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The Moraic Status of Initial Geminates in Trukese

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0. Introduction. According to the version of the moraic theory outlined in Hayes (1989), geminate consonants are distinguished from ordinary consonants by being underlyingly moraic. Trukese is a language which poses a theoretical challenge for moraic phonology, in that it contains both medial and initial geminates.

Hayes asserts (1989: p. 303) that initial geminates, like medial geminates, may be moraic. He gives no empirical justification for their moraic status, however. The implicit theoretical argument seems to be an argument from symmetry: initial geminates are assumed *a priori* to be as similar as possible to medial geminates.

In this paper, I will present evidence from Trukese which supports the position that initial geminates contribute moraic weight to the word in the same way that medial geminates do, and so they should properly be viewed as moraic. By analyzing the interaction of initial geminates with prosodic processes that are sensitive to mora count, I show that the initial geminate supplies a mora. The paper is organized as follows. Section 1 provides background information. Section 2 outlines a process of delinking from the final mora of a word, a process which is sensitive to moraic weight. Compensatory lengthening and its interaction with final delinking and minimality is analyzed in Section 3; the presence of initial geminates is crucially shown to block compensatory lengthening. Section 4 presents the process of "gemination throwback", and suggests an improved representation for geminate consonants.

1. Background Information. Trukese is a Micronesian language of the Trukic subgroup. It is spoken on the islands on Truk Atoll, south of Guam. Related languages in the same subgroup include Woleaian, Ulithian, and Puluwat. The data given here are from Goodenough and Sugita (1980, 1990). All examples are in Trukese orthography; diacritics over vowels merely indicate differences in vowel quality, not any accentual marking.

All the consonants in the inventory except glides may geminate. All geminates may appear in medial or initial position. (The phonemic inventory is given as an appendix.) Provisionally, we adopt the representation of geminates assumed in Hayes (1989).

(1a)

(1b)

Hayes suggests that, just as a medial geminate is doubly linked, to its pre-assigned mora and to the onset of the following syllable, so an initial geminate is doubly

linked, to the onset of the first syllable and to a word-initial mora which is extraprosodically licensed.¹

Syllables are maximally CCVV (*nnoo.wu*, 'be disgusted) or CVVC (*sóók.ku*, 'kind, way')². Syllables are subject to the following constraints on well-formedness:

(i) Onset satisfaction is absolute. (The effects of a rule inserting a default glide onset is not always indicated in the orthography: [y Δ Δ], 'fishhook' is spelled 'éé'.)

(ii) There are no complex onsets (except initial geminates).³

(iii) There are no sequences of two unlike vowels.

(iv) Coda consonants are subject to the following restriction underlyingly: they must be both moraic and doubly-linked. From this it follows that the first half of a medial geminate is the only possible coda consonant. In fact, in the native vocabulary, even a nasal homorganic with a following obstruent is not a licit coda. All words, then, are underlyingly vowel-final: no word ends in a consonant, since there is obviously no possibility of a word-final consonant being doubly-linked.

The minimal lexical-category word in Trukese is underlyingly bimoraic: [μμ]_{wmin}. All monomoraic words appear to belong to functional categories, like conjunctions and complementizers, e.g: *mé*, 'and'; *ngé*, 'but, while'. Following McCarthy and Prince (1986), I assume that this bimoraic unit is also the canonical foot of the language, although there is otherwise little direct evidence for foot structure, given that there is no recorded stress.⁴

2. Word-Final Delinking. Stems of all lexical categories in Trukese exhibit an alternation between the form in which they appear with inflectional suffixes, equivalent to the underlying form, and the unsuffixed form. When not followed by a suffix, short stem-final vowels are deleted; long vowels become short. (2) summarizes the two basic patterns.

(2) a. V → Ø / ____ #					Cf. 1st sg.
/ omosu /	→	omos	'turban shell'	omosu-y	
/ fféni /	→	ffén	'love'	fféni-y	
/ mékúre /	→	mékúr	'head'	mékúre-y	
/ nemeneme /	→	nemenem	'authority'	nemeneme-y	
b.	VV → V / ____ #				
/ pechee /	→	peche	'foot'	pechee-y	
/ tikkaa /	→	tikka	'coconut oil'	tikkaa-y	
/ etiruu /	→	etiru	'coconut matting'	etiruu-y	
/ chuuchuu /	→	chuuchu	'urine'	chuuchuu-y	

The shortening and deletion can be modelled as a single phenomenon: the delinking of the vowel from the final mora of the phonological word. The process is represented schematically in (3).

(3) Final Delinking

A formal objection to the Final Delinking rule inevitably arises: application of this rule to long vowels is a violation of the linking constraint (Hayes 1984). The linking constraint, originally motivated as an account of geminate integrity, says that all association lines in rules must be interpreted exhaustively. Because the long final vowel in /pechee/ is doubly linked, to two moras, the linking constraint should block the delinking rule from applying in such a case, since the rule mentions only a single association line. Schein and Steriade (1986), however, offer a different analysis of geminate integrity. The Uniform Applicability Condition states any rule may apply in a doubly-linked structure, provided that its application affects segmental content uniformly. In this view, a delinking rule such as (3) may apply freely, since the segmental content remains unaffected.⁵ Derivations illustrating the application of Final Delinking are given in (4):

(4) a. mékúre → mékúr

b. pechee → peche

When the final vowel is short (4a), Final Delinking delinks the vowel melody from the last mora (i). Now the final syllable itself undergoes "parasitic delinking" (Hayes 1989). The syllable, in Hayes' view, requires an overt nuclear element to

unlicensed and must be deleted, as shown in (ii). At this point, the consonant and vowel melodies which originally comprised the final syllable are left unassociated. The vowel melody is simply stray-erased. However, the stranded consonant, originally the onset of the final syllable, is now syllabified as a non-moraic coda (iii). Given our earlier statements about licensing of coda consonants in Trukese, what this involves is a relaxation of the requirement that coda consonants be both moraic and doubly-linked. In fact, the only singly-linked coda consonants in the language arise exclusively through resyllabification after Final Delinking - word-final coda consonants are never underlying. I would argue that the abandonment of restrictions on coda consonants can be seen as a last-ditch attempt to preserve irrecoverable melodic material.

When the final vowel is long (4b), stray erasure eliminates the last mora after it has been delinked from the vowel, since the mora, dominating no melody element, is no longer prosodically licensed. The final syllable itself remains well-formed here, since it continues to dominate a vowel, and therefore Parasitic Delinking does not occur. The derivation is complete. A question, however, arises: how exactly is it that the mora comes to be stray-erased? If syllabification is held to be a continuous process, as is generally assumed, it might be supposed that the vowel melody, once delinked from final mora, must inevitably reassociate to it, as shown in (5).

An appeal can be made to the Relinking Condition of Pulleyblank (1986, p. 115), which states:

Relinking Condition: When a rule of the form ... X ... applies,
 $\frac{\uparrow}{F}$

F is not subject to reassociation by convention on that cycle.

Although this condition was originally conceived by Pulleyblank in a tonal phonology context, its scope can legitimately be extended to prevent vacuous relinking in cases like (4b) above. The final vowel is blocked from re-linking to the same element from which it has just delinked.

How does delinking, which effectively shortens a word by a mora, interact with the bimoraic word requirement in Trukese? As it turns out, the answer varies with the lexical category - non-nouns behave differently from nouns. Considering the case of nouns first, the generalization to be made is that nouns, which like other lexical categories are underlyingly at least bimoraic, must remain minimally bimoraic on the surface.

(6)	$[\mu\mu]_N$	$*[\mu]_N$	
tée	(*té)		'islet'
oo	(*o)		'omen'
chúú	(*chú)		'bone'
máá	(*má)		'death'
maa	(*ma)		'behavior'

As the forms in (6) demonstrate, a noun which is underlyingly bimoraic apparently does not undergo delinking. A form like *tée* remains bimoraic; delinking, which would produce the monomoraic **té*, fails to apply. (Another possible account of the persistent bimoraicity of these forms will be given below in Section 3.)

We have seen that bimoraic nouns of the form CVV do not shorten. However, nouns that are underlyingly CCVV do undergo delinking:

(7)	/ssóó/	→	ssó	'thwart of canoe'
	/pwpwoo/	→	pwpwo	'navigator'
	/kkáá/	→	kká	'taro sp.'
	/ttoo/	→	tto	'clam sp.'
	/kkée/	→	kké	'cry'

If we assume that initial geminates are indeed moraic, contributing a mora to the overall weight of the word, this provides a principled explanation for the difference in behavior of the examples in (6) and (7). As diagrammed in (8b), if Delinking were to apply to underlyingly bimoraic nouns, these words would be left with only a single mora, and they would fail to meet the two-mora quota. Nouns of the form CCVV, on the other hand (8a), are underlyingly trimoraic. They can sacrifice a mora to delinking while continuing to satisfy the bimoraic minimal requirement.

(8) a. /ttoo/ → tto

b. $* /maa/ \rightarrow ma$

If initial geminates were non-moraic, delinking would be predicted to be blocked in (7), just as with the bimoraic examples in (6). If we assume the forms in (7) to be trimoraic, then their fact of their delinking is predictable, given that, as shown in (2), other words that are trimoraic or longer do delink. This distinction in behavior with respect to Delinking offers strong support for the moraicity of initial geminates.

3. Compensatory Lengthening. Final Delinking in nouns sometimes triggers a process of Compensatory Lengthening. Preliminary data are given in (9).

(9)	/feti/	→	fáát	(*fát)	'groove on bottom of canoe'
	/imwa/	→	iimw	(*imw)	'house'
	/wutu/	→	wuut	(*wut)	'interior'
	/tipe/	→	tiip	(*tip)	'emotions'
	/chúkú/	→	chúúk	(*chúk)	'basket'
	/pwopwu/	→	pwoopw	(*pwopw)	'base, trunk'

The basic pattern is clear: with delinking of the word-final vowel, the vowel of the preceding syllable lengthens, "compensating" for the loss of the last vowel.

The derivation of *tiip* illustrates the process:

(10) (i) Base Form (ii) Final Delinking (iii) Parasitic Delinking

(iv) CL

(v) Resyllabification

After Parasitic Delinking of the final syllable node has left the final mora unassociated (iii), the vowel melody of the first syllable spreads (iv), associating to the floating mora. Note that this penultimate vowel is the only possible candidate for spreading. By the Relinking Condition, the final /a/ cannot relink to the mora from which it has just been disassociated. Nor can the /p/ associate to the mora, since a singly-linked moraic consonant is never possible. Accordingly, the /i/ spreads, and then the /p/ is syllabified as a non-moraic coda (v), as in (4a) above, while the /a/ is stray-erased.

The real interest of compensatory lengthening for the present investigation lies in the fact not all nouns undergo the process. (11) gives examples of nouns which underlyingly contain three or more moras. In these cases, CL does not apply.

(11)	/piseki/	→	pisek	(*piseek)	'goods'
	/sékúru/	→	sékúr	(*sékúúr)	'back'
	/téénú/	→	téén	(*tééen)	'torch'
	/rááni/	→	ráán	(*rááán)	'day, daylight'
	/nemeneme/	→	nemenem	(*nemeneem)	'authority'
	/nikasafasafa/	→	nikasafasaf	(*nikasafasaaf)	'tall swamp grass'

This generalization, that only those nouns that are underlying at least trimoraic fail to undergo CL, is confirmed by the evidence of compound words (12):

(12)	/imwa /	→	iimw	(*imw)	'house, building'
	/imwa+kkana /	→	imwakkan	(*imwakkaan)	'nearby house'
	/ki+imwa+imwa /	→	kiimweimw	(*kiimweimw)	'house on lee platform of canoe'
	/sapa /	→	saap	(*sap)	'cheek, side of face'
	/fésapa /	→	fésap	(*fésaap)	'four cheeks (esp. of fish)'
	/fitesapa /	→	fitesap	(*fitesaap)	'how many cheeks (esp. of fish)'
	/ttiwesapa /	→	ttiwesap	(*ttiwesaaap)	'nine cheeks (esp. of fish)'

A form which in isolation is only bimoraic, like /sapa/, will undergo CL after delinking, becoming /saap/. However, once the root /sapa/ has been compounded with other morphemes, resulting in a lengthened form, CL no longer applies: *fésapa* becomes *fésap*, not **fésaap*.

We can account for the distribution of CL - why it happens in some cases, but not in others - if we see as its application as a reflection of the principle that nouns must remain minimally bimoraic. Compensatory lengthening is a repair strategy which operates only when minimality is threatened. Thus, it applies only to those forms which are underlying bimoraic, the only class of nouns actually in danger of falling below the bimoraic minimum through delinking. When they are threatened with the loss of their final mora through final delinking, rather than allowing them to become monomoraic, CL acts to conserve mora count. In cases where the base is trimoraic or longer (11), CL does not apply, since at least two moras remain even after delinking, and minimality is not at risk. CL, then, does not blindly conserve mora count under all circumstances; rather it applies only when necessary to maintain minimality.

Let us take into consideration once more the case of nouns of the form CVV, given in (6) above. These forms surface unchanged, remaining CVV. Our previous claim was that Delinking was blocked in these cases by the need to maintain minimality. But it would seem equally valid to assume that Delinking does in fact apply, followed by CL, just as in bases of the form CVCV, and that the surface CVV forms are the result of the application of both processes.⁶

Given that CL is sensitive to the mora count of a word, we can use its application as a diagnostic, to determine whether the base has two moras (CL will apply) or three (CL will not apply). In the case where the base has the form CCVCV, this test will enable us to decide whether this form has two moras or three - that is, whether the initial geminate contributes moraic weight. As expected, such forms do not undergo CL (13).

(13)	/ ffeſi /	→	ffes	(*ffees)	'pool of money'
	/ mmana /	→	mman	(*mmaan)	'first light of dawn'
	/ nnétú /	→	nnét	(*nnéét)	'half-flower'
	/ ttina /	→	ttin	(*ttiin)	'shine'
	/ nnifi /	→	nnif	(*nniif)	'wooden mortar'

The behavior of the forms in (9) and (13) is contrasted in (14). Since *tipa* is underlyingly bimoraic, it must preserve both moras through CL in order to remain bimoraic. But because the initial geminate supplies a mora, *ffesi* is underlyingly trimoraic, and has no need to resort to CL.

(14) a. / *tipa* / → *tiip* b. / *ffesi* / → *ffes* Ø

We have seen that the interaction of nouns with Delinking and Compensatory Lengthening is a function of the over-riding necessity of maintaining minimality. Other lexical categories, although always at least bimoraic underlyingly, are not constrained to remain bimoraic, and so behave differently with respect to these two processes. So, for example, non-nouns can become monomoraic through delinking (15):

(15)	/ sáá /	→	sá	'be removed'
	/ oo /	→	o	'be caught'
	/ faa /	→	fa	'be brave'
	/ kii /	→	ki	'assemble'
	/ maa /	→	ma	'be ashamed'

And, similarly, compensatory lengthening never takes place in lexical categories other than nouns (16):

(16)	/ nuku /	→	nuk	(*nuuk)	'haul on a line'
	/ tupwu /	→	tupw	(*tuupw)	'go'
	/ chona /	→	chon	(*choon)	'gossip' (v.)
	/ ménú /	→	mén	(*méén)	'blow, be a wind'
	/ topwu /	→	topw	(*toopw)	'dull, gray'
	/ para /	→	par	(*paar)	'red'
	/ chékú /	→	chék	(*chéék)	'only'

For example, *nuku*, 'haul on a line' becomes the monomoraic form *nuk* after delinking; it does not lengthen to *nuuk*. This confirms the view that compensatory

lengthening functions as a strategy for maintaining minimality. If it simply operated blindly to maintain overall mora count, we would expect it to apply uniformly to all words.

4. Gemination Throwback and the Representation of Initial Geminates. Verbs of the form CVCCV undergo a process called "Gemination Throwback" (Churchyard 1990a). When the final syllable is eliminated in the course of delinking, the medial geminate consonant is degeminated, and the initial consonant becomes geminate. Examples are given in (17):

- (17)
/pekki/	→	ppek	'shoot at (with a gun)'
/peppa/	→	ppep	'skip, bounce'
/monna/	→	mmon	'be prepared'
/mwékkú/	→	mwmwék	'be unable to walk'
/mwúchchú/	→	mwmwúch	'end, be finished'
/mwóttö/	→	mwmwót	'have a hollow, be cupped'
/kúttá/	→	kkúut ~ kkút	'search' (v.)
/kuchchu/	→	kkuch	'fit' (v.)

Modelling this process poses obvious problems for the representation of geminates we have been assuming so far. An attempted derivation, given in (18), makes the difficulties clear.

Once delinking (ii) and Parasitic Delinking of the syllable node (iii) have applied, the /k/ ceases to be a licensed coda consonant, since no moraic consonant can be singly-linked. Accordingly, the /k/ also delinks from its mora, leaving us in (iv) with two floating moras, but with no obvious means of achieving the desired result of associating one of them to the initial /p/. The only recourse would seem to be an ad-hoc destruction of the remaining syllable structure, followed by re-association across the board.

A resolution to the impasse has been proposed by Churchyard (1990a). He proposes a representation in which consonant and vowel moras are actually segregated on distinct tiers, as shown in (19):

(19)

This representation has the immediate technical advantage, as Churchyard points out, that it permits the modelling of gemination throwback, an apparently non-local phenomenon, as local - on the consonant mora tier. A derivation is given in (20).

Delinking and Parasitic Delinking take place; as before, the now-final /k/ degeminates (ii), and it leaves a mora floating on the consonant-mora tier (iii). This stranded mora can now simply associate to the only possible landing-site, the word-initial consonant (iv). (The mora cannot, of course, associate to the /k/, a possibility blocked both by the Relinking Condition and the prohibition on singly-linked moraic consonants.)

Another advantage of the multi-tiered representation is that it explains neatly why delinking leads to gemination throwback only in those cases where a medial consonant has become degeminated, but not in any other instance—these are the only cases in which a consonant mora has been made available for reassociation. Compensatory lengthening of a vowel, on the other hand, arises when delinking has led to a vowel mora being unassociated.

Since delinking plus degemination actually give rise to two floating moras, one on the consonant mora tier, one on the vowel mora tier, we might logically expect to find instances where a base CVCCV may undergo either compensatory lengthening or gemination throwback. Such cases are attested, as can be seen when we turn to the study of gemination throwback in nouns. The data are summarized in (21).

(21)	/ CVCCV /	CL	GT	
	/ kúnna, kuna /	kúún	kkún	'high tide'
	/ múnnú /	-----	mmún	'upper back'
	/ tappa /	taap	-----	'green coconut'
	/ wutta /	wuut	-----	'meeting house'
	/ tupwpwu /	tuupw	ttupw	'shrub sp.'
	/ kupwpwa /	kuupw	-----	'flower pod of breadfruit'
	/ mwúchchú /	mwúúch	mwmwúch	'end, finish'

Some bases, like *tappa*, 'green coconut', undergo CL, becoming *taap*. Others, like *múnnú*, 'upper back' undergo GT, and *mmún* is the result. A very few nouns actually have documented variation between the two possibilities: underlying *tupwpwu* emerges after delinking either as *tuupw*, with the vowel lengthened by CL, or as *ttupw*, with the initial consonant doubled by GT. Note first that the forms produced by GT are an additional piece of evidence in support of the moraicity of initial geminates. Given that these forms, like all nouns, must meet the bimoraic minimum, it is obvious that a noun of the form CCVC can satisfy this requirement only if the initial geminate supplies a mora. In the unmarked case, bimoraic noun bases must undergo CL to maintain minimality after delinking. For noun bases of the form CVCCV, however, delinking makes two moras available: one on the consonant mora tier, one on the vowel mora tier. CVCCV bases thereby actually have two possible strategies open to them for maintaining minimality: compensatory lengthening or gemination throwback.⁷

Morphemes in Trukese are subject to the following constraint: No simplex morpheme in Trukese ever contains more than one geminate consonant. The morphemes in the (22a) are licit; those in (22b) are not, since they contain more than one geminate consonant.

(22)	a.manna	'cleared ground'	b.	*mmanna
	sátte	'broken-off piece'		*ssátte

Words containing more than one geminate consonant do exist, certainly—but these are all compound words (23).

(23)	nnengngaw	'be bad-tasting'
	(nne-, 'taste', + ngngaw, 'be bad')	
	ppénúweffengen	'be even-numbered'
	(ppénú, 'opposite', + ffengen 'toward one another')	
	órossúngngeni	'bump against'
	(óór, 'side', + -ssúng, 'bump', + ngeni, 'against')	

Long vowels, by contrast, freely co-occur with other long vowels and with geminate consonants (24):

(24)	tuumwu	'dye'
	koneetaa	'tree sp.'
	fáánnóó	'loom beam'
	faakka	'light perspiration'
	chuffanaa	'be lying'

mwmwaawa
ttúúna

'(be) gentle'
'broil'

The representation utilizing separate moraic tiers is superior to previous representation from a purely technical point of view, in that it permits a principled account of the gemination throwback data. But the multi-tiered model also makes it possible to formalize this morpheme structure constraint quite simply:

(25) Morpheme Structure Constraint: No morpheme ever contains more than one mora on the consonant-mora tier.

*[... μ ... μ ...]
Morpheme C-mora tier

5. Conclusions. Using evidence from Trukese, I have provided clear empirical support for the hypothesis that initial geminates are moraic. I have shown how initial geminates crucially assist in maintaining minimality by contributing toward the overall mora count of a word in their interaction with three prosodic processes: final delinking, compensatory lengthening, and gemination throwback.

A representation has been proposed, using separate consonant and vowel-mora tiers, which permits an account of the gemination throwback data and also facilitates the expression of a morpheme structure constraint. What remains an open question at this point is why these languages that have initial geminates, which are clearly a very highly-marked phenomenon, should also have separate consonant and vowel mora tiers, which is also presumably a highly marked option; there is no motivation for supposing that languages with medial but no initial geminates make use of multiple moraic tiers. The connection may be related to the onset-rime distinction. In the unmarked case, rimes can be defined as those elements which are dominated by moras; onsets are those which are not. In a language which allows an onset to be moraic - i.e., that allows initial geminates - the distinction is lost, or at least blurred. So it may be that putting the consonant and vowel moras on separate tiers, as in the case of Trukese, is in some sense the functional equivalent of the onset-rime distinction in other languages.

Notes

1. Although Hayes does not make it explicit, the initial mora, although originally extraprosodic, is presumably required, like any other prosodic element, to be prosodically licensed in the sense of Ito (1986) by being integrated into higher prosodic structure. We might assume that it simply adjoins to the syllable node.
2. Such syllables, apparently trimoraic, although somewhat marked, are not uncommon. Since no processes in Trukese are sensitive to syllable weight as such, however, they cannot be shown empirically to be 'superheavy'.
3. There are no complex onsets in the native vocabulary, but they occasionally occur in loan words: *prismana*, 'policeman' (Eng.).
4. Additional evidence supporting the moraic trochee as the foot type comes from a pattern of reduplication forming denominal verbs, which apparently maps to a suffixed bimoraic template: /waa/, 'canoe'; /waawaa/, 'use as a vehicle', but /mwaane/, 'brother'; /mwaaneane/, 'treat as a brother'.

5. Schein and Steriade (1986) explicitly allow the shortening of a geminate (p.716). In the skeletal framework they assume, however, this is regarded as deletion of a skeletal slot, rather than delinking from a prosodic element.

6. If we assume that surface CVV forms are the result of Delinking followed by CL, however, then we will need to say that the Relinking Condition is over-ridden in such cases, presumably by the need for a well-formed output.

7. It is admittedly unclear to what extent the CL~GT alternation is productive, and whether speakers would accept the unattested possibilities as valid alternatives. The choice of strategy - CL or GT - taken by a given form may well be lexicalized. Recent loan words mostly are documented as using CL: /sákki/ → sák 'jack' (in cards) (Eng.); although GT is at least a possibility: /makka/ → mmak 'mark' (Eng.)

Appendix

Phonemic Inventory (in Trukese orthography; after Churchyard 1990a)

Consonants

	[-rnd]	[+rnd]		
stop.	p	pw	t	k
affric.			ch [č]	
fric.	f		s	
nasal	m	mw	n	ng [ŋ]
trill			r	
glide		w		y

Vowels

	<div>[-back] [-rnd]</div>	<div>[+back] [-rnd]</div>	<div>[+back] [+rnd]</div>
high	i	ú [i]	u
mid	e [e]	é [ʌ]	o
low	á [æ]	a	ó [ɔ]

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