<Comments are very welcome>

Osage fills the gap: The quantity insensitive iamb & the typology of feet*

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ABSTRACT

This paper presents evidence for the *quantity-insensitive* (QI) iamb, the existence of which is important because it fills an empirical gap that-while denied by many-is predicted by many extant prosodic theories (e.g. Prince & Smolensky 1993/2004, McCarthy & Prince 1993, Halle & Vergnaud 1987). Moreover, given the standard view that QI trochees exist, QI iambs in Osage show that whether a foot is right or left-headed in a given language is *independent* of whether stress in that language is affected by the moraic make-up of syllables (contra the standard view).

The claim that QI iambs exist is not new, but until now there has been no unambiguous evidence for them. Previously cited cases either do not have a contrast between long and short vowels and/or can be reanalyzed as trochaic. Osage is the first clear case with QI iambic feet.

KEYWORDS: Osage, stress/accent, tone, iamb, quantity (in)sensitive, foot typology Optimality Theory

1.0 Introduction

It is generally held in the literature that if stress in a given language is affected by the quantity distinction of syllables, then this language can have iambic (right-headed) and/or trochaic (left-headed) feet[1]. However, if stress in a given language is *not* affected by the quantity distinction of syllables, then this language must have trochaic feet. For example, Hayes (1995: 268) writes: "…consider the mirror image of the even iamb, the syllabic trochee. Here, we find cases where a quantity distinction exists, but stress is nevertheless assigned to every other syllable, irrespective of quantity…In contrast, there appear to be no cases of this sort among iambic systems."

An example of a language that has the syllabic trochees described by Hayes is Gooniyandi (McGregor 1990, 1993; Kager 1992; Elías-Ulloa 2006), where the distinction between long and short vowels isn't translated into weight distinction for footing. As illustrated in (1), trochees are parsed left-to-right with stress surfacing on every odd-

[1] For example, the foot type (iamb or trochee) in Yidiɲ is predictable based on the quantity distinction of syllables (see Dixon 1977, Kager 2006).

numbered syllable irregardless of the moraic make-up of syllables. Note that I make the standard assumption that a syllable is heavy ("H") if and only if it is at least bimoraic; a syllable is light ("L") if and only if it is monomoraic. For the purposes of this paper, what is crucial is that a syllable with a long vowel is necessarily heavy.

(1) <u>Gooniyandi</u>

a.	/LH/	→ (ˈ**L**H)	ˈ**nga**boː	'father'
b.	/LL/	→ (ˈ**L**L)	ˈ**ba**ga	'burr'
c.	/HL/	→ (ˈ**H**L)	ˈ**boːl**ga	'owl'
d.	/HH/	→ (ˈ**H**H)	ˈ**doː**mboː	'old man'
e.	/LLLH/	→ (ˈ**L**L)(ˌ**L**H)	ˈ**ja**mbinˌ**ba**roː	'a type of fish'
f.	/LHHH/	→ (ˈ**L**H)(ˌ**H**H)	ˈ**ba**boːˌ**ddoː**nggoː	'to the bottom'
g.	/LLLL/	→ (ˈ**L**L)(ˌ**L**L)	ˈ**ngi**ddiˌ**warn**di	'across'

Much of the literature on metrical theory over the past two decades has attempted to address the question of whether the lack of *quantity insensitive* (QI) iambs—the iambic counterparts to trochess in (1)—reflects a fundamental property of the grammar[2]. This question is highly non-trivial as a heavy burden is placed on the analyst to rule out the iambs in (2a), while also predicting that a language can have the trochees in (2b).

(2a) IAMBS	*(Hˈ**L**)	*(Hˈ**H**)
(2b) TROCHEES	(ˈ**L**H)	(ˈ**H**H)

The traditional view in metrical theory has been that there is a *universal foot inventory*, which is a primitive in every grammar. On this view, language x differs from language y in its selection of foot types from this inventory (Hayes 1985, 1987, 1995; McCarthy & Prince 1986; Prince 1990). If this inventory does not include the iambs in (2a) then it is predicted that no natural language has feet of this type (see Hayes' (1995)

[2] For example see Hyman (1977), Hayes (1981), (1985), (1987), (1995); McCarthy & Prince (1986); Halle & Vergnaud (1987); Prince (1990); Rice (1992), Kager (1993), (1995a,b), (2006); Alber (1997), (2005); Eisner (1997); Van de Vijver (1998); Revithiadou (2004), etc..

Iambic-Trochaic Law and the experiments in Rice (1992) for a functional explanation as to why QI iambs are unattested).

More recently, it has been argued that the typology of feet result from the interaction of Optimality Theoretic constraints (Prince & Smolensky 1993; McCarthy & Prince 1993a,b, 1995). On this view, language x differs from language y given that x and y require a different ranking of constraints, which are part of every grammar. To rule out the iambs in (2a), the set of constraints have to be defined in such a way that these foots types are harmonically bounded (Prince & Samek-Lodovici 2002) by an optimal parse in every language. To the best of my knowledge, no Optimality Theoretic account of feet has been successful in this regard (however, see Eisner 1997 for a different competition-based-theory of feet). For example, Kager (2006) follows Gordon (2002) in arguing that eight unidirectional quantity insensitive systems are predicted by the interaction of Optimality Theoretic constraints that are violated based on whether a prosodic word has: (i) right-headed or left-headed feet, (ii) a rightward or a leftward parse, and (iii) monosyllabic feet or stray syllables.

(3)	QUANTITY INSENSITIVE TROCHEES 45 languages		**QUANTITY INSENSITIVE IAMBS** **9 languages**	
	LEFT-TO-RIGHT 32 languages	RIGHT-TO-LEFT 13 languages	**LEFT-TO-RIGHT** **4 languages**	**RIGHT-TO-LEFT** **5 languages**
STRICTLY BINARY 29 languages	(a) (ˈσσ)(ˌσσ) (b) (ˈσσ)(ˌσσ)σ 14 languages (e.g. Pintupi)	(c) (ˌσσ)(ˈσσ) (d) σ(ˌσσ)(ˈσσ) 12 languages (e.g. Warao)	**(i) (σˈσ)(σˌσ)** **(j) (σˈσ)(σˌσ)σ** **3 languages** **(e.g. Araucanian)**	**(k) (σˌσ)(σˈσ)** **(l) σ(σˌσ)(σˈσ)** **unattested**
BINARY & UNARY 25 languages	(e) (ˈσσ)(ˌσσ) (f) (ˈσσ)(ˌσσ)(ˌσ) 18 languages (e.g. Murinbata)	(g) (ˌσσ)(ˈσσ) (h) (ˌσ)(ˌσσ)(ˈσσ) 1 language (Biangai)	**(m) (σˈσ)(σˌσ)** **(n) (σˈσ)(σˌσ)(ˌσ)** **1 language** **(Ojibwa)**	**(o) (σˌσ)(σˈσ)** **(p) (ˌσ)(σˌσ)(σˈσ)** **5 languages** **(e.g. Weri)**

The major problem with a theory that derives the typology in (3), is that the nine attested languages that can potentially be analyzed as having QI iambs either do not have a contrast between short and long vowels, and/or are subject to a trochaic re-analysis (see Kager 1989, Hayes 1995); crucially, none of the attested languages in (3) have the iambs in (2a)[3]. Therefore, a theory that derives the typology in (3) clearly lacks empirical basis and it remains an open question whether it over-generates.

The aim of this paper is argue that any typological theory of feet *must* predict the QI iambs in (2a). The argument rests on data from Osage (Quintero 1977, 1994a,b, 1995, 2001, 2004, 2005, 2006), which is typologically remarkable because it is the first clear case with QI iambic feet. The analysis advocated in this paper is Optimality Theoretic; it is shown that Osage fills the empirical gap that is inherent in a typology that results from the interaction of prosodic constraints in Prince & Smolensky (1993) and McCarthy & Prince (1993a,b, 1995). I provide measurements of vowel duration, amplitude and fundamental frequency to support my analysis.

The default stress pattern in Osage has primary stress on the peninitial syllable, followed by secondary stress on every other syllable:

(4)	a.	/nɑ̃ː-xõ/	→	[nɑ̃ːˈ**xo**]
		by.foot-break		‘break by foot’
	b.	/ɑ-ɑlẽː/	→	[ɑːˈ**leː**]
		A1S-leave		‘I left’
	c.	/ʰpɑːʃ͡tseka/	→	[ʰpɑːˈ**ʃ͡tse**kɑ]
		strawberry		‘strawberry’

[3] As noted in Hayes (1995), grammars in which many of these languages are documented do not provide phonological diagnostics to support their transcription and/or offer a limited set of relevant data. A prime example is Araucanian, which is claimed to have even iambs based on a very small sample of data from a single source (Echeverria and Contrreras 1965).

d. /ðyː- ʰkɑːmɑ̃/ → [ðyːˈ**ʰkɑː**mɑ̃]
by.hand-ring 'to ring the bell'

e. /xõːt͡se-o-ðiː-brɑ̃/ → [xõːˈ**t͡so**ðiːˌ**brɑ̃**]
cedar-LOC-by.hand-smell 'smoke cedar'

An alternative hypothesis is to say that the default pattern is initial stress and that peninitial stress is lexically marked. At first glance, there seems to be some support for this view since there are words with initial stress in Osage (see (5)); primary stress never surfaces on a syllable other than the first two (i.e. the 'window' for primary stress is the first two syllables).

(5) a. /ˈ**wɑ**-ðɑːwɑ-ɑ/ → [ˈ**wɑ**ðɑːˌ**wɑ**]
P3P-count-IMPER 'count them!"

b. /ˈ**i**-ʰpiːʒi/ → [ˈ**iʰ**piːˌ**ʒi**]
with-be.sick 'he's sick with [something]'

c. /ˈ**ʰkɑ**wɑ-ɑ-ɫiː/ → [ˈ**ʰkɑ**wɑːˌ**ɫiː**]
horse-upon-sit 'horseback riding'

d. /ˈ**ho**ːsɑːki/ → [ˈ**ho**ːsɑːˌ**ki**]
yell 'to yell'

e. /ˈ**mĩ**ː-ðoːpɑ/ → [ˈ**mĩ**ːðoːˌ**pɑ**]
sun-two 'moon'

However, upon a closer inspection, it is clear that this alternative hypothesis is inconsistent with the Osage data. The reason is that a default position can host a distinction between underlyingly stressed and underlyingly unstressed syllables, whereas a non-default position cannot. I argue that the affixal alternation patterns in Osage show that it is, in fact, the *second* syllable where this contrast must be admitted; forms with initial stress on the surface are lexically marked. I show that this hypothesis is consistent with the Osage data, predicted by the interaction between faithfulness constraints preserving lexical stress and markedness constraints that impose a certain prosodic structure.

Subsequently, I argue that the *default obeying* forms in, e.g. (4), are parsed as iambs from left-to-right (see (6)). And crucially, the vowel length distinction in these forms isn't translated into a weight distinction for footing.

(6)	a.	nɑ̃ːˈ**xo**	(Hˈ**L**)	'break by foot'
	b.	ɑːˈ**leː**	(Hˈ**H**)	'I left'
	c.	ʰpɑːˈ**ʃ͡tse**kɑ	(Hˈ**L**)L	'strawberry'
	d.	ðyːˈʰ**kɑː**mɑ̃	(Hˈ**H**)L	'to ring the bell'
	e.	xõːˈ**t͡so**ðiːˌ**brɑ̃**	(Hˈ**L**)(Hˌ**L**)	'smoke cedar'

Moreover, *default defying* forms in, e.g. (5), are also parsed as iambs from left-to-right with a monosyllabic foot at the left edge of the prosodic word: (ˈ**σ**)(σˌ**σ**). Things are more complex, however, when default defying forms with an even number of syllables are considered; the proposed analysis allows both an iambic and a trochaic parse, e.g. (ˈ**σ**)σ vs. (ˈ**σ**σ). This issue is addressed in section 4.3.

In addition to showing that the iambic analysis makes the correct predictions straightforwardly, I also consider and ultimately reject an alternative analysis in which the forms in (6) are parsed as trochees, with a stray syllable at the left edge of the prosodic word: σ(ˈ**σ**), σ(ˈ**σ**σ), σ(ˈ**σ**σ)σ, etc. The downfall of this an analysis is that it requires a non-initial stress constraint that makes odd typological predictions.

The major consequence of the argument in this paper is that if a language that distinguishes quantity of syllables has iambs, it *does not* necessarily follow that stress placement in that language is affected by the moraic make-up of syllables (contra the generally held view). In other words, whether a foot is right-headed or left-headed in a given language is *independent* of whether stress in this language is affected by the moraic make-up of syllables.

2.0 An introduction to the Osage data

2.1 *Background*

Osage is a Siouan language that is part of the Dhegiha subgroup, which also includes Omaha-Ponca, Kansa (Kaw) and Quapaw. As noted in Quintero (2004: 2), "Regional variation within Osage is limited. Some slight differences in lexical items are seen among speakers of different districts [in Oklahoma, United States]…but the number of these items is so small as not to constitute reason for positing a separate dialect." Moreover, "…by nearly everyone's estimates, there were approximately five to ten [fluent native] speakers of Osage alive in 1996, and these numbers had been reduced by half by the close of the century. Without extensive exploration, it is difficult to decide who is a [fluent] speaker and who is a semispeaker, as the language has lapsed into disuse. Some elders profess to understand Osage, but few claim to be able to speak it."

The data in this paper comes from eight sources: a grammar of Osage (Quintero 2004), four tape recordings of native speakers of Osage (Quintero 1977, 1994a,b, 2001), two Osage stories (Quintero 1995b, 2006) and a letter written in Osage (Quintero 2005).

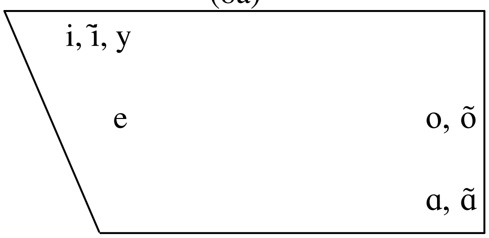
2.2 *Consonants and vowels*

The table in (7) illustrates Osage consonants that appear on the surface (see Quintero 2004: 16-37 for more discussion).

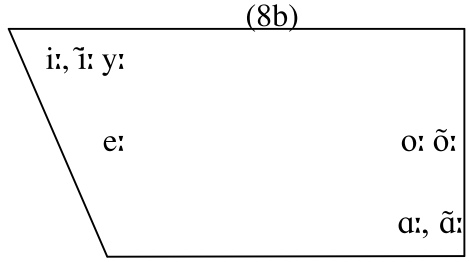
(7)	LABIAL	DENTAL	ALVEOLAR	POST-ALVEOLAR	VELAR	GLOTTAL
PLOSIVES	p, ʰp, pʔ, b	t̪, ʰt̪			k, ʰk, kʔ	
NASALS	m	n				
FRICATIVES		ð̪	s, z	ʃ, ʒ	x, ɣ	h
AFFRICATES			t͡s, ʰt͡s, t͡sʰ, t͡sʔ			
APPROXIMANTS	w	l				

The tables in (8) illustrate Osage vowels that appear on the surface.

(8a)



(8b)



It is important to note that vowel length is contrastive in Osage; long vowels differ from short vowels in terms of duration (see section 2.4.1). Minimal and near-minimal pairs are illustrated in (9)-(16).

(9)	a.	ˈw**e**li	‘oil’	(10)	a.	**o**ˈðɑhɑ	‘follow’
	b.	ˈw**eː**li	‘head’		b.	**oː**ˈðɑhɑ̃	‘you cook’
(11)	a.	ˈn**ɑ̃**ɣe	‘ice’	(12)	a.	ˈw**ɑ**t͡sʰi ˈnie	‘venereal disease’
	b.	ˈn**ɑ̃ː**ɣe	‘spirit’		b.	w**ɑː**ˈ t͡sʰi	‘to dance’
(13)	a.	mˈ**ĩ**t͡se	‘crawl’	(14)	a.	ˈwɑð**y**ˌwĩ	‘buy for them’
	b.	ˈ**ĩː**t͡se	‘face’		b.	ð**yː**ˈwɑsy	‘cleanse’
(15)	a.	ˈʃ**õ**	‘while’	(16)	a.	ˈ**i**stɑ	‘to bless with’
	b.	ʃ**õː**ˈʃoðẽ	‘always’		b.	**iː**ˈʃtɑ	‘eyes’

The fact that Osage has a length distinction is crucial because it is argued in section 4 that this distinction isn’t translated into a weight distinction for footing.

2.3 *Syllable structure*

2.3.1 Coda avoidance

According to Quintero (2004), the syllabic template for Osage is: ((C)C)V(ː). Quintero provides the following evidence that there are no codas in the language:

(17) a. No known phonological processes indicate syllabification of medial consonants as coda instead of onset.
b. There are no word-final consonants.

More evidence that there are no codas in Osage is a phonological process of *k*-deletion, which is common in Siouan. As illustrated in (18a,b,c) 1st person plural agentive prefix *ãk* is faithfully mapped to the surface when it precedes a vowel. On the other hand, (18d,e,f) illustrate that if *ãk* precedes a consonant, then the final consonant in this prefix is deleted[4].

(18)

	Verbal stem		1st person singular agentive form	
a.	oʰkɑ	'help'	**ãk**-oʰkɑ	'we help him/her'
b.	ɑðeː	'go'	**ãk**-ɑðeː	'we go'
c.	ɑhi	'arrive there'	**ãk**-ɑhi	'we arrive there'
d.	ðɑː t͡sʰe	'eat'	**ã**-ðɑːt͡sʰe	'we eat'
e.	tõpe	'look'	**ã**-tõpe	'we look'
f.	kˀy	'give'	**ã**-kˀy	'we give'

Note that an alternative hypothesis is to say that when the 1st person singular agentive prefix *ã* precedes a vowel, *k* is epenthesized in order to avoid vowel hiatus. Such an

[4] More evidence of coda avoidance is seen in (ii), where *ãk* is an infix that precedes the verbal stem beginning with a consonant.

(i) /i-xope/ → [ixope]
PREV-lie 'to lie'
(ii) /i-ãk-xope/ → [ãnãxope]
PREV-A1P-lie 'we lie'

analysis, however, puts a heavy burden on the analyst to explain why *k* and not some other consonant is epenthesized, especially since vowel hiatus is never resolved by an epenthetic *k* in other environments and to the best of my knowledge, there is no language in which this strategy is employed.

2.3.2 Obstruent clusters

As illustrated in (19) and (20), Osage allows obstruent clusters in the onset both word-initially and word-medially[5]. Note that these clusters constitute two voiceless segments, which are either stop-fricative or fricative-stop.

(19)	a.	ˈ**xt**ã	'spill'
	b.	ˈ**tx**ã	'standing'
	c.	ˈ**xp**ekɑ	'dull; faded'
	d.	ˈ**pʃ**e	'pound'
	e.	**ʃp**ɑːˈse	'you cut'
	f.	**ʃt**ɑːˈt͡se	'you name'
	g.	ˈ**kʃ**okã	'second son'

(20)	a.	ˈo**px**ɑ	'elk'
	b.	ðyːˈ**kʃ**iːt͡se	'miss [as when throwing or catching a ball]'
	c.	**ʃk**ãˈ**ʃk**ã	'moving'
	d.	ˈ**ʃk**õ**ʃt**ɑ	'you want'
	e.	ðyːˈ**ʃt**ɑke	'to undress'
	f.	ˈho**xp**e	'to cough'
	g.	ˈwɑː**sp**e	'to stay'

The table in (21) summarizes the obstruent consonant clusters in Osage (see Quintero 2004: 26-36 for more discussion).

[5] Note that various Osage forms violate Sonority Sequencing Principle (e.g. see (19a,c,e,f) and (20c,d,e,f,g,h)). Following Morelli (1999), I assume that SSP is not a universal principle. Morelli characterizes Dakota (Mississippi Valley Siouan) as a Type 5 language in the typology (see chapter 2), i.e. it allows fricative-stop, stop-fricative and stop-stop sequences. Moreover, Altshuler (2005a) characterizes Biloxi (Ohio Valley Siouan, see Einaudi 1976 and references therein) as a Type 5 language as well. As noted by Bob Rankin (p.c.), the initial stop in a stop-stop sequence in Dhegiha Siouan collapsed into the second historically.

(21)

STOP	FRICATIVE	+ FRICATIVE	+ STOP	RESULTING CLUSTER
p		x, ʃ		px, pʃ
t		x		tx
k		x, s, ʃ		kx, ks, kʃ
	ʃ		p, t, k	ʃp, ʃt, ʃk
	x		p, t	xp, xt
	s		p, t, k	sp, st, sk

In summary, Osage has long and short vowels and there are no closed syllables; complex clusters in the onset usually consist of two obstruents[6]. In the next section, I provide phonetic evidence that there is stress in Osage, correlating with a rise in fundamental frequency (F_0) and increased duration.

2.4 *Evidence for stress*

In this section I argue that Osage has feet and that foot heads are realized with *stress*, which correlates with a rise in fundamental frequency (F_0) and increased duration. This generalization is in accordance with e.g. Laver (1994), where it is argued that a stressed syllable is one that is made more prominent than other (unstressed) syllables by an exaggeration of one or more of the acoustic parameters of F_0, amplitude and duration. Although both F_0 and duration play a significant role in cuing stress in Osage, it is not

[6] In addition to obstruent clusters, *br* is productive in Osage, occurring word-initially and word medially as in (i) and (ii).

(i) ˈ**br**i**br**ɑ ‘I smell cedar’

(ii) ˈpo**br**ɑˌskɑ ‘flatten by shooting’

Moreover, the affricate *t͡s* also combines with fricatives to yield the clusters in (iii)-(v).

(iii) wɑˈ**st͡s**yt͡se ‘be slow’

(iv) ˈ**ʃt͡s**eː ‘you go’

(v) pɑːˈ**xt͡s**e ‘tie down [e.g. a drum]’ clear which cue is dominant. Moreover, amplitude consistently provides a cue for which syllable carries primary stress; in some forms, amplitude also provides a cue for which syllable carries secondary stress, while in other forms, this is less clear.

As illustrated in (22), two stress patterns were observed: (i) the first syllable is stressed and every other odd-numbered syllable carries secondary stress, and (ii) the second syllable is stressed and every other even-numbered syllable carries secondary stress. In sum, stress always alternates; there is neither clash nor lapse (see sections 2.4.1-2.4.2 for measurements)[7].

(22) <u>Distribution of stress in Osage</u>

a. [ˈ**σ**σˌ**σ**σ…]

b. [σˈ**σ**σˌ**σ**…]

Another hypothesis explored in section 2.4.3 is that there is tone in Osage. It is argued that high tones fall on stressed syllables and on unstressed initial syllables, while low tones fall on all other unstressed syllables (see (23)).

(23)

MAIN STRESS	ODD # OF σ'S	EVEN # OF σ'S
1st syllable	ˈ**σ** σ ˌ**σ** H L H	ˈ**σ** σ ˌ**σ** σ H L H L
2nd syllable	σ ˈ**σ** σ H L	σˈ**σ** σˌ**σ** H L H

To measure duration, amplitude and fundamental frequency in Osage, two programs were used: *Praat* (http://www.fon.hum.uva.nl/praat/) and *Speech Analyzer* (http://www.sil.org/computing/speechtools/speechanalyzer.htm). The data was recorded

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7 Note that no words containing more than five syllables were measured (mainly due to the fact that such forms are rare) and the forms with five syllables that were had primary stress on the second syllable (see word list in Appendix A). Therefore, the hypothesis that stress alternates is based on words with no more than two stressed syllables (i.e. first & third and second & fourth).

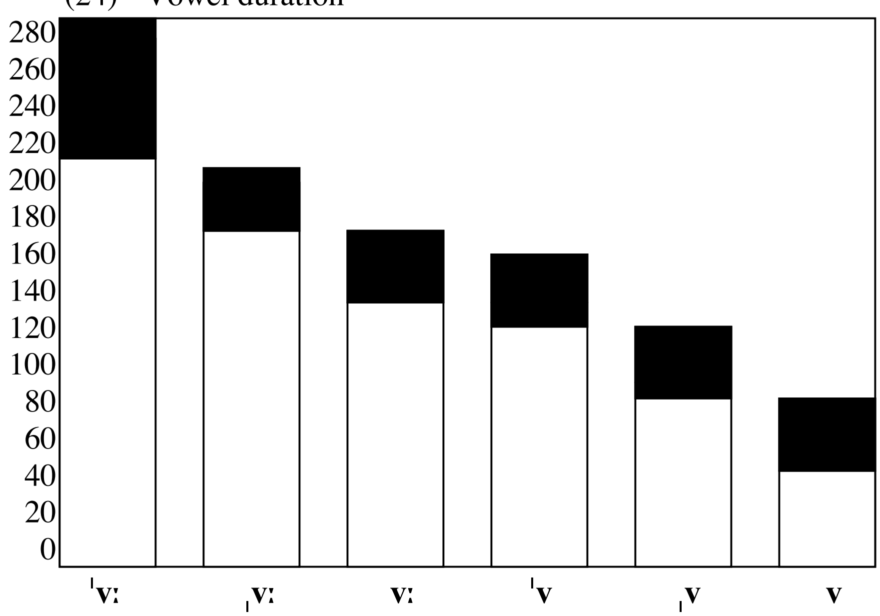
on analog tapes by Carolyn Quintero (1977, 1994a,b, 2001); the tapes were digitized by Paul de Lacy at mono 16-bit 44100kHz using a tape-deck attached to a Sound Blaster Audigy 2 ZS sound card into WAV format onto a Windows PC using Goldwave 5.06 (http://www.goldwave.com). Recordings of three female speakers were used for analysis: Margaret Red Eagle Iron (1912 – 1996), Frances Holding (1917 – 2002) and Myrtle Oberly Jones (1917-1986). The first speaker is recorded reading *Christmas and New Years Greeting* in Osage on one of the tapes (Quintero 1994a), and reciting various Osage words and expressions on the other (Quintero 199b); the second speaker is recorded reciting various Osage words and expressions after listening to Lenora Hamilton (1912-1991) on tape (Quintero 1994a); the third speaker is recorded reciting a vocabulary list and various common expressions in Osage (Quintero 1977).

The generalizations in this section reflect sixty-four words and expressions out of over one hundred fifty that were measured; all but a few of the sixty-four words correspond to the transcription in Quintero (1977, 1994a,b, 2004). Margaret Red Eagle Iron pronounced twenty of these words, Frances Holding pronounced twenty-one, and Myrtle Oberly Jones twenty-three (see Appendix A for the word-list). The main criteria used to select which words to analyze was the quality of the recorded speech. While the most of the recording of Margaret Red Eagle Iron and Myrtle Oberly Jones was clear, the recording of Frances Holding was marginal (some of the words were spoken softly and/or were affected by background noise). Note that the tapes used represent the few available live recordings of Osage and there has been no laboratory work done on this language until now. Although the resources are limited, the consistency in the data nevertheless points to a straightforward analysis.

2.4.1 Vowel duration

When measuring vowel duration, words with similar length and vowel sequences were compared; the consonants differed in various syllables in some of the forms. Crucially, these near-minimal pairs differed as to whether the first or the second syllable carried primary stress (see e.g. ˈ***wa****kõ*ˌ***ða****pi* vs. *wa*ˈ***ʰkõ****ta* in Appendix B, where a spectrogram analysis is provided). The measurements of vowel duration (in terms of milliseconds) are summarized in (24). The shading indicates the range of attested length of the vowels *a*, *o*, *e* and *i* (as well as their nasal counterparts); although vowels with greater sonority tended to be longer than the less sonorant vowels, this difference is not significant when comparing e.g. a high front vowel with primary stress and a low back vowel with secondary stress, etc. Note that the measurements of word-final syllables are not included in the table below due to phrase final lengthening in some of the forms[8].

(24) Vowel duration

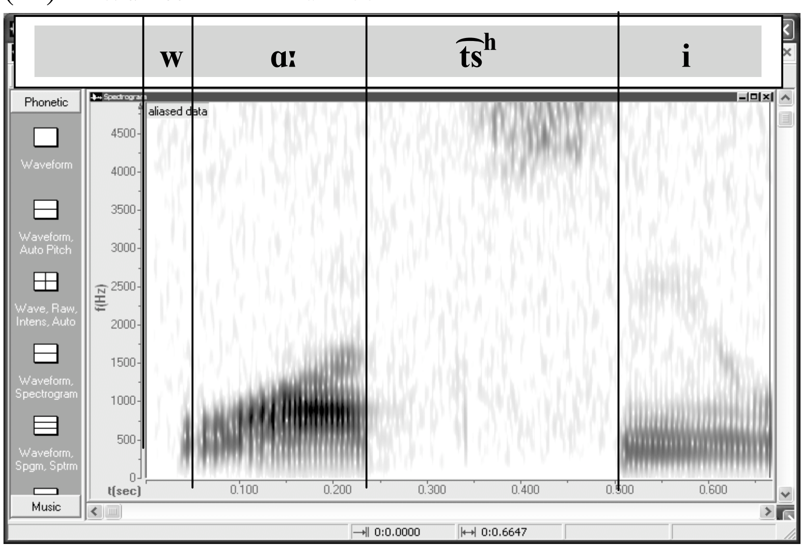


[8] Moreover, note that various words pronounced by Myrtle Oberly Jones were in isolation. Since vowels in these words are much longer than those pronounced in context, I omit them from the table in (24).

What is striking about (24) is that short vowels with primary stress often overlap in terms of duration with unstressed long vowels. Moreover, there is a consistent difference in duration between vowels that have primary stress, secondary stress, and vowels that are unstressed.

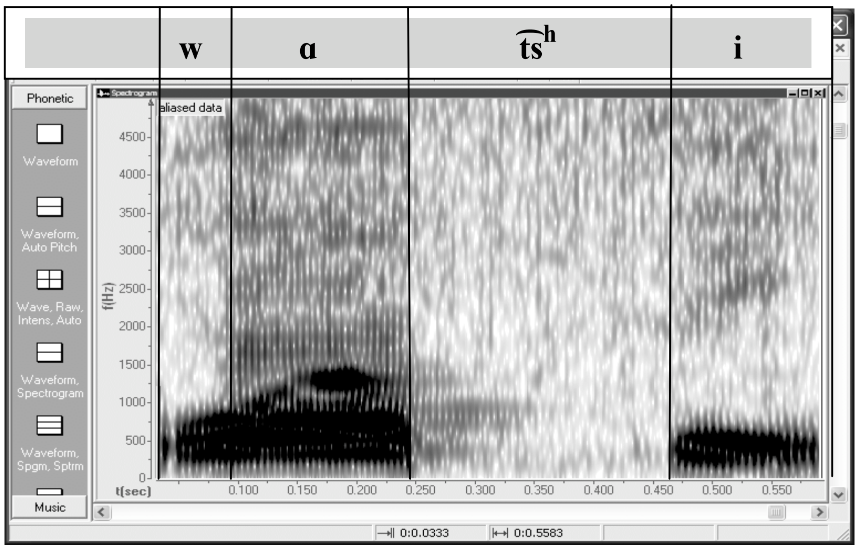
It is important to note that although there are no quantity adjustments of syllables in Osage, the consonant in the onset appears lengthened in some of the forms. For example, while the first vowel in *waːˈ**t͡sʰi*** is 175 ms. and the second vowel is 162 ms., the first syllable is 227 ms. and the second syllable is 443 ms. In other words, the consonant in the second syllable is longer than the entire initial syllable (see spectrogram below).

(25) wɑːˈ**t͡sʰi** ‘dance’



Although the length of the affricate is quite striking, note that aspirated and glottal consonants are significantly longer than other consonants whether or not the syllable is stressed. For example, while the first vowel in (26) is 167 ms. and the second vowel is 128 ms., the first syllable is 214 ms. and the second syllable is 343 ms. In other words, the consonant in the second syllable is longer than the entire initial syllable even though the first syllable is stressed.

(26) ˈ**wɑ**t͡sʰi ˈ**ni**e ‘venereal disease’



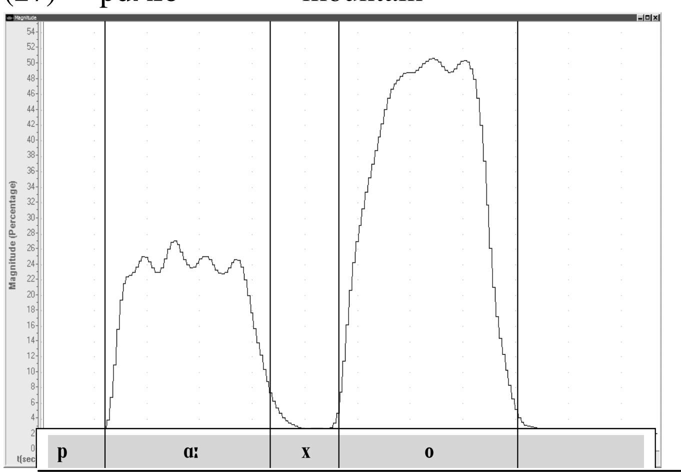
The similar length of *t͡sʰ* in (25) and (26) suggests that it intrinsically long and therefore, the appearance of lengthened consonants in strong positions is superficial. Moreover, it’s worth noting that the initial stressed *a* in (26) is only a few ms. shorter than the initial unstressed *aː* in (25). However, the peninitial unstressed *i* in (26) is much shorter than the peninitial stressed *i* in (25). Assuming that Osage has stress, these facts are expected.

2.4.2 Amplitude

To measure amplitude (in terms of linear magnitude %), words with at least three syllables were measured as well as forms with stressed light syllables, even though the neighboring syllable is heavy. As previously noted, unlike duration and fundamental frequency, amplitude does not provide a consistent cue for which syllable is stressed;

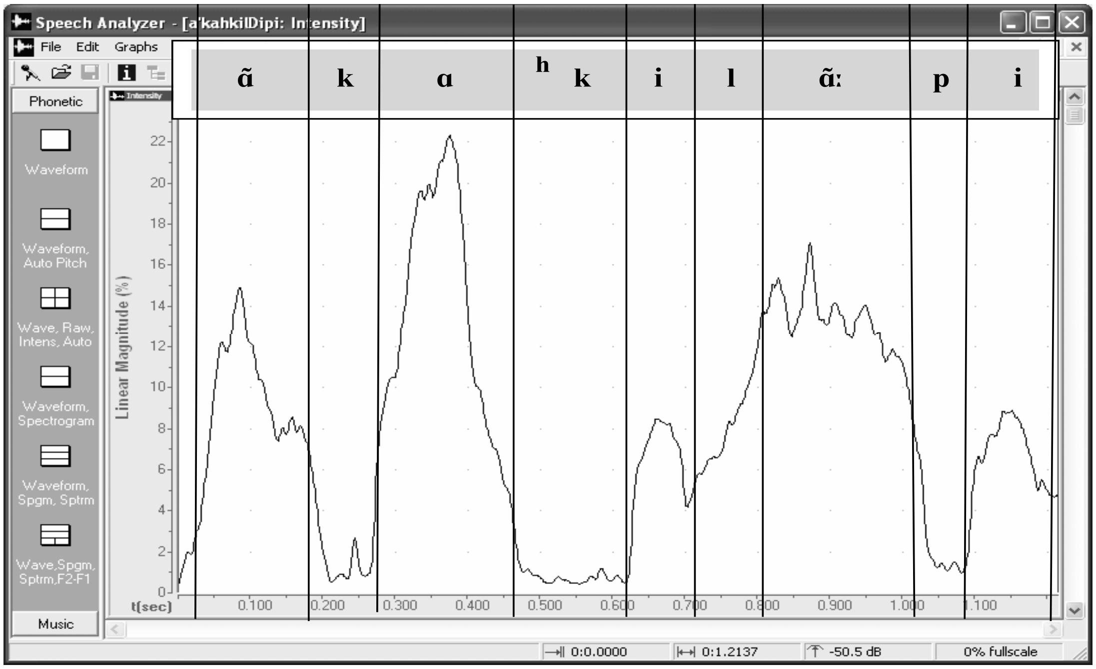
although the vowel with primary stress was consistently the loudest, the difference in the linear magnitude % increase varied quite a bit when comparing e.g. a stressed and an unstressed vowel in similar contexts. Moreover, the range of the linear magnitude % greatly varied not only from speaker to speaker, but also from word to word (partly due to the quality of the recordings). As a result, there are no numerical generalizations regarding amplitude provided in this paper. Instead, this section provides a few examples where the measurements were consistent with the other cues in terms of which vowel is stressed (see also Appendix C). For example, as illustrated in (27), the peninitial short vowel in *paː*ˈ***xo*** is louder than the initial long vowel; measurements of vowel length and F_0 indicate that primary stress is on the second vowel.

(27) pɑːˈ**xo** ‘mountain’



Moreover, as illustrated in (28), every even syllable is louder than every odd one in *ã*ˈ***ka***^{h}*ki*ˌ***lãː***_pi_, supporting the hypothesis that stress alternates in Osage.

(28) ãˈ**kɑʰ**kiˌ**lãː**pi ‘we carry ourselves’



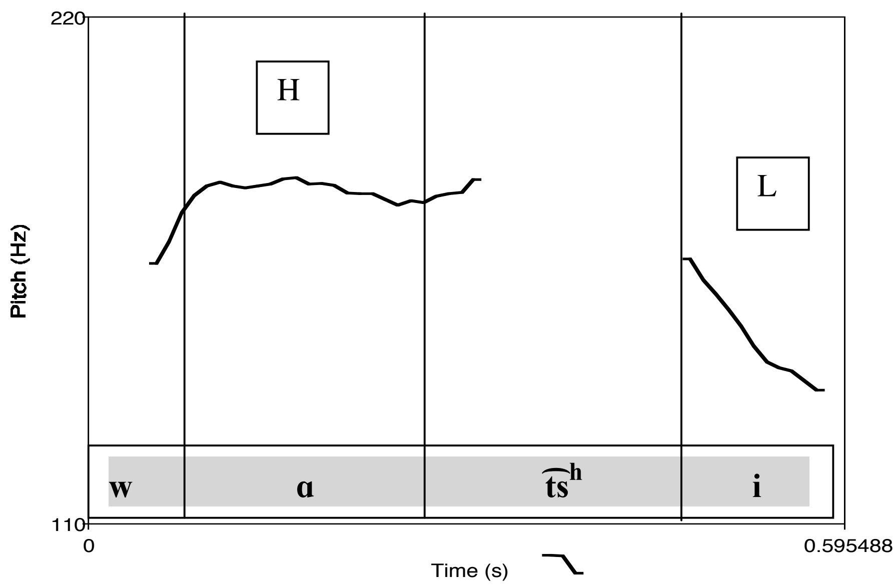
2.4.3 Fundamental frequency

Although the fundamental frequency of all sixty-four words was measured, words with sonorant consonants provided the clearest pitch tracks. The generalization in (29) summarizes the correlation between stress and tone in Osage.

(29) Generalization
A stressed vowel precedes a fall in the pitch contour; word-final stress correlates with a word-final peak in the pitch contour.

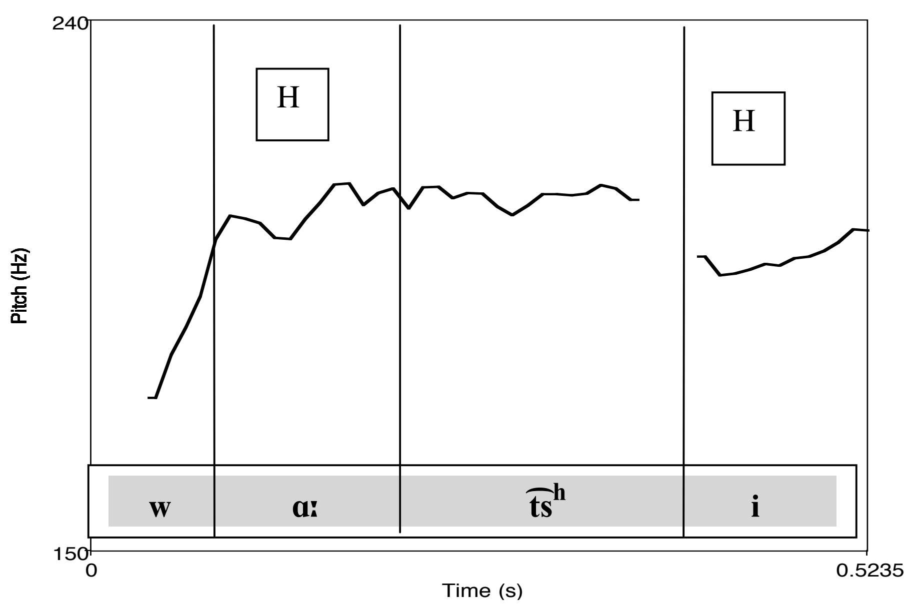
As illustrated in (30), the primary stress is on the first syllable, which precedes a fall in the pitch contour.

(30) Initial stress: ˈ***wa****t͡sʰi*



In (31), the first syllable is unstressed and the second syllable has primary stress; both syllables bear a high tone.

(31) Peninitial stress: *waː*ˈ***t͡sʰi***



Note that the initial high tone in (31) has a higher F_0 than the subsequent high tone, a pattern that is shared by many (though not all) forms[9]. For more pitch-tracks (including monosyllabic forms and ones with three or more syllables), the reader is referred to Appendix D.

Finally, it is important to note that according to Gandour (1977: 60): "Other factors being equal, vowels (syllables) on low tones are longer than those on high tones…" Since the opposite is true in Osage, we have further evidence that Osage has stress. That is, Osage data does not contradict Gandour's generalization if we assume that every stressed vowel is linked to a high tone, which is true of many (if not all) languages with tone and stress (see de Lacy 2002; Yip 2002, 2005, etc.).

3.0 The default stress pattern

Since the 'window' for the placement of primary stress in Osage is the first two syllables, only in the first two syllables does lexical stress make a difference. Therefore, there are two possible underlying forms of monosyllabic roots and prefixes and four possible underlying forms for disyllabic roots (see (32))[10]. Note that stress rather than tone is lexically specified because there is no tonal contrast in the language, and prefixes are not produced in isolation, i.e. their tone depends on their point of inflection. In other words, tone is completely predictable from stress (see section 4.1.4 for an analysis and Appendix D for measurements).

[9] The tonal down-drift is also observed in Winnebago, a related Siouan language (see Miner 1979, 1989; Hale & White Eagle 1980; Hayes 1995). See section 5.0 for further discussion.

[10] Without any evidence to the contrary, I assume that Osage does not have lexical secondary stress, which is extremely rare cross linguistically (however, see e.g. Liberman & Prince (1979) and Kager (1989) for discussion of stress in English and Hayes (1995) for a discussion of Fijian).

(32) Possible underlying forms

a. Monosyllabic roots and prefixes: /σ/ or /ˈ**σ**/

b. Disyllabic roots: /σσ/, /ˈ**σ**σ/, /σˈ**σ**/, /ˈ**σ**ˈ**σ**/

The hypothesis advocated in this paper says that the default stress pattern in Osage has primary stress on the peninitial syllable, followed by secondary stress on every other syllable. As mentioned in section 1, an alternative hypothesis is to say that the default pattern is initial stress and that peninitial stress is lexically marked. At first glance, there seems to be some support for this view since there are words with initial stress in Osage. In this section, two arguments are presented which show that the initial syllable is not where the contrast is admitted. Subsequently, I show that a straightforward iambic analysis of the Osage data is feasible once default peninitial stress is assumed.

3.1 *Argument #1: The default pattern is not initial stress*

The hypothesis refuted in this section says that surface forms with primary stress on the second syllable are lexically specified for stress (default defying), whereas surface forms with primary stress on the initial syllable (default obeying) are not. With this hypothesis in mind, consider the data in (33), where the patient 3rd person plural infix *wa* and the valence infix *wa* must be lexically stressed since the second syllable is stressed on the surface. The same is true in (34), where the second syllable of the verb *ðaːwa* must be lexically stressed given the surface representation.

(33) a. /ðɑ-ˈ**wɑ**-kˀy / → [ðɑˈ**wɑ**kˀy]
A2S-P3P-give 'you are giving it to them'

b. /ðɑ-ˈ**wɑ**-kˀy/ → [ðɑˈ**wɑ**kˀy]
A2S-VAL-give 'you are giving it to folks'

(34) /ðɑːˈ**wɑ**/ → [ðɑ**ː**ˈ**wɑ**]
count 'to count'

Given the underlying forms in (33) and (34), the different surface representations in (35a) and (35b) must have the same underlying forms. That is, (35a) and (35b) are minimal pairs differing solely in the placement of stress on the surface. However, since their underlying forms are identical, an inconsistent grammar is predicted.

(35) a. /ˈ**wɑ**-ðɑ**ː**ˈ**wɑ**/ → [ˈ**wɑ**ðɑːˌ**wɑ**]
P3P-count 'to count them'

b. /ˈ**wɑ**-ðɑ**ː**ˈ**wɑ**/ → [wɑˈ**ðɑː**wɑ]
VAL-count 'to count things/stuff'

In the next section, an alternative argument is presented which shows that the default pattern cannot be initial stress.

3.2 *Argument #2: The default pattern is not initial stress*

As illustrated in (36), the second syllable of the verb *waːʃka* and the agentive 2nd person singular infix *ða* must be lexically stressed given the surface representations.

(36) a. /wɑː-ˈ**ʃkɑ**/ → [wɑːˈ**ʃkɑ**]
PREV-do.one's.best 'to do one's best'

b. /wɑː-ˈ**ðɑ**-ˈ**ʃkɑ**/ → [wɑːˈ**ðɑ**ʃkɑ]
PREV-A2S-do.one's.best 'you do your best'

As illustrated in (37a), the second syllable of *ɣaːke* must also be lexically stressed. Given that the agentive 2nd person singular infix *ða* is lexically stressed in (36b), (37b) illustrates two lexical stresses in the input, but neither surface faithfully.

(37) a. /ɣɑːˈ**ke**/ → [ɣɑːˈ**ke**]
cry 'to cry'

b. /ˈ**ðɑ**-ɣɑːˈ**ke**/ → [ðɑˈ**ɣɑ**ːke]
A2S-cry 'you cry'

The fact that the lexical stress on the first syllable does not surface faithfully puts an insurmountable burden on the analyst to predict the surface forms in (37).

A possible reanalysis is to say that the underlying forms in (37) are really those in (38), where the verbal stem has lexical stress on both syllables.

(38)	a.	/ˈ**ɣɑːˈke/** cry	→	[ɣɑːˈ**ke]** 'to cry'
	b.	/ˈ**ðɑ-ˈɣɑːˈke/** A2S-cry	→	[ðɑˈ**ɣɑ**ːke**]** 'you cry'

Given the underlying forms above, the generalization would have to be that given a choice between lexical stress surfacing on the first or second syllable, the latter option is always chosen.

There are (at least) two problems with this analysis. The first problem is that within an Optimality Theoretic analysis, the positional faithfulness constraint in (39) must be stipulated without any independent motivation. That is, positional faithfulness constraints appeal to *prominent* positions such as an edge of a prosodic word (Beckman 1997) and it is far from clear that the second vowel of an input should be characterized in a similar way.

(39) (*Ad-hoc*) positional faithfulness constraint
IDENT (ˈV_2)
Incur a violation if the peninitial stressed vowel in the input does not correspond to a stressed vowel in the output.

Moreover, the problem presented in the previous section does not go away even if the constraint in (39) is part of the grammar. For example, consider the representation of the verb *ðaːwa* in (40a). Even if it has lexical stress on both syllables, the forms in (40b) and (40c) still have identical underlying forms but differ in their surface representations.

(40) a. /**ˈðɑːˈwɑ**/ → [ðɑ**ːˈwɑ**]
count ‘to count‘

b. /**ˈwɑ-ˈðɑːˈwɑ**/ → [**ˈwɑ**ðɑːˌ**wɑ**]
P3P-count ‘to count them’

c. /**ˈwɑ-ˈðɑːˈwɑ**/ → [wɑˈ**ðɑː**wɑ]
VAL-count ‘to count things/stuff’

Given the two arguments presented in this section, I conclude that the default pattern in Osage cannot be initial stress. Instead, the default is *peninitial* stress; all forms with initial stress on the surface are lexically marked. In the next section I show that this hypothesis is consistent with the Osage data, predicted by the interaction between faithfulness constraints preserving lexical stress and markedness constraints that impose a certain prosodic structure.

4.0 Foot structure: Evidence for the QI iamb

In this section it is argued that the hypothesis under which the default is *peninitial* stress is consistent with the Osage data. In order to argue for this position, I assume that Osage forms with initial and peninitial stress have an iambic parse (for more discussion see section 4.3). Subsequently, I show that the correct predictions are made given the interaction of Optimality Theoretic constraints. In section 5, a trochaic reanalysis is considered and shown to entail typologically bizarre consequences.

Consider the iambic parses in (41)-(46), which illustrate that Osage has every possible arrangement of heavy and light syllables. Crucially, note the contrast in stress placement in (43b) & (44c), as well as (44b) & (45c). Here we see LHL and HLL sequences respectively, but stress differs in its location, showing that a weight distinction among the syllables is not a factor in placement of stress.

(41) Feet with a single light syllable

a.	ˈ**si**	(ˈ**L**)	‘foot’
b.	ˈ**ky**	(ˈ**L**)	‘come back!’
c.	ˈ**kˀy**	(ˈ**L**)	‘give it!’

(42) Feet with a single heavy syllable

a.	ˈʰ**t͡seː**	(ˈ**H**)	‘may it be that’
b.	ˈ**leː**	(ˈ**H**)	‘he went back’
c.	ˈ**hyː**	(ˈ**H**)	‘to send to her’

(43) Feet with light-heavy syllables

a.	pɑˈ**xoː**	(LˈH)	‘mountain
b.	oˈ**ðɑː**kɑ	(LˈH)L	‘tell it’ (imperative)
c.	**t͡se**ɣe**niː**	(ˈ**L**)(LˌH)	‘drum’
d.	ãˈ**kɑː**kšĩːˌ**t͡se**	(LˈH)(HˌL)	‘we missed it’
e.	ˈ**o**ãˌ**tɑː**sɑːˌ**ki**	(ˈ**L**)(LˌH)(HˌL)	‘freezes hard on me’

(44) Feet with heavy-light syllables

a.	ĩːˈ**hõ**	(HˈL)	‘my mother’
b.	ʰpɑːˈ**ʃt͡se**kɑ	(HˈL)L	‘strawberry’
c.	ˈ**i**ʰpiːˌ**ʒi**	(ˈ**L**)(HˌL)	‘he’s sick with something’
d.	ˈ**hoː**sɑːˌ**ki**	(ˈ**H**)(HˌL)	‘he yells’
e.	xõːˈ**t͡so**ðiːˌ**brã**	(HˈL)(HˌL)	‘smoke cedar’
f.	ˈ**o**ãˌ**tɑː**sɑːˌ**ki**	(ˈ**L**)(LˌH)(HˌL)	‘freezes hard on me’
g.	ãːˈ**wɑ̃**lɑːˌ**xy**ɣe	(HˈL)(HˌL)L	‘I crunch up my own (e.g. prey) with teeth’

(45) Feet with light-light syllables

a.	iˈ**t͡se**	(LˈL)	‘face’
b.	nãˈ**lõ**lõ	(LˈL)L	‘call names repeatedly’
c.	ˈ**tɑː**pyˌ**ze**	(ˈ**H**)(LˌL)	‘to dry, boil’
d.	ˈ**t͡sˀe**ɑˌ**wɑ**ðe	(ˈ**L**)(LˌL)L	‘I killed them’
e.	ʰpɑˈ**sy**koˌ**ʃɑ**	(LˈL)(LˌL)	‘paisley pattern cloth'
f.	ˈ**tɑː**ʰkɑˌ**tɑ**mãˌ**ʒi**	(ˈ**H**)(LˌL)(LˌL)	‘I am not hot’
g.	wɑˈ**hõ**ĩˌ**ʒĩ**kɑ	(LˈL)(LˌL)L	‘orphan’

(46) Feet with heavy-heavy syllables

a.	ɑːˈ**leː**	(HˈH)	‘I left’
b.	leːˈ**leː**pe	(HˈH)L	‘vomit repeatedly’
c.	ðyːˈ**tɑːʰ**pɑ	(HˈH)L	‘made round’

d. kɑː'**mɑ̃ː**pe (<u>H</u>'**<u>H</u>**)L 'it rings'
e. 'ʰ**kɑ**wɑːˌ**ɫiː** ('**L**)(<u>H</u>ˌ**<u>H</u>**) 'horseback riding'
f. kɑː'**kš̃iː**tɑˌ**pe** (<u>H</u>'**<u>H</u>**)(Lˌ**L**) 'he missed'

In the next section, iambs of the form (H'**L**) and (H'**H**) are predicted by ranking a faithfulness constraint that prohibits quantity adjustments of syllable weight over markedness constraints that induce quantity adjustments of syllable weight. Before stating this analysis in detail, however, it is important to note that I assume the restrictions on GEN in (47), which are crucial in restricting the typology of foot types (see Hayes 1987, Selkirk 1995)[11].

(47) <u>Assumptions about GEN</u>

a. Every prosodic word has exactly one head foot, e.g. [σσ], [('**σ**)('**σ**)] are not possible candidates (GEN rules out prosodic words that disobey culminativity)[12].

b. Every foot has exactly one stressed syllable, e.g. [('**σ**'**σ**)], [('**σ**ˌ**σ**)] are not possible candidates (GEN rules out foot internal clash).

c. Feet are maximally binary, e.g. [(σ'**σ**σ)] is not a possible candidate (GEN rules out unbounded feet).

Moreover, I assume that default obeying forms in Osage that have an even number of syllables as in (48) are predicted by the interaction of the constraints in (49).

(48) /ʰpɑsykoʃɑ/ → (ʰpɑ'**sy**)(koˌ**ʃɑ**) 'paisley pattern cloth'

(49) <u>Markedness constraints</u>

a. IAMB
Incur a violation if a foot's head is at its left edge (after Prince & Smolensky 1993).

---

[11] GEN is a function that maps each lexical form into all possible output candidates (Prince & Smolensky 1993).

[12] It has been documented in the literature that some Scandinavian languages as well as Guugu Ymidhirr (Haviland 1979, Kager 1995b, Bye 1996) have words with two main stresses (level stress). However, this phenomenon is controversial at best and for the purposes of this paper, will not be discussed. Thanks to José Elías-Ulloa for pointing this out.

b. TROCHEE
Incur a violation if a foot's head is at its right edge (after Prince & Smolensky 1993).

c. HEADFTLEFT
ALIGN (PRWD, L, HEAD/PRWD, L): incur a violation if the head foot in a PrWd is not at the left edge (after McCarthy & Prince 1993b).

d. HEADFTRIGHT
ALIGN (PRWD, R, HEAD/PRWD, R): incur a violation if the head foot in a PrWd is not at the right edge (after McCarthy & Prince 1993b).

The tableau in (50) illustrates that iambs are parsed left-to-right as opposed to right-to-left given the ranking HFL >> HFR[13]. Moreover, feet are right-headed as opposed to left-headed given the ranking IAMB >> TROCHEE.

(50) /ʰpɑsykoʃɑ/	HFL	IAMB	HFR	TROCHEE	REMARKS
☞ (ʰpɑˈ**sy**)(koˌ**ʃɑ**)			1	2	iambic parse; head foot at left edge
a. ~ (ʰpɑˈ**sy**)(koˌ**ʃɑ**)	1 W		0 L	2	head foot at right edge
b. ~ (ʰpɑˈ**sy**)(koˌ**ʃɑ**)		2 W	1	0 L	trochaic parse

Finally, I assume that default obeying forms in Osage that have an odd number of syllables as in (51) are predicted by the interaction of the constraints in (52).

(51) /wɑhõĩʒĩkɑ/ → wɑˈ**hõĩ**ˌ**ʒĩ**kɑ 'orphan'

(52) <u>Markedness constraints</u>

a. PARSE-σ
Incur a violation if a syllable is not parsed (after Prince & Smolensky 1993).

b. FTBIN-σ
Incur a violation if a foot is less than two syllables (after Prince & Smolensky 1993, Elías-Ulloa 2006).

c. AFL
ALIGN (FT, L, PRWD, L): Every foot stands at the left edge of the PrWd. The total number of violation marks equals the sum of all individual violations by feet (after McCarthy & Prince 1993b).

---

[13] Note that the failed candidates, namely (50a) and (50b), are compared (denoted by "~") to the optimal candidate (denoted by "☞"). "W" denotes that the optimal candidate wins on a particular constraint, and "L" denotes that the optimal candidate loses; the numbers indicate the total number of violations incurred by the respective candidate. For more discussion, see Prince (2002).

d. AFR
Align (Ft, R, PrWd, R): Every foot stands at the right edge of the PrWd. The total number of violation marks equals the sum of all individual violations by feet (after McCarthy & Prince 1993b).

The tableau in (53) illustrates that the ranking FtBin-σ >> Parse-σ >> AFL >> AFR insures that syllables are parsed only into disyllabic feet such that stray syllables appear only at the right edge of the prosodic word.

(53) /wɑhõĩʒĩkɑ/	FtBin-σ	Parse-σ	AFL	AFR	Remarks
☞ (wɑˈ**hõ**)(ĩˌ**ʒĩ**)kɑ		1	2	4	stray syllable
a. ~ (wɑˈ**hõ**)ĩ(ʒiˌ**kɑ**)		1	3 W	3 L	left edge
b. ~ (wɑˈ**hõ**)ĩʒĩkɑ		3 W	0 L	3 L	three stray syllables
c. ~ (wɑˈ**hõ**)(ĩˌ**ʒĩ**)(ˌ**kɑ**)	1 W	0 L	6 W	4 W	monosyllabic foot

In sum, the default obeying forms in Osage are predicted by the rankings in (54).

(54)

<table>
<tr><td>Iamb
|
Trochee</td><td>HFL
|
HFR</td><td>FtBin-σ
|
Parse-σ
|
AFL
|
AFR</td></tr>
</table>

4.1 *The quantity insensitive iamb*

As was illustrated in the previous section and repeated below in (55), Osage has iambs of the form (Hˈ**L**) and (Hˈ**H**).

(55) <u>Quantity insensitive iambs</u>

a.	/nɑ̃ː-xõ/	→	[nɑ̃ːˈ**xo**]	(Hˈ**L**)
	by.foot-break		'break by foot'	
b.	/ɑ-ɑleː/	→	[ɑːˈ**leː**]	(Hˈ**H**)
	A1S-leave		'I left'	

The parse in (55a) is predicted by ranking a faithfulness constraint that prohibits quantity adjustments of syllable weight (see (56)) over markedness constraints that induce quantity adjustments of syllable weight (see (57)).

(56) Faithfulness constraint
IDENT(LENGTH)
Incur a violation if for a vowel's length is x in the input is not faithful to its output correspondent (after Prince & Smolensky 1993).

(57) Markedness constraints
a. WEIGHTTOSTRESS (WTS)
Incur a violation if a heavy syllable is unstressed (after Prince 1990).

b. STRESSTOWEIGHT (STW)
Incur a violation if a stressed syllable is light (after Kager 1999).

The tableau in (58) illustrates that markedness pressure to have stressed heavy syllables and unstressed light syllables does not cause the grammar to make quantity adjustments of syllable weight by lengthening and shortening vowels.

IDENT(L) >> {WTS, STW}

(58) /nɑ̃ː-xõ/	IDENT(L)	WTS	STW	REMARKS
☞ (nɑ̃ːˈ**xõ**)		1	1	heavy σ unstressed; stress on light σ
a. ~ (nɑˈ**xõː**)	2 W	0 L	0 L	F: length

The tableau in (58) illustrates that markedness pressure to have stressed heavy syllables and unstressed light syllables does not cause the grammar to parse the disyllabic words as a trochee.

IAMB >> {WTS, STW, TROCHEE}

(59) /nɑ̃ː-xõ/	IAMB	TROCHEE	WTS	STW	REMARKS
☞ (nɑ̃ːˈ**xõ**)		1	1	1	heavy σ unstressed; stress on light σ; iambic parse
a. ~ (ˈ**nɑ̃ː**xõ)	1 W	0 L	0 L	0 L	trochaic parse

The form in (55b), repeated below in (60), is predicted given the interaction between the faithfulness constraints in (61), which ban deletion and coalescence respectively, and the markedness constraint in (62), which bans onsetless syllables[14].

(60)	/ɑ-ɑleː/	→	[ɑːˈ**leː**]	(Hˈ**H**)
	A1S-leave		'I left'	

(61) Faithfulness constraints

a. MAX
Incur a violation if a segment in the input does not have a correspondent in the output (after McCarthy & Prince 1995).

b. UNIFORMITY
Incur a violation if a segment in the output corresponds to more than one segment in the input (after McCarthy & Prince 1995).

(62) Markedness constraint
ONSET
Incur a violation for every onsetless syllable (after Prince & Smolensky 1993).

The tableau in (63) illustrates that given a choice between resolving vowel hiatus via deletion, in which case the initial syllable is light and unstressed, and coalescence, in which case the initial syllable is heavy and unstressed, the ranking MAX >> {UNIFORMITY, WTS} insures that the latter option is chosen[15]. Moreover, the ranking ONSET >> UNIFORMITY insures that the vowel hiatus is resolved.

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[14] Although there are various strategies to resolve vowel hiatus in Osage, (i)-(ii) illustrate that coalescence is the strategy employed when a V1V2 sequence consists of two low back vowels.

(i)	/ˈ**ɑ**-ɑ̃-kɑːspe/	→	[ˈ**ɑ̃**ːkɑːˌ**spe**]
	LOC-P1S-cover		'I cover it up'
(ii)	/ˈ**wɑ**-ˈ**ɑ**-tõpe-ɑ/	→	[ˈ**wɑ́**ːtõˌ**pɑ**]
	P3P-LOC-look-IMPER		'you [plural], watch over them!'

[15] As illustrated in (i)-(ii), the Osage grammar sometimes resolves vowel hiatus by deletion. However, this only occurs when the sequence V1V2 constitutes a verbal stem and a suffix (or two suffixes). When the sequence V1V2 constitutes a verbal stem and a prefix, neither deletion nor a faithful parse are viable options. A detailed analysis of vowel hiatus resolution in Osage is beyond the scope of this paper and remains open for further research (see Altshuler 2005b for an analysis of V1V2 sequences in Osage that constitute a verbal stem and a prefix; see Casali 1996 for a typological theory of vowel hiatus resolution).

(i)	/ðyːze-ɑ /	→	[ðyːˈ**zɑ́**]
	take-IMPER		'pick it up; choose one!'

(63) /ɑ-ɑleː/	ONSET	MAX	UNIFORMITY	WTS	REMARKS
☞ (ɑː'**leː**)			1	1	heavy σ unstressed; coalescence
a. ~ (ɑ'**leː**)		1 W	0 L	0 L	F: delete V
b. ~ (ɑ'ɑ)leː	1 W		0 L	1	onsetless σ

In summary feet of the form (H'**L**) and (H'**H**) are predicted by the rankings below:

(64) Rankings

a. IDENT (L) >> {WTS, STW} (see (58a))

b. IAMB >> {TROCHEE, WTS, STW} (see (59a))

c. MAX >> {UNIFORMITY, WTS} (see (63a))

d. ONSET >> UNIFORMITY (see (63b))

In the next two sections, forms with lexical stress are predicted. First, an analysis of the so-called 'window' effects is proposed, and subsequently, this analysis is extended to predict forms with underlying stress on the first two syllables.

4.2 *'Window' effects*

The form in (65) illustrates 'window' effects in Osage. These effects are evident in environments where lexical stress is not within the first-two-syllable-window, in which case primary stress surfaces on the second syllable by default.

(65) /ɑ̃k-o-ði-'**xpɑ**ðe/ → [ɑ̃'**ko**ðiˌ**xpɑ**i] (ɑ̃'**ko**)(ðiˌ**xpɑ**)i
A1P-LOC-P2S-seprerate 'we lost you'

Note that the fourth syllable is lexically stressed in (65) given the surface form in (66), where primary stress surfaces on the initial syllable; the third syllable is not specified for stress in (66) given the surface form in (67), where the initial syllable is not stressed; the second syllable in (65) is not specified for stress given the surface form in (68), where the

(ii) /'**ni**ʰte-ɑʒi → ['**ni**ʰtɑˌ**ʒi**]
cold-NEG 'not cold'

initial syllable is not stressed; the first syllable in (65) is not specified for stress given that is not stressed on the surface[16].

(66)	/ˈ**xpɑ**ðe/ separate	→	[ˈ**xpɑ**ðe] 'to separate'
(67)	/ði-ˈ**kˀy**/ P1S-give	→	[ðiˈ**kˀy**] 'to give to you'
(68)	/o-ˈ**xpɑ**ðe/ LOC-separate	→	[oˈ**xpɑ**ðe] 'to lose'

The tableau in (69) illustrates that given an option between the first or the second syllable carrying primary stress, the rankings FTBIN-σ >> PARSE-σ and IAMB >> TROCHEE insure that the latter option is chosen.

(69) /ãk-o-ði-ˈ**xpɑ**ðe/	FTBIN-σ	IAMB	PARSE-σ	TROCHEE	REMARKS
☞ (ãˈ**ko**)(ðiˌ**xpɑ**)i			1	2	F: stress; stray σ
a. ~ (ˈ**ã**)(koˌ**ði**)(xpɑˌ**i**)	1 W		0 L	2	monosyllabic foot
b. ~ (ˈ**ã**ko)(ðiˌ**xpɑ**)i		2 W	1	0 L	trochaic parse

Note that I assume that the lexical stress on the optimal candidate surfaces *faithfully* as secondary stress. In other words, I assume that faithfulness to stress is enforced regardless of its degree of prominence. This idea is captured in the definition of the constraint in (70)[17].

[16] Even though (67) and (68) have lexical stress on the second syllable, the very fact that primary stress is not on the initial syllable on the surface provides evidence that the initial syllable is not lexically stressed. In other words, a syllable is lexically stressed if and only if primary stress falls on that syllable word-initially (see section 4.2 for more discussion).

[17] Note that cyclic stress in English, in which primary and secondary stress are lexicalized, provides evidence for the constraint in (70). For example, in o'**ri**ginal → oˌ**ri**gi'**na**lity the primary stress in the base is subordinated and surfaces as a secondary. The crucial observation is that both the optimal candidate oˌ**ri**gi'**na**lity and the failed candidate ˌ**o**rigi'**na**lity exemplify an unfaithful mapping if faithfulness to lexical stress were enforced based on its degree of prominence. Therefore, without the constraint in (70), the failed candidate is incorrectly predicted to win since it has default initial secondary stress.

However, it is also important to note that trochee words like Arizona, Oklahoma vs. Ladefoged, Aristotle, Studebaker show that faithfulness to lexical stress may also be enforced based on its degree of prominence. Arguing for this position, however, would take us too far a field, especially since an analysis

(70) IDENT (ˈV)
Incur a violation if a stressed vowel in the input does not correspond to a stressed vowel in the output (after McCarthy & Prince 1995).

Although (70) does not play an active role in predicting the optimal candidate in (69), things are different when forms like (71) are considered. Here we see that the third syllable carries lexical stress, but only the even syllables are stressed on the surface.

(71) /wɑ-py-ˈ**sʃtɑ**hɑ/ → (wɑˈ**py**)(ʃtɑˌ**hɑ**)
VAL-by.pressing-smooth 'iron something'

The tableau in (72) illustrates various candidates, which unlike the optimal candidate faithfully map lexical stress as either primary of secondary[18]. These candidates illustrate that the grammar does not respond to an unfaithful parse by having a monosyllabic foot at the left edge, a trochee at the right edge, or a misaligned head foot surrounded by two stray syllables[19].

(72) /wɑ-py-ˈ**ʃtɑ**hɑ/	HFL	IAMB	FTBIN-σ	PARSE-σ	IDENT(ˈV)	REMARKS
☞ (wɑˈ**py**)(ʃtɑˌ**hɑ**)					1	default pattern; delete stress on V3
a. ~ (ˈ**wɑ**)(pyˌ**ʃtɑ**)hɑ			1 W	1 W	0 L	degenerate foot
b. ~ (wɑˈ**py**)(ˌ**ʃtɑ**hɑ)		1 W			0 L	trochaic parse
c. ~ wɑ(pyˈ**ʃtɑ**)hɑ	1 W			2 W	0 L	misaligned head foot

of the 'window' effects in Osage is possible (albeit different) whether or not faithfulness to lexical stress is enforced based on its degree of prominence. Therefore, I leave this issue open for further research. Thanks to René Kager and Alan Prince for insightful discussions concerning lexical stress.

[18] The third syllable is lexically stressed in the optimal candidate given the surface form in (i), where primary stress surfaces on the initial syllable; the second syllable is not specified for stress given the surface form in (ii), where the initial syllable is not stressed; the first syllable is not specified for stress given that is not stressed on the surface.

(i) /ˈ**sʃtɑ**hɑ/ → (pyˈ**ʃtɑ**)hɑ
smooth 'smooth'

(ii) /py-ˈ**sʃtɑ**hɑ/ → (pyˈ**ʃtɑ**)hɑ
by.pressing-smooth 'iron'

[19] To the best of my knowledge, there is no evidence in Osage as to whether HFL dominates IDENT ('V).

The final issue concerning ‘window’ effects that is addressed in this section concerns five-syllable words like those (74), where lexical stress is word-final[20].

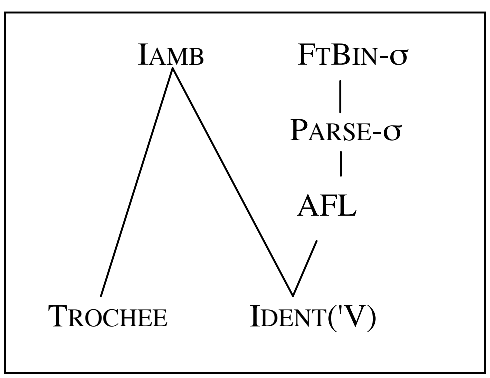
(73) /ɑ-wi-ð^{h}ĩ-ɑ-ˈ**c^{h}i**/ → (ɑˈ**wi**)(brĩˌ**ɑ**)c^{h}i
PREV-I.to.you-have-PREV-arrive.here I brought it to you.

The tableau in (74) illustrates a failed candidate that faithfully maps its lexical stress as secondary (see (74a)). Although it avoids a violation IDENT('V), it has a disyllabic foot at the right edge of the prosodic word and thus violates AFL three times, motivating the ranking AFL >> IDENT ('V).

(74) /ɑ-wi-ð^{h}ĩ-ɑ-ˈ**c^{h}i**/	AFL	IDENT(‘V)	REMARKS
☞ (ɑˈ**wi**)(brĩˌ**ɑ**)c^{h}i	2	1	default pattern; delete stress on V5
a. ~ (ɑˈ**wi**)brĩ(ɑˌ**c^{h}i**)	3 W	0 L	misaligned feet

In summary, ‘window’ effects result from the interaction between the faithfulness constraint IDENT('V), which preserves lexical stress, and markedness constraints, which demand a particular prosodic structure. In particular, ‘window’ effects are predicted by the rankings in (75).

(75)



[20] Evidence that the verbal stem *c^{h}i* is lexically stressed would involve a form where it is stressed word initially on the surface, followed by at least one syllable. Unfortunately, I have not been able to locate such a form (perhaps because *c^{h}i* does not occur in isolation, needing the preverbal prefix *a*). Therefore, (73) should be seen as a hypothetical form used for the purposes of illustrating the ranking in (74),

In the next section, an analysis of forms with underlying stress on the first two syllables is proposed.

4.3 *Competition within 'the window'*

As illustrated in (76), the second syllable is lexically specified for stress given the surface form in (77), in which primary stress surfaces on the initial syllable. Moreover, the first syllable in (76) must be lexically specified for stress given that it is stressed on the surface[21].

(76)	/ˈ**i**-ˈ**nõ**hpe-ɑ/	→	[ˈ**i**nõˌ**ʰpɑ**]	(ˈ**i**)(nõˌ**ʰpɑ**)
	with-afraid-IMPER		'be careful of'	
(77)	/ˈ**nõ**hpe/	→	[ˈ**nõ**ʰpe]	
	afraid		'to be afraid'	

The placement of stress in (76) is reminiscent of vowel hiatus resolution involving deletion: in an environment such as V_1V_2, the grammar must choose which vowel to delete[22]. Analogous to vowel hiatus resolution, the grammar must choose which stress to delete in order to avoid clash. In Osage, stress on the second vowel is deleted. In order to predict this fact, the grammar requires the constraint in (78)[23].

[21] Since imperative suffix *a* never occurs word-initial, there is no evidence as to whether it is lexically specified for stress. The same is true of all other suffixes in Osage.

[22] In the spirit of Prince & Smolensky (1993), Casali (1996: 19-24) proposes that constraints such as PARSE(F)-1SEG and PARSE(F)-LEX dominate the general PARSE(F) to predict vowel hiatus resolution involving deletion.

[23] Note that the constraint in (78) does not fall within Beckman's theory of positional faithfulness, which involve output-input correspondence as opposed to input-output a la Casali 1996. A constraint like OI-IDENT(ˈV_1), which refers to stressed peninitial vowels in the *output* rather than in the input, fails to make the correct predictions for (76); it does not rule out the failed candidate in which stress on the second (and not the first) vowel in the input is mapped onto the surface (i.e. OI-IDENT(ˈV_1) is vacuously satisfied). In order to maintain the Beckman-type analysis, one could treat stress as a binary feature [+/- stress], in which case this failed candidate would be ruled out by the OI-IDENT constraint. However, it is not immediately clear whether such a proposal is superior to positing the constraint in (78), which does not rely on a seemingly *ad hoc* stipulation of treating stress as a binary feature.

(78) IDENT(ˈV1)
Incur a violation if a stressed initial vowel in the input does not correspond to a stressed vowel in the output (after Casali 1996).

The tableau in (79) illustrates that given an option to delete stress on the first or second syllable, the ranking IDENT(ˈV_1) >> FTBIN-σ insures that the former option is chosen. Moreover, both lexical stresses do not surface faithfully (i.e. clash is avoided) given the ranking FTBIN-σ >> IDENT (ˈV). Note that the constraint PARSE-σ does not play a role since FTBIN-σ dominates it (see (53)).

IDENT(ˈV_1) >> FTBIN-σ >> IDENT(ˈV)

(79) /ˈ**i**-ˈ**nõ**hpe-ɑ/	IDENT (ˈV_1)	FTBIN-σ	IDENT (ˈV)	REMARKS
☞ (ˈ**i**)(nõˌ^h^**pɑ**)		1	1	monosyllabic foot; delete stress
a. ~ (iˈ**nõ**)pɑ	1 W	0 L	1	delete stress on V_1
b. ~ (ˈ**i**)(ˈ**nõ**)pɑ		2 W	0 L	two monosyllabic feet

Interestingly, the initial foot must be monosyllabic in words with initial stress and an odd number of syllables viz. the optimal candidate above[24]. This generalization is in accordance with Hayes' (1995) claim that monosyllabic feet must be in strong positions, i.e. the head of a prosodic word. A question that arises, however, is how to parse even-numbered words with initial stress (see (77)). As illustrated in (80), such forms can be parsed with a monosyllabic foot and a stray syllable given that IAMB dominates FTBIN-σ (which in turn dominates PARSE-σ). This ranking insures that no forms are parsed as trochees in Osage.

(80) /ˈ**nõ**hpe/	IAMB	FTBIN-σ	REMARKS
☞ (ˈ**nõ**)^h^pe		1	monosyllabic foot
a. ~ (ˈ**nõ**^h^pe)	1 W	0 L	trochaic parse

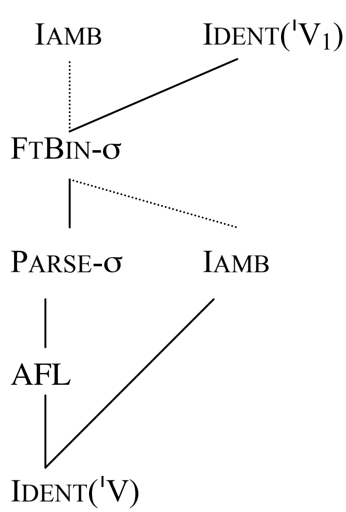
[24] Note that the only other available parse, namely (ˈσσ)(ˌσ), is ruled out given that IAMB >> TROCHEE.

However, (81) illustrates that even-numbered words with initial stress can also be parsed as trochees given the reverse ranking: FtBin-σ >> Iamb. Since Iamb dominates Trochee, the ranking motivated in (81) insures that trochees are parsed only to avoid monosyllabic feet.

(81) /ˈ**nõ**hpe/	Iamb	FtBin-σ	Remarks
☞ (ˈ**nõ**^{h}pe)	1		trochaic parse
a. ~ (ˈ**nõ**)^{h}pe	0 L	1 W	monosyllabic foot

To the best of my knowledge, the Osage data does not provide evidence for how to parse even-numbered words with initial stress. However, this fact does not undermine the goal of this section, namely to argue the Osage data can be predicted straightforwardly under an iambic analysis in which peninitial stress is the default; whether there is one or two rankings that make the correct predictions (albeit with different structural assumptions), this goal is achieved. The required rankings to predict forms with initial stress are summarized in (82). Note that Iamb appears in multiple places in the hierarchy (attached to a dashed line), reflecting the two possible rankings discussed above.

(82)



In the next section, an analysis for the interaction between stress and tone is proposed. Subsequently, it is argued that a trochaic reanalysis of the data examined thus far ought to be rejected.

4.4 *Interaction between stress and tone*

In section 2.4.3 it was shown that high tones fall on stressed syllables and on unstressed initial syllables, while low tones fall on all other unstressed syllables:

(83)	Main stress	Odd # of σ's	Even # of σ's
a.	1st syllable	ˈσ σ ˌσ H L H	ˈσ σ ˌσ σ H L H L
b.	2nd syllable	σ ˈσ σ H L	σˈσ σˌσ H L H

Note that tone is predictable in Osage, so faithfulness constraints that preserve underlying specification of tone do not play an active role in the grammar. Instead the constraints in (84) play a crucial role in predicting the distribution of tone and stress.

(84) Markedness constraints

a. *Non-Hd/H-tone
Non-head syllables linked to a high tone are prohibited (after de Lacy 2002).

b. *Hd/L
Head syllables linked to a low tone are prohibited (after de Lacy 2002).

The tableau in (85) illustrates that the optimal candidate with primary stress on the first syllable has a perfect "tonal grid": tones alternate in accordance with stress such that high tones are linked the stressed syllables and low tones are linked to unstressed syllables. The failed candidates in (85a) and (85b) are ruled out by the constraints in (85a) and (85b) respectively.

(85) /ˈ**i**-ˈ**nõ**hpe-ɑ/	*HD/L	*NON-HD/H	REMARKS
☞ (ˈ**i**)(nõˌʰ**pɑ**) H L H			perfect tonal grid
a. ~ (ˈ**i**)(nõˌʰ**pɑ**) H L	1 W		stressed σ with an L
b. ~ (ˈ**i**)(nõˌʰ**pɑ**) H		1 W	unstressed σ with an H

The positional markedness constraint in (86) plays a crucial role in predicting the interaction between stress and tone in words with primary stress on the second syllable.

(86) σ_1(H-TONE)[25]
Incur a violation if the first syllable in a prosodic word is not linked to a high tone.

The tableau in (87) illustrates that the optimal candidate violates *NON-HD/H since the initial syllable is unstressed but bears a high tone. The failed candidate in (87a) circumvents this violation by linking a low tone to the first syllable, but in doing so, incurs a violation of the constraint in (86). This motivates the ranking σ_1(H-TONE) >> *NON-HD/H[26].

(87) /xoːt͡se-o-ðiː-brã/	σ_1(H)	*NON-HD/H	REMARKS
☞ (xoːˈ**t͡so**)(ðiːˌ**brɑ**) H L H		1	unstressed σ with an H tone
a. ~ (xõːˈ**t͡so**)(ðiːˌ**brɑ**) L H L H	1 W	0 L	initial σ with L tone

[25] Although this constraint is undominated in Osage, it is violable since many tone languages have forms in which a high tone is not linked to the first syllable. The role of this constraint in such languages, however, is left open for further research.

[26] Note that I leave out the parse in which the first two syllables are each linked to different high tones, i.e. a candidate that violates the OCP. Note that Myers (1997) argues that candidates of this sort are possible and therefore, in principle, the optimal candidate could be represented in this way.

In summary, it was shown in this section that the iambic analysis under which the default is *peninitial* stress is consistent with the Osage data. In the next section it is argued that a trochaic analysis is not feasible. Subsequently, the foot typology in section 1 is derived and Osage is placed in this typology.

5.0 Rejecting a trochaic reanalysis: Invoking an initial extrametricality effect

In the previous section it was shown that the hypothesis under which the default is *peninitial* stress is consistent with the Osage data. The crucial assumption made was that that Osage forms with initial and peninitial stress have an iambic parse. However, a trochaic analysis is also possible in which the second syllable is the default position for stress placement[27]. In this section, I argue that such an analysis is unmotivated and highly stipulative at best.

Under the trochaic analysis explored in this section, forms with word initial stress are lexically specified and are parsed as trochees from left to right (see (88a)). Moreover, forms with default second syllable stress have a stray syllable at the left edge of the prosodic word and the rest of the syllables are parsed as trochees from left to right (see (89a)); words with an even number of syllables greater than two have a monosyllabic foot at the right edge in addition to the stray syllable word initially (see (89b)).

(88)		/ˈ**wɑ**-ðɑːwɑ/ P3P-count	→	(ˈ**wɑ**ðɑː)(ˌ**wɑ**) ‘to count them’
(89)	a.	/wɑ-ðɑːwɑ/ VAL-count	→	wɑ(ˈ**ðɑː**wɑ) ‘to count things/stuff’
	b.	/xõːt͡se-o-ðiː-brɑ̃/ cedar-LOC-by.hand-smell	→	xõː(ˈ**t͡so**ðiː)(ˌ**brɑ̃**) ‘smoke cedar’

[27] Thanks to Colin Wilson for suggesting the trochaic analysis explored in this section.

The stress in (88) surfaces on the initial syllable given that faithfulness to stress dominates the constraint in (90), while the stress in (89a,b) surfaces on the second syllable in order to avoid a violation of (90), thereby invoking the initial extrametricality effect[28].

(90) *INITIALSTRESS
Incur a violation if the initial syllable is stressed (after Visch 1996).

The main problem with the analysis above is that if crucially relies on a non-initial stress constraint, which yields odd typological predictions. For example, if *INITIALSTRESS were to interact with constraints that induce quantity adjustments of syllables (e.g. WEIGHT-TO-STRESS and STRESS-TO-WEIGHT), we would expect there to be languages in which: (i) there is foot reversal; initial iambs, but trochees elsewhere, e.g. (L'L)(ˌLL)(ˌLL), (ii) stress falls on the leftmost heavy syllable unless it is initial, e.g. HLL'HLH vs. 'HLLL, and (iii) stress alternates rightward, with pairs of light syllables to the right of a heavy syllable and words that start with a sequence of light syllables have second syllable stress, i.e. ('H)(ˌLL) vs. L('LL). To the best of my knowledge, no such languages exist.

On par with a non-initial stress constraint, NONFINALITY was proposed in Prince & Smolensky 1993/2004) to predict the effect of *final* extrametricality. However, unlike a non-initial stress constraint, it is well-known that NONFINALITY correctly predicts the seemingly quirky behavior of stress at the right edge in many languages (e.g. Southern Paiute, Choctaw, Estonian, Murik, Selkup, etc.) when it interacts with constraints that

[28] Note that a related constraint that would achieve this effect is NONINITIALITY (Kennedy 1994, Kenstowicz 1994, Alderete 1995), which is violated by candidate with a foot at the left edge of the prosodic word. For the purposes of this paper, it is not crucial which constraint is used since the discussion of *INITIALSTRESS in this section also applies to NONINITIALITY.

induce quantity adjustments of syllables. This contrast in the behavior of stress at the two edges has lead many researches to doubt that the effect of initial extrametricality is best explained by a non-initial stress constraint. For example, Hyde 2001 argues that a non-initial stress constraint does not exist and therefore, any analysis that relies on it should be abandoned. Moreover, Van de Vijver 1998 argues that a non-initial stress constraint fails to make the correct predictions for extrametricality effects in Carib. Instead, Van de Vijver proposes the constraint *EDGEMOST, which is violated by stressed syllables at either edge of the prosodic word. If Van de Vijver is correct, namely that *EDGEMOST rather than a non-initial stress constraint is part of the grammar, then the trochaic analysis of Osage explored in this section becomes problematic. For example, on this view it is not clear why Osage words with, e.g. four syllables, ever have second syllable stress since [σ'σσˌσ] and ['σσˌσσ] incur the same number of violations of *EDGEMOST.

Finally, Hayes (1995) analyzes Winnebago, an iambic language with default stress on the *third* syllable, without appealing to rules or constraints that explicitly prohibit stressed initial syllables (or word-initial feet); the extrametrical effect in Winnebago, according to Hayes, results from more general accentual and tonal rules such that “the metrical part of Winnebago phonology becomes typologically ordinary…the analysis does not invoke initial extrametricality, which is quite rare crosslinguistically.” Although Hayes' analysis of Winnebago differs from my analysis of Osage—the initial weak-strong pattern in Osage is due to iambic constituency rather than a tonal flop from a stressed initial vowel to the subsequent one—the crucial point is that in addition to odd typological predictions, a non-initial stress constraint appears to be spurious even in the analysis of a language with initial extrametrical effects[29].

In sum, there is powerful evidence in favor of rejecting an initial-stress constraint[30]. However, without such a constraint, a very heavy burden is placed on the analyst to justify a trochaic parse of default obeying forms in Osage, especially since vowel length has no effect on foot structure. On the other hand, an iambic parse of these forms is predicted straightforwardly, with no burden to explain initial extrametricality. effects. I therefore conclude that the trochaic analysis explored in this section is highly stipulative at best and should be rejected in favor of the iambic analysis[31].

6.0 The gap is filled: the typology of feet

As noted in Kager (2006), eight unidirectional quantity insensitive systems are predicted by the interaction of Optimality Theoretic constraints that are violated based on whether a prosodic word has: (i) right-headed or left-headed feet, (ii) a rightward or a leftward parse, and (iii) monosyllabic feet or stray syllables. The typology discussed in section 1 is

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[29] See Houghton (2006) for a purely metrical analysis of Winnebago that relies on a non-initial stress constraint.

[30] As noted by Donca Steriade (p.c.), metrical analyses that are grid-only-based rather than foot-based often appeal to a non-initial stress constraint. Therefore, a rejection of such a constraint potentially weakens the grid-only-based approach. Whether or not such is the case, the crucial observation is that a non-initial stress constraint makes odd typological predictions within a grid-only-based theory in addition to foot-based ones: non-attested languages are predicted in which stress falls on the leftmost heavy syllable unless it is initial: HLL'HLH vs. 'HLLL. In sum, a non-initial stress constraint fails to capture the contrast in the behavior of stress at the two edges regardless of whether feet exist.

[31] As noted by René Kager (p.c.), one of the major advantages of a foot-based, rather than a grid-only-based theory is that it has it has the formal tools necessary to address the iambic/trochaic asymmetry, which is meaningless without the existence of feet. Since the view advocated in this paper is that there is no such asymmetry, the burden is placed to provide other evidence for the existence of feet. Such evidence comes from well-known phenomena such as word minima, reduplicant shape, allomorphy, etc (see de Lacy (1996, 2001), Ussishkin (2000), Elías-Ulloa (2004), etc.). More evidence comes from the observation that the head of an iamb lengthens, i.e. /σσ/→[(σ»σˇ)], but this never happens with trochees, i.e. /σσ/ → [(»σσ)], never *[(»σˇσ)]. Thanks to Paul de Lacy for a helpful discussion regarding these issues.

repeated in (91)[32]. Note that Osage belongs to the shaded cell below, in which prosodic words have right-headed feet, a rightward parse and no monosyllabic feet (when there is no lexical stress).

(91)	QUANTITY INSENSITIVE TROCHEES 45 languages		QUANTITY INSENSITIVE IAMBS 10 languages	
	LEFT-TO-RIGHT 32 languages	RIGHT-TO-LEFT 13 languages	**LEFT-TO-RIGHT** **4 languages**	RIGHT-TO-LEFT 5 languages
STRICTLY BINARY 30 languages	(a) (ˈσσ)(ˌσσ) (b) (ˈσσ)(ˌσσ)σ 14 languages (e.g. Pintupi)	(c) (ˌσσ)(ˈσσ) (d) σ(ˌσσ)(ˈσσ) 12 languages (e.g. Warao)	**(i) (σˈσ)(σˌσ)** **(j) (σˈσ)(σˌσ)σ** **4 languages** **(e.g. Osage)**	(k) (σˌσ)(σˈσ) (l) σ(σˌσ)(σˈσ) unattested
BINARY & UNARY 25 languages	(e) (ˈσσ)(ˌσσ) (f) (ˈσσ)(ˌσσ)(ˌσ) 18 languages (e.g. Murinbata)	(g) (ˌσσ)(ˈσσ) (h) (ˌσ)(ˌσσ)(ˈσσ) 1 language (Biangai)	(m) (σˈσ)(σˌσ) (n) (σˈσ)(σˌσ)(ˌσ) 1 language (Ojibwa)	(o) (σˌσ)(σˈσ) (p) (ˌσ)(σˌσ)(σˈσ) 5 languages (e.g. Weri)

Kager notes that four patterns exemplify perfect grids (38 languages, e.g. Murinbata, Warao, Araucanian and Weri): they allow neither clash nor lapse. Of the remaining patterns (16 languages) that deviate from rhythmic perfection, Pintupi-type languages allow lapse in final position, while Biangai-type languages allow clash between two secondary stresses at the left edge, and Ojibwa at the right edge. The only unattested system that is predicted involves binary iambs going from right to left with a lapse on the initial syllables of odd-numbered forms (see (91-l))[33].

The rankings in (92) predict the eight systems in (91). Note that the definitions of the eight constraints below were introduced throughout the analysis of Osage, and no new constraints are needed to predict the typology[34].

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[32]The numbers of languages indicated in each cell of (89) are taken from Gordon (2002).

[33] As noted in Hayes (1995), a large percentage of the iambic systems in the world are found in the Americas. Since many of these languages have yet to be (adequately) documented, further research is needed to justify the unattested iambs in (91-l).

[34] Since the cells in (91) exemplify systems with QI feet, I assume that faithfulness constraints that ban

(92) <u>Rankings that derive the typology in (91)</u>

a. FTBIN-σ >> PARSE-σ >> AFL >> AFR (see 91a)
HFL >> HFR; TROCHEE >> IAMB (see 91b)

b. FTBIN-σ >> PARSE-σ >> AFL >> AFR (see 91c)
HFR >> HFL; TROCHEE >> IAMB (see 91d)

c. FTBIN-σ >> PARSE-σ >> AFL >> AFR (see 91i)
HFL >> HFR; IAMB >> TROCHEE (see 91j)

d. FTBIN-σ >> PARSE-σ >> AFL >> AFR (see 91k)
HFR >> HFL; IAMB >> TROCHEE (see 91l)

e. PARSE-σ >> FTBIN-σ and PARSE-σ >> AFR >> AFL (see 91e)
HFL >> HFR; TROCHEE >> IAMB (see 91f)

f. PARSE-σ >> FTBIN-σ and PARSE-σ >> AFR >> AFL (see 91g)
HFR >> HFL; TROCHEE >> IAMB (see 91h)

g. PARSE-σ >> FTBIN-σ and PARSE-σ >> AFR >> AFL (see 91m)
HFL >> HFR; IAMB >> TROCHEE (see 91n)

h. PARSE-σ >> FTBIN-σ and PARSE-σ >> AFR >> AFL (see 91o)
HFR >> HFL; IAMB >> TROCHEE (see 91p)

The tableau in (93) illustrates that left-to-right trochees (see (91a,e)) are predicted by ranking HFL over HFR and TROCHEE over IAMB.

(93) /σσσσ/	HFL	TROCHEE	HFR	IAMB	REMARKS
☞ (ˈ**σ**σ)(ˌ**σ**σ)			1	2	trochaic parse; head foot at left edge
a. ~ (ˌ**σ**σ)(ˈ**σ**σ)	1 W		0 L	2	head foot at right edge
b. ~ (σˈ**σ**)(σˌ**σ**)		2 W	1	0 L	iambic parse

The tableau in (94) illustrates that the difference between left-to-right trochees and right-to-left trochees (see (91c,g)) is predicted by the reverse ranking of HFR and HFL.

(94) /σσσσ/	HFR	TROCHEE	HFL	IAMB	REMARKS
☞ (ˌ**σ**σ)(ˈ**σ**σ)			1	2	trochaic parse; head foot at right edge
a. ~ (ˈ**σ**σ)(ˌ**σ**σ)	1 W		0 L	2	head foot at left edge
b. ~ (σˌ**σ**)(σˈ**σ**)		2 W	1	0 L	iambic parse

The tableau in (95) illustrates that left-to-right iambs (see (91i,k)) are predicted by ranking HFL over HFR and IAMB over TROCHEE.

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quantity adjustments of syllables are un-dominated in these systems and for the sake of brevity, are not discussed in this section.

(95) /σσσσ/	HFL	IAMB	HFR	TROCHEE	REMARKS
☞ (σˈ**σ**)(σˌ**σ**)			1	2	iambic parse; head foot at left edge
a. ~ (σˌ**σ**)(σˈ**σ**)	1 W		0 L	2	head foot at right edge
b. ~ (ˈ**σ**σ)(ˌ**σ**σ)		2 W	1	0 L	trochaic parse

The tableau in (96) illustrates that right-to-left iambs (see (94m,o)) are predicted by ranking HFR over HFL and IAMB over TROCHEE.

(96) /σσσσ/	HFR	IAMB	HFL	TROCHEE	REMARKS
☞ (σˌ**σ**)(σˈ**σ**)			1	2	iambic parse; head foot at right edge
a. ~ (σˈ**σ**)(σˌ**σ**)	1 W		0 L	2	head foot at left edge
b. ~ (ˌ**σ**σ)(ˈ**σ**σ)		2 W	1	0 L	trochaic parse

The tableau in (97) illustrates that left-to-right trochees with a stray syllable (see (91b)) are predicted by the ranking FTBIN-σ >> PARSE-σ >> AFL >> AFR.

(97) /σσσσσ/	FTBIN-σ	PARSE-σ	AFL	AFR	REMARKS
☞ (ˈ**σ**σ)(ˌ**σ**σ)σ		1	2	4	stray syllable
a. ~ (ˈ**σ**σ)σ(ˌ**σ**σ)		1	3 W	3 L	misaligned foot
b. ~ (ˈσ**σ**)σσσ		3 W	0 L	3 L	three stray syllables
c. ~ (ˈ**σ**σ)(ˌ**σ**σ)(ˌ**σ**)	1 W	0 L	6 W	4	monosyllabic foot

The tableau in (98) illustrates that left-to-right trochees with monosyllabic feet (see (91f)) are predicted by the rankings PARSE-σ >> FTBIN-σ and PARSE-σ >> AFR >> AFL.

(98) /σσσσσ/	PARSE-σ	FTBIN-σ	AFR	AFL	REMARKS
☞ (ˈ**σ**σ)(ˌ**σ**σ)(ˌ**σ**)		1	4	6	monosyllabic foot
a. ~ (ˈ**σ**)(ˌ**σ**σ)(ˌ**σ**σ)		1	6 W	4 L	misaligned foot
b. ~ (ˈ**σ**σ)σ(ˌ**σ**σ)	1 W	0 L	3 L	3 L	stray syllable

Note that in (97) and (98), the ranking HFL >> HFR insures that the candidates are parsed from left-to-right; the reverse ranking predicts a right-to-left parse (see (91d, h)). Moreover, the ranking TROCHEE >> IAMB insures that the feet in (94) and (96) are trochees; the reverse ranking predicts feet that are iambs (see (91j,l,n,p) as well as the analysis of default obeying forms in Osage in section 4). In sum, the interaction of the eight prosodic constraints considered in this section predicts the eight systems in the foot typology in (91).

7.0 Conclusion

Much of the literature on metrical theory over the past two decades has attempted to address the question of whether the lack of quantity insensitive iambs reflects a fundamental property of the grammar. This question presupposes that the iambs in (99) do not exist.

(99)	(Hˈ**L**)	(Hˈ**H**)

In this paper, I argued that such a presupposition is not warranted and that any typological theory of feet *must* predict the iambs in (99). The argument rested on data from Osage, which is typologically remarkable because it provides clear and unambiguous evidence for the existence of such feet. The analysis advocated in this paper is Optimality Theoretic; it was shown that Osage fills the empirical gap that is inherent in a typology that results from the interaction of Optimality Theoretic prosodic constraints in Prince & Smolensky (1993) and McCarthy & Prince (1993a,b, 1995).

The major consequence of the argument in this paper is that if a language that distinguishes quantity of syllables has iambs, it *does not* necessarily follow that stress placement in that language is affected by the moraic make-up of syllables (contra the generally held view). In other words, whether a foot is right-headed or left-headed in a given language is *independent* of whether stress in this language is affected by the moraic make-up of syllables.

8.0 The appendices

8.1 *Appendix A: Word List*

<u>Margaret Red Eagle Iron</u>

(1)	kɑːˈ**mɑ**	‘the noise a bell makes’
(2)	ðyːˈ**kɑː**mɑ	‘to ring the bell’
(3)	leːˈ**tɑ̃ː**mɑ̃ˌ**ze**	‘Paul’s adult name’
(4)	ðyːˈ**wɑː**sy	‘clean’
(5)	lɑːˈ**skɑ**ʒĩ	‘little flower’
(6)	wɑˈ**ʰkõ**tɑ	‘God’
(7)	iːˈ**tɑ**ðɑˌ**pe**	‘she gave birth to him’
(8)	ˈ**zɑ**ːni	‘all’
(9)	ðɑˈ**k**ˀ**e**ðɑˌ**pe**	‘be kind to’
(10)	ˈ**ðɑ**ːl̃i	‘good’
(11)	ˈ**wɑ**kõˌ**ðɑ**pi	‘he wants us’
(12)	ɑ̃ˈ**kɑ**ʰkiˌ**lɑ̃ː**pi ~ ɑ̃ˈ**kɑ**ʰkiˌ**lɑ**ðĩˌ**pi**	‘we carry ourselves’
(13)	ˈ**o**xtɑˌ**ðe**	‘to make sacred’
(14)	oˈ**mɑ**ĩˌ**ʰkɑ**	‘year’
(15)	oˈ**mɑ**ˌʒ**ɑ**	‘throughout the land’
(16)	ˈ**o**weːˌ**nɑ̃**	‘grateful’
(17)	ˈ**hõ**ːpɑ	‘day’
(18)	ɑ̃ˈ**nɑ̃**ðe	‘we see’
(19)	ɑ̃ˈ**nɑ̃**ðɑˌ**pi**	‘we saw you’
(20)	tʌlsɑ ðyːˈ**xtɑ**ðɑˌ**pɑ͡ɪ**	‘They are tearing Tulsa down’

<u>Frances Holding</u>

(1)	wɑˈ**nõ**bre	‘to dine’
(2)	wɑ́ˈ**tṍ** è	‘something’
(3)	wɑːˈ**t͡sʰi**	‘dance’
(4)	ɑˈ**wɑ**ːspe	‘I wait’
(5)	iːˈ**ʃtɑ**ː	‘eye’
(6)	ʒĩˈ**kɑ**ʒi	‘child’
(7)	ˈ**li**piː	‘return here’
(8)	iˈ**ʒi**ke	‘son’
(9)	wiˈ**ʃki**	‘I too’
(10)	ˈ**o**nɑ̃**l̃i**	‘to hurry’

(11)	ˈ**ðo**hɑ	‘almost’
(12)	ˈ**wɑː**spe	‘to wait, stay’
(13)	ˈ**hɑ̃**t͡se	‘last night’
(14)	ðɑːˈ**t͡se**	‘eat’
(15)	oˈ**t͡se**	‘to look for, search’
(16)	ˈ**to**e	‘some’
(17)	oːˈ**pi**xɑ	‘to blow’
(18)	iːˈ**stɑ**ʰkiˌ**e**pi	‘bless yourself’
(19)	pɑːˈ**ʃõ**we	‘binding’
(20)	ʃt͡syːˈ**wɑ**sy	‘you clean in’
(21)	ɑˈ**pyː**xe	‘boil’

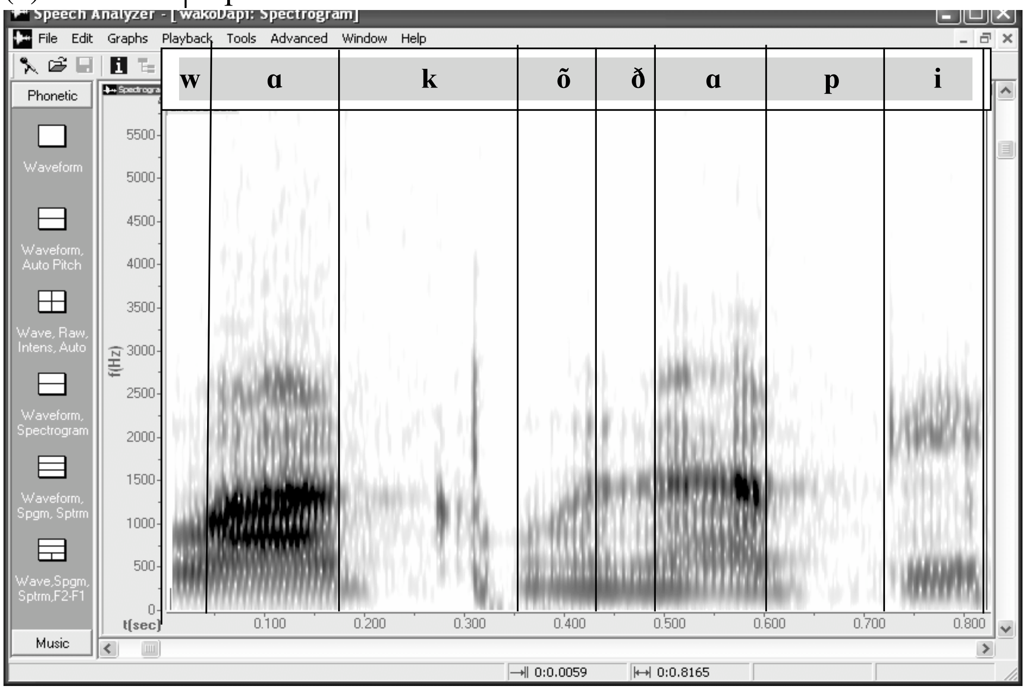
Myrtle Oberly Jones

(1)	ðyːˈ**ʰle**ke	‘to break into’
(2)	ˈ**ʰtáː**	‘deer’
(3)	ɑːˈ**ði**	‘has it’
(4)	iːˈ**ðɑ**ðe	‘I saw it’
(5)	ˈ**heː**	‘lice’
(6)	pɑːˈ**xo**	‘mountain’
(7)	ðiːˈ**ʰtɑ**	‘to pull’
(8)	ˈ**i**ʰt͡sɑˌ**ʰtɑː**	‘rat’
(9)	ˈ**ʰkeː**	‘turtle’
(10)	ˈ**hɑ**	‘go ahead’
(11)	ˈ**ki**	‘flight like a plane’
(12)	kɑːˈ**sɑː**ki	‘to knock someone out’
(13)	ˈ**y**ʒeˌ**wɑ**moˌ**e**	‘lizard’
(14)	nɑ̃ːˈ**lo**xɑ	‘undercover, sneak’
(15)	ˈ**hɑː**kxɑˌ**ʰtɑ**	‘when’
(16)	ˈ**ɑ**mɑ̃ˌ**ʃi**	‘up’
(17)	ˈ**mi**lɑ̃ˌ**ke**	‘a man marries’
(18)	ˈ**ɑ̃**nɑ̃ːˌ**ʒi**	‘step on it’
(19)	ˈ**ni**wɑˈ**ʰt͡se**	‘cold’
(20)	ˈ**we**t͡sʔɑ	‘snake’
(21)	ˈ**wɑ**t͡s**ʰ**i ˈ**ni**e	‘venereal disease’
(22)	siːˈ**kɑ**	‘squirrel’
(23)	hɑːˈ**xĩ**	‘blanket’

8.2 *Appendix B: Duration*

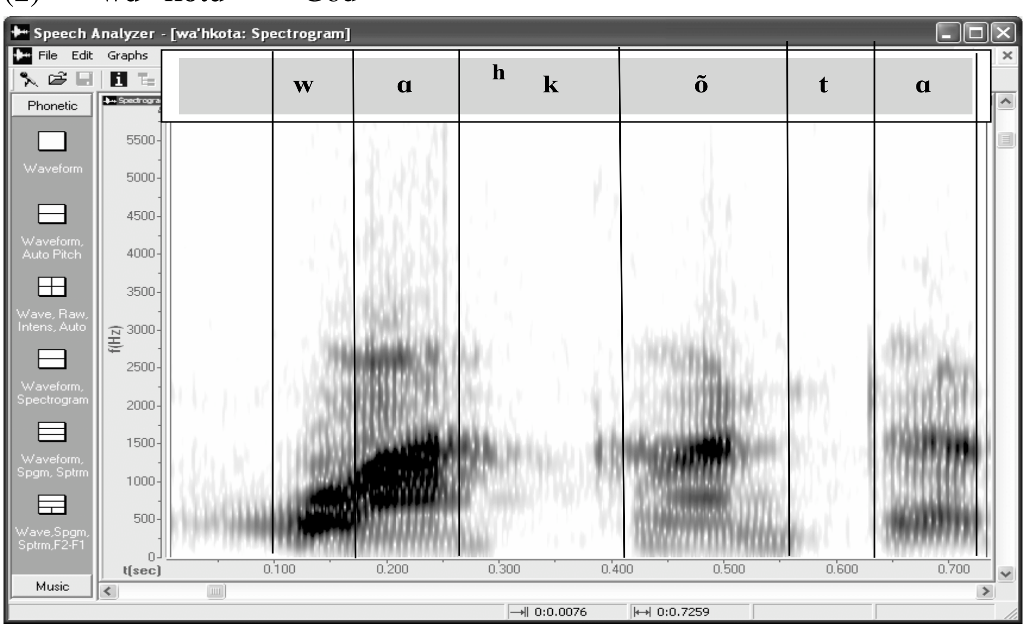
In (1), the vowels in the odd-numbered syllables are shorter than the vowels in the even-numbered syllables. More precisely, the initial vowel in is 132 ms., the second vowel is 78 ms., the third vowel is 108 ms., and the fourth vowel is 92 ms.

(1) ˈ**wɑ**kõˌ**ðɑ**pi ‘he wants us’



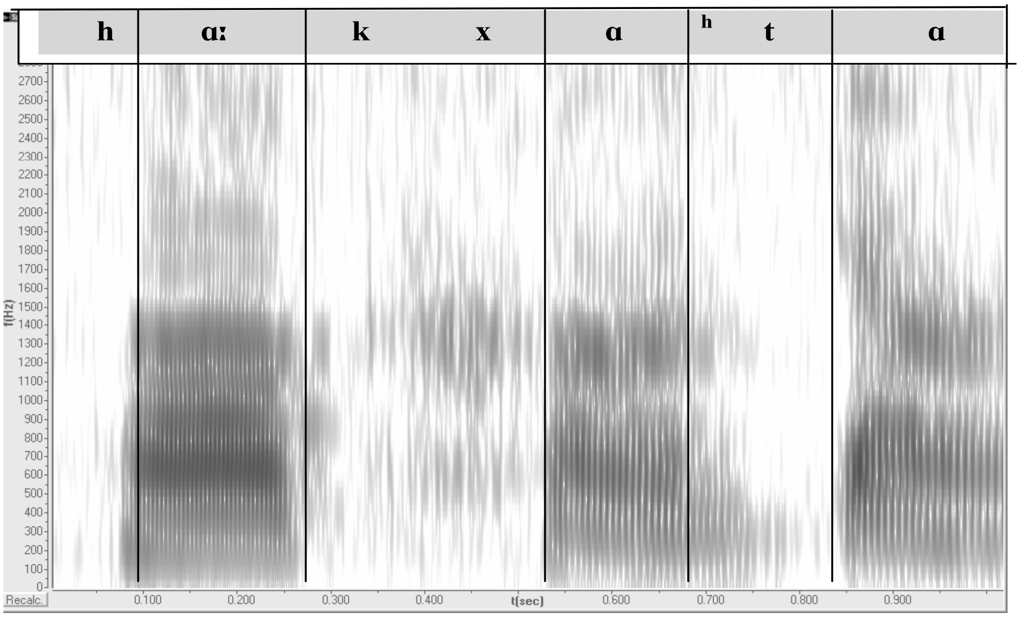
In (2), the first vowel is 90 ms., the second vowel is 152 ms., and the third vowel is 98 ms.

(2) wɑˈ**ʰkõ**tɑ ‘God’



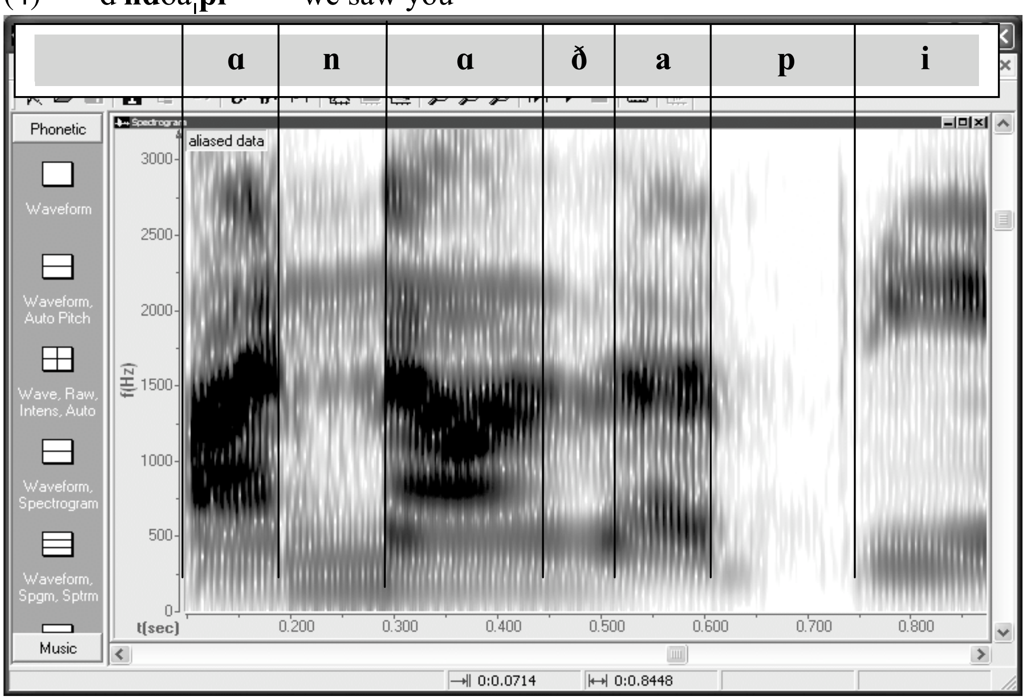
In (3), the peninitial vowel is shorter than the vowels in the odd-numbered syllables. More precisely, the initial vowel in is 180 ms., the second vowel is 100 ms. and the third vowel is 150 ms..

(3) **ˈhɑː**kxɑˌ**ʰtɑ** ‘when’



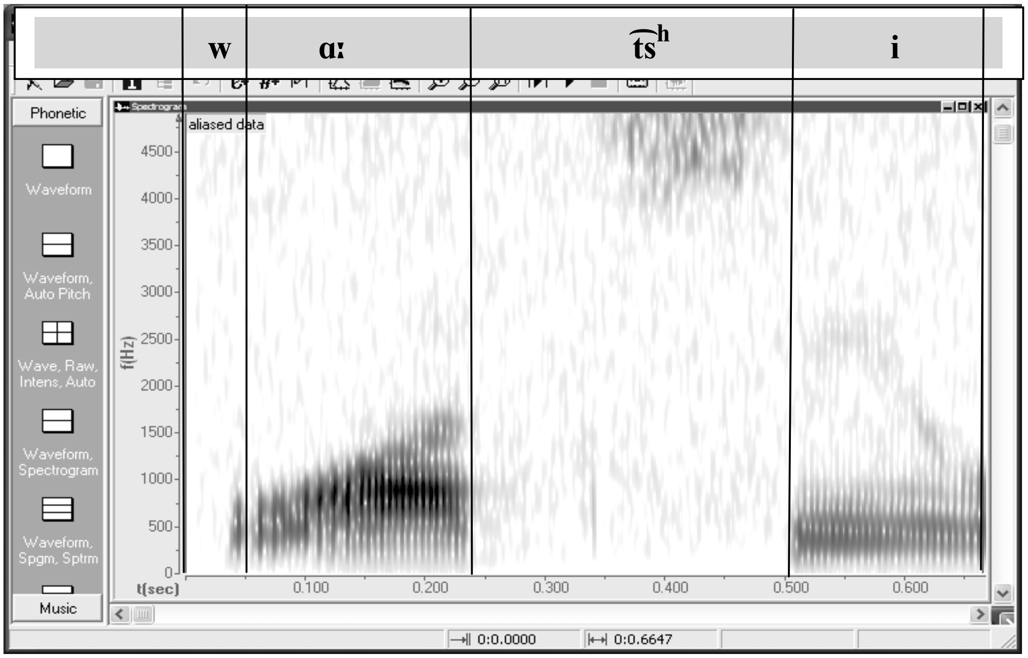
In (4), the vowels in the even-numbered syllables are longer than the vowels in the odd-numbered syllables. More precisely, the initial vowel in is 91 ms., the second vowel is 154 ms., the third vowel is 88 ms. and the fourth vowel is 138 ms..

(4) ãˈ**nã**ðaˌ**pi** ‘we saw you’



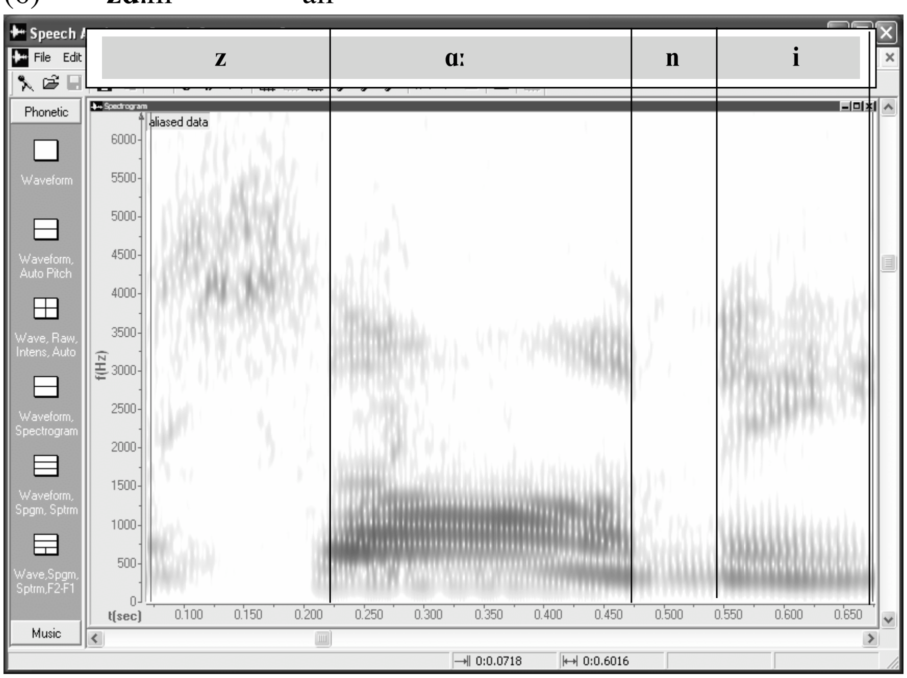
In (5), the first vowel is 175 ms. and the second vowel is 162 ms..

(5) wɑː**t͡sʰi** ‘dance’



As illustrated in (6), the first vowel is significantly longer than the second; the first vowel is 250 ms. and the second vowel is 126 ms..

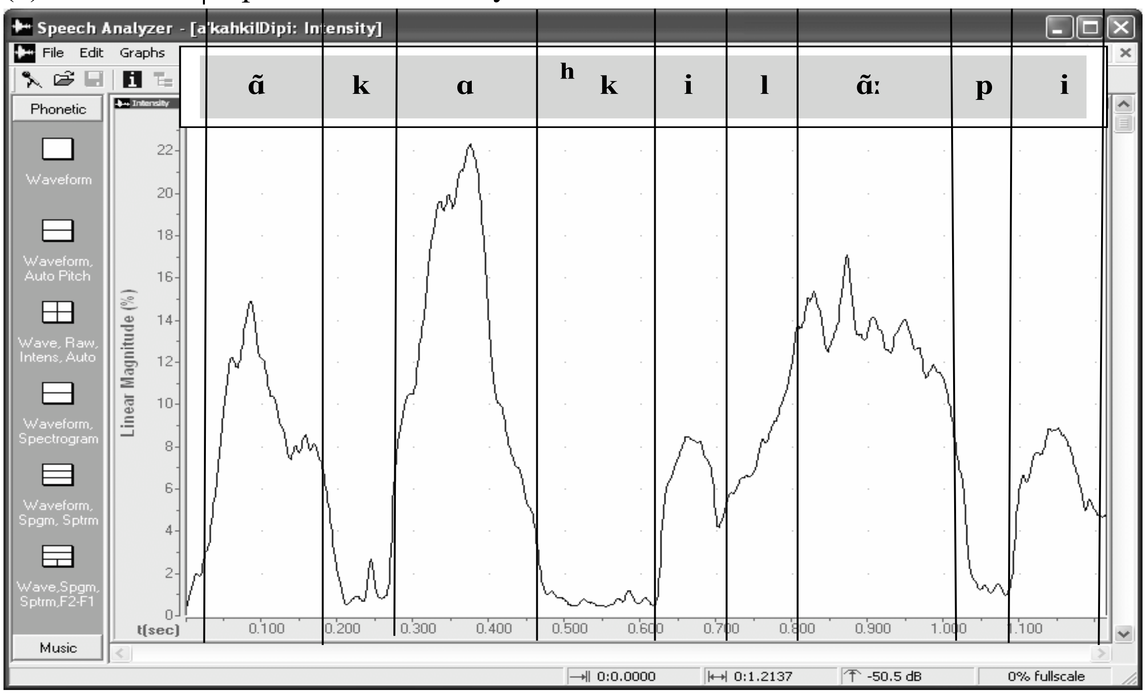
(6) ˈ**zɑ**ːni ‘all’



8.3 *Amplitude*

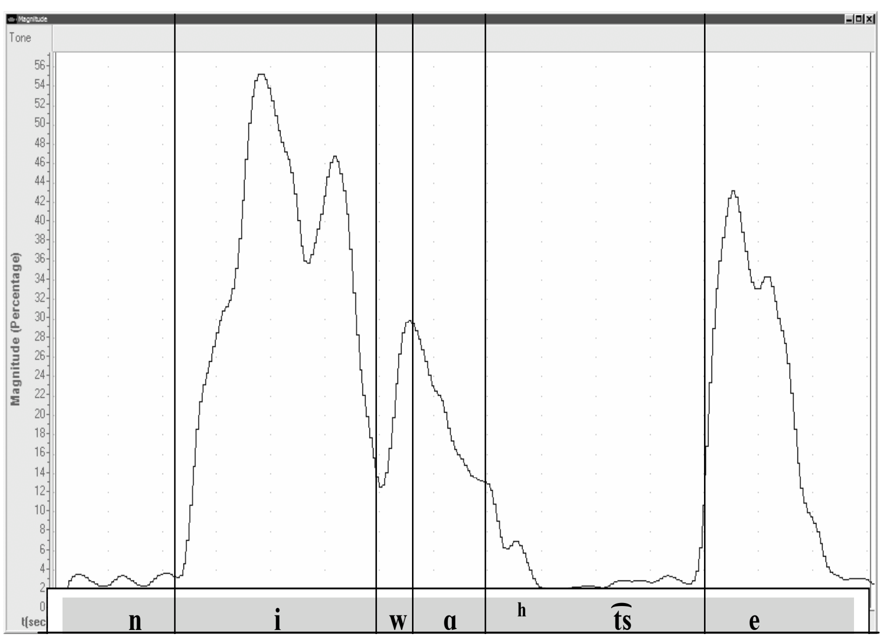
As illustrated in (1), every even syllable is louder than every odd one.

(1) ãˈ**kɑ**ʰkiˌ**lãː**pi ‘we carry ourselves’



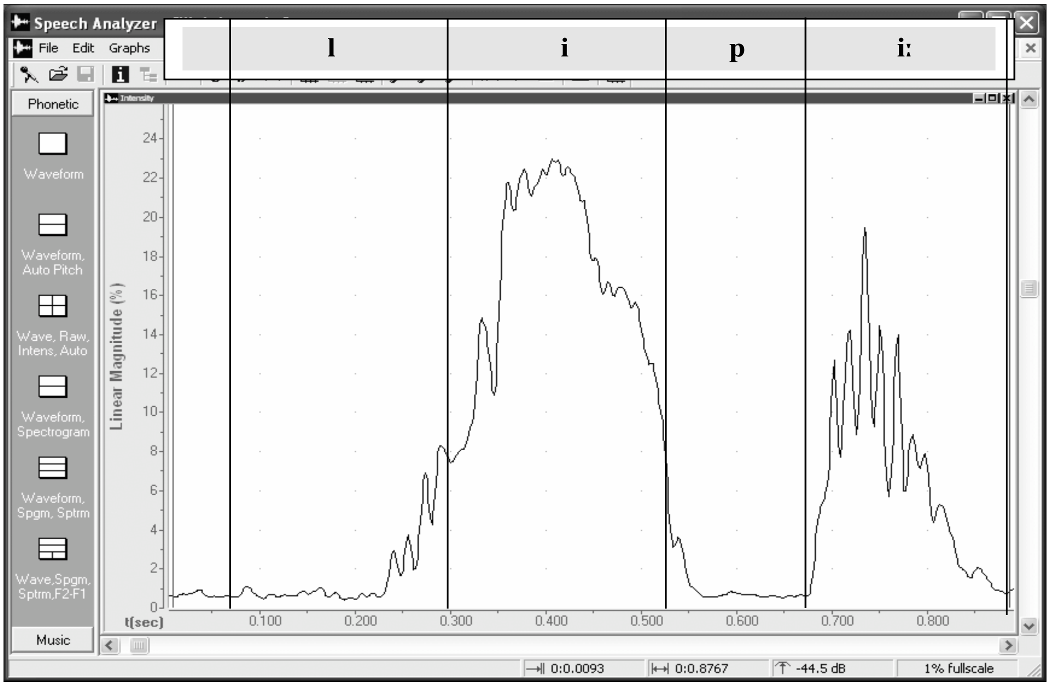
As illustrated in (2), every odd syllable is louder than every even one.

(2) ˈ**ni**wɑˈʰ**t͡se** ‘cold’



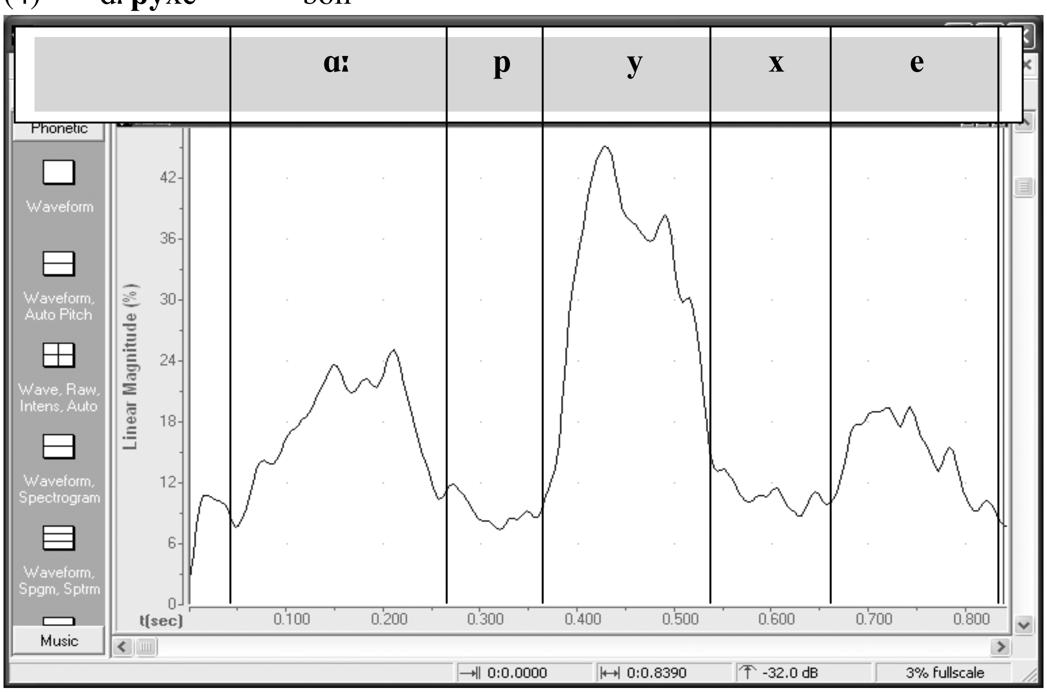
As illustrated in (3), the initial vowel is louder than the word final one even though the latter one is long.

(3) ˈ**li**piː ‘return here’

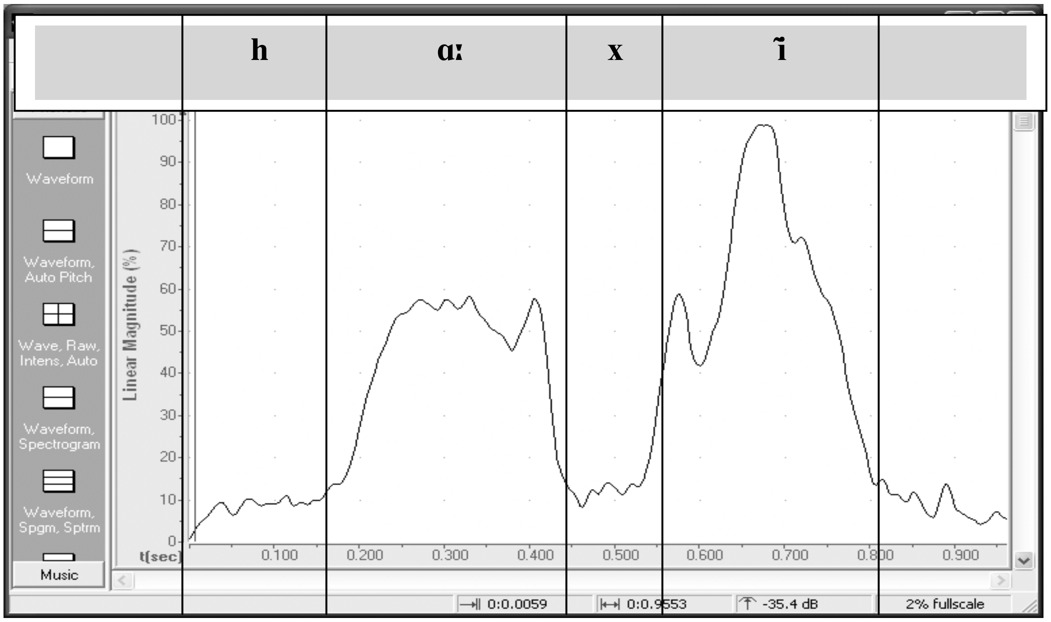


As illustrated in (4) and (5), the peninitial vowel is louder than the initial one even though the former one is long.

(4) ɑːˈ**py**xe ‘boil’

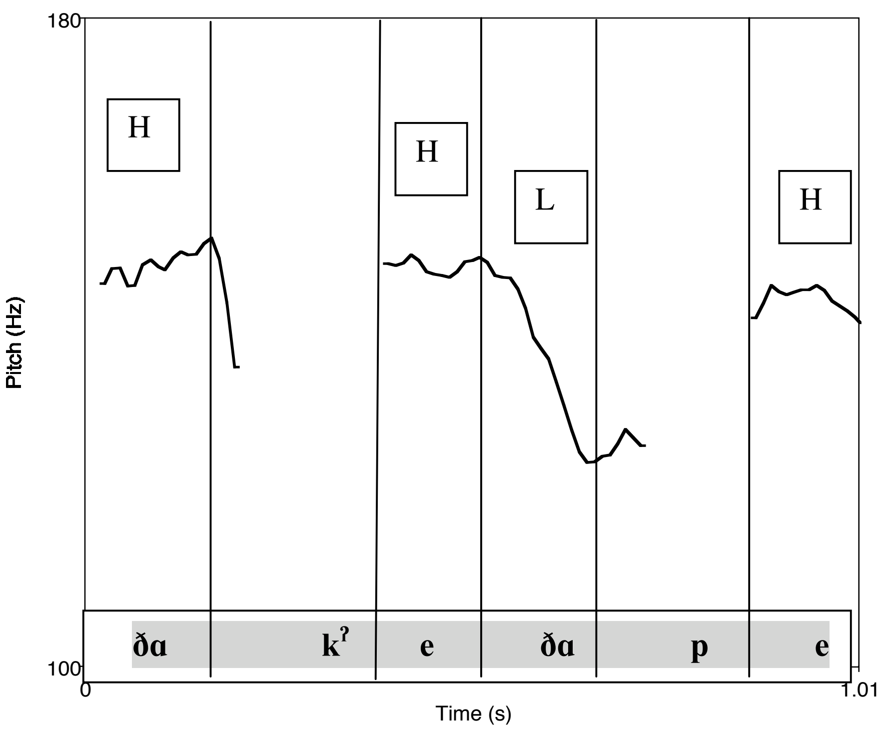


(5) hɑːˈ**xĩ** ‘blanket’

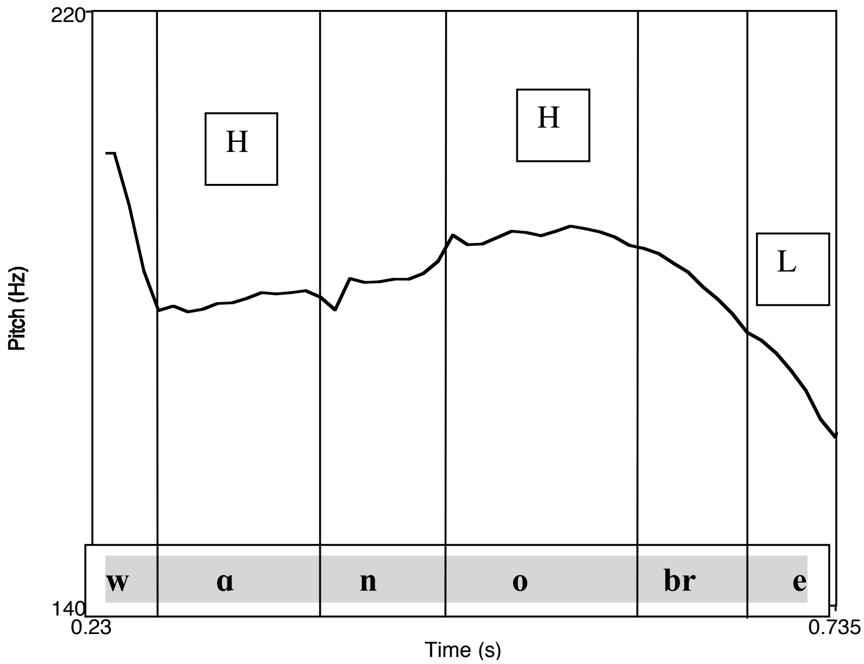


11.0 Appendix D: Fundamental frequency

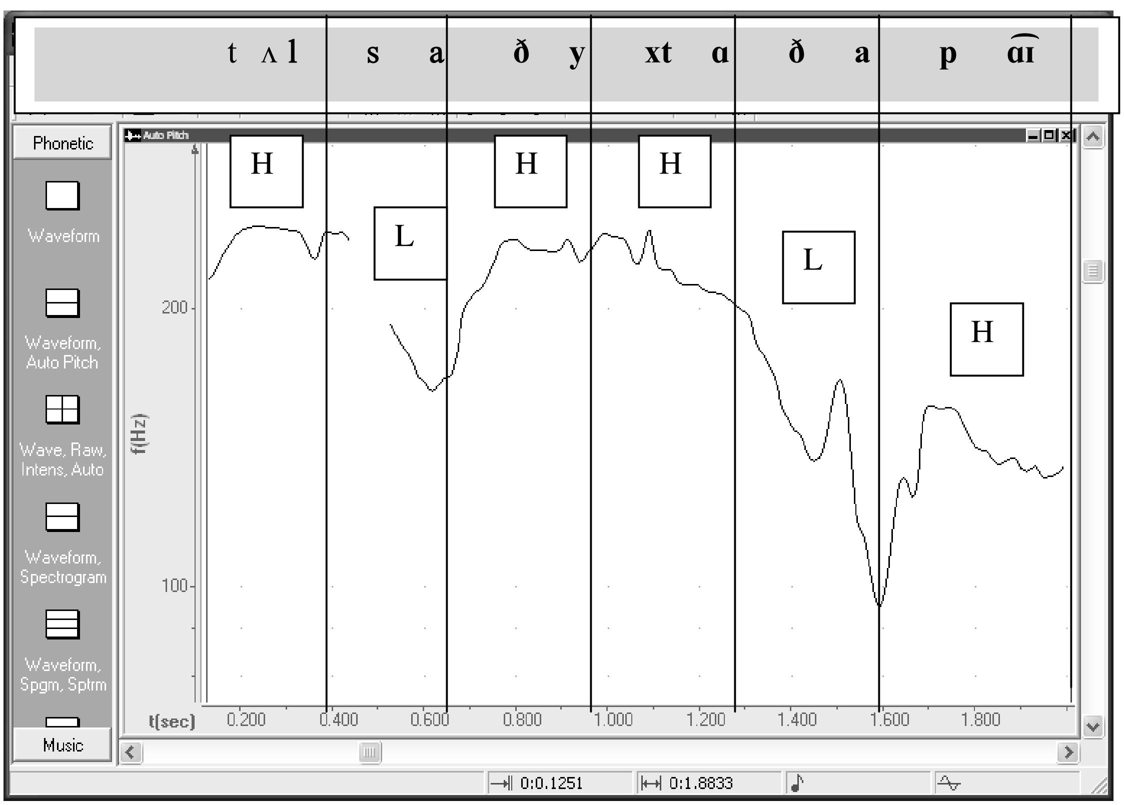
(1) ðɑˈ**kˀe**ðɑˌ**pe** ‘be kind to’



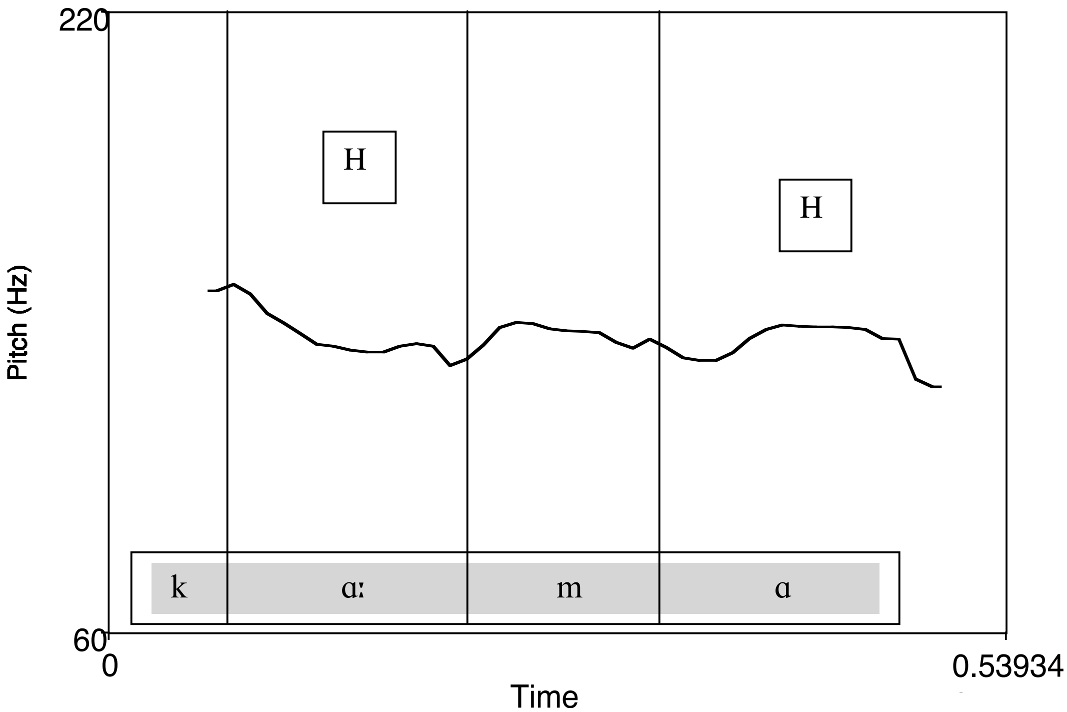
(2) wɑˈ**nõ**bre ‘to dine’



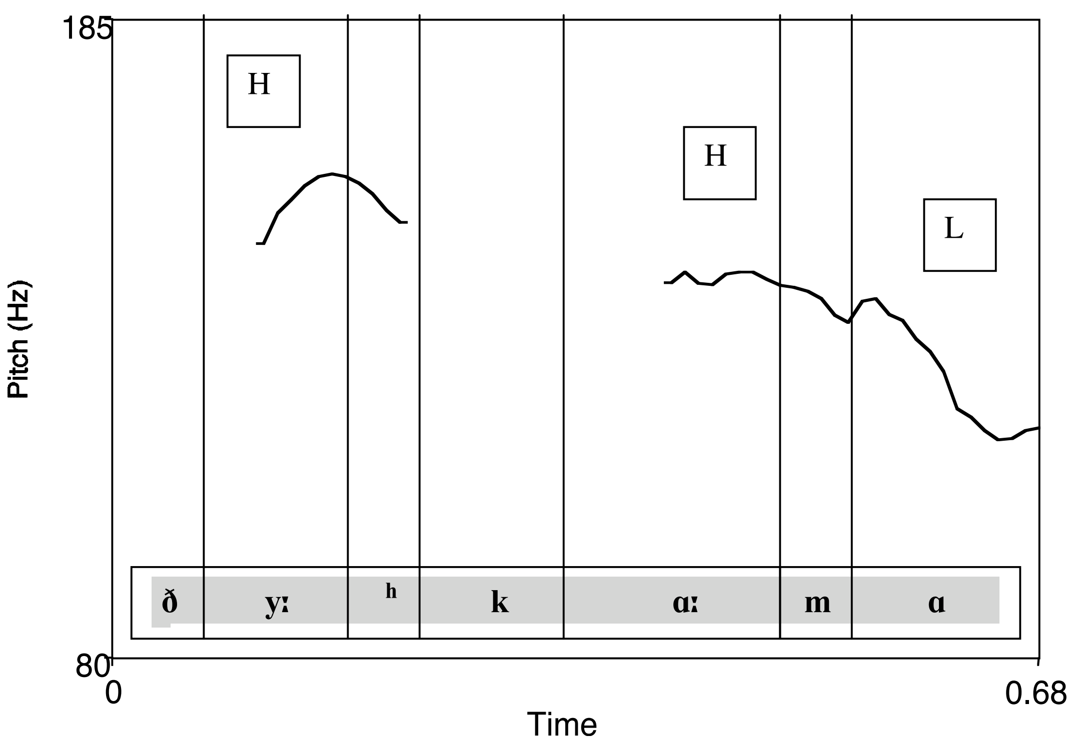
(3) tʌlsɑ ðy:ˈ**xtɑ**ðaˌ**pɑ͡ɪ** ‘They are tearing Tulsa down’



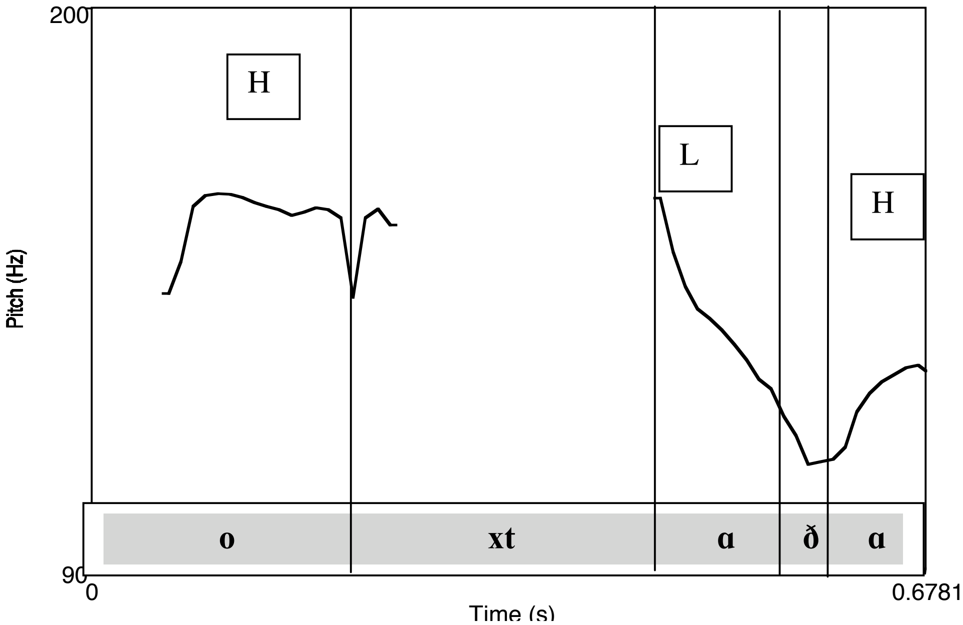
(4) kɑː**ˈmɑ** ‘the noise a bell makes’



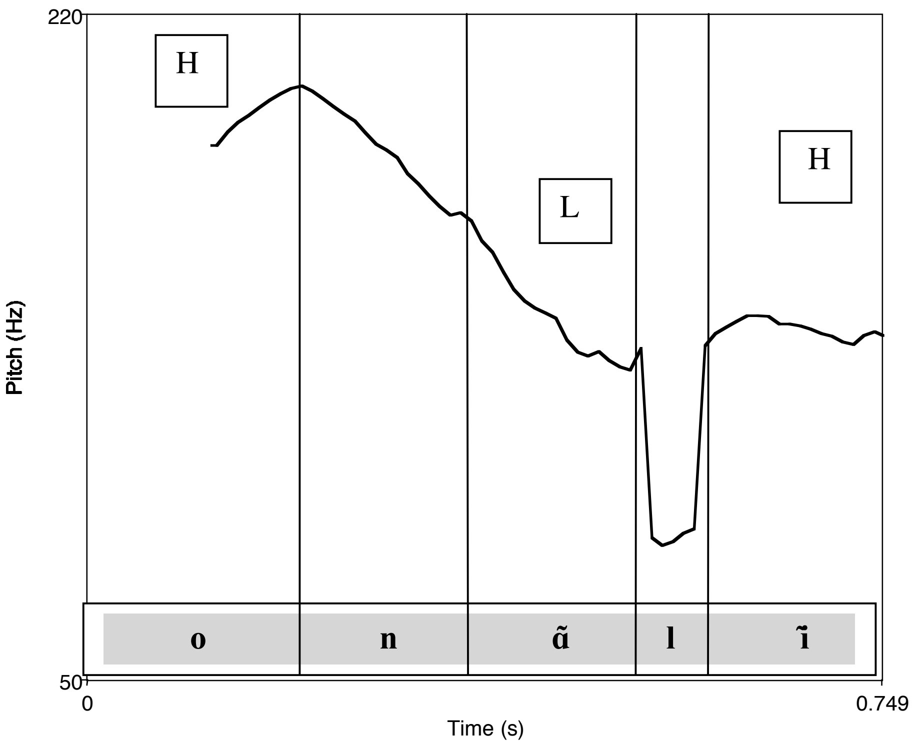
(5) ðyːˈ**ʰkɑː**mɑ ‘to ring the bell’



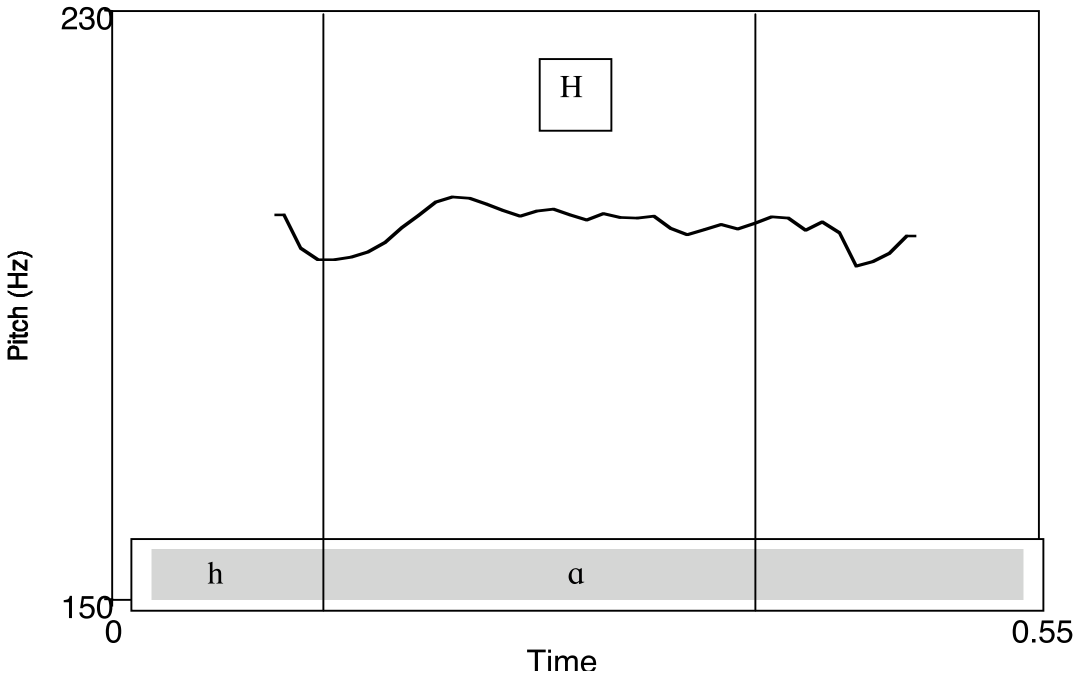
(6) ˈ**o**xtɑˌ**ðe** ‘to make sacred’



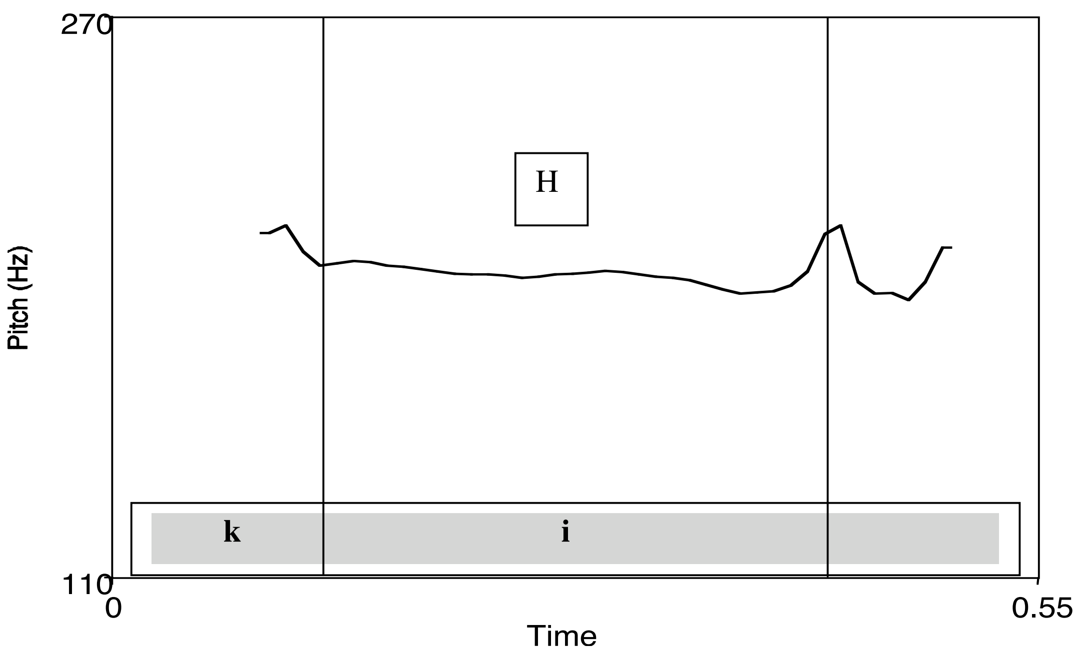
(7) ˈ**o**nãˌ**lĩ** ‘to hurry’



(8) ˈ**hɑ** ‘go ahead’



(9) ˈ**ki** ‘fly like a plane’



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