15th Manchester Phonology Meeting
University of Manchester, UK May 26, 2007

Moraic Faithfulness: Evidence from Blackfoot and English*

Emily Elfner
University of Massachusetts, Amherst
eelfner@linguist.umass.edu

1. Introduction

- The issue: Under Moraic Theory (Hyman 1985, McCarthy & Prince 1986, Hayes 1989), contrastive vowel and consonant length are derived from underlying moraic contrasts. Many languages show contrasts in vowel length (one vs. two moras) and in intervocalic consonant length (zero vs. one mora). However, no language appears to contrast for weight in coda position (weightless vs. heavy codas).

- Optimality Theory (OT, Prince & Smolensky 1993/2004) predicts that such languages should be possible, based on the factorial typology obtained by permuting the ranking of moraic faithfulness constraints with moraic and other markedness constraints.

- Is it true that the weight of CVC syllables is never contrastive within a language? If so, then the theory of moraic faithfulness is in need of revision, as proposed by Bermúdez-Otero (2001), McCarthy (2003), and Campos-Astorkiza (2004) (but cf. Morén 1999).

- However, two sets of data suggest that the weight of CVC syllables can be contrastive and therefore that no revisions to moraic faithfulness are required:
  - Blackfoot (Algonquian: Alberta & Montana) shows tautomorphemic syllabification contrasts which can be derived via faithfulness to preconsonantal weight contrasts.
  - English shows contrastive stress in final CVC syllables (Ross 1972), which can also be derived via moraic faithfulness in coda position.

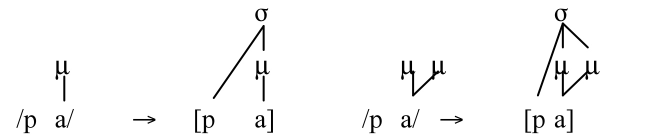
> GOAL: to develop an analysis of coda weight contrasts in Blackfoot and English using moraic faithfulness, and to show that moraic faithfulness constraints in their simplest form do not pose a theoretical problem.

* Special thanks to my Blackfoot consultant, Rachel Ermineskin, and to Darin Howe and John McCarthy for discussion and comments at various stages. Thanks also to the UMass Phonology Group, and audiences at the University of Calgary, UMass Amherst and WCCFL 25. All errors are my own. This research has been supported by grants from the Social Sciences and Humanities Research Council of Canada.

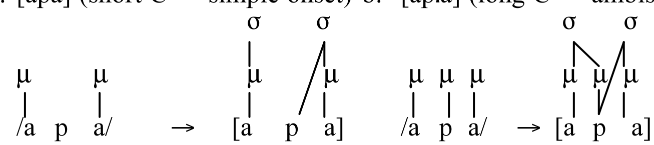
2. Theoretical Background

- Under a moraic analysis, vowel and consonant length contrasts are derived from underlying moraic contrasts (Hayes 1989):

(1) a. [pa] (short vowel = light) b. [paː] (long vowel = heavy)



(2) a. [apa] (short C = simple onset) b. [apːa] (long C = ambisyllabic)



- In OT, contrast is derived via faithfulness constraints (McCarthy & Prince 1995, 1999), which require correspondence between elements in the input and elements in the output.

- Moraic faithfulness constraints (minimally, DEPμ and MAXμ) are necessary to derive vowel and consonant length contrasts from underlying moraic contrasts:

(3) a. MAXμ: assign one violation mark for every mora present in the input which is not present in the output.
b. DEPμ: assign one violation mark for every mora present in the output which is not present in the input.

- For example, long vowels are derived by ranking MAXμ over *LONGV, and long consonants by ranking MAXμ over NOCODA:

(4) a. Long vowel

/$pa_{\mu\mu}$/	MAXμ	*LONGV
☞a. $pa_{\mu\mu}$		*
b. pa_{μ}	*!	

b. Long consonant

/$a_{\mu}p_{\mu}a_{\mu}$/	MAXμ	NOCODA
☞a. $a_{\mu}p_{\mu}.pa_{\mu}$		*
b. $a_{\mu}.pa_{\mu}$	*!	

- When moraic faitihfulness constraints dominate moraic markedness constraints (such as WBYP and *Cμ) or syllable structure markedness constraints (such as constraints banning appendices or syllabic consonants), we predict that the underlying moraic contrast given by Richness of the Base (Prince & Smolensky 1993/2004) will surface faithfully in coda position:

(5) WEIGHTBYPOSITION (WBYP): assign one violation mark for every coda consonant that is not associated with a mora. (Hayes 1989)

(6) *Cμ: assign one violation mark for every consonant that is associated with a mora. (Zec 1988, Broselow et al. 1997, Morén 1999)

(7) Moraic Contrast in Coda Position

/pa$_{\mu}$t/	DEPμ	WBYP
☞a. pa$_{\mu}$t		*
b. pa$_{\mu}$t$_{\mu}$	*!	

/pa$_{\mu}$t$_{\mu}$/	MAXμ	*Cμ
☞a. pa$_{\mu}$t$_{\mu}$		*
b. pa$_{\mu}$t	*!	

- Word-medially, such a language could potentially show contrastive syllabification, when moraic faithfulness dominates NOCODA and *COMPLEXONSET:

(8) Contrastive Syllabification

/a$_{\mu}$kla$_{\mu}$/	DEPμ	NO CODA	*COMP
☞a. a$_{\mu}$.kla$_{\mu}$			*
b. a$_{\mu}$k$_{\mu}$.la$_{\mu}$	*!	*	
c. a$_{\mu}$k.la$_{\mu}$		*!	

/a$_{\mu}$k$_{\mu}$la$_{\mu}$/	MAXμ	NO CODA	*COMP
☞a. a$_{\mu}$k$_{\mu}$.la$_{\mu}$		*	
b. a$_{\mu}$.kla$_{\mu}$	*!		*
c. a$_{\mu}$k.la$_{\mu}$	*!	*	

- Neither the contrasts in (7) nor the contrasts in (8) are thought to occur. This typological gap prompted Bermúdez-Otero (2001) and Campos-Astorkiza (2004) to reformulate DEPμ such that it is not violated when moras are epenthesised in coda position:

(9) Positional DEPμ (Bermúdez-Otero 2001:18):
Let μ be a mora in the output. Either (i) μ has a correspondent in the input, or (ii) μ is a positional μ-licenser.

(10) Positional μ-licensing (Bermúdez-Otero 2001:7)
A nonsyllabic segment α is positionally μ-licensed by a mora μ if, and only if,
(a) α does not have an input correspondent linked to a mora, and
(b) α is immediately dominated only by μ.

- The details will not be discussed here; however, this definition essentially ensures that languages can neutralise /a$_{\mu}$kla$_{\mu}$/ to [a$_{\mu}$k$_{\mu}$.la$_{\mu}$], without violating moraic faithfulness.[1]

- The data presented in this paper illustrate that the contrasts presented above do occur: I argue that Blackfoot shows the contrastive syllabification patterns in (8) and English the CVC patterns in (7).

3. Contrastive Syllabification in Blackfoot[2]

- Blackfoot has a relatively small phoneme inventory, which is expanded by a number of length contrasts:

(11) Blackfoot Phoneme Inventory

	Labial	Coronal	Dorsal	Glottal
Stops	p pː	t tː	k kː	ʔ
Fricatives		s sː	x	
Affricates		t͡s t͡ːs	(k͡s k͡ːs)	
Nasals	m mː	n nː		
Glides	w	j		

Vowels
i iː
o oː
a aː

- Like many other languages, Blackfoot contrasts consonant length intervocalically:[3]

(12) a. nina: 'man/chief' (also /pː, tː, kː, sː, t͡ːs, k͡ːs, mː/)
b. nɪnːa 'my father'

- More unusually, Blackfoot also contrasts consonant length before consonants: /s/ before stops (13) and stops before /s/ (14):

(13) istawáʔsiwa 's/he grew' isːtatánsːiwa 's/he bragged'

(14) a. ipiksit[4] 'flee' ipikːsit 'be anxious'
b. nitsikstaki 'I bit' oxpatótːsin 'appendix'
c. sit͡sípsat͡sisa 'speak to him' ikipːsak͡siwa 'he briefly went out'

---

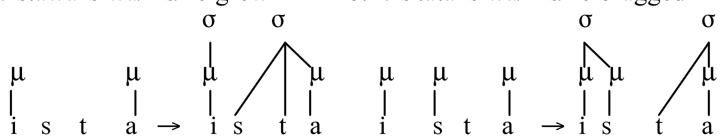
[1] The treatment of MAXμ under this hypothesis is not pursued in either Bermúdez-Otero (2001) or Campos-Astorkiza (2004).
[2] For detailed descriptive work on Blackfoot, see Frantz & Russell (1989) and Frantz (1991).
[3] Blackfoot data are from Frantz & Russell (1989), and have been independently elicited from a native speaker of the Siksiká dialect.
[4] Blackfoot contrasts the sequences /ts/ and /ks/ with the affricates /t͡s/ and /k͡s/. The difference is arises from the duration of /s/.

- Phonotactic evidence indicates that long consonants are moraic, while short consonants are not. For example, short vowels become lax in closed syllables and before long consonants, but remain tense before short consonants.

- In analogy with the moraic analysis of contrastive vowel and consonant length, preconsonantal length contrasts can also be derived from an underlying moraic contrast.

- As predicted by the tableau in (8), non-moraic /s/ is syllabified as part of the following onset, while moraic /sː/ is syllabified as a simple coda consonant:

(15) a. /istawaʔsiwa/ ‘s/he grew’ b. /isːtatansiwa/ ‘s/he bragged’



- This pattern follows from the constraint ranking established for contrastive syllabification in (8):

(16) Contrastive Syllabification in Blackfoot

$/i_\mu sta_\mu/$	DEPμ	NO CODA	*COMP
☞a. $i_\mu.sta_\mu$			*
b. $i_\mu s_\mu.ta_\mu$	*!	*	
c. $i_\mu s.ta_\mu$		*!	

$/i_\mu s_\mu ta_\mu/$	MAXμ	NO CODA	*COMP
☞a. $i_\mu s_\mu.ta_\mu$		*	
b. $i_\mu.sta_\mu$	*!		*
c. $i_\mu s.ta_\mu$	*!	*	

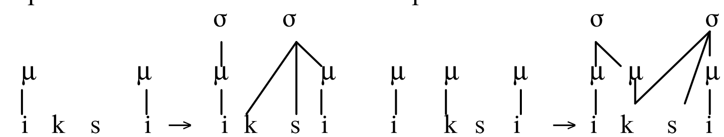
- The preconsonantal moraic geminate is not ambisyllabic, as is the case with intervocalic geminates. This structure is harmonically bound under this constraint set, because it spuriously creates a complex onset:

(17) Harmonic Bounding of Ambisyllabic Structure

$/i_\mu s_\mu ta_\mu/$	MAXμ	NO CODA	*COMP
☞a. $i_\mu s_\mu.ta_\mu$		*	
☠b. $i_\mu s_\mu.sta_\mu$		*	*!

- Other constraints might compel ambisyllabicity: in Blackfoot, preconsonantal stops (as in (14)) are true geminates, represented as follows:[5]

(18) a. /ipiksit/ ‘flee’ b. /ipikːsit/ ‘be anxious’



- Ambisyllabicity here is motivated by the Syllable Contact Law (Murray & Vennemann 1983), which prefers sonority to decrease over a syllable boundary:

(19) SYLLCON: assign one violation mark for every coda consonant that is more sonorous than an adjacent onset consonant. (see Davis & Shin 1999, Rose 2000, and Gouskova 2004, among others, for discussion of the Syllable Contact Law in OT)

(20) Preconsonantal Ambisyllabicity is compelled by SYLLCON

$/i_\mu k_\mu si_\mu/$	NO CODA	SYLLCON	*COMP
☞a. $i_\mu k_\mu.ksi_\mu$	*		*
b. $i_\mu k_\mu.si_\mu$	*	*!	

- Blackfoot’s syllabification contrasts can be accounted for by ranking moraic faithfulness (DEPμ, MAXμ) above syllable structure markedness (NOCODA, *COMP), thus fulfilling the predictions of the factorial typology. This language illustrates the need for moraic faithfulness constraints to apply in preconsonantal positions.

---

[5] This representation is supported by preliminary phonetic measurements of duration: preconsonantal /sː/, as in /isːtatánsiwa/ ‘s/he bragged’, is shorter in duration than intervocalic geminate /sː/, as in /isːapjaʔt͡sis/ ‘telescope/binoculars’ (192 ms vs. 336 ms), while preconsonantal /kː/, as in /ipikːsit/ ‘be anxious’, is of approximately equal duration as intervocalic geminate /kː/, as in /ikːaminiwa/ ‘s/he fainted’ (320 ms vs. 289 ms). The measurements are the average values of two tokens with three repetitions each, spoken by a native speaker of the Siksiká dialect.

4. Contrastive Coda Weight in English

4.1. Ross' Generalisation

- Ross (1972) observed that a pattern of contrastive stress exists for word-final closed syllables in English.

- In general, English final CVC syllables have a secondary stress (Ross 1972:250-252):

(21) Final secondary stress:

hándicàp	Bándersnàtch
Áhàb	scálawàg (scállywàg)
físticùff	máckintòsh
Yúgoslàv	cámouflàge
máyhèm	tómahàwk
cáravàn	álcohòl
métaphòr	bóycòtt
nómàd	álbatròss
Álcatràz	ázòth

- However: final CVC syllables ending in a coronal obstruent (/t, d, s, z, θ/) or a sonorant (/l, r, m, n/) are sometimes unstressed, resulting in contrasts such as the following (Ross 1972:250-251):

(22) Contrastive final stress:

a. Sonorants		b. Coronal obstruents	
máyhèm	ídiom	scúttlebùtt	póet
cáravàn	cínnamon	nómàd	flúid
métaphòr	vínegar	álbatròss	sýllabus
álcohòl	fúneral	Álcatràz	Fernández
		ázòth	Elízabeth

- The pattern is as follows:

(23) Ross' Generalisation (Ross 1972)

a. A final syllable is optionally stressed if it ends in either a coronal obstruent or a sonorant.
b. A final syllable is always stressed if it ends in a non-coronal obstruent.
c. Apparent exceptions (e.g. Árab, wállop, hámmock, shériff) follow from the "Arab Rule" (also Hayes 1995): CVC is stressless after a stressed light syllable.

- How can this pattern of contrast vs. non-contrast be accounted for?

- Lexical stress marking alone cannot account for why some final syllables can be stressed contrastively and others can't.

- Observation: heavy syllables are almost always stressed in English, due to the Weight-to-Stress constraint (WSP, Prince 1990), which is high-ranked.

- Proposal: contrastive final stress can be derived from moraic contrasts: heavy final CVC_μ is stressed by WSP, while light final CVC is left unstressed.

- Because the contrast is lexical, the weight contrast must be present in the input, and therefore governed by moraic faithfulness constraints.

- As is necessary under Richness of the Base, the moraic faithfulness account requires that all consonants have two possible underlying representations: one non-moraic, and the other moraic.

- Therefore: if contrastive final stress derives from an underlying moraic contrast, it is neutralised in the case of final non-coronal obstruents, but is preserved faithfully by final sonorants and coronal obstruents.

- Two tasks: motivate moraic neutralisation in final non-coronal obstruents, and preservation in final sonorants and coronal obstruents.

4.2. Task # 1: Neutralisation of Weight for Non-coronal Obstruents

- Final obstruents neutralise with respect to their underlying moraic status: they are always stressed.

- For non-moraic obstruents, a mora is epenthesised to avoid a violation of WBYP, while for moraic obstruents, the mora is preserved:

(24) a. Mora epenthesis compelled by high-ranking WBYP

skæ$_\mu$li$_\mu$wæ$_\mu$g	WBYP	DEPμ
☞a. (skǽ$_\mu$.li$_\mu$)(wæ̀$_\mu$g$_\mu$)		*
b. (skǽ$_\mu$.li$_\mu$)wæ$_\mu$g	*!	

b. Input mora preserved by high-ranking MAXμ

skæ$_\mu$li$_\mu$wæ$_\mu$g$_\mu$	MAXμ	*Cμ
☞(skǽ$_\mu$.li$_\mu$)(wæ̀$_\mu$g$_\mu$)		*
(skǽ$_\mu$.li$_\mu$)wæ$_\mu$g	*!	

- Both inputs will therefore surface as heavy CVC_μ, which receives stress by high-ranking WSP.

4.3. Task # 2: Deriving the Contrast for Sonorants and Coronal Obstruents

- This will be done in two steps, because sonorants and coronal obstruents do not form a natural class.

4.3.1. Preserving the Contrast for Sonorants

- As was the case for non-coronal obstruents, final CVC syllables ending in a sonorant are stressed when the final consonant is underlyingly moraic, as in *cáravàn*:

(25) Input mora preserved by high-ranking MAXμ

kε$_{\mu}$rə$_{\mu}$væ$_{\mu}$n$_{\mu}$	MAXμ	*Cμ
☞ a. (kέ$_{\mu}$.rə$_{\mu}$)(væ̀$_{\mu}$n$_{\mu}$)		*
b. (kέ$_{\mu}$.rə$_{\mu}$)və$_{\mu}$n	*!	
c. (kέ$_{\mu}$.rə$_{\mu}$)vn̩$_{\mu}$	*!	

- Question: why isn't the moraic contrast neutralised for final sonorants?

- Observation: In unstressed syllables, moraic sonorants are syllabic. This is true of the examples in (22), where the final syllable is unstressed (e.g. cínna[mn̩], fúne[rl̩]).

- In keeping with the moraic faithfulness analysis, a possible derivation of these forms would see the vowel being deleted and transferring its mora to the underlyingly non-moraic sonorant, resulting in a syllabic sonorant. In this way, DEPμ is satisfied:[6]

(26) Satisfaction of DEPμ by deleting input vowel

sɪ$_{\mu}$nə$_{\mu}$mə$_{\mu}$n	WBYP	DEPμ	MAX-V
☞ a. (sɪ$_{\mu}$.nə$_{\mu}$)mn̩$_{\mu}$			*
b. (sɪ$_{\mu}$.nə$_{\mu}$)mə$_{\mu}$n	*!		
c. (sɪ$_{\mu}$.nə$_{\mu}$)(mæ̀$_{\mu}$n$_{\mu}$)		*!	

- This strategy is not used in the case of non-coronal obstruents because obstruents are generally not allowed to be syllabic in English: the constraint *PEAK/OBS (Prince & Smolensky 1993/2004), which militates against syllabic obstruents, is undominated:[7]

[6] Under Richness of the Base, /sɪnəmn$_{\mu}$/ is also a possible input, which will be pronounced faithfully.
[7] /ŋ/ seems to pattern with obstruents in attracting stress, e.g. bóomeràng, mústàng, because, like obtruents, this segment cannot be syllabic in English.

(27) Intolerance for syllabic obstruents neutralises moraic contrast

skæ$_{\mu}$li$_{\mu}$wæ$_{\mu}$g	*PEAK/OBS	DEPμ	MAX-V
☞a. (skǽ$_{\mu}$.li$_{\mu}$)(wæ̀$_{\mu}$g$_{\mu}$)		*	
b. (skǽ$_{\mu}$.li$_{\mu}$)wg$_{\mu}$	*!		*

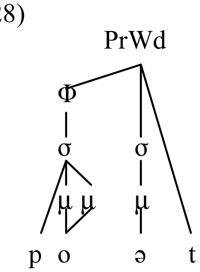
- Moraic faithfulness is therefore responsible for deriving the contrast between stressed and unstressed final syllables ending in a sonorant.

4.3.2. Preserving the Contrast for Coronal Obstruents

- Final coronal obstruents also contrast with respect to whether or not they add weight to the syllable.

- This can be attributed to the special status of coronals within English and other languages in their ability to act as weightless appendices (Paradis & Prunet 1991). Appendices attach to a higher node in the prosodic structure; to avoid confounds with WBYP, I will assume that appendices are attached directly to the prosodic word level:

(28)

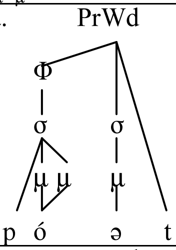
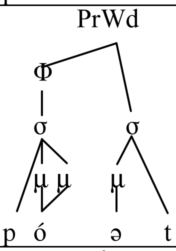
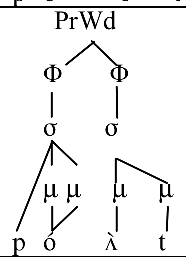


- For the purposes of this analysis, I will assume that this structure violates exhaustivity (Selkirk 1995), which I formulate as place-dependent PARSE/SEG constraints:

(29) a. PARSESEG[+cor]: assign one violation mark for every [+coronal] segment that is not dominated by a syllable node.
b. PARSESEG[-cor]: assign one violation mark for every [-coronal] segment that is not dominated by a syllable node.

- Underlyingly non-moraic final coronals are parsed as appendices because WBYP and DEPμ dominate PARSESEG[+cor]:

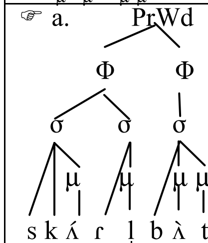
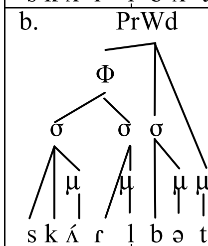
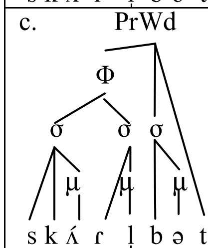
(30) Underlyingly non-moraic coronals are parsed as appendices

$\text{po}_{\mu\mu}\text{ə}_{\mu}\text{t}$	WBYP	DEPμ	PARSESEG[+cor]
☞ a. 			*
b. 	*!		
c. 		*!	

- On the other hand, underlyingly moraic final coronals receive final stress. This is due to an (unrankable) constraint that requires all moras to be parsed into syllables:

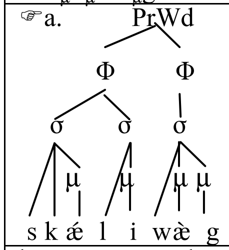
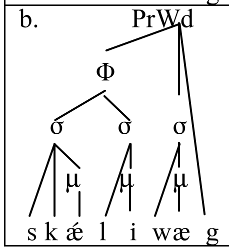
(31) PARSEμ: Assign one violation mark for every mora that is not dominated by a syllable node.

(32) Input mora on a coronal is preserved faithfully, and not as an appendix

$\text{sk}\text{ʌ}_{\mu}\text{ɾl}_{\mu}\text{b}\text{ʌ}_{\mu}\text{t}_{\mu}$	MAXμ	*Cμ	PARSEμ
☞ a. 		*	
b. 		*	*!
c. 	*!		

- To avoid the appendage of non-coronal final non-moraic consonants, PARSE-SEG[-cor] dominates DEPμ:

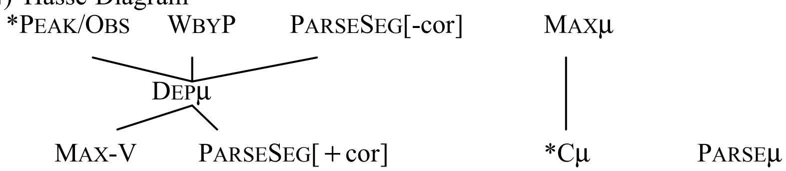
(33) Non-coronals are not parsed as appendices

skæ$_\mu$li$_\mu$wæ$_\mu$g	PARSESEG[-cor]	DEPμ
☞a. 		*
b. 	*!	

- Moraic faithfulness distinguishes between coronals that are parsed as appendices and those which are not.

4.4. Summary: Ranking of Constraints in English

(34) Hasse Diagram



5. Conclusion

- Analyses of contrastive syllabification in Blackfoot and contrastive final stress in English were presented using the means of moraic faithfulness.

- These analyses captured many generalisations that would be impossible to account for if moraic faithfulness is assumed not to apply to consonants in coda position: it is therefore unnecessary and undesirable to reformulate the moraic faithfulness constraints.

References:

Bermúdez-Otero, Ricardo. 2001. Underlyingly non-moraic coda consonants, faithfulness, and sympathy. Ms., University of Manchester.

Broselow, Ellen, Su-I Chen, and Marie Huffman. 1997. Syllable weight: convergence of phonology and phonetics. *Phonology* 14:47-82.

Campos-Astorkiza, Rebeka. 2004. Faith in moras: A revised approach to prosodic faithfulness. In K. Moulton and M. Wolf (eds.) *Proceedings of NELS 34*. Amhert, MA: GLSA.

Davis, Stuart and Seoung-Hoon Shin. 1999. The syllable contact constraint in Korean: an optimality theoretic analysis. *Journal of East Asian Linguistics* 8:285-312.

Frantz, Donald G. 1991. *Blackfoot Grammar*. Toronto: University of Toronto Press.

Frantz, Donald & Norma Jean Russell. 1989. *Blackfoot Dictionary of Stems, Roots, and Affixes*. Toronto: University of Toronto Press.

Gouskova, Maria. 2004. Relational hierarchies in Optimality Theory: the case of syllable contact. *Phonology* 21:201-250.

Hayes, Bruce. 1989. Compensatory lengthening in moraic phonology. *Linguistic Inquiry* 20:253-306.

Hayes, Bruce. 1995. *Metrical Stress Theory*. Chicago: University of Chicago Press.

Hyman, Larry. 1985. *A Theory of Phonological Weight*. Dordrecht: Foris.

McCarthy, John J. 2003. Sympathy, cumulativity, and the Duke-of-York gambit. In Caroline Féry and Ruben van de Vijver (eds.) *The Syllable in Optimality Theory*. Cambridge: Cambridge University Press, 23-76

McCarthy, John J. and Alan Prince. 1986. Prosodic Morphology, ms.

McCarthy, John J. and Alan Prince. 1995. Faithfulness and reduplicative identity. In Jill Beckman, Laura Walsh Dickey, and Suzanne Urbanczyk (eds.) *University of Massachusetts Occasional Papers in Linguistics* 18: 239-384.

McCarthy, John J. and Alan Prince. 1999. Faithfulness and identity in Prosodic Morphology. In René Kager, Harry van der Hulst, and Wim Zonneveld (eds.) *The Prosody-Morphology Interface*. Cambridge: Cambridge University Press, 218-309.

Murray, Robert W. and Theo Vennemann. 1983. Sound change and syllable structure in Germanic phonology. *Language* 59: 514-528.

Morén, Bruce T. 1999. Distinctiveness, coercion and sonority: A unified theory of weight. Doctoral dissertation, University of Maryland at College Park.

Paradis, Carole and Jean-François Prunet (eds). 1991. *The Special Status of Coronals: external and internal evidence*. San Diego: Academic Press.

Prince, Alan and Paul Smolensky. 1993/2004. *Optimality Theory: Constraint Interaction in Generative Grammar*. Oxford: Blackwell.

Prince, Alan. 1990. Quantitative consequences of rhythmic organization. In *Papers from the 26th Annual Regional Meeting of the Chicago Linguistic Society*, vol. 2, 355–398.

Rose, Sharon. 2000. Epenthesis positioning and syllable contact in Chaha. *Phonology* 17:397-425.

Ross, John Robert. 1972. A reanalysis of English word stress. In M. Brame (ed.) *Contributions to Generative Phonology*. Austin: University of Texas Press, 229-324.

Selkirk, Elisabeth. 1995. The prosodic structure of function words. In Jill Beckman, Laura Walsh Dickey, and Suzanne Urbanczyk (eds.) *Papers in Optimality Theory*. Amherst, MA: GLSA Publications, 439-470.

Zec, Draga. 1988. *Sonority Constraints on Prosodic Structure*. Doctoral dissertation, Stanford University.