatively straightforward. If the noun root contains more than a single mora, as in (17), the allomorph is [-e]; if it contains just a single mora, then it is [-ee]. First consider (17). The item in (17a) is representative of nominal roots that are two syllables or longer. With such nouns the genitive is always

[-e]. The roots in (17b)–(1
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are lexically monomoraic.
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or geminates. The prenasa
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is realized as [-ee] if the nc
surfaces as [-e].

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(2). For example, if one se
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geminate consonants.

3.3. The Nonmoraic Vie

So far in this chapter I
related phenomena in

[-e]. The roots in (17b)–(17e) are all monosyllabic, but they are bimoraic, because they either contain a long vowel, a diphthong, or a geminate. Each of the roots would be underlyingly bimoraic given Hayes's (1989) moraic algorithm. In particular the roots with geminates in (17d)–(17e) would be bimoraic since the vowel of the root constitutes a mora and the geminate constitutes a mora. The roots in (17f)–(17g) are also bimoraic since in these roots the prenasal is underlyingly moraic. This can be demonstrated for these forms since we noted their plural forms in (5l)–(5m). In contrast, the roots in (18) are lexically monomoraic. Only the single vowel in these roots contributes a mora. The roots are monosyllabic and do not contain long vowels, diphthongs, or geminates. The prenasals in (18c) and (18d) are not moraic. This can be clearly observed in the plural forms in (4l–m). Thus, we see that the genitive is realized as [-ee] if the nominal root is monomoraic; otherwise, the genitive surfaces as [-e].

The generalization regarding the genitive allomorphy is relevant because the generalization is difficult and awkward to express given a nonmoraic view of geminates, such as the skeletal view in (3) or the two-root node theory in (2). For example, if one sees a geminate as consisting of a consonant linked to two skeletal slots, as in (3), then one might posit that the genitive is [-e] for forms in which one root node branches to two skeletal slots; however, that would handle neither bisyllabic roots like (17a) nor roots with diphthongs like (17c). Moreover, an analysis based on (18) suggesting that noun roots with three or fewer skeletal slots take [-ee] as genitive would make a wrong prediction regarding (17f). Similar problems would arise if one tried to state the generalization under the two-root node theory of geminates given in (2).

What seems to be happening with the Sinhala genitive is that there is a weight requirement demanding nouns in the genitive to surface with at least three moras. The three-mora requirement is specific to the genitive and not to nouns in general. The genitive suffix is underlyingly /-e/. When it suffixes onto a monomorphemic root like in (18), it undergoes lengthening so that the genitive noun actually surfaces with three moras. Consequently, the genitive provides an ideal test to see which roots are treated as monomoraic and which are not. Thus, the grouping together in (17) of monosyllabic nominal roots containing geminates, diphthongs, and long vowels with roots containing more than a single syllable reflects not the number of skeletal slots or root nodes but the fact that such nominal roots contain more than one mora. This grouping provides strong evidence for the underlying moraic nature of geminate consonants.

3.3. The Nonmoraic View of Geminates within Optimality Theory

So far in this chapter I have argued, based on an analysis of geminate-related phenomena in Sinhala, for the underlying moraic nature of

geminate consonants within OT. In this section I want to consider a couple of cases in the optimality-theoretic literature that have been used to argue against the underlying moraic analysis of geminates. I discuss the case of the initial geminates of the Austronesian language Leti, which Hume et al. (1997) argue to be nonmoraic, and then I discuss work on stress like that of Baker (1997) where geminates do not behave as moraic. In the case of Leti, I argue that the nonmoraic behavior of initial geminates documented in Hume et al. can be understood as a case of word-initial extraprosodicity. I maintain that stress systems in which geminates pattern as nonmoraic do not provide evidence against the underlying moraic nature of geminates but rather result from the role of certain high-ranked constraints.

3.3.1 Evidence from Leti against the Moraic Representation of Geminates

Hume et al. (1997), working in an optimality-theoretic framework, provide evidence against the moraic representation of initial geminates in Leti. Their main argument centers on Leti having a minimal word condition that requires lexical words to be minimally bimoraic. Leti also permits geminate consonants in word-initial position. Hume et al. argue that if initial geminates were moraic then one would expect to find words like [ppe], which consist of an initial geminate followed by a short vowel. Such words would be bimoraic if geminates contribute a mora. However, Leti has no such words. Consequently, Hume et al. claim that Leti initial geminates are not moraic and that such evidence argues generally against the moraic view of geminates as in (1).

I want to show in this section that Leti initial geminates are more properly analyzed as being extraprosodic. This becomes clear if we compare Leti with another Austronesian language, Trukese, which also has initial geminates and a minimal word constraint. Consider the data in (19) and (20) from Trukese. (The data are based on the Central Lagoon dialects and come from Goodenough and Sugita 1980 and Dyen 1949, 1965. The discussion here owes much to the insights of Churchyard 1991 and Hart 1991, both working in nonlinear derivational phonology. See Davis and Torretta 1998 for a detailed optimality-theoretic analysis of Trukese.)

(19)

	Underlying representation	Output form	Gloss	Wrong output
a.	/maa/	[maa]	'behavior'	*ma
b.	/tɛɛ/	[tɛɛ]	'islet'	*tɛ
c.	/oo/	[oo]	'omen'	*o

(20)

	Underlying representation	O fo
a.	/ttoo/	[t
b.	/čča/	[č
c.	/ssɔɔ/	[s

Trukese has a general proc
seen in (20). However, as (
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vn, vl, vr]), a sonorant + ob
rant ([mr, nr, rm, rn, rl]), a
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of the cluster syllabifies w

(20)	Underlying representation	Output form	Gloss	Suffixed form -n = relational
a.	/ttoo/	[tto]	'clam (sp.)'	[ttoo-n]
b.	/c̄c̄aa/	[c̄c̄a]	'blood'	[c̄c̄aa-n]
c.	/ssɔɔ/	[ssɔ]	'thwart of a canoe'	[ssɔɔ-n]

Trukese has a general process whereby a word-final long vowel shortens, as seen in (20). However, as (19) shows, shortening does not apply if the result would be monomoraic, because Trukese has a minimal word constraint that requires nouns to be bimoraic. That the word-final vowel does shorten in (20) strongly suggests that the initial geminate is moraic. That is, an output like [tto] in (20a) is bimoraic, with a mora being contributed by both the vowel and the geminate. Moreover, it would be difficult to account for the difference between (19) and (20) with either the two-root node theory of geminates in (2) or the two-skeletal position theory of geminates in (3). It might be suggested that the minimal word constraint could be one on the number of root nodes or X-slots with the requirement that words must have at least three. This works for the data in (20); the forms underlying have four root nodes (or four X-slots), so vowel shortening is allowed. However, a problem for this view is the form in (19c) (/oo/ – [oo] 'omen'). This word only has two root nodes, not three. Clearly, the comparison between (19) and (20) shows that the geminate is adding weight to the forms in (20). This is best captured by the moraic theory of geminates shown in (1).

Now let us consider Leti, which has initial geminates but lacks words consisting of an initial geminate followed by a short vowel, such as [ppe]. Hume et al. (1997) maintain that the lack of such words argues against the moraicity of geminates. Here, following Davis (1999b), I maintain that Leti is different from Trukese in that the initial geminates of Leti (but not Trukese) are extraprosodic and that this is supported by the phonotactics of Leti. To see this, we can compare Leti geminates and word-initial clusters with those in Trukese. In Leti, underlying geminates only occur in word-initial position (Jen Muller, personal communication). In Trukese, they occur in both word-initial and word-internal positions. Moreover, in Trukese, word-initial clusters other than geminates do not occur (with the exception of a few loanwords). Word-initial clusters are pervasive in Leti, allowing for almost any possible sequence of two consonants at the beginning of the lexical word. There are no sonority restrictions on what these two consonants can be. The two consonants in a word-initial sequence can be an obstruent + sonorant ([pn, pl, pr, tm, tl, tr, vn, vl, vr]), a sonorant + obstruent ([mb, ms, mv, ns, rs, rv]), a sonorant + sonorant ([mr, nr, rm, rn, rl]), and two obstruents ([pt, tp, pk, kp, tk, kt]). Furthermore, as Hume et al. show, in phrase-internal position the initial consonant of the cluster syllabifies with the preceding word. Given this patterning, one

could realistically analyze the first consonant of a word-initial cluster in Leti as being extraprosodic. The initial consonant of such a cluster is unrestricted and can be identical to the following consonant. This means that the word-initial geminate of Leti consists of a sequence of identical consonants; the first consonant of the sequence would be extraprosodic just like the first consonant of any other word-initial cluster. Such an analysis would explain the absence of Leti words like [ppe] or any other word of the shape CCV. With initial extraprosodicity these forms would not comply with the bimoraic minimum. Given that underlying geminates only occur word-initially in Leti and given the general phonotactics of word-initial clusters in Leti discussed, I conclude that Leti presents a different type of situation from Trukese and Sinhala. Consequently, we can maintain that geminates are normally underlyingly moraic; however, there may be cases, such as Leti, where the language has extraprosodic consonants with geminates patterning with such consonants.

3.3.2 Stress Evidence Against the Moraic Representation of Geminates

One argument against the moraic representation of geminates in the preoptimality-theoretic literature comes from stress. As independently noted by Selkirk (1990) and Tranel (1991), if geminates are underlyingly moraic we would expect languages with stress systems whereby syllables with long vowels and syllables closed by geminates would pattern together as heavy. This would be expected in a language where stress is sensitive to syllable weight, but where coda consonants do not generally acquire a mora. However, according to Selkirk (1990) and Tranel (1991), such languages do not seem to occur. While Davis (1994) has shown that there are languages whereby only syllables with long vowels and those closed by geminates pattern as heavy with respect to stress, there are nonetheless quantity-sensitive languages that systematically ignore syllables closed by geminates. Consider the data from Selkup in (21).

(21) Selkup (Halle and Clements 1983)

a.	qumó:qi	'two human beings'
b.	ú:ciqo	'to work'
c.	u:cɔ́:mit	'we work'
d.	qúminik	'human being (dat.)'
e.	ámirna	'eats'
f.	ú:cikkak	'I am working'

In Selkup, primary stress falls on the rightmost heavy syllable. A CVC syllable does not count as heavy for stress, even if it is closed by a geminate,

as seen in (21f). As noted
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consonants.

More recently, Baker (1
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(22) Ngalakan (capitalize

a.	ciwi	'liver
b.	céraTa	'wom
c.	páRamùnu	'sand
d.	cálapir	'red
e.	kúpuy	'swea
f.	purúTci	'wate
g.	miRárppu?	'crab
h.	puTólko?	'brol
i.	kipíTkuluc	'frog
j.	màcapúrka	'plan
k.	LáRkurca	'vine
l.	cálpurkic	'fish

The data in (22a)–(22l) sh
most (nonfinal) heavy syl

as seen in (21f). As noted by Tranel (1991), if stress is targeting bimoraic syllables and geminates are underlyingly moraic, then the second syllable in (21f) would be the rightmost bimoraic syllable. Both the vowel and the geminate would contribute a mora to the second syllable. That (21f) does not receive stress seems to provide evidence against the moraic theory of geminates. However, in an optimality-theoretic framework the inertness of syllables closed by a geminate for stress does not really argue against the moraic theory of geminates; rather it would just be a consequence of certain high-ranking constraints that have the effect of ignoring the bimoraicity of any CVC syllable. As Steriade (1990: 275) suggests, some languages may restrict the set of stress-bearing segments so that such segments also must be tone-bearing, "for reasons that are clearly related to the fact that pitch is one of the main realizations of metrical prominence." Thus, Steriade concludes that in a language like Mongolian a CVC syllable is bimoraic, but for it to attract stress it must contain two tone-bearing elements (i.e., vowels and perhaps other sonorant segments, as discussed in Zec 1995). Steriade's suggestion can be incorporated into an optimality-theoretic approach in which there is a constraint that restricts pitch realization to vocalic elements. Such a constraint would choose to place stress on any CVV syllable over any syllable closed by an obstruent, even if that obstruent were part of a geminate. Thus, the lack of second-syllable stress in (21f) of the Selkup data does not reflect on the underlying moraicity of geminate consonants.

More recently, Baker (1997), working within OT, argues against the moraic representation of geminates based on the stress pattern of the Australian language Ngalakan. Consider the data in (22).

(22) Ngalakan (capitalized consonants are postalveolar)

a.	cíwi	'liver'	
b.	céraTa	'women's ceremony'	
c.	páRamùnu	'sand goanna'	
d.	cálapir	'red ant (species)'	
e.	kúpuy	'sweat (n.)'	
f.	purúTci	'water python'	
g.	miRárppu?	'crab'	
h.	puTólko?	'brolga (bird)'	
i.	kipíTkuluc	'frogmouth (bird)	
j.	màcapúrka	'plant (sp.)'	
k.	LáRkurca	'vine (sp.)'	
l.	cálpurkic	'fish (sp.)'	
m.	kaNTálppuru	'female plains kangaroo'	
n.	cákanta	'female plains kangaroo'	
o.	ŋúruNTuc	'emu'	
p.	ŋóloŋko?	'eucalyptus'	
q.	ŋámucculo	'subsection term'	
r.	cápatta	'tortoise (sp.)'	
s.	móLoppoL	'catfish (sp.)'	
t.	ŋáNa?pay	'and moreover'	
u.	kiNálk	'white ibis'	
v.	kappúRk	'dry'	

The data in (22a)–(22l) show that primary stress in Ngalakan falls on the leftmost (nonfinal) heavy syllable; otherwise, it falls on the initial syllable. The

data in (22m)–(22v) are quite interesting. The data in (22m)–(22p) show that a syllable closed by a nasal homorganic to the following consonant (i.e., a partial geminate) does not count as heavy. The data in (22q)–(22s) show that a syllable closed by a geminate also does not count as heavy. (22t) shows that a syllable closed by a glottal does not count as heavy, and (22u)–(22v) show that a final syllable can count as heavy if it ends in two consonants. The Ngalakan data are unusual because closed syllables are treated as heavy unless they are closed by a geminate or partial geminate. That is, the only closed syllables that are picked out for primary stress are ones where the coda consonant is heterorganic to the following consonant. Thus, it would seem that geminates do not contribute a mora at all, while coda consonants in general do. Such data appear to provide evidence against the moraic representation of geminates.

Baker (1997), in his analysis of the Ngalakan stress pattern in (22), refers to a high-ranking constraint, CrispEdge-μ. This constraint requires moraic segments to have a crisp edge (i.e., it must be affiliated to a segment that is not place linked). Given that the only codas that would respect CrispEdge-μ are ones that are heterorganic to the following consonant, the constraint will not pick out any coda that shares place features with the following onset. While this pattern of stress is of some interest (especially since it is not observed in Hayes 1995), it is actually not incompatible with the view that geminates are underlyingly moraic. It is just that in Ngalakan they may not surface as moraic so as to respect CrispEdge-μ. Alternatively, one could analyze the Ngalakan stress pattern as making reference not to mora structure but directly to consonantal place. This is supported by the observation that syllables closed by glottals do not attract stress, as in (20t). Thus, for a closed syllable to attract stress the coda must have its own place features. Syllables closed by geminates, partial geminates, and glottals would not have codas with their own place features. Again, such an analysis does not necessarily argue for the nonmoraicity of underlying geminates. Consequently, while the Ngalakan stress pattern ignores geminates it does not constitute evidence against the underlying moraic nature of geminate consonants.

3.4. Conclusion

The issue of the representation of geminate consonants has been controversial within OT. Baker (1997) and Hume et al. (1997) specifically argue against the moraic representation of geminate consonants. In this chapter I argued for the position that geminate consonants are underlyingly moraic within an optimality-theoretic grammar. In support of this I offered detailed optimality-theoretic analyses of geminate behavior in Sinhala, where I specifically

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argued for the underlying moraicity of the geminate consonants. I also showed that an alternative view of geminates, such as the two-root node theory or the skeletal slot theory, is highly problematic in accounting for the geminate behavior. Finally, I considered the evidence against the moraic view of geminates put forth by Baker (1997) and Hume et al. (1997). I demonstrated that in the case of Ngalakan the stress evidence does not argue against geminates being underlyingly moraic in an optimality-theoretic grammar, and in the case of Leti the evidence points to the extraprosodicity of an edge element. With the possible caveat regarding the extraprosodicity of an edge element, as in Leti, the arguments and analyses presented in this chapter provide strong evidence for the view that geminates are always underlyingly moraic.

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4

The Syllable as a Un in Japanese

Haruo Kubozon

4.1. Introduction

The traditional typology Japanese as a typical "mor The conception of the mor ported by a wide range o summary). In comparison, in the same prosodic syste of Optimality Theory (OT

The goal of this chapte pendent phenomena in Jap light-heavy structures. The language), emphatic mime which all have drawn little well-known phenomena o cians' language). Moreove longer words involving thr chanting phrases used in b with which such a prosodic

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