Sonority-Driven Stress

Michael Kenstowicz
MIT
August 1994

It is well known that the sonority hierarchy plays a major role in determining the peaks and margins of the syllable. In this paper we look at several languages in which the relative sonority of syllabic nuclei determines the optimal stress-bearing units. Our analysis is couched in the constraints-based Optimality Theory (Prince & Smolensky 1993) as this framework provides a way to formally express the attraction of stress to the most sonorous vowel in a straightforward and natural way. In order to extend the OT model to the systems we consider here, several proposals are made. First, the Peak Prominence constraint Prince & Smolensky (1993) develop for quantitative distinctions in Hindi stress is extended to sonority distinctions. Second, comparable to the Prince & Smolensky (1993) analysis of Berber syllabification, the Peak Prominence constraint is broken down into a set of micro constraints for each level of the sonority hierarchy. It is demonstrated how these constraints can be interleaved with other constraints that orient prominence with respect to the edges of the word either directly or indirectly through controlling the size of the metrical constituent. Finally, in order to express the two opposing edge orientations in languages such as Mari (Cheremis), it is suggested that sonority distinctions also optimize the trough ("nonpeak") portions of metrical constituents. This application of sonority parallels the margin constraints in the Prince & Smolensky (1993) analysis of Berber syllabification.

1. Introduction

We begin by briefly reviewing the basics of the OT model and the metrical parsing constraints that form the background of our discussion. In OT input is matched with output via two functions. For any input, a function GEN(erate) constructs a large pool of candidate structures--large enough to encompass the output in any possible human language. The correct output is found by a function EVAL(uate) which imposes a language-particular ordering on a fixed set of UG constraints. The constraints sift through the pool of candidates eliminating all but one, which is defined as the output for the given input. Many of the constraints represent conflicting forces that pull the input in divergent directions expressing the intuition that phonological systems possess an inherent dynamism. Individual grammars resolve this tension in their own characteristic ways, modeled as differing prioritizations of the fixed set of constraints. A major objective of the OT program is to express typological distinctions as different constraint rankings. Through its key notion of constraint conflict, the OT model can impose crosslinguistically different outputs for essentially equivalent inputs and thus more readily come to terms with the undeniable variability found in phonology that has stymied previous constraint-based models. On the other hand, to the extent that the variability can be expressed in terms of a fixed set of constraints, OT gives a more restricted view of phonological structure than rule-based systems which have greater latitude in mapping input to output.

Three metrical parsing constraints form the backdrop of our analysis (McCarthy & Prince 1993): Parse (syllables into feet), Align (feet with the right/left edge of the word), and Binarity (feet are binary at the moraic or syllabic level). For the languages we consider here, there is just one stress per word. Assuming that stress reflects the head of a metrical foot, this means one foot is assigned per word and hence that Align >> Parse. In some of the languages the stress is located inside a disyllabic window at the word's right (Chukchee, Kobon) or left (Aljutor) edge; in others (Mordwin and Mari) the metrical constituent potentially encompasses the entire word. In the former systems Bin >> Parse, while in the latter Parse >> Bin. The schematic tableaux in (1) illustrate the effects of different constraint rankings for a generic five-syllable word.

(1) a. Bin >> Parse >> Align-Lf (alternating stress)

/sssss/	Bin	Parse	Align-Lf
$('ss)('ss)s	√	*	#, #ss
('ss)sss	√	**!*	#
('sssss)	*!	√	#

b. {Align-Lf, Bin} >> Parse (disyllabic window)

/sssss/	Align-Lf	Bin	Parse
('ss)('ss)s	#, #s!s	√	*
$('ss)sss	#	√	***
('sssss)	#	*!	√

c. {Align-Lf, Parse} >> Bin (unbounded foot)

/sssss/	Align-Lf	Parse	Bin
('ss)('ss)s	#, #s!s	*	√
('ss)sss	#	*!**	√
$('sssss)	#	√	*

In languages where sonority plays no role in determining the location of stress, the Peak Prominence constraint is ranked below Parse and directionality constraints that align the head of the foot with the left or the right edge of the metrical constituent. In the languages we look at here, the relative sonority of the vowels determines the capacity of the syllable to bear or to avoid stress--to be the peak or the margin of a foot: the greater the sonority of the syllable's nucleus, the better foot peak that syllable makes; the weaker the sonority, the better suited the syllable is to occupy a foot margin or trough. This type of sonority distribution is of course best known in determining the peaks and margins of the syllable. Prince & Smolensky (1993:127-67) propose to formalize this phenomenon as the "alignment" of two separate UG prominence scales: the Sonority Scale for phonemes a > e,o > i,u > ə > .... > p,t,k and the Peak > Margin (a.k.a. Nucleus > Onset,Coda) for syllables. A one-to-one alignment of the two scales generates the harmony scales of (2) that grade phonemes for their suitability as syllable peaks and margins.

(2) peak$_{syll}$ a > e,o > i,u > ..... > p,t,k
margin$_{syll}$ p,t,k > ..... > i,u > e,o > a

Prince and Smolensky derive the scales in (2) by deploying the alignment in the form of a series of rankable constraints in (3) that evaluate candidate peaks and margins from "worst to best".

(3) Peak Prominence
*P/p,t,k >> ..... >> *P/i,u >> *P/e,o >> *P/a

Margin Prominence
*M/a >> *M/e,o >> *M/i,u >> .... >> *M/p,t,k

Casting the role of sonority in this way has two effects: first each step in the scale is a separate constraint that can be evaluated in a binary yes/no fashion. More importantly, other constraints can be interleaved inside the sonority hierarchy. Our goal in this paper is to demonstrate the existence of languages whose metrical stress is defined in terms of essentially the same family of constraints through the alignment of the sonority scale with the Head > Margin (or Peak > Trough) scale for metrical feet. The result is a scaling of vocalic nuclei as optimal peaks and troughs of the stress "wave" seen in (4a). These hierarchies are derived from the constraint rankings in (4b).

(4) a. peak$_{foot}$ á > é,ó > í,ú > ə́

margin$_{foot}$ ə̆ > ĭ,ŭ > ĕ,ŏ > ă

b. Peak Prominence for metrical feet

*P/ə >> *P/i,u >> *P/e,o >> *P/a

Margin Prominence for metrical feet

*M/a >> *M/e,o >> *M/i,u >> *M/ə

2. Mordwin

We begin with a simple but instructive example from the Mokshan dialect of Mordwin, a Finno-Ugric language of the Volga region in Central Russia. Mokshan syllabic nuclei divide into two groups for purposes of stress assignment: the "narrow" vowels [i,u,ə] and the "broad" vowels [e,o,ä,a]. Tsygankin and Debaev (1975:32-33) summarize the distribution of stress as follows: wide vowels attract the word stress; in words with all narrow vowels or all wide vowels the stress is located on the initial syllable. Examples of words with all narrow and all wide vowels appear in (5a) and (5b), respectively. In our Mordwin transcriptions, the stressed vowel is underlined; C' denotes a palatalized consonant.

(5) a. pu̲vəndəms 'to press', ki̲z'əfn'əms 'to ask', pə̲s't'ərdəms 'to roll with the feet', ku̲lit'i 'in that ash'
b. s'ä̲r'äd'an 'I ache', rä̲masak 'you buy it', ke̲la'skä 'fox', no̲ldasak 'you release it'
c. sa̲šəndat 'you arrive', tərga̲dat 'you fight', tušənda̲t 'you go away', tuc'ä̲n'ä 'cloud', k'e̲l'əpt'əms 'to widen'

d. putəms 'to set down', putat 'you set down'; m'isən'd'əms 'to sell' m'išən'd'an 'I sell'

(5c) are words containing a mixture of broad and narrow vowels. For these Tsygankin & Debaev state that stress falls on the first (i.e. leftmost) broad vowel. (5d) shows some alternations in the inflectional paradigm.

Intuitively, stress in Mokshan wants to be as far to the left edge of the word as possible but will move away from the left edge in order to avoid stressing a "narrow" vowel. We may account for this stress pattern by supposing that an unbounded left-headed foot is aligned at the right edge of the word. The Parse constraint forcing the foot to expand to encompass the entire word is dominated by the Peak Prominence constraint that avoids stressing a "weak" vowel. In effect, the Peak Prominence constraint family splits at the high-mid juncture and the weaker faction decamps to the other side of the Parse constraint.

(6) *P/ə >> *P/i,u >> Parse >> *P/e,o >> *P/a

To see how this constraint ranking sorts among the relevant candidates, we examine the tableau in (7). We assume that high ranking Align has eliminated candidates in which there is more than one foot or where the right edge of the foot does not coincide with the right word edge. First consider a word with a mixture of broad and narrow vowels such as tušəndat. The Parse constraint wants the left edge of the foot (and hence the stressed syllable) to be as far to the left edge of the word as possible; but the higher ranking Peak Prominence constraints penalizing stress on the weaker narrow vowels [ə] and [u] eliminate candidates with an earlier stress.

(7)	/tušəndat/	*P/ə	*P/i,u	Parse
	('sss)	√	*!	√
	s('ss)	*!	√	*
	$ss('s)	√	√	**

In words with all wide vowels such as noldasak Parse will intervene before Peak Prominence has a chance to grade these words for sonority. The result is a structure in which the metrical and grammatical boundaries coincide.

(8) /noldasak/	*P/ə	*P/i,u	Parse	*P/e,o	*P/a
$('sss)	√	√	√	*	√
s('ss)	√	√	*!	√	*
ss('s)	√	√	*!*	√	*

The same type of alignment obtains in words with all narrow vowels such as pəs't'ərdəms: each candidate receives a * from the *P/ə constraint passing the decision on to Parse.

(9) /pəs't'ərdəms/	*P/ə	*P/i,u	Parse
$('sss)	*	√	√
s('ss)	*	√	*!
ss('s)	*	√	*!*

While Tsygankin & Debaev cite all-narrow words with a high vowel preceding schwa, their discussion includes no examples of the form CəCi... or CəCu... where a less sonorous schwa precedes a more sonorous [i,u]. If *P/ə dominates *P/i,u then the candidate with initial stress will be eliminated first forcing stress to move away from the edge.

(10) /CəCi.../	*P/ə	*P/i,u	Parse
('ss...	*!	√	√
s('s...	√	*	*

Assuming that Tsygankin & Debaev's statement that all-narrow words have initial stress holds in these cases as well, we must block this incorrect derivation. One possibility is to allow individual grammars to ignore certain distinctions in the Peak Prominence constraint hierarchy. What of course is not possible is to impose a ranking that runs contrary to the universal scale (i.e. *P/i,u >> *P/ə). If this reasoning is correct, it would imply that the constraints cannot form a totally ordered set; certain constraints must be crucially unordered. An alternative that would leave the basic architecture of the OT model in tact would be to localize the problem to the alignment relation between the prominence scales. Suppose grammars may differ in the granularity with which sonority distinctions are recognized so that the Peak > Trough scale is not aligned one to one with every step of the sonority scale--in particular, there is no alignment at the i,u > ə step. The result is to collapse the *P/ə and *P/i,u constraints.

(11) Peak > Trough
/ \
a > e,o > i,u > ə

We note that in the tableau of (8) the *P/a constraint plays no active role in sorting candidates because it is ranked below the Parse constraint that shrinks the candidate set to one. Another possibility is to restrict the alignment between the prominence scales to the mid > high boundary. More study of the OT model will be required to be able to narrow such descriptive options.

One final point. According to Tsygankin & Debaev in the Erzyan dialect of Mordwin speakers either fail to distinguish any stress contours or assign uniform initial stress. For the latter, the difference with Mokshan is a simple reranking of Parse above the entire Peak Prominence family; in effect, aligning the left edge of the foot with the left edge of the word through a maximization of Parse is more important than stressing a weak vowel.

3. Kobon

The Kobon language of Papua New Guinea (Davies 1981) discriminates the sonority of vowels in a particularly granulated way.[1] Stress placement draws a four-way distinction among syllabic nuclei. The phonemic inventory of Kobon is composed of the familiar vowel triangle distinguishing low, mid, and high vowels supplemented with a pair of unrounded central vowels which, as in Chukchee and Mari (see below), prove to be the weakest elements in the hierarchy. Also, the low vowel [a] combines with a following high vowel [i] or [u] to form diphthongs.

(12) i ɨ u
e ö o
a

For unaffixed words stress is restricted to one of the final two syllables, seeking out the most sonorous nucleus in this disyllabic window. The table in (13) illustrates this point. We follow Davies' transcriptions in which the stressed syllable is marked by a tick to its left.

---

[1] Thanks to Stuart Davis for bringing these data to our attention.

(13)	a > e	ha'gape	'blood' [226]
		g'ałe#'gałe	'to cry, of pig' [225]
	a > o	al'ago	'snake species' [226]
		kɨdol'maŋ	'arrow type' [226]
	a > i	ki.'a	'tree species' [220]
	a > i	'hau.i	'vine species' [221]
	a > u	'ai.ud	'story' [221]
	a > ɨ	'añɨm#'añɨm	'to lightening' [225]
	a > ö	'wai.öŋ	'cassowary' [221]
		'ai.ön	'witch' [221]
	o > u	'mo.u	'thus' [220]
	o > i	si.'og	'bird species' [221]
	o > ɨ	gɨ'ro#gɨ'ro	'to "talk" - of mother pig to piglet' [225]
	i > ö	ga'łinöŋ	'bird species' [226]
		'wi.ör	'mango tree' [221]
	u > ö	'łu.öł	'horizontal house timbers' [221]
	u > ɨ	'mu.ɨs	'edible fungus species' [221]

What is less clear is how a tie is resolved in Kobon. The forms in (14a) suggest that stress lodges on the penult--i.e. on the left edge of the disyllabic window. But the forms in (14b) show final stress in case of a tie.

(14) a. u ≈ u 'dubu#'dubu 'to make noise by footsteps' [225]
i ≈ u 'jinup#'jinup 'to make squeaking noise, bird, rat' [225]
ɨ ≈ ɨ kɨ'jɨgɨl 'tattoo' [226]

b. ɨ ≈ ö gɨ'sö#gɨ'sö 'to tap' [225]
a ≈ a kau.'ai 'tree species' [221]

We have found one exception in the cited data in which stress falls on a weaker vowel [ö] instead of the stronger [u]: ru.'ö 'day after tomorrow' [221]. According to Davies (p. 219) the /ö/ phoneme (an unrounded central vowel) has a more open allophone in final syllables. It is possible that in this position it functions as a low and hence strong vowel. This would also explain the final stress in gɨ'sö#gɨ'sö 'to tap' [225], suggesting in turn that ties are resolved on the left as trochees.

While Davies statement of the stress generalizations is tentative, it seems clear that for the data we do have the sonority of syllabic nuclei is playing a decisive role.[2] Assuming that central vowels follow the peripheral vowels on the sonority scale (i.e. a > e,o > i,u > ɨ, ö) we have the Peak Prominence scale in (15).

(15) *P/ɨ,ö >> *P/i,u >> *P/e,o >> *P/a >> Trochee?

In Kobon the entire Peak Prominence constraint rises above the constraints that orient stress laterally in the foot as iambs or trochees. This makes Kobon appear as the stress-wise analog of the justly celebrated Tashylhyt dialect of Berber (Dell & Elmedlaoui 1985) in which the peak of the syllable spans the entire gamut of the sonority scale. Kobon syllabic nuclei are restricted to vowels; given that metrical stress is computed over syllables, Peak Prominence for stress is necessarily bounded at the low end by the least sonorous nucleus--in our case, ɨ, ö. See however Everett (1988) for Pirahã where features of the syllable onset like voicing play a role.

Let us examine a few tableaux to show how the analysis works. A form such as ga'łinöŋ shows that the search for a more prominent vowel is confined to a disyllabic window at the right edge of the word. This follows if Bin and Align-Ft right dominate Peak Prominence.

(16) /gałinöŋ/	Bin	Align-Rt	*P/ɨ,ö	*P/i,u	Trochee
('ss)s	√	s#!	√	√	√
('sss)	*!	#	√	√	√
$s('ss)	√	√	√	*	√

This example also suggests that Peak Prominence is competing with constraints that align the head of the foot to the left or right (a.k.a. trochaic, iambic) rather than with the alignment of the feet with respect to the edge of the prosodic word. If Peak Prominence dominated foot alignment, then g'ałinöŋ ('ss)s would be expected, other things being equal.

---

[2] Davies remarks (p.226) "the rules for positioning stress in two syllable words have yet to be determined. Relative vowel strength is almost certainly a conditioning factor since stress is almost always placed on the syllable which is strongest according to the following hierarchy: a/au/ai>o/e/u/i>ö/ɨ".

In (17) we show a few cases where Peak Prominence seeks out the most prominent vowel before Trochee gets a chance to stress the penult.

(17)

/kɨdol'maŋ/	*P/ɨ,ö	*P/i,u	*P/e,o	*P/a	Trochee
s('ss)	√	√	*!	√	√
$ s(s's)	√	√	√	*	*
/mo.u/					
$ ('ss)	√	√	*	√	√
(s's)	√	*!	√	√	*
/si.og/					
('ss)	√	*!	√	√	√
$ (s's)	√	√	*	√	*

4. Chukchee

Like the Mokshan dialect of Mordwin and Kobon, the Paleo-Siberian language Chukchee exhibits a sonority-based gradation among its vowels in their willingness to bear stress. The Chukchee hierarchy distinguishes nonhigh vowels from high vowels and schwa from the rest and thus recruits three of the four divisions along the sonority scale: {a,e,o} > {i,u} > {ə}. Our data come from the chapter on stress in Skorik's grammar (1961:67-71) and from Krause (1979).

We first survey the generalizations governing stress as set out by Skorik, putting schwa to the side. A basic limitation is that stress is bound to the base--it never appears on an inflectional suffix. The location of stress within the base is governed by the following factors. When the final syllable of the base is not the final syllable of the word (i.e. when one or more syllabic suffixes follow) then stress is located on the final syllable of the base.

(18) a. pójg-a 'spear' erg. (67), wə́kw-a 'stone' erg. (67), íw-ək 'to say' (68) winrét-ək 'help' infin, winrét-ərkən 3sg., winrét-ərkənitək 2pl. (68)
b. jará-ŋə 'house' (68), weló-lgən 'ear' (68), ekwét-ək 'to send (68), wiríŋ-ək 'to defend' (68), reqoká-lgən 'sand' (68), migcirét-ək 'to work' (68)

However, when there is no suffix (e.g. the absolutive sg.) or the suffix lacks a vowel, then stress is retracted from the final syllable of the base. The plural suffix /-ti/ apocopates its vowel unless the base ends in a coronal to produce an apparent shift of stress from left to right (e.g. rícit, ricít-ti) or from right to left (e.g. qorá-ŋə, qóra-t) in singular-plural pairs.

(19)

abs.sg.		abs.pl.	
tití-ŋə	'needle'	títi-t	(69)
qorá-ŋə	'reindeer'	qóra-t	(69)
melotá-lgən	'rabbit'	milúte-t[3]	(69)
rícit	'belt'	ricít-ti	(69)
wárat	'people'	warát-te	(69)
játjol	'fox'	jatjól-te	(69)
jéjwel	'orphan'	jejwél-ti	(69)

The data introduced so far indicate that certain constraints are active in Chukchee. First, there is an undominated alignment constraint optimizing candidates in which the right edge of the base coincides with the right edge of a binary metrical constituent: {Align-Rt, Bin} >> Parse. This constituent is right-headed (iambic) but an overriding constraint of Nonfinality blocks candidates with stress on the word-final syllable to chose candidates with a retracted stress (trochee): Nonfinality >> Iambic.

(20)

/milute+t/	Align-Rt	Bin	Parse	Nonfin	Iambic
$ s('ss)	√	√	*	√	*
s(s's)	√	√	*	*!	√
('ss)s	*!	√	*	√	*

Evidence for a sonority distinction among the vowels comes from cases in which the stress unexpectedly retracts from the final syllable of the base (21a). They contrast with the examples in (21b) and indicate that stress will seek out a more sonorous nonhigh vowel in the penultimate syllable of the base. In the nouns of (21) the absolute sg. is marked by a reduplicative suffix that many disyllabic CVCV nouns take to protect themselves from apocope (Krause 1979).

---

[3] This form is stressed as mílute-t; we assume this is a printing error since it occurs in the list of examples Skorik uses to illustrate the generalization that when the suffix lacks a vowel then stress appears on the penult instead of the final syllable of the base.

(21)	a.	wéni-wen	'bell' (68)
		céri-cer	'dirt' (68)
		kéli-kel	'paper' (68)
	b.	nuté-nut	'land' (68)
		piŋé-piŋ	'snowfall' (68)
		jil?é-jil	'squirrel' (68)

We may account for the data of (21) if the Iambic constraint invades the Peak Prominence constraint at [±high].

(22) *P/i,u >> Iambic >> *P/e,o >> *P/a

Due to the regular rule of vowel harmony whereby [i] and [u] become [e] and [o] in words with [o] and [a], the stress prominence of the nonhigh vowels [o] and [a] with respect to the high vowels [i] and [u] cannot be directly assessed. Skorik (p. 68) cites one example (wáne+wan 'no, not at all') in which stress has retracted from a mid vowel to a preceding low vowel possibly suggesting that Iambic is pushed further down the hierarchy (i.e. *P/e,o >> Iambic >> *P/a). However, it might also derive from /wani/ by vowel harmony. Also, there is no retraction to the antepenult in jatjól-te fox' pl. (cf. játjol sg.); so unless the distinction between open and closed syllables is also factored into the retraction calculation, the distinction between low and nonlow vowels remains inconclusive.

The tableaux in (23) show the role of Peak Prominence in forcing violations of Iambic.

(23)	/keli+kel/	*P/i,u	Iambic
	$('ss)s	√	*
	(s's)s	*!	√
	/nute+nut/		
	('ss)s	*!	*
	$(s's)s	√	√

However, attraction of stress to the more sonorous mid vowel is always overridden by Nonfinality, as seen in the plurals núte-t and píŋe-t (Krause 1979: 122). These forms indicate that Nonfinality dominates *P/i,u.

(24) /nute+t/	Nonfinality	*P/i,u
$('ss)	√	*
(s's)	*!	√

The table in (25) summarizes the constraint rankings of interest that have been introduced so far.

(25) Nonfinality >> *P/i,u >> Iambic >> *P/e,o >> *P/a

Let us now turn to the behavior of schwa. According to Skorik (p. 70) if the final syllable of the base has a schwa nucleus then stress is retracted to the preceding vowel unless the preceding vowel is also schwa, in which case stress remains on the final syllable of the base.

(26)	pátgərg-ən	'hole'	(70)
	pipíqəlg-ən	'mouse'	(70)
	tátləŋ-ək	'to answer'	(70)
	rócgəp-ək	'to enervate'	(70)
	məcə́kw-ən	'shirt'	(70)
	təlwə́lq-ən	'fire site'	(70)
	rəkgə́t-ək	'to get stuck'	(70)
	rəmə́t-ək	'to wash up'	(70)

This behavior follows from the analysis we have developed if the Peak Prominence constraint splits off the schwa from the remaining vowels making it the weakest in the hierarchy: *P/ə >> *P/i,u >> Iambic >> *P/a. Stress will retract from the final syllable of the base to a preceding stronger vowel (27a); but when the preceding syllable is also schwa (27b), then the two candidates tie on Peak Prominence and the lower-ranked Iambic constraint decides in favor of stress on the final syllable of the base.

(27) a. /pipigəlg+ən/	*P/ə	*P/i,u	Iambic
$s('ss)s	√	*	*
s(s's)s	*!	√	√
b./rəmət+ək/			
('ss)s	*	√	*
$(s's)s	*	√	√

There is, however, one respect in which the Chukchee schwa behaves differently from the other vowels in the sonority hierarchy. As shown by the forms in (28), when the penult is a schwa, the final syllable is stressed provided it is a stronger vowel. But when both the final and the penult are schwa, then the stress lands on the penult--as predicted by Nonfinality >> Iambic.

(28)	a.	ətlá	'mother' (K. 123
		ləlé-t	'eyes' (K. 123
		?əló	'day' (K. 123
		ənré	'a little, somewhat' (K. 123
		ɣənín	'your' (D. 43
		ɣənún	'middle' (D. 43
	b.	ə́tləq	'tundra' (K. 124
		kə́tɣət	'sable' (K.124
		ə́ttəm	'bone' (K. 124
		cə́mŋə	'old bull' (K. 124

Thus, in a form such as ləlé-t Peak-Prominence wins out over Nonfinality while in núte-t Nonfinality wins out over Peak-Prominence. This contrast is further motivation for breaking the Peak Prominence constraint into the hierarchy of micro constraints ranked from "worst to best". The hierarchy is split at two points, as indicated in (29).

(29) *P/ə >> Nonfinality >> *P/i,u >> Iambic >> *P/e,o >> *P/a

The tableaux in (30) show the effect of ranking Nonfinality below *P/ə. In ətlá the *P/ə constraint rejects the candidate with stress on the schwa, allowing the candidate with final stress to win. In ə́tləq the initially and finally stressed candidates tie at *P/ə allowing the lower ranked Nonfinality to decide in favor of retracted stress. Finally, in núte+t both candidates tie on *P/ə in virtue of lacking a schwa. Once again, lower ranked Nonfinality eliminates final stress in favor of retracted stress.

(30)	/ətla/	*P/ə	Nonfinality
	('ss)	*!	√
	$(s's)	√	*

/ətləq/	*P/ə	Nonfinality
$('ss)	*	√
(s's)	*	*!
/nute+t/		
$('ss)	√	√
(s's)	√	*!

The Chukchee data furnish an empirical argument that the Peak Prominence constraint must be evaluated from "worst to best". Consider the problems a "best to worst" scenario of (31) encounters. We assume that these constraints also evaluate stress over a vowel in a binary up or down fashion.

(31) P/a >> P/e,o >> P/i,u >> P/ə

As shown by the schematic example in (32), the "best to worst" mode of evaluation also succeeds in isolating the most prominent vowel of the domain. Each of the three candidates fails the P/a constraint for lack of an [a]. P/e,o then passes the CiCéCəC candidate and fails any other that does not stress a mid vowel. It should be clear that "best to worst" evaluation homes in on the most sonorous vowel in the domain.

(32)

/CiCeCəC/	P/a	P/e,o	P/i,u	P/ə
'sss	*	*	√	*
$s'ss	*	√	*	*
ss's	*	*	*	√

Consider now the ranking of the Iambic and Nonfinality constraints. To derive pipíqəlg-ən, Iambic must be ranked below P/i,u. Any higher ranking would eliminate pipíqəlg-ən in favor of pipiqə́lg-ən. Similarly, in order to derive /ɣənín/ Nonfinality must rank below P/i,u. Any higher ranking would eliminate final stress and incorrectly generate a stress on the schwa.

(33)

/ɣənín/	P/i,u	Nonfin	P/ə
('ss)	*!	√	√
(s's)	√	*	*

But if Nonfinality ranks below P/i,u then we cannot account for the retraction in núte+t.

(34) /nute+t/	P/e,o	P/i,u	Nonfin
('ss)	*!	√	√
(s's)	√	*	*

Reranking Nonfinality ahead of P/e,o (i.e. Nonfinality >> P/e,o) correctly derives nútet. But this constraint ordering then fails to get ɣənín. We thus have empirical evidence in favor of the "worst to best" evaluation scheme in Chukchee.

Let us summarize the crucial points of the analysis. First, Chukchee stress draws a three-way distinction in sonority. This is captured by reranking the first two links of the Peak Prominence constraint chain in front of Iambic. Second, the schwa behaves differently from the other vowels with respect to Nonfinality. This is explained by reranking the *P/ə member of the Peak Prominence constraint above Nonfinality. The Peak Prominence constraint is thus decoupled at two separate points. Finally, Chukchee offers crucial empirical evidence for evaluating Peak Prominence from "worst to best" instead of "best to worst".

5. Aljutor

The stress system of Chukchee's sister language Aljutor differs in subtle ways that are perspicuously expressed in OT. Our data come from Kodzasov & Muravjova (1980).[4] In Aljutor stress is rigidly restricted to the first two syllables of the word. It is phonetically realized as vowel lengthening in an open syllable and lengthening of the coda in a syllable closed by a consonant. Like Chukchee, Aljutor stress tries to sidestep schwa; the language scrupulously avoids prominence on a light Cə syllable.

We set the stage by first considering nonschwa syllables. Here the generalizations are straightforward. In words of three or more syllables, the second syllable is stressed. Disyllabic words stress the initial syllable. As in Chukchee, monosyllabic nonfunction words are not found.

(35) quráNa	'reindeer'	(K&M. 122)

---

[4] Thanks to Andrew Spencer for bringing this paper to our attention; see also Muravjova 1986 for a reconstruction of the protolanguage from which Aljutor, Chukchee and Korjak descend.

?alá?al	'summer'	(K&M. 105)
?all'ó?əpaNa	'sweet soup'	(K&M. 105)
vitátək	'to work'	(K&M. 122)
navítatən	'he would work'	(K&M. 122)
?arNínati	'it rained'	(K&M. 105)
nutágitanaN	'binoculars'	(K&M. 119)
tátul	'fox'	(K&M. 122)
qápar	'wolverene	(K&M. 120)
jánut	'today'	(K&M. 121)
?áNar	'star'	(K&M. 122)
?ékul	'bedding, litter'	(K&M. 122)
wála	'knife'	(K&M. 122)

These data indicate that Aljutor words contain a single binary foot that is preferably right-headed (iambic) but may take the guise of a trochee in order to avoid final stress: in other words, Nonfinality >> Iambic. Aljutor differs from Chukchee in aligning its foot with the left edge of the word/base instead of the right.

Let us now turn to the Aljutor schwa. Closed syllables with a schwa nucleus behave like ordinary syllables in every respect. They are regularly stressed when they form the second syllable of a trisyllabic or longer word (vagə́lNən 'nail', K&M. 122); they accept initial stress in disyllables (?ə́ngam 'worm', K&M. 104); and they trigger retraction when final in disyllables (?ákək 'son', K&M. 122). Schwa stands out in Aljutor in that it never realizes prominence when it forms the nucleus of an open syllable. However, unlike in Indonesian (Cohn 1989), Aljutor's schwa is not simply invisible to metrical calculations. When occupying the second syllable of a trisyllabic or longer word, stress is regularly retracted to the initial syllable: jíləjil 'tongue' (K&M. 122); tə́rgətər 'meat' (K&M. 122); táwəjatək 'to feed' (K&M. 112). If schwa were simply invisible to metrical constraints we would expect stress on the third syllable of táwəjatək (i.e. *tawəjátək instead of the correctly stressed táwəjatək). Similarly, when the initial syllable is Cə stress stops on the second syllable: təgétatək 'to tell' (K&M. 113) not *təgetátək. Cə syllables thus count like other syllables in defining the disyllabic window within which stress must be located.

The Aljutor treatment of stressed syllables with schwa differs from Chukchee in a couple of respects. First, Chukchee appears to draw no distinction between open and closed syllables, equally avoiding trying to stress either one (cf. 26). Second, as shown by the phonetic measurements reported by Kodzasov & Muravjova, Aljutor stressed vowels are noticeably lengthened in open syllables indicating that a bimoraic requirement is imposed on the head of the metrical constituent.[5] The failure of open syllable schwa to support a stress can thus be seen as constraint against bimoraic schwa--a not uncommon gap (cf. Yupik). More formally, we suppose that the sonority scale is aligned with gemination ($\mu\mu > \mu$), again evaluated from worst to best. This yields the package of peak constraints in (36).

(36)
$$\begin{array}{cccc} *\mu\ \mu & *\mu\ \mu & *\mu\ \mu & *\mu\ \mu \\ \backslash/ & \backslash/ & \backslash/ & \backslash/ \\ \text{ə} & \text{i,u} & \text{e,o} & \text{a} \end{array}$$

In the theory of Green (1993), the lengthening of stressed syllables reflects a member of the BIN family of constraints requiring a unit on one tier to dominate two elements of another tier in a given domain. In our case, a foot head must dominate two moras within the domain of a syllable: BIN: Ft → mora in a syllable. Aljutor intercalates this constraint between *ə$_{mm}$ and *i,u$_{mm}$. It is of course also ranked above Fill, which constrains free mora insertion to cases where it does useful phonological work--i.e. in satisfying the BIN: Ft→m/s constraint.

The tableau in (37) shows how the proposed analysis works. We consider cases in which a single foot is flush against the left edge of the word satisfying the undominated alignment and foot binarity constraints. The winning candidate satisfies *ə$_{mm}$ and Bin: Ft→m/s. (táwə)jatək and (tawə́)jatək fail bimoraicity. (tawə́:)jatək, the expected winner, is eliminated from the competition by the higher ranking ban on bimoraic schwa.

(37) /tawəjatək/	*ə$_{mm}$	Bin: Ft→m/s	*a$_{mm}$	Fill
$(tá:wə)jatək	√	√	*	*
(táwə)jatək	√	*!	√	√
(tawə́:)jatək	*!	√	√	*
(tawə́)jatək	√	*!	√	√

---

[5] Stressed vowels are lengthened in both right-headed and left-headed (retracted stress) constituents: ?iní:ri 'today' (K&M 121) and já:nut 'today' (K&M 121). Also, Chukchee i,e and u,o correspond to i and u, respectively, in Aljutor. Aljutor e and o are secondary developments according to Murav'ova (1986).

The coupling of gemination with sonority expressed in (35) makes sense on phonetic grounds as more sonorous vowels tend to have greater absolute duration. It predicts that, other things being equal, languages failing to distribute length evenly across the vowel space should show gaps in the high vowels, then mid, and then low.[6] Finally, retraction of stress to the initial syllable in táwəjatək shows that $*\text{ə}_{mm}$ dominates Iambic rhythm: Aljutor accepts a trochee to avoid stressing a schwa and still retain alignment of the foot with the left edge of the word.

We recall that when faced with /CəCV/ words (V ≠ schwa), Chukchee avoids stressing the schwa and incurs a Nonfinality violation in the process. As shown by the data in (38), when Aljutor is faced with the same structures it manages to satisfy both constraints by inserting a dummy CV syllable at the end of the word. This dummy is minimally specified by gemination of the preceding consonant to fill the onset and a schwa to fill the nucleus.

(38)	/pəHun/	→ pəHúnnə	'mushroom'	(K&M. 122)
	/tənup/	tənúppə	'sopka'	(K&M. 122)
	/səgaj/	səgájjə	'sand'	(K&M.122)

Thus, Nonfinality is an undominated constraint in Aljutor. It is normally satisfied by retraction; but when this is not possible (due to high ranking $*\text{ə}_{mm}$), a final syllable is added at the price of a "Fill" violation. The tableau in (39) shows the effect of ranking Nonfinality above Fill. Reversing the ranking to Fill >> Nonfinality gives the CəCV́C Chukchee output.

(39) /pəHun/	$*\text{ə}_{mm}$	BIN	Nonfin	Fill
$(pəHún)nə	√	√	√	**
(pə́:Hun)	*!	√	√	*
(pə́Hun)	√	*!	√	√
(pəHún)	√	√	*!	√

Since stress retraction is normally employed instead of augmentation, Fill must dominate Iambic. Otherwise, /tatul/ would be realized as tatúllə instead of tá:tul as shown in (40).

---

[6] In the Italian dialect of Borgo San Sepolcro (Merlo 1929) consonants degeminate and lengthen preceding nonhigh vowels [a,e,o]. This can be seen as reassigment of the mora to the most optimal (sonority-wise) vowels. See Repetti (1992) for recent discussion.

(40)	/tatul/	Nonfin	Fill	Iambic
	$(tá:tul)	√	√	*
	(talúl)lə	√	**!	√

If augmentation is pressed into service only when retraction is blocked, there is just one additional case where we expect to find it--when the base is a monosyllable. Significantly, underlying monosyllables regularly augment as well.

(41)			
/Naj/	Nájjə	'hill'	(K&M 122)
/Nal/	Nállə	'herd'	(K&M 122)
/?al/	?állə	'no'	(K&M 122)

As the tableau in (42) demonstrates, the high ranking Nonfinality eliminates the monosyllable at the cost of a left-headed augmented structure with Fill violations.

(42)	/Nal/	Nonfin	Fill	Iambic
	$(Nállə)	√	**	*
	(Nál)	*!	√	√

Finally, words beginning with two successive open Cə syllables have no stress according to Kodzasov & Muravjova (1980:124), who cite the examples in (43).

(43)		
nəkəkaqin	'hot'	(cf. tətánəkəkavNən 'I will make it hot')
nəgətiNqin	'beautiful'	
jəraNatək	'to stick'	
gəməkəN	'to me'	(cf. gə́mmə 'me' abs.)

We recall that when Chukchee was faced with a comparable situation (e.g. 26), it stressed the schwa. Aljutor's high ranking *$ə_{mm}$ blocks prominence from surfacing inside the foot. Furthermore, táwəjatək 'to feed' (K&M. 112) shows that foot binarity and strict alignment do not allow the foot to shift to the right to seek out a more suitable host for the prominence. The tableau in (44) passes /nəkəkaqin/ through the constraint ranking we have established; the optimal candidate is the one which lengthens neither of the initial two syllables. It is presumably this lack of phonetic prominence that Kodzasov and Muravjova refer to when they say these words are "unstressed".

(44)	/nəkəkaqin/	Align-ft	*ə$_{mm}$	Bin: Ft→m/s
	$(nəkə́)kaqin	√	√	*
	(nəkə́:)kaqin	√	*!	√
	nə(kəká:)qin	*!	√	√

To summarize, Aljutor is an interesting counterpoint to Chukchee showing the twists and turns that languages may take in order to avoid stressing a schwa--a phenomenon that the output-oriented OT model is well-suited to express.

6. Mari

It has been known since Kiparsky (1973) (based on the work of Itkonen 1955) that there are languages whose words composed entirely of weak vowels place stress at the opposite edge from full-vowel words. We need only examine Mordwin's sister language Mari (Cheremis) to find a clear example. Mari distinguishes between a set of full and reduced (centralized) vowels with respect to their capacity to bear stress. The full vowels include a, ä, o, e, ö, u, i, ü while the reduced set is comprised by schwa and in certain dialects front and back round and unround variants of schwa. In general, stress is as far to the right as possible. But in words with all reduced vowels, stress falls on the initial syllable. An overriding constraint of Nonfinality blocks final stress. We briefly consider two dialects illustrating these patterns.

In Literary Mari (Gruzov 1960) the reduced vowels are limited to schwa. A final open syllable is never stressed.

(45)	ə́rəše	'rotten'	(G.138)
	ə́ləžtəše	'incendiary'	(G. 138)
	kə́čkərləše	'tattler'	(G. 138)
	ə́štəktəšəže	'find doing'	(G. 138)
	pələšánəšte	'large-eared' loc.	(G. 138)

Final closed syllables take the stress (unless their vowel is schwa). In words with only reduced vowels in nonfinal syllables, stress appears on the initial syllable.

(46)	áŋəšər	'narrow'	(G.137
	aŋəšəremáš	'to narrow'	

aŋəremdáš	'narrows'	
aŋəšəremdəmáš	'narrowing'	
pə́ləš	'ear'	(G. 138
pələšánəšte	'large-eared'	
pələšémən	'of my ear'	
kalasáš	'to say'	(G. 138)
kalásəšəm	'said'	
kalásəktəšəm	'find saying'	

To account for the absence of final stress, an undominated constraint of Nonfinality can be called on to eliminate candidates that stress a vowel that is flush against the right edge of the word. For this dialect of Mari, nonfinality is calculated at the lowest level of the prosodic hierarchy--at the moraic (or possibly the segmental) level. Peak Prominence correctly eliminates candidates that stress a schwa instead of a full vowel. The problem is that words containing one or more full vowels stress the rightmost one while words composed entirely of (nonfinal) reduced vowels stress the leftmost one.

For the Northwest Mari dialect described by Ivanov and Tuzarov (1970) this disparity in direction is even more acute. Unlike the Literary dialect, it distinguishes front vs. back and round vs. nonround variants of the reduced (schwa-like) vowels (transcribed here as Ü vs. U and I vs. Ɨ). A second difference is that Nonfinality is calculated at the syllable level so that both open and closed final syllables reject the stress. The upshot is that stress falls on the penult (47a) unless the penult contains a reduced vowel in which case stress recedes to the closest full vowel if one is available (47b) and otherwise stays on the penult (47c).

(47)	a.	jalúnto	'heel'	(89)
		šoráŋaš	'to get dirty'	
		roséta	'sprouts'	
		äšɨnt'äräš	'to remember'	
	b.	tIgén'IkI	'such a'	(89)
		unálɨkeš	'as a guest'	(89
		šátsɨktaš	'to give birth'	(89
		kídIštIžI	'in his hand'	(90
		p'örtIštIžI	'in his house'	(90

c.	'Iräš	'to heat up'	(38
	k'Iškäš	'to throw'	(39
	k'Unam	'when'	(41
	m'Uro	'song'	(41
	k'Üver	'bridge'	(43
	v'Ütšer	'key'	(43

The data of interest are words with more than a single reduced vowel in the nonfinal domain (48).

(48)	Ud'UrUštaš	'to row	(90
	Üš'ÜkÜštö	'in shade'	

šIž'IšI ≈ š'IžIšI	'autumnal'	(90
tɨl'ɨzɨ ≈ t'ɨlɨzɨ	'month'	
tsIt'Iräš ≈ ts'ItIräš	'to shake' refl.	

tÜt'Ürä	'mist'	(90
tUv'Urgaš	'to curdle'	
mUr'UktUlaš	'to thunder'	

t'Üdɨ	'he'	(88
š'Uldɨ	'cheaper'	
'Urɨ	'handful'	

k'UrUk	'mountain'	(87
š'ÜdÜr	'axle'	(87

Here stress shifts to the second syllable (apparently obligatorily if rounded U or Ü and optionally if nonround I or ɨ --a detail we overlook here) but not further: <u>Ud'UrUštaš</u>. These data indicate that leftmost stress in the reduced vowel words is modulated by a Noninitial factor and more generally that directional orientation must apparently distinguish the full and reduced vowels.

Our suggestion for dealing with this problem is to take another leaf from the Prince & Smolensky (1993) analysis of Berber. As they show, not only is sonority relevant for the peak of the syllable, it also plays a role in optimizing syllable margins. Briefly, the less sonorous the margin of the syllable the better. Accordingly, the UG sonority hierarchy is distributed through the Margin hierarchy generating a family of margin constraints ordered from worst to best (see Prince & Smolensky 1993 for details).

(49) *M/a >> *M/e,o >> *M/i,u >> *M/ə >> ..... >> *M/p,t,k

Our proposal is that when the sonority scale is aligned with the Peak$_{foot}$ > Trough$_{foot}$ scale it defines a set of Margin constraints of the form (49) that optimize unstressed syllables of the foot in terms of their relative lack of sonority. It is these Margin constraints (rather than Peak Prominence) that are active in Mari and more generally in systems where stress appears to default to the opposite edge in weak-vowel words.

Intuitively, the analysis runs as follows. The stress foot is aligned at the right edge of the word (Align-Rt) and as in Mordwin, it wants to be as big as possible (i.e. Parse >> Bin). Also, again as in Mordwin, the stressed syllable (head of the foot) wants to be as far to the left as possible: metrical constituents are left-headed in Mari. When all the vowels in the word are drawn from the weakest schwa-like class (the most optimal marginal vowel) the left edge of the foot may extend to the left edge of the word optimizing Parse. But optimization of Parse is blocked if a stronger vowel were to appear in the margin.

We may achieve this effect if Mari's Parse constraint appears between *M/i,u and *M/ə.

(50) *M/a >> *M/e,o >> *M/i,u >> Parse >> *M/ə

To see how the proposal works, let us examine some cases. We abstract away from the effects of Nonfinality. First consider words composed of a mixture of strong and weak vowels such as the schematic (51a). Restricting the margin of the foot to weak vowels blocks expansion of the foot past the rightmost strong vowel at the expense of failing to metrify preceding syllables. Similarly, in a word with no nonfinal weak vowels (51b), the left edge of the foot does not extend past the rightmost (nonfinal) vowel. But if the word is composed of all weak vowels (51c), then every candidate runs the *M/a .... *M/i,u constraint gauntlet unscathed leaving the lower ranked Parse to select the biggest foot--one which essentially coincides with the word--to yield initial stress.

(51) a. /CəCaCəCaCəC/	*M/a	Parse	*M/ə
('sssss)	*!*	√	
s('ssss)	*!	*	
ss('sss)	*!	**	
$sss('ss)	√	***	

b. /CaCeCiCaCəC/	*M/a	*M/e,o	*M/i,u	Parse
('sssss)	*!	√	√	*
s('ssss)	√	*!	√	*
ss('sss)	√	√	*!	*
$sss('ss)	√	√	√	*
c. /CəCəCəCəC/				
$('ssss)	√	√	√	√
s('sss)	√	√	√	*!
ss('ss)	√	√	√	*!*
sss('s)	√	√	√	*!**

Finally, let us consider the retraction from the initial syllable of an all-weak word in the Northwest dialect (51). Evidently, a Noninitial constraint is modulating Parse. But we want to block it from affecting /C'aCə.../ words. This is reminiscent of the phenomenon operating in Chukchee: stress moves away from the edge but fails to do so if the effect is to stress a weak vowel instead of a strong one. We may achieve this effect for Mari if *P/ə dominates Noninitial and Noninitial dominates Parse, which in turn must dominate *M/ə.

(52) *P/ə >> Noninitial >> Parse >> *M/ə

The tableaux in (53) demonstrate how proper placement of the Noninitial constraint accounts for the shift of stress from the left edge.

(53) /CaCəCəCəC/	*P/ə	Noninit	Parse	*M/ə
$('sssss)	√	*!	√	√
s('sss)	*!	√	*	√
/CəCəCəC/				
('sss)	*	*!	√	√
$s('ss)	*	√	*	√

For inputs with an initial nonreduced vowel *P/ə eliminates candidates that stress a later syllable, leaving the initially stressed candidate as the only survivor. In words with all reduced vowels all candidates tie on *P/ə allowing the lower ranked Noninitial to eliminate initial stress. The Parse constraint then zeroes in on the candidate with peninitial stress.

This example shows that the Peak and Margin constraints can overlap (i.e. *P/ə >> *M/ə)--another effect similar to the Prince & Smolensky (1993) analysis of Berber. More generally, it illustrates the subtle effects that can be achieved from optimization in the most minute realms of the phonology.

Finally, let us return to Mordwin to briefly compare it with Mari. Both systems stress the initial syllable in the all-weak words but they shift the stress peak in opposite directions in words containing one or more strong vowels.

(54)	Mordwin	Mari
all weak	leftmost	leftmost
one or more strong	leftmost	rightmost

In our analysis the Parse constraint wants to align the edges of the metrical foot with the edges of the word to give initial (i.e. left-headed) stress. This condition can be satisfied in all-weak words and in words of the shape /Aə...ə/. But in words of the shape /ə..əAə..ə/ one of the sonority constraints pushes the left edge of the metrical foot away from the left edge of the word ə...ə(Aə..ə) to introduce a disparity between alignment of the left edge and Parse. If Peak Prominence is ranked above Parse, it rejects ('ə...əAə..ə) in favor of ə..ə('Aə..ə) in order that stress land on a full vowel. If Margin Prominence is ranked above Parse, it rejects ('ə...əAə...ə) in favor of ə...ə('Aə...ə) so that the trough contains no full vowel. These two different rankings distinguish themselves empirically in structures with multiple full vowels: /ə..əAə..əAə...ə/. Optimization of peaks aligns the left edge of the foot with the leftmost full vowel ə...ə(Aə...əAə..ə) while optimization of troughs seeks out the rightmost full vowel ə...əAə..ə(Aə...ə).

If this interpretation is correct, it suggests that the default to the "same side" versus "opposite side" typology of unbounded stress systems can be reduced to a difference in constraint ranking. More generally, it shows that the sonority of syllabic nuclei can have a direct effect on the alignment of syllables with the peaks and troughs of metrical constituents. The constraints that enforce this sonority effect are not rigid phonetic interface requirements or general meta-conditions or parameters but interact in a complex fashion with other constraints (e.g. Nonfinality, Parse, Iambic, etc.). In the OT model they are quite literally woven into the fabric of the language as ranked constraints.

References

Cohn, Abigail. 1989. Stress in Indonesian and bracketing paradoxes. Natural Language & Linguistic Theory 7. 167-216.

Dell, François & Mohamed Elmedlaoui. 1985. Syllabic consonants and syllabification in Imdlawn Tashlhiyt Berber. Journal of African Languages and Linguistics 7. 105-30.

Everett, Daniel.1988. On metrical constituent structure in Pirahã phonology. Natural Language & Linguistic Theory 6. 207-46.

Green, Thomas. 1993. Configurational constraints in a generalized theory of phonological representation. MIT Ph.D. dissertation.

Gruzov, L.P. 1960. Sovremennyj Marijskij jazyk. Joškar-ola

Ivanov, I.G. & G.M. Tužarov. 1970. Severo-zapadnoje narečije marijskogo jazyka. Joškar-ola.

Itkonen, Erkki. 1955. Über die Betonungsverhältnisse in der finnisch-ugrischen Sprachen. Acta Linguistica Hungaricae 5. 21-34.

Kenstowicz, Michael. 1979a. Chukchee vowel harmony and epenthesis. The elements: a parasession on linguistic units and levels, ed. by P. Clyne et al. Chicago Linguistics Society. 402-412.

Kenstowicz, Michael. 1979b, 1986. The phonology of Chukchee consonants. Studies in the Linguistic Sciences 16,1. 79-96.

Kiparsky, Paul. 1973. "Elsewhere" in phonology. S. Anderson & P. Kiparsky eds. A festschrift for Morris Halle. New York: Holt. 93-106.

Kodzasov, S.V. & I.A. Muravjova. 1980. Slog i ritmika slova v aljutorskom jazyke. Aktual'nyje voprosy strukturnoj i prikladnoj lingvistiki. Sbornik statej. M. pp. 103-128.

Krause, Scott. 1979. Topics in Chukchee phonology and morphology. University of Illinois Ph.D. dissertation.

McCarthy, John & Alan Prince. 1993. Generalized alignment. Yearbook of Morphology 1993. 79-153.

Merlo, C. 1929. Consonanti brevi e consonanti lunghi nel dialetto di Borgo San Sepolcro. L'Italia dialettale 5. 66-80.

Muravjova, I.A. 1986. Rekonstrukcija fonologičekoj sistemy pračukotsko-korjakskogo jazyka. Fonetičeskije struktury v sibirskix jazykax. Novosibirsk. 144-165.

Prince, Alan & Paul Smolensky. 1993. Optimality theory: constraint interaction in generative grammar. Rutgers Univ. ms. To appear, MIT Press.

Repetti, Lori. 1992. Vowel length in Northern Italian dialects. Probus 4. 155-82.

Skorik, P. Ja. 1961. Grammatika čukotskogo jazyka. Moscow.

Tsygankin, D.B. & C.Z. Debaev. 1975. Očerk sravnitel'noj grammatiki mordovskix (mokšanskogo i erz'anskogo) literaturnix jazykov. Saransk.

Michael Kenstowicz
Linguistics, 20-D 219
MIT
Cambridge, MA 02139
e-mail: kenstow@mit.edu

Portions of this paper were presented at the First Rutgers Optimality Workshop, Rutgers University, the First International Conference on Linguistics at Chosun University, Kwangju Korea, and Budapest University as well as in class lectures at MIT. Thanks to members of these audiences as well as to Judy Baek, Jonathan Bobaljik, Tony Bures, Tom Green, Morris Halle, Hubert Truckenbrodt, ...