MARKEDNESS AND FAITHFULNESS CONSTRAINTS ON THE ASSOCIATION OF MORAS: THE DEPENDENCY BETWEEN VOWEL LENGTH AND CONSONANT WEIGHT

by

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Thesis submitted to the Faculty of the Graduate School of the
University of Maryland at College Park in partial fulfillment
of the requirements for the degree of
Master of Arts
1997

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CHAPTER I

Introduction

Many languages require that certain syllables be heavy. For example, Icelandic requires that all stressed syllables be heavy, Dutch requires that all syllables be heavy, and Italian requires that stressed penultimate syllables be heavy. However, regardless of why and in what context, there are specific strategies for ensuring that this weight requirement is met: either vowels surface as long, or coda consonants count for weight. Moreover, there is a dependency between whether a language has distinctive vowel length or distinctive consonant weight, and the type of strategy employed. In some cases, vowel length is determined by the weight of the following consonant[1], and in others, the weight of a consonant is determined by vowel length[2].

In this paper, I propose an analysis of the distribution of moraic segments in certain stressed syllables in three dialects of English. The three English dialects are: Received Pronunciation (RP) spoken in Southern England[3], Standard American (SAE) spoken from South West New England to the Pacific Coast[4], and Metropolitan New

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1 For example, /$CV^{\mu}C$/→ [$CV^{\mu\mu}C$] and /$CV^{\mu}C^{\mu}$/ → [$CV^{\mu}C^{\mu}$].

2 For example, /$CV^{\mu}C$/→ [$CV^{\mu}C^{\mu}$] and /$CV^{\mu\mu}C$/ → [$CV^{\mu\mu}C$].

3 Moulton (1990) and Giegerich (1992).

4 Moulton (1990) - SAE3.

York (NYE)[5]. RP is discussed because it has a system where all stressed vowels have distinctive length - vowel length always determines the weight of the following consonant. SAE is discussed because it has some stressed vowels which always have distinctive length, but others which always surface as long (non-distinctive length). This is important because it shows that within the same language there can be some vowels which determine consonant weight, and some vowels whose length is determined by the inability of consonants to bear weight. NYE is interesting because it has a three-way classification of stressed vowels. Some vowels have distinctive length, others only surface as long (non-distinctive length), and still others either have distinctive vowel length or are long depending on the context. In other words, NYE has a hybrid system (æ-tensing) where vowel length determines consonant moraicity, and consonant moraicity determines vowel length. I will argue that NYE æ-tensing is the result of a vowel length distinction (at times neutralized) not found in other dialects of English. In addition to the analyses of English, a preliminary analysis of Icelandic is provided in Chapter VI because in Icelandic stressed syllables, vowel length is never distinctive but consonant weight is. This is important because it shows a language in which consonant weight always determines vowel length, and it fills in part of the larger typology predicted here.

Using the Optimality Theory of Prince and Smolensky (1993) (henceforth P&S93) and the Correspondence Theory of faithfulness of McCarthy and Prince (1995)

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[5] See Chapter IV for a list of references.

(henceforth M&P95), I propose that the systems of syllable weight in the target languages can easily be accounted for by interleaving faithfulness constraints on the moraic content of segments with a universal markedness hierarchy (Zec, 1988) against moraic segments.

Chapter I gives a brief review of the aspects of Correspondence Theory relevant to this paper, as well as the definitions of the constraints used in the analyses, a demonstration of the constraint ranking resulting in heavy stressed syllables, and a brief discussion of English vowel length. The analysis of RP (distinctive-length) vowels is found in Chapter II, followed by SAE (non-distinctive length) vowels and NYE (hybrid) vowels, Chapters III and IV respectively. A brief discussion of Zec 1988 relevant to the analysis of NYE is provided in Chapter V. A discussion of typologies predicted, including a preliminary analysis of the Icelandic (distinctive consonant weight) vowel system, is given in Chapter VI, followed by the conclusion and goals for future research.

1.1 Correspondence Theory

In studying reduplicative morphology, M&P95 expand on the idea of faithfulness constraints proposed by P&S93. They observe that the identity relationship between base and reduplicant (McCarthy and Prince, 1993) is similar in several ways to the faithfulness relationship between input and output. In an attempt to bridge the gap between these (and other) otherwise separate phenomena, McCarthy and Prince developed a general theory of correspondence between various relationships (base-reduplicant, input-output, etc.). This correspondence relation is formalized as follows:

(1) Correspondence (adapted from M&P95)

Given two strings S_1 and S_2, correspondence is a relation $\mathcal{R}$ from the elements of S_1 to those of S_2. Segments α (an element of S_1) and β (an element of S_2) are referred to as correspondents of one another when $\alpha\mathcal{R}\beta$.

Under this theory, outputs and reduplicants are evaluated in correspondence with related inputs and bases, respectively. However, it is important that correspondence is not absolute, since it is regulated via violable faithfulness constraints, including:

(2) MAX - Every segment of S_1 has a correspondent in S_2. (Do not delete segments.)

(3) DEP - Every segment of S_2 has a correspondent in S_1. (Do not epenthesize segments.)

(4) IDENT[F] - Let α be a segment in S_1 and β be any correspondent of α in S_2. If α is [γF], then β is [γF]. (Correspondent segments are identical in feature F.)

The MAX and DEP family of constraints regulate strings of segments, and mitigate against the deletion and insertion of entire segments, respectively. The family of IDENT[F] constraints requires that the features of corresponding segments be identical. In this paper, I will use a variation of the IDENT[F] constraint. However, rather than requiring that the feature specifications of corresponding segments be identical, my constraints require that the moras associated with corresponding segments be identical.

1.2 Constraints

The constraints used in the following analyses are:

(5) *TRIMOR (P&S93) - a markedness constraint against trimoraic syllables.

(6) STRESS-TO-WEIGHT PRINCIPLE (StoW)[6] (Jespersen, 1909; Liberman and Prince, 1977; Andersen and Ewen, 1987; Prince, 1990;

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6 There is evidence, at least in SAE and NYE, that English is like other Germanic Languages (Icelandic/Swedish) in that is has a Stress-to-Weight Principle. This has been proposed before (see above references), but is not uncontroversial, especially when it comes to issues like antepenultimate stress (where stress-bearing syllables sometimes seem to be light). Obviously, a full account of English stress must be made at some point for the proposals made in this paper to be fully tested. For now, I put aside a full treatment of English stress, and simply adopt the Stress-to-Weight Principle to drive bimoraicity in stressed penults and monosyllables.

Giegerich, 1993; P&S93; Pater, 1995) - stressed syllables (the head syllables of prosodic words) must be heavy (bimoraic).

(7) IDENTMORA[SEG] (constraint family) (based on M&P95; Pater, 1995)[7]- mora associations in the output should be the same as those in the input. This constraint is actually short hand for a family of constraints relativized to different segments - e.g. IDENTMORA[i], IDENTMORA[t], etc. Future research may show that these constraints refer to features, not segments - e.g. IDENTMORA[low].

(8) *MORA[SEG] (constraint family) (Zec, 1988[8]; P&S93[9])- do not associate a mora with a particular segment. This constraint is actually short hand for a family of constraints relativized to different segments - e.g. *MORA[i], *MORA[t], etc. Future research may show that these constraints refer to features, not segments - e.g. *MORA[nasal].

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[7] M&P95 do not specifically address identity constraints on mora associations, but their system allows for the possibility of such a constraint family. Pater (1995) proposes a Containment Theory (P&S93) constraint PARSE(mora) which is similar in intuition to some aspects of my IDENTMORA constraint.

[8] Zec (1988) develops a typology of coda consonant moraicity based on sonority. Her claim is that the more sonorous a segment is, the more likely it will be moraic. She proposes either a negative constraint family (*MORA[SEG]) or a positive constraint family (MORA[SEG]). I make use of the former. This is explored further in Chapter V.

[9] This constraint family is very similar to P&S93 peak and margin markedness hierarchies. However, my constraint family is different in that it refers to a specific type of syllable margin (moraic), and I do not address the question of syllabicity (peak) at all. Instead, I assume some higher-ranked set of constraints that drive syllabicity.

Since not all vowels are treated the same in the various English dialects, the IDENTMORA[V] constraint family must be split into constraints relativized to each vowel. However, for ease of exposition, these constraints are clustered into the minimum number of groups necessary for each of the three types of vowel distributions. For example, in RP, since all vowels act similarly, IDENTMORA[V] will be used. This constraint is a cover constraint for IDENTMORA[i], IDENTMORA[e], IDENTMORA/[u], etc. However, in NYE, which has three types of vowel behaviors, one constraint is relativized to those vowels that show distinctive length (IDENTMORA[i,u,e,o]), another is relativized to those vowels that are always long (IDENTMORA[a,ɔ]), and the third is relativized to the low, front vowel (IDENTMORA[æ]). This same type of notational convenience will be used in the *MORA[SEG] family of constraints.

1.3 Bimoraic Syllables

Since this paper assumes that the stressed syllables being evaluated (including monosyllables) must be heavy (minimally and maximally bimoraic), neither mono- nor trimoraic stressed syllables surface. This section demonstrates that ranking StoW and *TRIMOR high in the constraint hierarchy ensures this result. (9) shows that with a monomoraic monosyllable in the input, only bimoraic syllables (candidates (b) and (c)) are available for evaluation by lower-ranked constraints[10].

(9) /C V^{μ} C/	*TRIMOR	StoW	IDENT MORA [SEG]
a. C V^{μ} C		*!	
☞b. C V^{μ} C^{μ}			*
☞c. C $V^{\mu\mu}$ C			*
d. C $V^{\mu\mu}$ C^{μ}	*!		**

Candidate (a) is monomoraic, therefore it fatally violates the constraint requiring stressed syllables to be heavy. Candidate (d) is trimoraic, therefore it fatally violates the markedness constraint against trimoraic syllables. Candidates (b) and (c) violate neither of these constraints, but they are both unfaithful to the input - have an additional mora. Therefore, some other constraint must decide between them (whether it is worse to add a mora to the vowel or to the consonant).

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10 To satisfy Richness of the Base (P&S93), it is possible to posit a non-moraic underlying vowel. The evaluation of this input will be virtually identical to that of a monomoraic input, therefore only monomoraic inputs are discussed in this paper. Yer-vowels, as well as glide/vowel alternations, may be evidence that non-moraic vowels are possible inputs. Richness of the Base says that there can be no language-specific restrictions on underlying forms. All predictable aspects of a language's phonology must come from the constraint ranking for that language.

(10) shows that with a trimoraic monosyllable in the input (a long vowel and moraic coda), only the bimoraic candidates pass when evaluated by *TRIMOR and StoW.

(10) /C $V^{\mu\mu}$ C^{μ}/	*TRIMOR	StoW	IDENT MORA [SEG]
a. C V^{μ} C		*!	**
☞ b. C V^{μ} C^{μ}			*
☞ c. C $V^{\mu\mu}$ C			*
d. C $V^{\mu\mu}$ C^{μ}	*!		

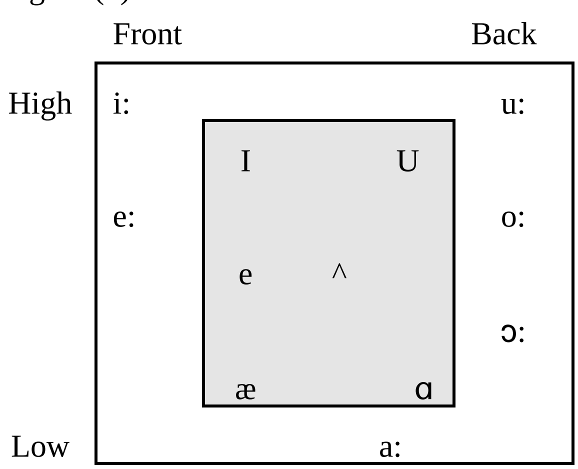
Candidate (a) is monomoraic, therefore fatally violates the constraint requiring that stressed syllables be heavy. Candidate (d) is trimoraic, therefore fatally violates the markedness constraint against trimoraic syllables. Candidates (b) and (c) violate neither of these constraints. Even though they are unfaithful to the input because they each have one less mora than the input, it is up to some other constraint to decide whether it is better to lose a mora on the vowel or a mora on the consonant.

Since only bimoraic syllables will surface in the data that follow, I leave out the StoW and *TRIMOR constraints, as well as the relevant mono- and trimoraic candidates from the rest of the discussion and tableaux unless necessary.

1.4 English Vowels - Distinctive Length (General and RP)

The standard pre-theoretic description of English vowels is that they come in two classes: checked and free.[11] In monosyllables, checked vowels are found only in closed syllables, while free vowels are found in both open and closed syllables. Figure (1) shows the relative articulatory distribution (approximate) of checked (shaded box) and free vowels in RP. (11) shows relevant open and closed monosyllables containing these vowels.

Figure (1) Surface RP Vowels



[11] I am only addressing full (stressable) vowels, not reduced vowels (unstressed [ə] or [ɨ]) or syllabic consonants. I treat [^] as a full vowel, not a version of the phonetically similar reduced vowel ([ə]).

(11) <u>Free</u> <u>Checked</u>

[i:]	bee, beat, bean	[I]	bit, bin	*[CI]
[u:]	too, boot, dune	[U]	put, pull	*[CU]
[e:]	bay, bait, bane	[ɛ]	bet, den	*[Cɛ]
[o:]	bow, boat, bone	[^]	but, bun	*[C^]
[a:]	bra, bath, psalm	[æ]	bat, ban	*[Cæ]
[ɔ:]	paw, caught, dawn	[ɑ]	cot, don	*[Cɑ]

Abstracting away from tenseness and diphthongization, Halle and Mohanan (1985) conclude that at least some of the English vowels have distinctive length between phonetically-related checked and free vowels. So, the difference between 'bid' and 'bead' is one of vowel length. Part of the evidence they use to support this proposal comes from the fact that English, like many other languages, has a Minimal Word Condition that ensures that monosyllables are heavy (contain either a long vowel or a coda consonant).

Within moraic theory (McCawley, 1968; Hyman, 1985; Hayes, 1989; Zec, 1988), the Minimal Word Condition translates into the need for monosyllables to be bimoraic. If checked vowels are monomoraic (short) and free vowels are bimoraic (long), then checked vowels are unable to be in open monosyllables (see (11)) because of the Minimal Word Condition[12]. It is also the Minimal Word Condition that is the

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[12] This is obviously only part of a more complicated phenomenon since short vowels are generally disallowed word finally in English regardless of the number of syllables or (continued...)

main evidence used to argue for the moraicity of coda consonants in monosyllables containing short vowels. If monosyllables must be bimoraic, and they can contain short (monomoraic) vowels followed by coda consonants, then the coda consonants must be moraic.

This paper will assume that the Minimal Word Condition holds for English, and that Halle and Mohanan are correct in their characterization of English as having a phonemic length distinction in some vowels. Henceforth, checked vowels will be referred to as short, and free vowels as long. The question now becomes how to group these vowels into long/short pairs so that stressed syllables containing them can be evaluated and analyzed.

Most analyses of English vowels agree that /i:/ and /I/ are high front vowels, /e:/ and /ɛ/ are mid front vowels, and /u:/ and /U/ are high back vowels; and that these three groups form pairs (either long/short or tense/lax). The difficulty comes in trying to find consensus in characterizing the vowels in the rest of the vowel space. Although /æ/ and /o:/ are fairly uncontroversially low front and mid back, respectively, there is quite a bit of diversity in the features used to describe /^/, /ɔ:/, /ɑ/, and /a:/.

Following in the spirit of Chomsky and Halle (1968), Giegerich (1992) proposes a taxonomy of the English vowels based on the free/checked dichotomy. Closely related (phonetically/featurally) free and checked vowels are formed into pairs.

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[12](...continued)
stress.

His system for RP vowel phonemes is presented in (12) (with minor transcription changes).

(12)		Front	Back
	High	/i/ - /I/	/U/ - /u/
	Mid	/e/ - /ɛ/	/^/ - /o/
			/ɑ/ - /ɔ/
	Low	/æ/ -	/a/

Modifying this system to coincide with the proposal that the relevant distinction between English vowels is one of quantity (length), not quality, the taxonomy of RP vowels is figure (2). Henceforth, the transcription system for English vowels will reflect only the length opposition, but the standard IPA symbols will be displayed in parentheses where necessary for clarity.

Figure (2) Surface RP Vowels

	Front		Back	
High	i:	i (I)	u (U)	u:
Mid	e:	e (ɛ)	o (^) ɔ (ɑ)	o: ɔ:
Low		a (æ)	a:	

It is not crucial what phonological features are assumed for the vowels in figure (2), since the analysis in this paper will refer only to segments, not features. What is important is that each vowel is a member of a long/short pair; where the long vowels are represented as bimoraic and the short vowels as monomoraic. For concreteness, I assume the feature specifications in figure (2)[13].

[13] To avoid unnecessary controversy, I assume what seem to be the most common feature specifications for English vowels. However, as a part of a larger research program, I am pursuing the intuition that the low and mid-back vowels in at least some dialects of English are: [æ] - short, low, front; [a] - long, low, front; [ɑ] - short, low, back; and [ɔ] - long, low, back. This provides a vowel system composed of long/short pairs that are describable within the standard three-way height and two-way front/back dimensions.

CHAPTER II

Received Pronunciation English (RP) - Distinctive Vowel Length

In RP, all vowels have distinctive vowel length in stressed syllables. Underlyingly long vowels always surface as long and underlyingly short vowels always surface as short. (13) shows a representative sample of mono- and disyllables containing long and short high front vowels. The disyllables have penultimate stress.

(13)	a.	Monosyllables		
		*[CV] - stressed syllables must be bimoraic		
		[CV:]	[bi:]	bee
		[CVC]	[bit]	bit
		[CV:C]	[bi:t]	beet
		[CVCC]	[lint]	lint
		[CV:CC]	[fi:nd]	fiend
	b.	Disyllables		
		[CV:.CV(C)]	[bi:kɝ]	beaker
		[CVCV(C)]	[bikɝ]	bicker
		[CVC.CV(C)]	[kidni:]	kidney
		[CV:C.CV(C)]	[ri:zliŋ]	Riesling[14]

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[14] Disyllables containing word-medial long vowels in closed syllables are rare in English. The limited number that exist seem to be either borrowings, as in 'Riesling' (a (continued...)

Since these vowels show a length distinction, underlyingly short vowels surface as short, and long vowels surface as long, regardless of the underlying moraic content of the following consonant. In addition, since the moraic content of consonants is not distinctive, Richness of the Base requires that regardless of the surface weight of the consonant, it can arise from either an underlyingly moraic or non-moraic consonant.

2.1 Monosyllables

Assuming that stressed English monosyllables are both minimally and maximally bimoraic, (14) shows that vowel length is distinctive in monosyllables closed by a single coda consonant, and that coda consonant moraicity is dependent on the length of the vowel. The inputs in (14a) and (14b) both converge on the same output, as do the inputs in (14c) and (14d).

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[14](...continued)
type of wine (German)), or can be analyzed as morphologically complex, as in 'beatnik'.

Regardless, they do occur, and are readily produced by the grammar. There are several factors that can conspire to restrict the number found in native, underived English. It may be a diachronic artifact (historically, English had a much more strict Weight-by-Position condition); or it may be due to a general tendency to limit syllable size (*STRUC, *COMPLEX, etc.), etc.

(14)	a.	/b i^{μ} t/	→	[b i^{μ} t^{μ}]	bit
	b.	/b i^{μ} t^{μ}/	→	[b i^{μ} t^{μ}]	bit
	c.	/b $i^{\mu\mu}$ t/	→	[b $i^{\mu\mu}$ t]	beet
	d.	/b $i^{\mu\mu}$ t^{μ}/	→	[b $i^{\mu\mu}$ t]	beet

In (14a), an input with a short vowel and a non-moraic coda surfaces with a short vowel and a moraic coda (recall that being completely faithful to the monomoraic input violates high-ranked StoW). This means that the faithfulness constraint against changing the moras associated with vowels (IDENTMORA[V]) must be higher-ranked than both the constraint against moraic consonants (*MORA[C]) and the faithfulness constraint against changing the moras associated with consonants (IDENTMORA[C]). (15) shows the former, and (16) shows the latter.

(15) /b i^{μ} t / 'bit'	IDENT MORA [V]	*MORA [C]
☞ a. b i^{μ} t^{μ} [bIt]		*
b. b $i^{\mu\mu}$ t [bi:t]	*!	

Candidate (b) loses because it violates the high-ranked faithfulness constraint by adding a mora to the vowel. The input vowel is monomoraic, but the vowel in candidate (b) is bimoraic. Although candidate (a) violates the markedness constraint against moraic consonants, the competing candidate fatally violates the higher-ranked constraint. This results in the moraicity of the consonant being subordinate to the length of the vowel.

(16) shows that IDENTMORA[V] outranking IDENTMORA[C] also results in a short vowel and a moraic coda consonant.

(16) /b i^{μ} t / 'bit'	IDENT MORA [V]	IDENT MORA [C]
☞ a. b i^{μ} t^{μ} [bIt]		*
b. b $i^{\mu\mu}$ t [bi:t]	*!	

Candidate (a) violates the consonant faithfulness constraint by adding a mora to the coda consonant. However, candidate (b) fatally violates the higher-ranked vowel faithfulness constraint by adding a mora to the vowel. Like(15), this shows that the moraicity of the consonant is dependent on the length of the vowel.

(17) demonstrates that with a short vowel and moraic coda consonant in the input, as in (14b), the surface form is faithful to both vowel and consonant moraicity despite violating the markedness constraint against moraic consonants.

(17) /b i^{μ} t^{μ} / 'bit'	IDENT MORA [V]	IDENT MORA [C]	*MORA [C]
☞ a. b i^{μ} t^{μ} [bIt]			*
b. b $i^{\mu\mu}$ t [bi:t]	*!	*	

Candidate (b) fatally violates the highest-ranked constraint because it adds a mora to the vowel.

In (14c), the vowel surfaces as long even though it is more marked to have two moras associated to a vowel then to have one. (18) shows that with the vowel faithfulness constraint (IDENTMORA[V]) ranked higher than the markedness constraint against moraic vowels (*MORA[V]), long vowels surface[15].

(18) /b $i^{\mu\mu}$ t/ 'beet'	IDENT MORA [V]	*MORA [V]
a. b i^{μ} t^{μ} [bIt]	*!	*
☞ b. b $i^{\mu\mu}$ t [bi:t]		**

Since candidate (b) has two moras associated with the vowel, it violates the markedness constraint twice - once per mora. Candidate (a) only violates the markedness constraint once since it has a short vowel. However, candidate (b) is optimal because candidate (a)

[15] By positing a markedness hierarchy against moras associated with all segments, including vowels, the universal markedness of long vowels over short vowels can be captured with a single type of constraint, *MORA[V]. Since long vowels always incur more violations of this constraint than do short vowels, they are always more marked. This constraint evaluation may preclude the necessity of a separate constraint of the type, *LONG[V]. Although not pursued in this paper, the implications of *MORA[V] are interesting for several reasons, not the least of which is the question of the existence of constraints against moraic vowels when moraic vowels are considered unmarked. It is possible that there are higher-ranked constraints on other aspects of prosodic structure which force the *MORA[V] constraints to always be violated at least once. I leave this question to further research.

fatally violates the higher-ranked constraint requiring faithfulness to the underlying moraic content of vowels.

There is no evidence in the data presented above to motivate ranking *MORA[C], IDENTMORA[C], and *MORA[V] with respect to each other. They are therefore unranked in the hierarchy (although according to my interpretation of Zec (1988), *MORA[C] must be higher-ranked than *MORA[V] universally - see Chapter V). (19) shows the constraint ranking motivated so far (excluding high-ranking *TRIMOR and StoW):

(19) IDENTMORA[V] >> *MORA[C], IDENTMORA[C], *MORA[V]

With this ranking, the distribution of long and short vowels and moraic coda consonants in monosyllables is straight forwardly accounted for. Of the above examples in (14), only (14d) has not been evaluated. (20) demonstrates that with the full hierarchy, an input with a long vowel and a moraic consonant will surface with a long vowel and non-moraic consonant. The moraicity of the consonant is dependent on the length of the vowel. In fact, given a bimoraic requirement, as long as IDENTMORA[V] is higher ranked than the other constraints, vowel length is distinctive and the moraic content of the coda consonant is subordinated to the vowel length. After long vowels, codas are non-moraic. After short vowels, codas are moraic.

(20) /b $i^{\mu\mu}$ t^{μ}/ 'beet'	IDENT MORA [V]	*MORA [C]	IDENT MORA [C]	*MORA [V]
a. b i^{μ} t^{μ} [bIt]	*!	*		*
☞ b. b $i^{\mu\mu}$ t [bi:t]			*	**

Candidate (a) violates the highest-ranked constraint against changing the number of moras associated with a vowel because it has a short vowel. The other constraints are not yet ranked, but since they are all lower-ranked than IDENTMORA[V], their violations are inconsequential here.

Using this same constraint hierarchy, monosyllables ending in consonant clusters are straight forwardly accounted for. Monosyllables containing a short vowel followed by a consonant cluster surface with a short vowel and one moraic consonant regardless of the underlying weight of the consonants. In addition, long vowels remain long, and consonants in the following cluster are non-moraic.

(21)	a.	/l i^{μ} n t/	→	[l i^{μ} n^{μ} t]	lint
	b.	/l i^{μ} n^{μ} t/	→	[l i^{μ} n^{μ} t]	lint
	c.	/f $i^{\mu\mu}$ nd/	→	[f $i^{\mu\mu}$ nd]	fiend
	d.	/f $i^{\mu\mu}$ n^{μ} d/	→	[f $i^{\mu\mu}$ nd]	fiend

In (21a), an underlyingly non-moraic consonant becomes moraic, and in (21b), the input and output are completely faithful. These are shown in (22) and (23), respectively.

(22) /l i^{μ} n t/ 'lint'	IDENT MORA [V]	*MORA [C]	IDENT MORA [C]	*MORA [V]
☞ a. l i^{μ} n^{μ} t [lInt]		*	*	*
b. l $i^{\mu\mu}$ nt [li:nt]	*!			**

Candidate (b) fatally violates the constraint against changing the number of moras associated with a vowel. The input has a short vowel, and candidate (b) has a long vowel. Although candidate (a) violates a number of constraints, it is still optimal.

(23) shows that with a short vowel and moraic consonant in the input, the output will have a short vowel and moraic consonant.

(23) /l i^{μ} n^{μ} t/ 'lint'	IDENT MORA [V]	*MORA [C]	IDENT MORA [C]	*MOR A [V]
☞ a. l i^{μ} n^{μ} t [lInt]		*		*
b. l $i^{\mu\mu}$ nt [li:nt]	*!		*	**

Again, candidate (b) fatally violates the highly-ranked constraint against changing vowel length. Candidate (a) is optimal because candidate (b) violates a higher-ranked constraint.

In (21c) and (21d), it is more important to maintain a long vowel than it is to have a moraic consonant in the coda cluster. (24) and (25) show this result.

(24) /f $i^{\mu\mu}$ n d/ 'fiend'	IDENT MORA [V]	*MORA [C]	IDENT MORA [C]	*MORA [V]
a. f i^{μ} n^{μ} d [fInd]	*!	*	*	*
☞ b. f $i^{\mu\mu}$ nd [fi:nd]				**

(25) /f $i^{\mu\mu}$ n^{μ} d/ 'fiend'	IDENT MORA [V]	*MORA [C]	IDENT MORA [C]	*MORA [V]
a. f i^{μ} n^{μ} d [fInd]	*!	*		*
☞ b. f $i^{\mu\mu}$ nd [fi:nd]			*	**

In both tableaux, candidate (b) is optimal because it does not violate the highest-ranked constraint against changing vowel length, but candidate (a) does.

Given the assumptions of word minimality and maximal bimoraicity, the evidence from monosyllables clearly shows that consonant weight is dependent on vowel length. Long vowels in the input always surface as long, regardless of the underlying moraic content of the following consonant. These consonants always surface as non-moraic. In addition, short vowels in the input always surface as short, regardless of the underlying moraic content of the following consonant. The consonant closest to the nucleus always surfaces as moraic.

2.2 Disyllables

Given the constraint ranking in (19), motivated by the distribution of moras in monosyllables, disyllables are evaluated straight forwardly. Since vowel length is distinctive (unpredictable), but coda moraicity is not, disyllables containing long vowels surface with long vowels in open syllables regardless of the moraic content of the following consonant. (27) and (28) show this result. Since stress is penultimate, the moraicity and syllabification of the final syllable are not discussed.

σ

μμ μμ

(26) a. /b i kɝ/ → [b i kɝ] beaker

σ

μμ μ μμ

b. /b i k ɝ/ → [b i kɝ] beaker

(27) /bi^{μμ} kɝ/ 'beaker'	IDENT MORA [V]	*MORA [C]	IDENT MORA [C]	*MORA [V]
a. bi^{μ} k^{μ} ɝ [bIkɝ]	*!	*	*	*
☞ b. b i^{μμ} .kɝ [bi:.kɝ]				**

(28) /bi$^{\mu\mu}$ k$^{\mu}$ɝ/ 'beaker'	IDENT MORA [V]	*MORA [C]	IDENT MORA [C]	*MORA [V]
a. bi$^{\mu}$ k$^{\mu}$ɝ [bIkɝ]	*!	*		*
☞ b. b i$^{\mu\mu}$ .kɝ [bi:.kɝ]			*	**

In both tableaux, candidate (b) is optimal because candidate (a) violates the highest-ranked constraint requiring output vowel length to be faithful to input vowel length[16]. The difference between the tableaux is in which candidate violates the IDENTMORA[C] constraint - candidate (a) violates it in (27) because a mora is added to the consonant, and candidate (b) violates it in (28) because a mora is deleted from the consonant. However, since IDENTMORA[V] outranks IDENTMORA[C], only the candidates with long vowels surface.

2.2.1 Ambisyllabicity[17]

Disyllables containing short vowels not followed by heterosyllabic consonants are interesting because in order to satisfy the condition that stressed syllables be bimoraic

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[16] Recall that stressed syllables must be bimoraic, this means that candidate (a) has an ambisyllabic consonant. See 2.2.1 for more details.

[17] See Footnote 6. Although I am assuming that StoW is dominant in RP, SAE, and NYE, this is not a necessary conclusion in all English dialects. Future research may show some interesting differences in syllabification among dialects depending on the interaction between the constraints on moras proposed here and other constraints needed for English stress.

(StoW), either the vowel can lengthen or the following consonant can become moraic (ambisyllabic). Since RP vowels do not surface as long in this situation, then the consonant must be ambisyllabic, as shown in (29). The moraicity and syllabification of the final syllable is discussed only when necessary.

σ σ

μ μ μ

(29) a. /b i k ɝ/ → [b i k ɝ] bicker

σ σ

μ μ μ μ

b. /b i k ɝ/ → [b i k ɝ] bicker

(30) shows that with a short vowel and a non-moraic consonant in the input, the optimal candidate has an ambisyllabic consonant.

(30) /bi$^{\mu}$ kɝ/ 'bicker'	StoW	IDENT MORA [V]	*MORA [C]	IDENT MORA [C]	*MORA [V]
a. bi$^{\mu}$ .kɝ [bI.kɝ]	*!				
☞ b. bi$^{\mu}$ k$^{\mu}$ɝ [bIkɝ]			*	*	*
c. bi$^{\mu\mu}$ .kɝ [bi:.kɝ]		*!			**

The completely faithful candidate (a), is suboptimal because it violates the highly ranked constraint requiring the stressed syllables be bimoraic[18]. Candidate (c) fatally violates the constraint against changing the moras associated with the vowel because it has a long vowel in correspondence with a short vowel in the input. Therefore, candidate (b) is optimal even though it violates several lower-ranked constraints.

(31) shows that with a short vowel and moraic consonant in the input, the output will have a short vowel and moraic consonant (ambisyllabic). In the following tableaux and discussions, only candidates with bimoraic stressed syllables are considered, as well as relevant constraints.

(31) /bi$^{\mu}$ k$^{\mu}$ɝ/ 'bicker'	IDENT MORA [V]	*MORA [C]	IDENT MORA [C]	*MORA [V]
☞ a. bi$^{\mu}$ k$^{\mu}$ɝ [bIkɝ]		*		*
b. bi$^{\mu\mu}$ .kɝ [bi:.kɝ]	*!		*	**

Candidate (b) fatally violates the constraint against changing the number of moras associated with the vowel because it has a long vowel in correspondence with a short vowel in the input. Therefore, candidate (a) is optimal.

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18 However, if FootBinarity (FTBIN), not StoW, is the active constraint in a particular dialect, it is possible to posit surface short vowels in open stressed syllables.

2.3 Summary of Distinctive Vowel Length

In RP, the moraic content of a consonant following stressed vowels is dependent on the underlying length of the vowel. If the input vowel is short, then regardless of the underlying moraic content of the following consonant, the vowel will remain short and the consonant will surface as moraic, even if that means being ambisyllabic. If the input vowel is long, then regardless of the underlying moraic content of the following consonant, the vowel will remain long and the consonant will be non-moraic in the output. Distinctive vowel length results from ranking the faithfulness constraint on the moraic content of vowels above the markedness and faithfulness constraints on the moraicity of consonants and the markedness constraint against moraic vowels. The complete constraint ranking is:

(32) StoW, *TRIMOR, IDENTMORA[V] >> *MORA[C], IDENTMORA[C], *MORA[V]

CHAPTER III

Standard American English (SAE) - Distinctive and Non-distinctive Vowel Length

In SAE, all vowels come in distinctive-length pairs, except the lower-mid back vowel which always surfaces as long[19]. This vowel has no short counterpart. (33) shows examples of the various SAE vowels in monosyllables, and figure (3) gives their surface distributions.

(33)	Long		Short	
	[i:]	beet	[i](I)	bit
	[u:]	boot	[u](U)	put
	[e:]	bait	[e](ɛ)	bet
	[o:]	boat	[o](^)	but
	[a:]	rot	[a](æ)	rat
	[ɔ:]	caught/cot	*[ɔ](ɑ)	

---

[19] The fact that SAE (and NYE) vowels fall into different classes, some of which have a length distinction and some of which only surface as long, is not very unusual in the languages of the world. A quick review of Maddieson (1984) reveals the following languages which have distinctive vowel length in some vowels, but some vowels only surface as long: Arabic, Brahui, Dagbani, German, Kabardian, Karok, Khmer, Kurdish, Lakkia, Lithuanian, Ojibwa, Pashto, Po-Ai, Telefol, Telugu, and Tigre. In addition, the following languages have distinctive vowel length in some vowels, but some vowels only surface as short: Angas, Atayal, Bardi, Chipewyan, Fur, Hausa, Hungarian, Hupa, Iai, Khasi, Korean, Lakkia, Manchu, Mongolian, Neo-Aramaic, Pashto, Po-Ai, Sa'ban, Tuareg, Vietnamese, and Yay.

Figure (3) Surface SAE Vowels

	Front		Back	
High	i:	i (I)	u (U)	u:
Mid	e:	e (ɛ)	o (^)	o: ɔ:
Low		a (æ)	a:	

This distribution contrasts with the RP vowels, which all come in long/short pairs (have distinctive length). The length difference in the lower-mid back vowel which distinguished the RP minimal pair 'caught' and 'cot' is neutralized to long in SAE, where these words are homophonous.

There are two major reasons for not positing that this is merely the result of an underlyingly long vowel. First, the standard markedness assumption is that long vowels are more marked than short vowels (Maddieson, 1984), so it would seem odd to have a vowel system with an underlyingly long vowel, but no short counterpart. Second, since there is no length contrast in this vowel, length is predictable, and no claims can be made about underlying length because of Richness of the Base. Therefore, we must posit that the vowel will surface as long regardless of its underlying length or the moraicity of the following consonant (which is predictably non-moraic on the surface).

Since not all vowels are treated the same in SAE, the IDENTMORA[V] constraint must be split into two constraints relativized to each of the SAE vowel types (as described in Chapter I). Since there are two vowel types in SAE, one constraint is relativized to those vowels that show distinctive length (IDENTMORA[i,u,e,o,a]), and another is relativized to the vowel that always surfaces long (IDENTMORA[ɔ]). In the following sections, I will show that a simple re-ranking of the IDENTMORA[ɔ] below *MORA[C] will yield the correct distribution of vowels and moraic consonants in SAE.

3.1 Non-distinctive Vowel Length

3.1.1 Monosyllables

Since the lower-mid back vowel always surfaces as long, it can be either short or long underlyingly since we are assuming a rich base. In addition, since the output must be maximally bimoraic, then regardless of the weight of the input coda consonant, it will surface as non-moraic. (34) shows an example of relevant input/output pairs, where four different inputs converge on a single output.

(34)	a.	/kɔ$^{\mu}$ t/	➞	[kɔ$^{\mu\mu}$t]	caught/cot
	b.	/kɔ$^{\mu}$ t$^{\mu}$/	➞	[kɔ$^{\mu\mu}$t]	caught/cot
	c.	/kɔ$^{\mu\mu}$ t/	➞	[kɔ$^{\mu\mu}$t]	caught/cot
	d.	/kɔ$^{\mu\mu}$ t$^{\mu}$/	➞	[kɔ$^{\mu\mu}$t]	caught/cot

In (34a), it is preferable to lengthen an underlyingly short vowel than it is to have a moraic consonant in the output. (35) shows that with *MORA[C] outranking *MORA[V], it is better to have a long vowel than to have a moraic consonant.

(35) /kɔ$^{\mu}$ t$^{\mu}$/ 'caught/cot'	*MORA [C]	*MORA [V]
a. kɔ$^{\mu}$ t$^{\mu}$ [kɑt]	*!	*
☞ b. kɔ$^{\mu\mu}$ t [kɔ:t]		**

Even though candidate (b) violates the vowel markedness constraint twice (once per mora), it is still optimal because candidate (a) violates the higher-ranked consonant markedness constraint.

(36) shows that the length of the vowel is dependent on the inability of the consonant to be moraic because the markedness constraint against moraic consonants (*MORA[C]) is ranked higher than the vowel faithfulness constraint (IDENTMORA[ɔ]).

(36) /kɔ$^{\mu}$ t/ 'caught/cot'	*MORA [C]	IDENT MORA [ɔ]
a. kɔ$^{\mu}$ t$^{\mu}$ [kɑt]	*!	
☞ b. kɔ$^{\mu\mu}$t [kɔ:t]		*

Candidate (a) fatally violates the constraint against having a moraic consonant. Although candidate (b) violates the vowel faithfulness constraint by adding a mora to the vowel, this candidate is optimal because the competing candidate violates a higher-ranked constraint.

(34) demonstrates that it is preferable to lose a mora from an underlyingly moraic consonant than it is to have a moraic consonant. In (37), the higher-ranked markedness constraint forces a loss of the mora associated with the input consonant.

(37) /kɔ$^{\mu}$ t$^{\mu}$/ 'caught/cot'	*MORA [C]	IDENT MORA [C]
a. kɔ$^{\mu}$ t$^{\mu}$ [kɑt]	*!	
☞ b. kɔ$^{\mu\mu}$t [kɔ:t]		*

Although candidate (b) violates the constraint against deleting moras associated with consonants, it is still optimal because candidate (a) fatally violates the higher-ranked constraint against moraic consonants.

The constraint ranking that is motivated by the above discussion is shown in (38). With the markedness constraint against moraic consonants ranked higher than the faithfulness constraint on the underlying moraic content of consonants, the faithfulness constraint on the moraic content of lower-mid back vowels, and the markedness constraint against moraic vowels, then the length of the vowel is subordinate to the non-moraicity of the consonant. All lower-mid back vowels surface as long because they cannot be followed by moraic consonants.

(38) *MORA[C] >> IDENTMORA[ɔ], IDENTMORA[C], *MORA[V]

With this constraint ranking, (34c) and (34d) are evaluated straight forwardly. (39) shows that with a long vowel and a non-moraic coda in the input, the output will also have a long vowel and non-moraic coda.

(39) /kɔ$^{\mu\ \mu}$ t/ 'caught/cot'	*MORA [C]	IDENT MORA [ɔ]	IDENT MORA [C]	*MORA [V]
a. kɔ$^{\mu}$ t$^{\mu}$ [kɑt]	*!	*	*	*
☞ b. kɔ$^{\mu\mu}$ t [kɔ:t]				**

Candidate (b) is optimal. Although it violates the vowel markedness constraint twice, candidate (a) fatally violates the higher-ranked consonant markedness constraint, and therefore loses.

In (40), a long vowel and moraic consonant in the input surfaces as a long vowel and non-moraic consonant.

(40) /kɔ^{μμ} t^{μ} / 'caught/cot'	*MORA [C]	IDENT MORA [ɔ]	IDENT MORA [C]	*MORA [V]
a. kɔ^{μ} t^{μ} [kɑt]	*!	*		*
☞ b. kɔ^{μμ} t [kɔ:t]			*	**

Even though candidate (b) violates the consonant faithfulness constraint because it has one less mora associated with the consonant than the input, this candidate is still optimal because the losing candidate violates the higher-ranked consonant markedness constraint. Recall that the fully faithful candidate (not shown) fatally violates *TRIMOR.

3.1.2 Disyllables

Just as in monosyllables, disyllables containing lower-mid back vowels in penultimate stressed syllables always surface with a long vowel regardless of the moraic content of either the stressed vowel or the following consonant. This, again, shows that vowel length is determined by the inability of consonants to be moraic in this environment.

(41)	a.	/kɔ^{μ} fi:/	→	[kɔ^{μμ} .f i:]	coffee
	b.	/kɔ^{μ} f^{μ} i:/	→	[kɔ^{μμ} .f i:]	coffee
	c.	/kɔ^{μμ} f i:/	→	[kɔ^{μμ} .f i:]	coffee
	d.	/kɔ^{μμ} f^{μ} i:/	→	[kɔ^{μμ} .f i:]	coffee

(42) and (43) show that with a monomoraic vowel input, the vowel will surface as bimoraic, regardless of the moraic content of the following consonant (41a, 41b).

(41) /kɔ^{μ} fi:/ 'coffee'	*MORA [C]	IDENT MORA [ɔ]	IDENT MORA [C]	*MORA [V]
a. kɔ^{μ} f^{μ} i: [kɑfi:]	*!		*	*
☞ b. kɔ^{μμ} .f i: [kɔ:.fi:]		*		**

(42) /kɔ^{μ} f^{μ} i :/ 'coffee'	*MORA [C]	IDENT MORA [ɔ]	IDENT MORA [C]	*MORA [V]
a. kɔ^{μ} f^{μ} i: [kɑfi:]	*!			*
☞ b. kɔ^{μμ} .fi: [kɔ:.fi:]		*	*	**

In both tableaux, candidate (b) is optimal because the competing candidate violates the highest-ranked constraint against moraic consonants.

The evaluations of both (41c) and (41d) are straightforward. (44) and (45) show that with a long vowel in the input, the output will have a long vowel regardless of the underlying weight of the consonant.

(44) /kɔ$^{\mu\mu}$ fi:/ 'coffee'	*MORA [C]	IDENT MORA [ɔ]	IDENT MORA [C]	*MORA [V]
a. kɔ$^{\mu}$ f$^{\mu}$ i: [kɑfi:]	*!	*	*	*
☞ b. kɔ$^{\mu\mu}$.f i: [kɔ:.fi:]				**

(45) /kɔ$^{\mu\mu}$ f$^{\mu}$ i :/ 'coffee'	*MORA [C]	IDENT MORA [ɔ]	IDENT MORA [C]	*MORA [V]
a. kɔ$^{\mu}$ f$^{\mu}$ i: [kɑfi:]	*!	*		*
☞ b. kɔ$^{\mu\mu}$ .fi: [kɔ: .fi:]			*	**

In both tableaux, candidate (b) is optimal because the competing candidate violates the highest-ranked constraint against moraic consonants.

In SAE stressed syllables, the lower-mid back vowel only surfaces as long. This distribution is handled by ranking *MORA[C] above IDENTMORA[C], IDENTMORA[ɔ], and *MORA[V]. The complete hierarchy thus far motivated for SAE is:

(46) *TRIMOR, StoW >> *MORA[C] >> IDENTMORA[ɔ],

IDENTMORA[C], *MORA[V]

With this constraint ranking, consonants cannot be moraic after the lower-mid back vowel. Therefore, the lower-mid back vowel always surfaces as long in order to meet the condition that stressed syllables be bimoraic.

3.2 Distinctive Vowel Length

Notice that the constraint ranking in (46) does not mention any vowels other than the lower-mid back vowel. It only handles vowels which only surface as long. However, in SAE, most vowels have distinctive length, as seen in Figure (3) above. To handle this distribution, the constraint requiring identity to the length of distinctive-length vowels (IDENTMORA[i,u,e,o,a]) must be ranked higher than the constraint against moraic consonants. This was the same mechanism used to maintain distinctive vowel length in all RP vowels. The full constraint ranking for SAE, including distinctive vowel length, is:

(47) *TRIMOR, StoW, IDENTMORA[i,u,e,o,a] >> *MORA[C] >>

IDENTMORA[ɔ]}, IDENTMORA[C], *MORA[V]

With this hierarchy, long and short distinctive-length vowels will surface as long or short regardless of the underlying weight of the following consonant. (48) shows a representative evaluation of an input with a short vowel.

(48) /bi$^{\mu}$t/ 'bit'	IDENT MORA [i,u,e,o,a]	*MORA [C]	IDENT MORA [ɔ]	IDENT MORA [C]	*MORA [V]
☞ a. bi$^{\mu}$ t$^{\mu}$ [bIt]		*		*	*
b. bi$^{\mu\mu}$ t [bi:t]	*!				**

Even though candidate (a) violates the highly-ranked constraint against moraic consonants, it is still optimal because candidate (b) fatally violates the even higher ranked constraint against adding a mora to the high front vowel.

(49) shows that with a long distinctive-length vowel in the input, the optimal candidate contains a long vowel and non-moraic consonant, even if the consonant was underlyingly moraic.

(49) /bi$^{\mu\mu}$t$^{\mu}$/ 'beet'	IDENT MORA [i,u,e,o,a]	*MORA [C]	IDENT MORA [ɔ]	IDENT MORA [C]	*MORA [V]
a. bi$^{\mu}$ t$^{\mu}$ [bIt]	*!	*			*
☞ b. bi$^{\mu\mu}$ t [bi:t]				*	**

Candidate (b) is optimal because the competing candidate violates the high-ranked constraint against changing the number of moras associated with a distinctive-length vowel.

3.3 Summary of SAE Vowels

In SAE, all vowels come in distinctive-length pairs, except the lower-mid back vowel which always surfaces as long. Distinctive length is accomplished by the constraint ranking in (50). With this ranking, consonant weight is dependent on underlying vowel length.

(50) IDENTMORA[i,u,e,o,a] >> *MORA[C], IDENTMORA[C], *MORA[V]

Non-distinctive length (long-only vowels) is accomplished by the constraint ranking in (51). With this ranking, vowel length is dependent on the inability of consonants to be moraic.

(51) *MORA[C] >> IDENTMORA[ɔ], IDENTMORA[C], *MORA[V]

This vowel system differs minimally from that of RP English by a simple re-ranking of IDENTMORA[ɔ] below *MORA[C].

CHAPTER IV

New York English (NYE) - Distinctive and Non-distinctive Vowel Length

(with a twist)

In addition to having distinctive-length vowels (like RP and SAE), and vowels that only surface as long (like SAE), I propose that NYE also has a vowel which has either distinctive length or is only long depending on the quality of the following consonant. That is, the low front vowel only surfaces as long before voiceless stops, but has distinctive length before consonants more sonorous than voiceless stops. The surface vowels of NYE are shown in Figure (4), with the distinctive length vowels unshaded, the long-only vowels in light shade, and the hybrid vowels in dark shade. A relevant sample of each type of vowel given in (52).

Figure (4) Surface NYE Vowels

	Front		Back	
High	i:	i (I)	u (U)	u:
Mid	e:	e (ɛ)	o (^)	o:
				ɔ:
Low	æ (E)	æ:	a:	

(52)	a.	Distinctive length:	[bi:t]	beet	[bit]	bit
			[bi:n]	bean	[bin]	bin
			[bu:t]	boot	[put]	put
			[pu:l]	pool	[pul]	pull
			[be:t]	bait	[bet]	bet
			[pe:n]	pain	[pen]	pen
			[bo:t]	boat	[bot]	but
			[bo:n]	bone	[bon]	bun
	b.	Long-only:	[kɔ:t]	caught	*[kɔt]	
			[dɔ:n]	dawn	*[dɔn]	
			[ra:t]	rot	*[rat]	
			[ra:n]	Ron	*[ran]	
	c.	Hybrid:	[kæ:t]	cat	*[kæt](E)	
			[kæ:n]	can - aux.	[kæn](E)	can - noun

The distribution of the distinctive-length and long-only vowels are readily explained using the same mechanism used to analyze these type of phenomena in RP and SAE. However, the distribution of the low front vowels in NYE has been both a puzzle and the topic of much research for decades[20]. Although all previous accounts have characterized it as a strictly allophonic alternation, in doing so, they have been

[20] NYE is one of several geographically-related dialects with the phenomenon commonly described as æ-tensing. Although several dialects have varying forms of this phenomenon, this paper only addressed NYE.

unable to account for the extremely wide range of variation found in the data - including minimal pairs. Taking a closer look at the data, I will show that the distribution of the low front vowel is actually a combination of distinctive and non-distinctive vowel length, similar to that found in the other NYE vowels. Specifically, the low front vowel has distinctive length that is neutralized in a particular environment (before voiceless stops).

4.1 NYE æ-Tensing

4.1.1 Canonical Data

One of the distinguishing features of NYE speech is that the low front vowel is phonetically tensed in syllables closed by certain consonants (Ferguson 1972, Kahn 1976, Payne 1980, Labov 1981, Dunlap 1987, Benua 1995). The tensed vowel is sometimes transcribed as [E], and has been characterized as diphthongized and slightly higher than [æ]. All the consonants in the shaded box in Figure (5) condition tensing if they are tautosyllablic codas (based on Dunlap, 1987), and (53) shows representative monosyllables containing the canonical distribution of tense and lax low front vowels[21].

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[21] {h, ž, y, w} never occur in coda position following /æ/ in English. It is unclear if these segments would condition tensing. It is also unclear if {l, r} condition tensing. Dunlap (1987) says that these segments do not. However, to me, the stressed vowel in 'Mary' and 'pale', etc. sound just like the tensed low front vowel (I do speak this dialect). It may be that a phonetic lowering and backing effect of the liquids on the tensed mid front vowel /e/ causes it to be phonetically indistinct from the tensed low front vowel in this environment. I reserve judgment until I can gather phonetic evidence from the lab. For now, I include the liquids in the tensing environment. {ŋ} is the only segment left (continued...)

Figure (5) NY æ-Tensing Conditioning Environment

stop, -vce	p	t	č	k	
stop, +vce	b	d	ĵ	g	
fric., -vce	f	θ	s	š	h
fric., +vce	v	ð	z		ž
nasal	m	n			
liquid	l	r			
glide	w	y			

(53)	[tæp]	'tap'	[mæt]	'mat'	[bæč]	'batch'	[bæk]	'back'
	[tEb]	'tab'	[mEd]	'mad'	[bEĵ]	'badge'	[bEg]	'bag'
	[lEf]	'laugh'	[bEθ]	'bath'	[bEs]	'bass'	[kEš]	'cash'
	[kEv]	'calve'	[ĵEz]	'jazz'	[pEðz]	'paths'	?[Er]	'air'
	[ĵEm]	'jam'	[tEn]	'tan'			?[El]	'ale'

The most striking aspect of this distribution is that <u>only</u> the lax low front vowel occurs before voiceless stops, while the tense vowel is canonically found before consonants more sonorous than voiceless stops[22].

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[21](...continued)
unaccounted for. Benua (1995) suggests that there is a dorsal component that presents coarticulation difficulties (some kind of OCP effect) and prevents tensing/raising the vowel. It cannot only be the [dorsal] feature because /g/ does condition tensing. However, perhaps it is some kind of combination of OCP [dorsal] and OCP [sonorant]. I do not have a solution to this puzzle, and leave it to future investigation.

[22] We will see below that the lax vowel may also occur in this environment.

4.1.2 Previous Analyses

All previous analyses of NYE æ-tensing agree in two ways:

- ♦This is an allophonic distribution, where /æ/ → [E]; and
- ♦There are a host of exceptions.

Putting aside the question of exceptions for a moment, the standard tensing rule (based on Labov 1972) is:

(54)			+nas	
	/æ/ → [E] /	____	-back	#
		[-wk]	-αvoice	C
			αcont	

Basically, this translates into: /æ/ becomes [E] in stress bearing positions before tautosyllabic front nasals and segments more sonorous than voiceless stops.

4.1.3 "Exceptions"

One of the major problems with the standard view that [E] is an allophone of /æ/ is that there is a whole range of what have been considered "exceptions" to the tensing rule.

Labov (1972) listed a variety of exceptions of different types: some have lax vowels where tense vowels are expected, and some have tense vowels where lax vowels are expected. The examples in (55) and (56) are considered exceptional because they contain low front vowels followed by tautosyllabic codas of the right type, but do not condition tensing.

(55) Unexpectedly Lax - Phonologically Conditioned

a. Before voiced fricatives (variable and unpredictable[23])

'razz', 'jazz', 'raspberry', 'avenue', 'salve', etc.

b. Before dorsal nasals (variable)

'bang', 'twang', etc.

(56) Unexpectedly Lax - Grammatically Conditioned

a. Rule does not apply to "weak" words - functionals (variable)

'an', 'am', 'can' - aux., 'have', 'has', 'had', etc.

b. Adjectives (variable and unpredictable)

'sad', 'glad', 'mad', etc.

c. Ablauted forms (variable and unpredictable)

'swam', 'began', etc.

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[23] "Variable" means that some speakers consistently have tense vowels in this environment and others have lax vowels. "Unpredictable" means that some speakers either consistently tense or lax the vowel in specific lexical items, or inconsistently tense or lax the vowel in specific lexical items. E.g. Speaker 1: [ræz] and [ĵEz], *[rEz] and *[ĵæz]. Speaker 2: [ræz] and *[rEz], [ĵæz] or [ĵEz].

The examples in (57) are considered exceptional because, although they contain low front vowels not obviously followed by tautosyllabic codas of the right type, they are tense.

(57) Unexpectedly Tense

a. After sibilants (variable)

'fashion', 'fascinate', etc.

b. Lexical exceptions (variable and unpredictable)

'wagon', 'magic', 'cabin', 'dragon', etc.

In addition to being "exceptions" to the tensing rule, some of the functional words are actually members of minimal pairs[24]:

(58) Minimal pairs

[kæn]	'can' - aux.	[kEn]	'can' - noun
[hæv]	'have'	[hEv]	'halve'

There are two important things to note about the exceptions to Labov's tensing rule. First, the variation is so widespread (by both types and tokens) that Labov actually restricts his analysis to monosyllables since they are much more regular than

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24 The word 'have' is not only a functional word. It is also a full, stress-bearing verb with an unexpectedly lax vowel.

polysyllables - although as seen above, even monosyllables are quite variable and unpredictable. Second, the pattern of exceptions is asymmetrical - something not noted in previous accounts of the phenomenon. That is, it is possible to have a lax vowel followed by a tautosyllabic "tensing" consonant (examples (55) and (56)), and it is possible to have a tense vowel in an otherwise open syllable followed by a "tensing" consonant (example (57)), but it is impossible to have a tense vowel in an otherwise open syllable followed by a voiceless stop, as in (59). These two problems for previous analyses will be explained by the account that follows.

(59) *[rE.pId] [ræ.pId] 'rapid'

Using these exceptions, the variability, and the fact that there are minimal pairs, I suggest that the previous accounts have not been as straightforward as thought, and I propose that these "exceptions" are not exceptional at all[25]. It is only by starting with the assumption that the underlying vowel is lax that previous analyses have been forced to analyze the distribution as anything but regular. I will argue that the data above give evidence of a length distinction of /æ:/ and /æ/(E), and that making this assumption

[25] One further bit of support may come from morphological truncation. Truncated forms must satisfy the Minimal Word Condition: 'Timothy' - [tIm]/*[tI], 'Bruce' - [bru:], 'Leroy' - [li:]. Truncated forms containing low front vowels are variably tense or lax if there is coda, but invariably lax if the syllable is open: 'Kathy' - [kæθ]/[kEθ]/[kæ]/*[kE], 'dad' - [dæ]/*[dE]. This leads to the conclusion that the lax vowel is bimoraic because it satisfies Minimal Word. More research is required to fully explore this hypothesis.

avoids the issue of exceptionality completely. Under my analysis, the tense/lax difference corresponds to a difference in phonological length.

4.2 Analysis of the NYE Vowel Distribution

I propose that NYE has three classes of vowels. Some vowels have a length distinction (i,u,e,o), and always surface as long or short depending on the number of moras they have underlyingly. These follow the pattern of distinctive length vowels in RP and SAE. The weight of consonants following these vowels is strictly dependent on the length of the vowel. Some vowels surface only as long (ɔ,a), and the consonants following these vowels are always non-moraic. These vowels follow the pattern of the non-distinctive length vowel in SAE. In addition, I propose that one NYE vowel (æ) has distinctive length before consonants more sonorous than voiceless stops, but is always long before voiceless stops. I attribute these patterns to interactions between markedness and faithfulness constraints on the moraicity of consonants and vowels.

4.2.1 Low Front Vowels in Monosyllables - ‘can’ - aux. versus ‘can’ - noun

The fact that there are minimal pairs with the lax and tense low front vowel supports the claim that low front vowels have a length distinction. Assuming that this is true, the distinction can be captured the same way it was in other English vowels, by ranking the

IDENTMORA[æ] constraint higher than *MORA[C]. (60) and (61) show that if a stressed vowel is underlyingly long, it will surface as long and the following consonant will be non-moraic; and if the vowel is underlyingly short, it will surface as short, and the following consonant will be moraic. (60) shows that with a monomoraic vowel in the input, the output will have a monomoraic vowel and a moraic coda.

(60) /kæ$^{\mu}$n/ 'can' -noun	IDENT MORA [æ]	*MORA [C]
☞ a. kæ$^{\mu}$ n$^{\mu}$ [kEn]		*
b. kæ$^{\mu\mu}$ n [kæ:n]	*!	

Candidate (b) loses because it fatally violates the vowel faithfulness constraint by lengthening the vowel. Even though candidate (a) has added a mora to the coda, the other candidate violates a higher-ranked constraint.

(61) shows that with a long vowel in the input, the output will also have a long vowel.

(61) /kæ$^{\mu\mu}$n/ 'can' -aux	IDENT MORA [æ]	*MORA [C]
a. kæ$^{\mu}$ n$^{\mu}$ [kEn]	*!	*
☞ b. kæ$^{\mu\mu}$ n [kæ:n]		

In tableau 28, candidate (b) wins because it does not violate either of these constraints. Candidate (a) violates the faithfulness constraint because the output vowel has one less mora than the input, and it violates the markedness constraint because the coda has a mora.

The problem now is explaining the fact that the length contrast of low front vowels is neutralized before voiceless stops. Based on the work of Zec (1988), I claim that NYE shows a distinction in the moraicity of stops based on voicing[26], where moraic voiceless stops are more marked than more sonorous moraic segments. This distinction results in the non-distinctive length of the low front vowel before voiceless stops.

4.2.2 Low Front Vowels in Monosyllables - ‘cat’

In SAE, non-distinctive vowel length is captured by ranking *MORA[C] above IDENTMORA[V]. Assuming that the above analysis of 'can'-aux/'can'-noun is correct, and that NYE has distinctive vowel length in the low front vowels, then simply ranking *MORA[C] above IDENTMORA[æ] will not work because this predicts that the low front vowel is always long. However, relativizing the *MORA[C] constraint to different consonants allows a split in this constraint based on sonority. Just as the IDENTMORA[Seg] constraint is actually a family of constraints corresponding to each segment, *MORA[C] is shorthand for a set of constraints relative to each consonant. Until now, all consonants behaved similarly with respect to vowel length and consonant

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[26] See Chapter V for a more detailed look at Zec's work.

weight, so there was no reason to separate the constraint by individual segments. However, since NYE has a distribution that requires different consonants to behave differently with respect to moraicity, there is evidence that the *MORA[C] constraint is a composite of constraints on different consonant types. Since NYE consonants fall into two classes, those that are either moraic or non-moraic following low front vowels and those that are always non-moraic following low front vowels, the *MORA[C] constraint is relativized to the class of voiceless stops (*MORA[t,p,k,č]) and the class of consonants more sonorous than voiceless stops (*MORA[d,b,g,ĵ, etc.]). Given this notational device, the distribution of the low front vowel can now be accounted for by the ranking in (62).

(62) *MORA[t,p,k,č] >> IDENTMORA[æ]>> *MORA[d,b,g,ĵ,etc.]

Distinctive length before codas more sonorous than voiceless stops is accomplished by ranking the vowel faithfulness constraint above the markedness constraint against moraic "sonorous" segments (see (65) and (66)). However, ranking the vowel faithfulness constraint lower than the constraint against moraic voiceless stops forces the low front vowel to always be long before those vowels (Tableaux (63) and (64)). (63) shows that with a short vowel in the input, the vowel surfaces as long.

(63) /kæ$^{\mu}$t/ 'cat'	*MORA [t,p,k,č]	IDENT MORA [æ]	*MORA [d,b,g,ĵ, etc.]
a. kæ$^{\mu}$ t$^{\mu}$ [kEt]	*!		
☞ b. kæ$^{\mu\mu}$ t [kæ:t]		*	

Candidate (a) fatally violates the constraint against having a moraic voiceless stop. Candidate (b) violates the vowel faithfulness constraint because the output vowel has an additional mora, but it is optimal because the other candidate violates a higher-ranked constraint.

(64) shows that with a long vowel in the input, the output will have a long vowel and non-moraic consonant.

(64) /kæ$^{\mu\mu}$ t/ 'cat'	*MORA [t,p,k,č]	IDENT MORA [æ]	*MORA [d,b,g,ĵ, etc.]
a. kæ$^{\mu}$ t$^{\mu}$ [kEt]	*!	*	
☞ b. kæ$^{\mu\mu}$ t [kæ:t]			

Candidate (b) is optimal because it does not violate any of these constraints. However, candidate (a) has a moraic voiceless stop and has deleted a mora from the vowel, therefore it violates two constraints and loses.

(65) and (66) repeat the evaluations of 'can'-noun and 'can'-aux using the separate *MORA[C] constraints. (65) shows that with a short vowel in the input, the output will contain a short vowel followed by a moraic "sonorous" consonant.

(65) /kæ$^{\mu}$n/ 'can' - noun	*MORA [t,p,k,č]	IDENT MORA [æ]	*MORA [d,b,g,ĵ, etc.]
☞ a. kæ$^{\mu}$ n$^{\mu}$ [kEn]			*
b. kæ$^{\mu\mu}$ n [kæ:n]		*!	

Even though candidate (a) violates the markedness constraint against moraic consonants (other than voiceless stops), it is still optimal because candidate (b) fatally violates the higher-ranked constraint against lengthening the vowel.

(66) shows that with a long vowel in the input, the output will contain a long vowel and non-moraic consonant.

(66) /kæ$^{\mu\mu}$n/ 'can' - aux	*MORA [t,p,k,č]	IDENT MORA [æ]	*MORA [d,b,g,ĵ, etc.]
a. kæ$^{\mu}$ n$^{\mu}$ [kEn]		*!	*
☞ b. kæ$^{\mu\mu}$ n [kæ:n]			

Candidate (b) is optimal because it does not violate any of these constraints. Candidate (a) violates the constraint against deleting a mora from the vowel and the constraint against having a moraic consonant (other than voiceless stops).

4.2.3 Summary of NYE Low Front Vowels in Monosyllables

At first, the NYE low front vowel seems to show a puzzling distribution. There is evidence of distinctive length when the vowel is followed by consonants more sonorous than voiceless stops (minimal pairs, fairly random distribution, etc.), however, this distinction is neutralized before voiceless stops. I have analyzed these facts as resulting from an interleaving of the constraint requiring faithfulness to the underlying length of the low front vowel with a markedness hierarchy of constraints against moraic consonants. It is worse to have a moraic voiceless stop than it is to have a more sonorous moraic segment.

As will be discussed in more detail in Chapter V, these results are foreshadowed by Zec's (1988) work on moraic dependency if we assume the voiceless stops are lowest on the sonority scale. Short vowels are expected before sonorous consonants, like nasals, as in 'man' [mæn] ([mEn]); and long vowels are expected before less-sonorous consonants, like voiceless stops, as in 'cat' [kæ:t]. The only unexpected result of this analysis is that the low front vowel can either be long or short before sonorous consonants. However, this falls out naturally from the constraint ranking schema already needed for distinctive length in other English vowels.

4.3 NYE Low Front Vowels in Disyllables

Further support for the above analysis comes from the distribution of low front vowels in disyllables. In disyllables, low front vowels in open stressed syllables followed by voiceless stops can only be of the long (lax) variety. However, if they are followed by consonants more sonorous than voiceless stops, then they can be either long (lax) or short (tense).

(67)	Only long	Long	Short
	[ræ:.pId] 'rapid'	[kæ:.bIn] 'cabin'	[wægən] 'wagon'
	*[ræpId]		([wEgən])
	(*[rEpId])		

Under previous analyses, this fact went completely unexplained. However, under my analysis, assuming that the lax vowel is long and the tense vowel is short, the distribution of the low front vowels in disyllables is perfectly coherent with the analyses of the length phenomena in the other NYE vowels.

(68) and (69) show that before consonants more sonorous than voiceless stops, the surface length of the vowel is determined by the underlying length. If the vowel is underlyingly long, it surfaces as long, and the following consonant is non-moraic. If the vowel is underlyingly short, then it surfaces as short, and the following consonant is moraic and ambisyllabic (the evaluation of the final syllable is unimportant). Notice

that this parallels exactly the analyses of 'beaker' and 'bicker' presented in Chapter II. (68) shows an underlyingly long vowel surfacing as long.

(68) /kæ$^{\mu\mu}$ bin/ 'cabin'	*MORA [t,p,k,č]	IDENT MORA [æ]	*MORA [d,b,g,ĵ, etc.]
a. k æ$^{\mu}$ b$^{\mu}$ in [kEbIn]		*!	*
☞ b. k æ$^{\mu\mu}$ .bin [kæ:.bIn]			

Candidate (b) is optimal because it does not violate any of these constraints. Candidate (a) is sub-optimal because it both deletes a mora from the stressed vowel and has a moraic consonant.

(69) shows the evaluation of the word 'wagon'. This example was problematic for previous analyses because it unexpectedly contains a tense vowel. However, this tableau demonstrates that under the distinctive length hypothesis promoted here, a short vowel before a consonant more sonorous than a voiceless stop will surface as short. That is, the medial consonant is ambisyllabic.

(69) /wæ$^{\mu}$ gin/ 'wagon'	*MORA [t,p,k,č]	IDENT MORA [æ]	*MORA [d,b,g,ĵ, etc.]
☞ a. wæ$^{\mu}$ g$^{\mu}$ in [wEgIn]			*
b. wæ$^{\mu\mu}$ .g in [wæ:.gIn]		*!	

Candidate (b) loses because it fatally violates the vowel faithfulness constraint by adding a mora to an underlyingly monomoraic vowel. Although candidate (a) violates the markedness constraint, candidate (b) violates a higher-ranked constraint.

In contrast with tableaux (68) and (69), tableaux (70) and (71) show that with this constraint ranking, it is impossible to have a short low front vowel followed by a voiceless stop regardless of underlying vowel length[27]. This is because the vowel length is dependent on the inability of the following consonant to be moraic in this environment. In (70), an underlyingly short vowel surfaces as long.

(70) /ræ$^{\mu}$ pid/ 'rapid'	*MORA [t,p,k,č]	IDENT MORA [æ]	*MORA [d,b,g,ĵ, etc.]
a. ræ$^{\mu}$ p$^{\mu}$ id [rEpId]	*!		
☞ b. ræ$^{\mu\mu}$ .pid [ræ:.pId]		*	

Candidate (a) is sub-optimal because it violates the highly-ranked markedness constraint. Candidate (b) violates the vowel faithfulness constraint, but is still optimal because the other candidate violates a higher-ranked constraint.

(71) shows that an underlyingly long vowel surfaces as long.

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27 Here we see that simply driving bimoraicity in monosyllables by a high-ranking FTBIN constraint is not adequate. It would be difficult to block the short vowel in penultimate (and pre-penultultimate) position without StoW.

(71) /ræ$^{\mu\mu}$ pid/ 'rapid'	*MORA [t,p,k,č]	IDENT MORA [æ]	*MORA [d,b,g,ĵ, etc.]
a. r æ$^{\mu}$ p$^{\mu}$ id [rEpId]	*!	*	
☞ b. r æ$^{\mu\mu}$ .pid [ræ:.pId]			

Candidate (b) is optimal because it does not violate any of these constraints. Candidate (a) violates the markedness constraint against moraic voiceless stops, and it violates the faithfulness constraint on vowel length.

4.4 Summary of NYE Vowels and æ-Tensing

In the above discussion, I showed that previous analyses of NYE æ-Tensing are inadequate because they assume that the phenomenon is strictly an allophonic alternation. By making that assumption, they are unable to account for the extremely wide range of variation in the distribution of [æ] and [E] in monosyllable and disyllables - including minimal pairs and a large number of "exceptions". My analysis combines distinctive length, non-distinctive length, and the inability of some consonants to be moraic in certain environments; and it is able to account for all the data without resorting to "exceptionality". Those cases that look like exceptions to previous analyses are simply the result of constraint interactions already needed for length phenomena in other NYE vowels. One additional result of this analysis is to show that the sonority scale for moras should contain the feature [voice].

Since some vowels in NYE have distinctive length all the time, and other have non-distinctive length all the time, the vowel faithfulness constraints for these two groups of vowels must be ranked as follows:

(72) Distinctive Length - only

IDENTMORA[i,u,e,o] >> *MORA[t,p,k,č] *MORA[d,b,g,ĵ, etc.]

(73) Non-distinctive Length - only

*MORA[t,p,k,č], *MORA[d,b,g,ĵ, etc.] >> IDENTMORA[a,ɔ]

Combined with the ranking motivated by the æ-tensing pattern, the full constraint ranking for NYE is:

(74) StoW, *TRIMOR, IDENTMORA[i,u,e,o] >>*MORA[t,p,k,č] >>

IDENTMORA[æ] >> *MORA[d,b,g,ĵ,etc.] >> IDENTMORA[a,ɔ]

CHAPTER V

Sonority Constraints on Syllable Structure - Zec 1988

The analysis I have given of the distribution of NYE low front vowels differentiates between consonant moraicity based on voicing. Voiceless stops (the most non-sonorous segments) always surface as non-moraic following a low front vowel. This idea that moraicity is based on sonority is not new, Zec (1988) proposes that there is a strong correlation not only between sonority and syllabicity, but also between sonority and syllable weight (moraicity). She claims that a subset relationship holds between segmental inventories and what languages will allow to be syllabic, moraic, or neither. So, the more sonorous a segment is, the more likely it will be moraic. The four-way typology which she sets up is shown in (75) with attested languages of each type.

(75)	a. Syllabic set < Moraic set = Segment inventory	English, Cairene Arabic
	b. Syllabic set = Moraic set < Segment inventory	Khalkha Mongolian, Lardil
	c. Syllabic set < Moraic set < Segment inventory	Lithuanian, Kwakwala
	d. Syllabic set = Moraic set = Segment inventory	Berber

(76) shows the various syllabic and moraic segment classes for a language from each of the four types.

(76) a. English[28]:

Syllabic	Moraic	Segments
vowels	vowels	vowels
liquids	liquids	liquids
nasals	nasals	nasals
	obstruents	obstruents

b. Khalkha Mongolian:

Syllabic	Moraic	Segments
vowels	vowels	vowels
		liquids
		nasals
		obstruents

c. Lithuanian:

Syllabic	Moraic	Segments
vowels	vowels	vowels
	liquids	liquids
	nasals	nasals
		obstruents

[28] Zec claims that English allows all segments to be moraic. However, this paper argues that some English dialects (SAE, NYE) only allow moraic consonants in certain environments (following certain vowels).

d. Berber:	Syllabic	Moraic	Segments
	vowels	vowels	vowels
	liquids	liquids	liquids
	nasals	nasals	nasals
	obstruents	obstruents	obstruents

Only those languages of type (b) and (c) are interesting to the discussion of NYE because they show that the same language can have some segments that count for syllable weight and others that do not. In Khalkha Mongolian, for example, only vowels are moraic, consonants are not. In Lithuanian, sonorants are moraic, but obstruents are not. Since the purpose of discussing Zec (1988) is to motivate the split in moraicity of consonants based on a universal ranking of constraints based on the sonority scale, the remaining discussion of this work will be confined to those languages in type (c).

5.1 Lithuanian

There are three arguments that Zec uses to support the claim that Lithuanian differentiates between the moraicity of consonants based on sonority. They are: the distribution of pitch accents, the phenomenon known as leftward accent retraction, and ablaut. Only the discussion of pitch accent is summarized here.

Lithuanian is a pitch accent language that has three accents: acute, grave, and circumflex. These accents are formed by associating a tone with various components of some syllables. The tone bearing unit is the mora, and contour tones (acute and circumflex accent) are found only on bimoraic syllables. Grave accent is found only on monosyllables. Zec assumes the following representations of the three accents (based on Kiparsky and Halle 1977) (Zec 1988:23):

(76) a. Acute (x´): σ

μ μ

H

b. Circumflex (xˆ): σ

μ μ

H

c. Grave (x`): σ

μ

H

(76a) shows that the acute accent is formed by associating a high tone with the first mora of a bimoraic syllable. (76b) shows that the circumflex accent is formed by associating a high tone with the second mora of a bimoraic syllable, and (76c) shows that the grave accent is a high tone associated with the single mora of a monomoraic syllable.

It is the circumflex accent which is of interest to the question of coda consonant moraicity because this particular tone is associated with the second mora. As it turns out, in Lithuanian, the circumflex accent appears only in syllables containing either a long vowel or a sonorant coda consonant. This is demonstrated in (77) (circumflex accent is marked with a tilde).

(77)	CVV:	*vĩ̯nas*	'wine'
	CVL:	*gar̃sas*	'sound'
	CVN:	*lañkas*	'rainbow'

However, it is never found in syllables closed by obstruents. According the Zec, this strongly suggests that obstruents are not moraic.

Based on this evidence, as well as leftward accent retraction and ablaut, Zec comes to the conclusion that Lithuanian distinguishes between sonorants and obstruents in the association of moras. Sonorants are moraic (CVS patterns like CVV), and obstruents are not (CVO patterns like CV).

5.2 Kwakwala

Another interesting case that Zec cites, and one that is perhaps more relevant to the discussion of NYE and my claim that voiced and voiceless stops pattern differently with respect to moraicity comes from Kwakwala. In Kwakwala, not only is there evidence of a difference in the moraicity of obstruents and sonorants, where obstruents are non-moraic and sonorants are generally moraic, but within the class of sonorants, there is a difference in moraicity based on glottalization. This is similar to my proposal that NYE stops differ in moraicity based on another laryngeal feature, [voice].

In Kwakwala, glottalization is distinctive. Obstruents can be voiced, voiceless and unglottalized, or voiceless and glottalized. Sonorants are either unglottalized or glottalized. (78) shows sample obstruents and sonorants (glottalization is marked with a ' diacritic).

(78) t d t' n n'

The evidence for the split in weight between obstruents and glottalized sonorants on the one hand and unglottalized sonorants on the other comes from the stress patterns of this language. Kwakwala has a quantity sensitive stress system, where main stress falls on the right-most syllable if all syllables are light, but on the left-most heavy syllable if there is one. This is demonstrated in open syllables in (79) and (80). If all syllables are light (CV) the stress is on the right-most syllable. All examples are taken by Zec from Boas (1947).

(79) bəxá 'to cut'

m' əkʷəlá 'moon'

məc'ətá (pl.) 'to heal'

In (80), stress is not final, but falls on a heavy syllable (CVV). (79) and (80) clearly show that CVV syllables are heavy and CV syllables are light.

(80) qá:sa 'to walk'

c'é:kʷa 'bird'

xʷá:kʷəna 'canoe'

t'əlí:dᶻu ‘large board on which fish are cut'

(81) shows that unglottalized sonorants in coda position pattern with the CVV syllables. They attract stress.

(81) m'ə́nsa 'to measure'

də́lxa 'damp'

dᶻ ə́mbətəls 'to bury in hole in ground'

On the other hand, (82) shows that closed syllables containing obstruent codas do not attract stress. Stress is final.

(82) c' ətxá 'to squirt'

maxʷc'á 'to be ashamed'

gasxá 'to carry on fingers'

These data clearly show that Kwakwala has a distinction in moraicity between obstruents and unglottalized sonorants. Obstruents are non-moraic and unglottalized sonorants are moraic. But, as pointed out by Zec, the situation is more complex than this. As seen in (83), glottalized sonorants do not attract stress. They behave like CV and CVO syllables.

(83) gəm'xá 'to use the left hand'

məl'qá 'to repair canoe'

There are even minimal pairs containing glottalized and unglottalized sonorant codas, and these minimal pairs show the expected stress difference.

(84) an'qá 'to put fire among' ánqa 'to squeeze'

gəl'qá 'to wipe the anus' gə́lqa 'to swim'

From this Kwakwala evidence, Zec concludes(1995, p. 107), "moraic segments may correspond to only a subset of sonorants, in this case the set of unglottalized sonorants, just as they can correspond to only a subset of consonants." This is a welcome conclusion because it opens the door to arguing for a similar distinction in the voicing of certain obstruents in NYE.

5.3 Summary

Based on the evidence of several languages, only some of which was discussed here, Zec proposes a set of filters which result in an implicational relationship of moraic segments based on sonority. She convincingly argues that the more sonorous a segment is, the more likely it will be moraic. This can be translated straight forwardly into the following OT constraint hierarchy (similar to the peak and margin markedness hierarchies of P&S93):

(85) *MORA[obstruent] >> *MORA[sonorant] >> *MORA[vowel][29]

Although she does not specifically address either NYE or the moraicity of stops based on voicing, she does give evidence for a universal hierarchy based on other aspects of sonority. Lithuanian differentiates between obstruents which are not moraic and sonorants which are moraic. Kwakwala differentiates between obstruents and glottalized sonorants which are non-moraic and unglottalized sonorants which are moraic. It is not unreasonable to suggest that these results would allow a language

[29] Not fully articulated for all features affecting sonority.

which differentiates between voiceless stops (the most non-sonorous segments) which are non-moraic and all other segments (more sonorous) which are moraic. This is exactly what I claim explains the distribution of short (tense) and long (lax) low front vowels in NYE.

CHAPTER VI

Typological Predictions - Re-ranking Markedness and Faithfulness Constraints[30]

Re-ranking the markedness and faithfulness constraints on segment moraicity provides an enormous typology, especially if each constraint is relativized to every possible segment. The following is only a limited typology showing the basic systems predicted by re-ranking these constraints. Assuming that the simplest case is the one where all vowels and all consonants pattern together respectively, then the following typology is produced by re-ranking the constraints *MORA[C], *MORA[V], IDENTMORA[C], and IDENTMORA[V]. Since I am assuming Zec (1988), *MORA[C] universally outranks *MORA[V]. Given a choice between a moraic consonant and a moraic vowel, all languages choose a moraic vowel[31]. The following sections show various constraint

[30] Other constraints on syllable structure (Weight by Position, final extrametricality, etc.) are not addressed here, but can certainly play a role in modifying the typology if introduced into the constraint ranking.

[31] Unless forced to choose the consonant by other considerations. See the P&S93 (continued...)

rankings and the resulting distribution of monosyllables closed by a single coda consonant. The tableaux for these constraint rankings are given in Appendix 1.

6.1 Syllables without a Bimoraicity Requirement

6.1.1 Allows Only Monomoraic Syllables

This type of language is not uncommon (Senufo - Kenstowicz, 1994). All vowels are short, and consonants are never moraic. This system can include both CV only and light CVC languages. If codas are not allowed in the language, some other constraint (NO CODA) will ensure that they do not surface. The following constraint ranking produces this type of system:

(86) *MORA[C] >> *MORA[V] >> IDENTMORA[C], IDENTMORA[V]

(87) shows that all consonants neutralize to non-moraic and all vowels neutralize to short.

(87) a. /$CV^{\mu}C$/ → [$CV^{\mu}C$]

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[31](...continued)
analysis of Berber syllabification.

b.	/$CV^{\mu}C^{\mu}$/	→	[$CV^{\mu}C$]
c.	/$CV^{\mu\mu}C$/	→	[$CV^{\mu}C$]
d.	/$CV^{\mu\mu}C^{\mu}$/	→	[$CV^{\mu}C$]

6.1.2 Allows Long Vowels, but No Moraic Consonants

This type of language is also attested (Khalkha Mongolian - Zec, 1988). Vowel length is distinctive, but coda consonants (if allowed) are non-moraic. The following constraint rankings produce this type of system:

(88) a. IDENTMORA[V], *MORA[C] >> *MORA[V], IDENTMORA[C]

b. *MORA[C] >> IDENTMORA[V], IDENTMORA[C] >> *MORA[V]

(89) shows that vowels retain underlying length, but all consonants neutralized to non-moraic.

(89)	a.	/$CV^{\mu}C$/	→	[$CV^{\mu}C$]
	b.	/$CV^{\mu}C^{\mu}$/	→	[$CV^{\mu}C$]
	c.	/$CV^{\mu\mu}C$/	→	[$CV^{\mu\mu}C$]

d. /$CV^{\mu\mu}C^{\mu}$/ → [$CV^{\mu\mu}C$]

6.1.3 Allows Long Vowels, and Consonants are Sometimes Moraic, Sometimes Non-moraic

This type of language is seen less often (Kashmiri - Morén, 1997b), Finnish), and actually falls into two groups: those that have distinctive consonant weight subordinate to distinctive vowel length, and those that have distinctive vowel length subordinate to distinctive consonant weight. The first type results from the following constraint ranking:

(90) IDENTMORA[V] >> IDENTMORA[C] >>*MORA[C] >> *MORA[V]

This produces the distribution shown in (91). Outputs are faithful to inputs except that all consonants neutralize to non-moraic following long vowels. Presumably, this is due to a high-ranking markedness constraint against trimoraic syllables[32].

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32 With a low-ranking *TRIMOR, [$CV^{\mu\mu}C^{\mu}$] will surface (Finnish).

(91) a. $/CV^{\mu}C/ \rightarrow [CV^{\mu}C]$

b. $/CV^{\mu}C^{\mu}/ \rightarrow [CV^{\mu}C^{\mu}]$

c. $/CV^{\mu\mu}C/ \rightarrow [CV^{\mu\mu}C]$

d. $/CV^{\mu\mu}C^{\mu}/ \rightarrow [CV^{\mu\mu}C]$

The second type of language results from the following two constraint rankings:

(92) a. IDENTMORA[C] >> *MORA[C], IDENTMORA[V] >> *MORA[V]

b. IDENTMORA[C] >> *MORA[C] >> IDENTMORA[V] >> *MORA[V]

These rankings produce the distribution in (93). Outputs are faithful to inputs, except that long vowels are neutralized to short before underlyingly moraic consonants. Again, this is due to a high-ranked markedness constraint against trimoraic syllables (see footnote 32).

(93) a. $/CV^{\mu}C/ \rightarrow [CV^{\mu}C]$

b. $/CV^{\mu}C^{\mu}/ \rightarrow [CV^{\mu}C^{\mu}]$

c. $/CV^{\mu\mu}C/ \rightarrow [CV^{\mu\mu}C]$

d. $/CV^{\mu\mu}C^{\mu}/ \rightarrow [CV^{\mu}C^{\mu}]$

6.1.4 No Long Vowels, and Consonants are Sometimes Moraic, Sometimes Non-moraic

This language is presumably rare[33], if it exists at all. The ranking in (94) makes a very strong prediction that there can be languages which violate Trubetzkoy's generalization that the presence of a bimoraic CVC in a language implies the presence of CVV. Although I have not been able to find an entire language behaving in this way, there are a number of languages which manifest this syllable type in certain syllables. Two examples are Italian and Ilocano. In Italian, unstressed non-final syllables can contain geminates, but not long vowels. In addition, stressed pre-penults can contain geminates, but not long vowels. Ilocano has a similar distribution. It has heavy CVC syllables, but not CVV syllables except in stressed penults or unless they are the result of compensatory lengthening (Hayes, 1989). The ranking for this type of language is:

(94) IDENTMORA[C] >> *MORA[C] >> *MORA[V] >> IDENTMORA[V]

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[33] However, further research may show that this is actually quite common as part of a grammar, if not for a whole language. For example, Italian allows geminates, but not long vowels in unstressed syllables.

This ranking produces the following distribution, where consonant weight is distinctive and all vowels neutralize to short.

(95) a. $/CV^{\mu}C/$ → $[CV^{\mu}C]$

b. $/CV^{\mu}C^{\mu}/$ → $[CV^{\mu}C^{\mu}]$

c. $/CV^{\mu\mu}C/$ → $[CV^{\mu}C]$

d. $/CV^{\mu\mu}C^{\mu}/$ → $[CV^{\mu}C^{\mu}]$

6.2 Systems Requiring Bimoraic Syllables

These types of systems are quite common. Each is the result of ranking some constraint or set of constraints requiring various syllables to be bimoraic higher than the faithfulness and markedness constraints on the moraic content of consonants and vowels. As was done above, bimoraicity will be ensured by a combination of StoW and *TRIMOR. However, this does not preclude the possibility of other constraints performing the same function in other instances. Given the requirement that syllables be bimoraic, the distribution of each ranking is strictly determined by the highest ranked markedness or faithfulness constraint.

6.2.1 Only Long Vowels, and Consonants are Never Moraic

The constraint ranking that results in this type of language is:

(96) StoW, *TRIMOR >> *MORA[C] >> *MORA[V], IDENTMORA[V], IDENTMORA[C]

An example of this is seen in the distribution of the lower-mid back vowel in SAE (Chapter III), and the lower-mid back and low back vowels in NYE (Chapter IV). This ranking results in the following distribution, where all vowels neutralize to long, and all consonants neutralize to non-moraic:

(97)

a.	$/CV^{\mu}C/$	→	$[CV^{\mu\mu}C]$
b.	$/CV^{\mu}C^{\mu}/$	→	$[CV^{\mu\mu}C]$
c.	$/CV^{\mu\mu}C/$	→	$[CV^{\mu\mu}C]$
d.	$/CV^{\mu\mu}C^{\mu}/$	→	$[CV^{\mu\mu}C]$

6.2.2 Distinctive Vowel Length, and Consonant Weight is Determined by Vowel Length

The constraint ranking that results in this type of language is:

(98) StoW, *TRIMOR >> IDENTMORA[V] >> *MORA[C], *MORA[V], IDENTMORA[C]

Examples of this are seen in the analyses of all RP vowels (Chapter II), and some SAE and NYE vowels (Chapter III and Chapter IV, respectively). This ranking results in the distribution shown in (99), where vowel length is distinctive. Underlyingly short vowels surface as short, and underlyingly long vowels surface as long. Consonants neutralize to moraic following short vowels, and they neutralize to non-moraic following long vowels.

(99)

a.	/$CV^{\mu}C$/	→	[$CV^{\mu}C^{\mu}$]
b.	/$CV^{\mu}C^{\mu}$/	→	[$CV^{\mu}C^{\mu}$]
c.	/$CV^{\mu\mu}C$/	→	[$CV^{\mu\mu}C$]
d.	/$CV^{\mu\mu}C^{\mu}$/	→	[$CV^{\mu\mu}C$]

6.2.3 Distinctive Consonant Weight, and Vowel Length is Determined by Consonant Weight

The constraint ranking that results in this type of language is:

(100) StoW, *TRIMOR >> IDENTMORA[C] >> IDENTMORA[V], *MORA[C], *MORA[V]

An example of this is seen below in the analysis of Icelandic. This ranking results in the distribution shown in (101), where consonant weight is distinctive. All vowels neutralized to long before underlyingly non-moraic consonants, and all vowels neutralize to short before underlyingly moraic consonants.

(101) a. $/CV^{\mu}C/$ → $[CV^{\mu\mu}C]$

b. $/CV^{\mu}C^{\mu}/$ → $[CV^{\mu}C^{\mu}]$

c. $/CV^{\mu\mu}C/$ → $[CV^{\mu\mu}C]$

d. $/CV^{\mu\mu}C^{\mu}/$ → $[CV^{\mu}C^{\mu}]$

6.2.3.1 Icelandic[34]

[34] The following analysis only accounts for monosyllables not closed by consonant clusters. Consonant clusters require a much more complicated discussion, including additional constraints such as Final Consonant Extrasyllabicity and Weight by Position . In addition, there is evidence that the IDENTMORA[SEG] family of constraints is inadequate to explain the full distribution of Icelandic syllables. Instead, IDENTMORA[SEG] must be split into MAXMORA[SEG] and DEPMORA[SEG]. Although this is not necessarily problematic for the analysis given here, it adds complication to the constraint system and discussion. See Morén 1997 for work in this direction.

Icelandic is relevant to a discussion concerning the interaction between vowel length and consonant moraicity because, unlike RP English in which vowel length determines consonant weight, Icelandic consonant weight determines vowel length. In Icelandic, all stressed syllables must be heavy (Árnason, 1980). Open stressed syllables must contain long vowels, and closed stressed syllables either have a long vowel followed by a non-moraic consonant, or a short vowel followed by a moraic consonant. (102) shows a representative sample of mono- and disyllables containing long and short vowels. The disyllables have penultimate stress since main stress is always initial.

(102) Monosyllables

*[CV] - stressed syllables must be bimoraic

[CV:]	[ni:]	*ny*	'new'
[CV:C]	[pa:r]	*bar*	'deceit'
[CVC]	[par:]	*barr*	'needle'

Disyllables

[CV:.CV]	[vi:.sa]	*visa*	'to show'
[CVC:V]	[vis:a]	*vissa*	'certainty'

In the case of [pa:r]/[par:], the standard analysis is that the former has a non-moraic consonant (extrasyllabic) , but the latter has a moraic consonant. This has been interpreted as a difference in the underlying moraicity of the coda consonants, and under this analysis, since consonant weight is distinctive, the vowel in [pa:r] is forced to be long in order to meet the bimoraic weight requirement on stressed syllables. Similarly, in the disyllabic minimal pair [vi:sa]/[vis:a], the former has an underlyingly non-moraic medial consonant. This forces the vowel to be long. However, in the latter, the medial consonant is a geminate, therefore is underlyingly moraic, and the vowel always surfaces as short.

Monosyllables

To ensure that consonant weight is distinctive, the faithfulness constraint on underlying moraicity must be highly ranked. Since moraic consonants surface, the faithfulness constraint must be ranked higher than the markedness constraint against moraic consonants. (103) shows that with this constraint ranking, a moraic consonant in the input will surface as moraic.

(103) /pa$^{\mu}$r$^{\mu}$/ *barr*	*TRIMOR	StoW	IDENT MORA [C]	*MORA [C]
a. p a$^{\mu}$ r [par]		*!		
☞ b. p a$^{\mu}$ r$^{\mu}$ [par:]				*
c. p a$^{\mu\mu}$ r [pa:r]			*!	
d. p a$^{\mu\mu}$ r$^{\mu}$ [pa:r:]	*!		*!	*

Candidates (a) and (d) are suboptimal because they violate the condition the stressed syllables are both minimally and maximally bimoraic. Candidate (c) fatally violates the constraint against changing the moraic content of consonants by deleting a mora. Candidate (b) violates the markedness constraint against moraic consonant, but it is still optimal because candidates (a), (c), and (d) violate a higher-ranked constraints.

An input with a non-moraic consonant in the input will surface with a non-moraic consonant in the output. Since the consonant is non-moraic, the winning candidate will have a long vowel to maintain the bimoraicity condition. (104) shows that the faithfulness constraint on consonants must be higher ranked than both the faithfulness constraint on vowels and the markedness constraint against moraic vowels, since the vowel adds a mora to ensure that the consonant does not.

(104) /pa$^{\mu}$r/ *bar*	*TRIMOR	StoW	IDENT MORA [C]	*MORA [V]	IDENT MORA [V]
a. pa$^{\mu}$ r [par]		*!		*	
b. pa$^{\mu}$ r$^{\mu}$ [par:]			*!	*	
☞ c. pa$^{\mu\mu}$r [pa:r]				**	*
d. pa$^{\mu\mu}$ r$^{\mu}$ [pa:r:]	*!		*!	**	*

Candidate (d) fatally violates the constraint against trimoraic syllables, and candidate (a) fatally violates the constraint against monomoraic stressed syllables. Even though candidate (c) violates the vowel faithfulness constraint by lengthening the vowel, and it violates the vowel markedness twice, it is optimal because the competing bimoraic candidate (b) crucially violates the higher-ranked consonant faithfulness constraint.

With the constraint ranking in (105), with IDENTMORA[C] (and *TRIMOR and StoW) highest-ranked, vowel length is always determined by underlying consonant moraicity. Consonant weight is distinctive.

(105) StoW, *TRIMOR, IDENTMORA[C] >> IDENTMORA[V], *MORA[C], *MORA[V]

Disyllables

Given the constraint ranking in (105), disyllables are evaluated straight forwardly. Stressed vowels surface as short before underlyingly moraic consonants (geminates), and they surface as long before underlyingly non-moraic consonants. The following tableaux and discussions will only address the evaluation of bimoraic stressed syllables.

(106) demonstrates short vowels surfacing before geminates.

(106) /vi$^{\mu}$s$^{\mu}$a/ *vissa*	IDENT MORA[C]	IDENT MORA [V]	*MORA [C]	*MORA [V]
☞ a. v i$^{\mu}$ s$^{\mu}$ a [vis:a]			*	*
b. v i$^{\mu\mu}$ .sa [vi:.sa]	*!	*		**

Candidate (b) fatally violates the consonant faithfulness constraint because it has lost a mora from the consonant.

(107) shows that an input with a non-moraic medial consonant will surface with a long vowel and non-moraic consonant.

(107) /vi$^{\mu}$sa/ *visa*	IDENT MORA [C]	IDENT MORA [V]	*MORA [C]	*MORA [V]
a. vi$^{\mu}$ s$^{\mu}$ a [vis:a]	*!		*	*
☞ b. v i$^{\mu\mu}$ .s a [vi:.sa]		*		**

Candidate (b) is optimal because candidate (a) fatally violates the highly-ranked consonant faithfulness constraint.

Summary of Icelandic

In Icelandic stressed syllables, all consonants have distinctive weight, and vowels have non-distinctive length. This means that in stressed syllables that are required to be bimoraic, the length of the vowel is determined by the weight of the following consonant. If a consonant is underlyingly moraic, the preceding vowel surfaces as short. If a consonant is underlyingly non-moraic, the preceding vowel surfaces as long. This system of distinctive consonant weight is captured by ranking faithfulness to consonant moraicity above the markedness constraint against moraic consonants and the markedness and faithfulness constraints on vowel length.

CHAPTER VII

Conclusion

The immediate goal of this paper was to show that interleaving faithfulness constraints on underlying mora associations and a universal Zec-like markedness hierarchy on mora associations straight forwardly accounts for the distribution of vowels in (at least) stressed monosyllables and penultimate syllables in monomorphemes in three dialects of English (RP, SAE, and NYE). In doing this, I argued for constraint rankings that result in three types of vowels: distinctive-length vowels, non-distinctive-length vowels, and a hybrid vowel which has the characteristics of both. RP has only distinctive-length vowels. SAE has distinctive-length vowels and non-distinctive-length vowels. NYE has all three types. In the case of the distinctive-length vowels, vowel length determines the weight of the following consonant. In non-distinctive length, (lack of) consonant weight determines vowel length. The length of the hybrid vowel is sometimes determined by the (lack of) weight of the following consonant, and sometimes it determines the weight of the following consonant.

In addition, the broader goal of this paper was to show that re-ranking the members of the constraint families: IDENTMORA[SEG] and *MORA[SEG], provides a general mechanism for analyzing the dependency between vowel length and consonant moraicity.

7.1 Goals for Future Research

There are several issues mentioned in this paper that require further investigation. These include:

- ♦Finding evidence (languages) to support the full typology proposed in Chapter VI.
- ♦Provide an adequate analysis of the English stress system, and explore the possibility of variation in the stress systems and syllabification of different dialects.
- ♦Be more precise about the nature of English vowel systems. What is the relationship between vowel quantity, quality, and diphthongization.
- ♦Do a more careful phonetic/phonological investigation of the lax and tense low front vowel in NYE. My claim is that the tense vowel is phonologically short and the lax vowel is phonologically long. This is counter to all other accounts and requires further exploration.
- ♦Give a more adequate account of Icelandic which includes all the relevant data. This will have interesting implications on the nature of moras in correspondence. It will provide evidence for splitting the IDENTMORA[SEG] constraint into MAX-like and DEP-like constraints. It will also introduce an interaction between the constraints already proposed and constraints requiring word-final extrametricality and Weight by Position.

♦Investigate Weight by Position and its relationship with IDENTMORA[SEG] and constraints requiring bimoraicity.

APPENDIX

Tableaux evaluating the typology presented in Chapter VI.

6.1.1 - *MORA[C] >> *MORA[V] >> IDENTMORA[V], IDENTMORA[C]

(108) /CV$^{\mu}$C/	*MORA [C]	*MORA [V]	IDENT MORA[V]	IDENT MORA[C]
a. ☞ CV$^{\mu}$C		*		
b. CV$^{\mu}$C$^{\mu}$	*!	*		*
c. CV$^{\mu\mu}$C		**!	*	
d. CV$^{\mu\mu}$C$^{\mu}$	*!	**	*	*

(109) /CV$^{\mu}$C$^{\mu}$/	*MORA [C]	*MORA [V]	IDENT MORA[V]	IDENT MORA[C]
a. ☞ CV$^{\mu}$C		*		*
b. CV$^{\mu}$C$^{\mu}$	*!	*		
c. CV$^{\mu\mu}$C		**!	*	*
d. CV$^{\mu\mu}$C$^{\mu}$	*!	**	*	

(110) /CV$^{\mu\mu}$C/	*MORA [C]	*MORA [V]	IDENT MORA[V]	IDENT MORA[C]
a. ☞ CV$^{\mu}$C		*	*	
b. CV$^{\mu}$C$^{\mu}$	*!	*	*	*
c. CV$^{\mu\mu}$C		**!		
d. CV$^{\mu\mu}$C$^{\mu}$	*!	**		*

(111) /CV$^{\mu\mu}$C$^{\mu}$/	*MORA [C]	*MORA [V]	IDENT MORA[V]	IDENT MORA[C]
a. ☞ CV$^{\mu}$C		*	*	*
b. CV$^{\mu}$C$^{\mu}$	*!	*	*	
c. CV$^{\mu\mu}$C		**!		*
d. CV$^{\mu\mu}$C$^{\mu}$	*!	**		

6.1.2 - IDENTMORA[V], *MORA[C] >> *MORA[V], IDENTMORA[C]

(112) /$CV^{\mu}C$/	IDENT MORA[V]	*MORA [C]	*MORA [V]	IDENT MORA[C]
a. ☞ $CV^{\mu}C$			*	
b. $CV^{\mu}C^{\mu}$		*!	*	*
c. $CV^{\mu\mu}C$	*!		**	
d. $CV^{\mu\mu}C^{\mu}$	*!	*!	**	*

(113) /$CV^{\mu}C^{\mu}$/	IDENT MORA[V]	*MORA [C]	*MORA [V]	IDENT MORA[C]
a. ☞ $CV^{\mu}C$			*	*
b. $CV^{\mu}C^{\mu}$		*!	*	
c. $CV^{\mu\mu}C$	*!		**	*
d. $CV^{\mu\mu}C^{\mu}$	*!	*!	**	

(114) /$CV^{\mu\mu}C$/	IDENT MORA[V]	*MORA [C]	*MORA [V]	IDENT MORA[C]
a. $CV^{\mu}C$	*!		*	
b. $CV^{\mu}C^{\mu}$	*!	*!	*	*
c. ☞ $CV^{\mu\mu}C$			**	
d. $CV^{\mu\mu}C^{\mu}$		*!	**	*

(115) /$CV^{\mu\mu}C^{\mu}$/	IDENT MORA[V]	*MORA [C]	*MORA [V]	IDENT MORA[C]
a. $CV^{\mu}C$	*!		*	*
b. $CV^{\mu}C^{\mu}$	*!	*!	*	
c. ☞ $CV^{\mu\mu}C$			**	*
d. $CV^{\mu\mu}C^{\mu}$		*!	**	

6.1.2 - *MORA[C] >> IDENTMORA[V], IDENTMORA[C] >> *MORA[V]

(116) /CV$^{\mu}$C/	*MORA [C]	IDENT MORA[V]	IDENT MORA[C]	*MORA [V]
a. ☞ CV$^{\mu}$C				*
b. CV$^{\mu}$C$^{\mu}$	*!		*	*
c. CV$^{\mu\mu}$C		*!		**
d. CV$^{\mu\mu}$C$^{\mu}$	*!	*	*	**

(117) /CV$^{\mu}$C$^{\mu}$/	*MORA [C]	IDENT MORA[V]	IDENT MORA[C]	*MORA [V]
a. ☞ CV$^{\mu}$C			*	*
b. CV$^{\mu}$C$^{\mu}$	*!			*
c. CV$^{\mu\mu}$C		*!	*	**
d. CV$^{\mu\mu}$C$^{\mu}$	*!	*		**

(118) /CV$^{\mu\mu}$C/	*MORA [C]	IDENT MORA[V]	IDENT MORA[C]	*MORA [V]
a. CV$^{\mu}$C		*!		*
b. CV$^{\mu}$C$^{\mu}$	*!	*	*	*
c. ☞ CV$^{\mu\mu}$C				**
d. CV$^{\mu\mu}$C$^{\mu}$	*!		*	**

(119) /CV$^{\mu\mu}$C$^{\mu}$/	*MORA [C]	IDENT MORA[V]	IDENT MORA[C]	*MORA [V]
a. CV$^{\mu}$C		*!	*	*
b. CV$^{\mu}$C$^{\mu}$	*!	*		*
c. ☞ CV$^{\mu\mu}$C			*	**
d. CV$^{\mu\mu}$C$^{\mu}$	*!			**

6.1.3 - IDENTMORA[V] >> IDENTMORA[C] >> *MORA[C] >> *MORA[V]

(120) /CV$^{\mu}$C/	IDENT MORA[V]	IDENT MORA[C]	*MORA [C]	*MORA [V]
a. ☞ CV$^{\mu}$C				*
b. CV$^{\mu}$C$^{\mu}$		*!	*	*
c. CV$^{\mu\mu}$C	*!			**
d. CV$^{\mu\mu}$C$^{\mu}$	*!	*	*	**

(121) /CV$^{\mu}$C$^{\mu}$/	IDENT MORA[V]	IDENT MORA[C]	*MORA [C]	*MORA [V]
a. CV$^{\mu}$C		*!		*
b. ☞ CV$^{\mu}$C$^{\mu}$			*	*
c. CV$^{\mu\mu}$C	*!	*		**
d. CV$^{\mu\mu}$C$^{\mu}$	*!		*	**

(122) /CV$^{\mu\mu}$C/	IDENT MORA[V]	IDENT MORA[C]	*MORA [C]	*MORA [V]
a. CV$^{\mu}$C	*!			*
b. CV$^{\mu}$C$^{\mu}$	*!	*	*	*
c. ☞ CV$^{\mu\mu}$C				**
d. CV$^{\mu\mu}$C$^{\mu}$		*!	*	**

(123) /CV$^{\mu\mu}$C$^{\mu}$/	IDENT MORA[V]	IDENT MORA[C]	*MORA [C]	*MORA [V]
a. CV$^{\mu}$C	*!	*		*
b. CV$^{\mu}$C$^{\mu}$	*!		*	*
c. CV$^{\mu\mu}$C		*!		**
d. ☞ CV$^{\mu\mu}$C$^{\mu}$			*	**

6.1.3 - IDENTMORA[C] >> *MORA[C], IDENTMORA[C] >> *MORA[V]

(124) /CV$^{\mu}$C/	IDENT MORA[C]	*MORA [C]	IDENT MORA[V]	*MORA [V]
a. ☞ CV$^{\mu}$C				*
b. CV$^{\mu}$C$^{\mu}$	*!	*		*
c. CV$^{\mu\mu}$C			*!	**
d. CV$^{\mu\mu}$C$^{\mu}$	*!	*	*	**

(125) /CV$^{\mu}$C$^{\mu}$/	IDENT MORA[C]	*MORA [C]	IDENT MORA[V]	*MORA [V]
a. CV$^{\mu}$C	*!			*
b. ☞ CV$^{\mu}$C$^{\mu}$		*		*
c. CV$^{\mu\mu}$C	*!		*	**
d. CV$^{\mu\mu}$C$^{\mu}$		*	*!	**

(126) /CV$^{\mu\mu}$C/	IDENT MORA[C]	*MORA [C]	IDENT MORA[V]	*MORA [V]
a. CV$^{\mu}$C			*!	*
b. CV$^{\mu}$C$^{\mu}$	*!	*	*	*
c. ☞ CV$^{\mu\mu}$C				**
d. CV$^{\mu\mu}$C$^{\mu}$	*!	*		**

(127) /CV$^{\mu\mu}$C$^{\mu}$/	IDENT MORA[C]	*MORA [C]	IDENT MORA[V]	*MORA [V]
a. CV$^{\mu}$C	*!		*	*
b. CV$^{\mu}$C$^{\mu}$		*	*!	*
c. CV$^{\mu\mu}$C	*!			**
d. ☞ CV$^{\mu\mu}$C$^{\mu}$		*		**

6.1.3 - IDENTMORA[C] >> *MORA[C] >> IDENTMORA[C] >> *MORA[V]

(128) /CV$^{\mu}$C/	IDENT MORA[C]	*MORA [C]	IDENT MORA[V]	*MORA [V]
a. ☞ CV$^{\mu}$C				*
b. CV$^{\mu}$C$^{\mu}$	*!	*		*
c. CV$^{\mu\mu}$C			*!	**
d. CV$^{\mu\mu}$C$^{\mu}$	*!	*	*	**

(129) /CV$^{\mu}$C$^{\mu}$/	IDENT MORA[C]	*MORA [C]	IDENT MORA[V]	*MORA [V]
a. CV$^{\mu}$C	*!			*
b. ☞ CV$^{\mu}$C$^{\mu}$		*		*
c. CV$^{\mu\mu}$C	*!		*	**
d. CV$^{\mu\mu}$C$^{\mu}$		*	*!	**

(130) /CV$^{\mu\mu}$C/	IDENT MORA[C]	*MORA [C]	IDENT MORA[V]	*MORA [V]
a. CV$^{\mu}$C			*!	*
b. CV$^{\mu}$C$^{\mu}$	*!	*	*	*
c. ☞ CV$^{\mu\mu}$C				**
d. CV$^{\mu\mu}$C$^{\mu}$	*!	*		**

(131) /CV$^{\mu\mu}$C$^{\mu}$/	IDENT MORA[C]	*MORA [C]	IDENT MORA[V]	*MORA [V]
a. CV$^{\mu}$C	*!		*	*
b. CV$^{\mu}$C$^{\mu}$		*	*!	*
c. CV$^{\mu\mu}$C	*!			**
d. ☞ CV$^{\mu\mu}$C$^{\mu}$		*		**

6.1.4 - IDENTMORA[C] >> *MORA[C] >> *MORA[V] >> IDENTMORA[C]

(132) /$CV^{\mu}C$/	IDENT MORA[C]	*MORA [C]	*MORA [V]	IDENT MORA[V]
a. ☞ $CV^{\mu}C$			*	
b. $CV^{\mu}C^{\mu}$	*!	*	*	
c. $CV^{\mu\mu}C$			**!	*
d. $CV^{\mu\mu}C^{\mu}$	*!	*	**	*

(133) /$CV^{\mu}C^{\mu}$/	IDENT MORA[C]	*MORA [C]	*MORA [V]	IDENT MORA[V]
a. $CV^{\mu}C$	*!		*	
b. ☞ $CV^{\mu}C^{\mu}$		*	*	
c. $CV^{\mu\mu}C$	*!		**	*
d. $CV^{\mu\mu}C^{\mu}$		*	**!	*

(134) /$CV^{\mu\mu}C$/	IDENT MORA[C]	*MORA [C]	*MORA [V]	IDENT MORA[V]
a. ☞ $CV^{\mu}C$			*	*
b. $CV^{\mu}C^{\mu}$	*!	*	*	*
c. $CV^{\mu\mu}C$			**!	
d. $CV^{\mu\mu}C^{\mu}$	*!	*	**	

(135) /$CV^{\mu\mu}C^{\mu}$/	IDENT MORA[C]	*MORA [C]	*MORA [V]	IDENT MORA[V]
a. $CV^{\mu}C$	*!		*	*
b. ☞ $CV^{\mu}C^{\mu}$		*	*	*
c. $CV^{\mu\mu}C$	*!		**	
d. $CV^{\mu\mu}C^{\mu}$		*	**!	

6.2.1 - StoW, *TRIMOR >> *MORA[C] >> *MORA[V], IDENTMORA[V], IDENTMORA[C]

(136) /CV$^{\mu}$C/	StoW	*TRIMOR	*MORA [C]	*MORA [V]	IDENT MORA [V]	IDENT MORA [C]
a. CV$^{\mu}$C	*!			*		
b. CV$^{\mu}$C$^{\mu}$			*!	*		*
c. ☞ CV$^{\mu\mu}$C				**	*	
d. CV$^{\mu\mu}$C$^{\mu}$		*!	*	**	*	*

(137) /CV$^{\mu}$C$^{\mu}$/	StoW	*TRIMOR	*MORA [C]	*MORA [V]	IDENT MORA [V]	IDENT MORA [C]
a. CV$^{\mu}$C	*!			*		*
b. CV$^{\mu}$C$^{\mu}$			*!	*		
c. ☞ CV$^{\mu\mu}$C				**	*	*
d. CV$^{\mu\mu}$C$^{\mu}$		*!	*	**	*	

(138) /CV$^{\mu\mu}$C/	StoW	*TRIMOR	*MORA [C]	*MORA [V]	IDENT MORA [V]	IDENT MORA [C]
a. CV$^{\mu}$C	*!			*	*	
b. CV$^{\mu}$C$^{\mu}$			*!	*	*	*
c. ☞ CV$^{\mu\mu}$C				**		
d. CV$^{\mu\mu}$C$^{\mu}$		*!	*	**		*

(139) /$CV^{\mu\mu}C^{\mu}$/	StoW	*TRIMOR	*MORA [C]	*MORA [V]	IDENT MORA [V]	IDENT MORA [C]
a. $CV^{\mu}C$	*!			*	*	*
b. $CV^{\mu}C^{\mu}$			*!	*	*	
c. ☞ $CV^{\mu\mu}C$				**		*
d. $CV^{\mu\mu}C^{\mu}$		*!	*	**		

6.2.2 - StoW, *TRIMOR >> IDENTMORA[V] >> *MORA[C], *MORA[V], IDENTMORA[C]

(140) /$CV^{\mu}C$/	StoW	*TRIMOR	IDENT MORA [V]	*MORA [C]	*MORA [V]	IDENT MORA [C]
a. $CV^{\mu}C$	*!				*	
b. ☞ $CV^{\mu}C^{\mu}$				*	*	*
c. $CV^{\mu\mu}C$			*!		**	
d. $CV^{\mu\mu}C^{\mu}$		*!	*	*	**	*

(141) /$CV^{\mu}C^{\mu}$/	StoW	*TRIMOR	IDENT MORA [V]	*MORA [C]	*MORA [V]	IDENT MORA [C]
a. $CV^{\mu}C$	*!				*	*
b. ☞ $CV^{\mu}C^{\mu}$				*	*	
c. $CV^{\mu\mu}C$			*!		**	*
d. $CV^{\mu\mu}C^{\mu}$		*!	*	*	**	

(142) /CVμμC/	StoW	*TRIMOR	IDENT MORA [V]	*MORA [C]	*MORA [V]	IDENT MORA [C]
a. CVμC	*!		*		*	
b. CVμCμ			*!	*	*	*
c. ☞ CVμμC					**	
d. CVμμCμ		*!		*	**	*

(143) /CVμμCμ/	StoW	*TRIMOR	IDENT MORA [V]	*MORA [C]	*MORA [V]	IDENT MORA [C]
a. CVμC	*!		*		*	*
b. CVμCμ			*!	*	*	
c. ☞ CVμμC					**	*
d. CVμμCμ		*!		*	**	

6.2.3 - StoW, *TRIMOR >> IDENTMORA[C] >> *MORA[C], *MORA[V], IDENTMORA[V]

(144) /CVμC/	StoW	*TRIMOR	IDENT MORA [C]	*MORA [C]	*MORA [V]	IDENT MORA [V]
a. CVμC	*!				*	
b. CVμCμ			*!	*	*	
c. ☞ CVμμC					**	*
d. CVμμCμ		*!	*	*	**	*

(145) /$CV^{\mu}C^{\mu}$/	StoW	*TRIMOR	IDENT MORA [C]	*MORA [C]	*MORA [V]	IDENT MORA [V]
a. $CV^{\mu}C$	*!		*		*	
b. ☞ $CV^{\mu}C^{\mu}$				*	*	
c. $CV^{\mu\mu}C$			*!		**	*
d. $CV^{\mu\mu}C^{\mu}$		*!		*	**	*

(146) /$CV^{\mu\mu}C$/	StoW	*TRIMOR	IDENT MORA [C]	*MORA [C]	*MORA [V]	IDENT MORA [V]
a. $CV^{\mu}C$	*!				*	*
b. $CV^{\mu}C^{\mu}$			*!	*	*	*
c. ☞ $CV^{\mu\mu}C$					**	
d. $CV^{\mu\mu}C^{\mu}$		*!	*	*	**	

(147) /$CV^{\mu\mu}C^{\mu}$/	StoW	*TRIMOR	IDENT MORA [C]	*MORA [C]	*MORA [V]	IDENT MORA [V]
a. $CV^{\mu}C$	*!		*		*	*
b. ☞ $CV^{\mu}C^{\mu}$				*	*	*
c. $CV^{\mu\mu}C$			*!		**	
d. $CV^{\mu\mu}C^{\mu}$		*!		*	**	

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