PITCH ACCENT AND INTONATION IN CAYUGA: AN ACOUSTIC ANALYSIS AND ToBI RECOMMENDATIONS

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Pitch Accent and Intonation in Cayuga: An acoustic analysis and ToBI recommendations

by

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Abstract

This thesis provides an acoustic analysis of prosody in Cayuga (Northern Iroquoian) narrative speech. I analyze the relationship between acoustic variables (e.g. pitch, intensity, and duration) and the language's prosodic system (more specifically, its accent and intonation patterns) using Praat scripting and statistical analysis. Through this research I found that (a) pitch is the acoustic variable most relevant to describing Cayuga pitch accent and intonational patterns; (b) Cayuga intonation patterns can be described within the Generative framework proposed by Pierrehumbert and Beckman (Beckman 1996; Pierrehumbert 1980; Pierrehumbert and Beckman 1988)); and (c) Cayuga intonation patterns are generally 'additive', in the sense that a combination of word-accent (pitch-accent) and phrasal accents (boundary tones) determines the overall contour of the intonation pattern. Additionally, I propose a framework for annotating Cayuga prosody using a Tone and Break Index (ToBI) system that has been set up to account the prosody of narratives in Cayuga.

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Last, but certainly not least, I wish to thank my family and friends outside Memorial. You all have been, and remain to be, a constant source of support in my life both academically and otherwise. Thank you for being there. I love you all.

Nya:wę̨h!
Thank you!

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Chapter 1: Introduction

In this thesis, I carry out an acoustic analysis of pitch accent and intonation in a Cayuga (Northern Iroquoian) narrative. I examine the role of pitch, intensity, and duration in the narrative, using statistical analysis to determine which factors are significant to accent and intonation in the Cayuga prosodic system. I also propose a framework for a Cayuga Tone and Break Index (ToBI) system for annotating Cayuga prosody in narratives.

There is little previous acoustic research on Cayuga accent and intonation: Doherty (1993) conducted an acoustic analysis of Cayuga pitch accent, but his analysis was based on a small set of acoustic tokens of words in isolation; similarly, Foster (1982) briefly provides an impressionistic description of Cayuga intonation, but this is only several sentences long. My thesis builds on these findings: my acoustic analysis includes both pitch accent and intonation, and is based on an extensive database of words and phrases recorded in context, developed from a narrative by a native Cayuga speaker. In addition, my thesis addresses the topic of how pitch accent interacts with intonation in Cayuga. The results of my analysis provide the basis for an acoustically and statistically supported description of accent and intonation in Cayuga. Through my analysis, I am able to describe a system in Cayuga whereby pitch is indeed a primary marker of prominence, while other factors such as intensity and duration (which play a key role in languages like English) appear to play only a supporting role in Cayuga. Additionally, I am able to describe the interaction of intonation patterns with accent patterns in different Cayuga phrases. For example, I examine how an intonation contour in WH- questions is able to modify the accent of words following a WH-word to produce a level contour.

Finally, my thesis provides the basis for further study and modelling of accent and intonation in Cayuga, through an evidence-based Tone and Break Index (ToBI) system that is adapted for Cayuga and is suitable for other Iroquoian languages.

Chapters 2 and 3 present the background of my thesis, the theoretical approach and literature review respectively. The remaining content chapters (Chapters 4-7) present my research. Chapter 4 (Methodology) details my research process from an initial description of the data used, to how that data was annotated and analyzed using

Praat scripts. Chapter 5 (Results) discusses the output of the scripts, and statistical analysis of my data. Chapter 6 (Interpretation), takes the results from Chapter 5 and discusses them in terms of what I call 'blueprints' for both the phrase and word-accent types examined. Finally, Chapter 7 (Toward a C_ToBI) presents a preliminary approach to annotating Cayuga based on a Tone and Break Index system specifically tuned to capture the intonation and accent found in Cayuga phrases. Additionally, this chapter presents annotated examples which employ this proposed C_ToBI annotation system. Concluding remarks summarizing the thesis overall, and present ideas for future research in Cayuga prosody are found in Chapter 8.

Chapter 2: Theoretical Approach

For this thesis, I adopt an approach in which the location of pitch accent (and stress) is defined in the lexical phonology, and intonational tunes are defined in the post-lexical component of the grammar. Additionally, the phonetic realization of both pitch accent and intonation is specified at the level of Phonetic Implementation.

1. Generative Grammar Model Phonology

My work is couched within the general framework of Generative Phonology (e.g. Chomsky and Halle 1968), and more specifically within Prosodic Phonology (e.g. Selkirk 1984). The approach to intonation adopted in this thesis follows the tradition set by Mary Beckman and Janet Pierrehumbert (Beckman 1996; Pierrehumbert 1980; Pierrehumbert and Beckman 1988). I specifically assume that "the [intonational] tune is specified using an independent string of tonal segments, and the prosody of an utterance is viewed as a hierarchically organized structure of phonologically defined constituents and heads" (Beckman 1996, 19).

There are three levels of phonology important to my description: **Lexical Phonology** is where the location of pitch accent is defined within the word; **Post-lexical phonology** is where intonational tunes are defined within the phrase. The level of **Phonetic implementation** is where the phonetic realization of pitch accent and intonational tunes occurs, as well as where the interactions between pitch accent and intonational tunes occur.

2. Pitch Accent

The term pitch refers to the perception of fundamental frequency (F0). Fundamental frequency, in turn, is the lowest frequency (i.e. number of cycles per second) of a periodic waveform. Pitch is measured in Hertz (Hz) (Raphael, Borden, and Harrie 2007).

Pitch accent is analogous to (primary) stress in English. It is the term by which we refer to how prominent syllables in a given word or phrase are marked as such. In English (a so-called stress accent language) prominence is referred to as stress which manifests as an increase in combination of prosodic qualities including intensity (loudness), duration, and pitch. However, in languages such as Cayuga or Japanese (so-called pitch accent languages) prominence is, in theory, marked primarily by the modulation of pitch.[1] Prominent syllables in this type of language are said to be pitch-accented.

In languages like Cayuga and Japanese, the domain of pitch accent placement is the Prosodic Word. In Cayuga, a pitch peak H tone is associated with the most metrically-prominent syllable of every word (with some exceptions; Dyck 2009). In Japanese, words generally begin with L tone on the first syllable and are followed by H toned syllables until an abrupt drop from H tone which occurs at a lexically-specified syllable. However, some words are considered unaccented (i.e. they lack this lexically-specified drop from H tone, and continue on a H tune) (Abe 1998).

In the following chapter, I will discuss other pitch accent languages including Japanese (as mentioned above), Serbo-Croatian, Korean, and Kalaallisut. The discussion of other pitch accent language (including accent's interaction with intonation) provides

1 Later, I will consider the contribution of other factors (e.g. intensity and duration) to the marking of prominence in Cayuga. See Chapter 5 (Results) and Chapter 6 (Interpretation) for more information regarding these additional factors.

valuable background on this type of language that currently does not exist in reference to Cayuga specifically.

3. Intonational Phonology

To analyze Cayuga intonation, I will adopt a theoretical approach in which intonation contours have an abstract, underlying structure or grammar which provides "… a way to specify all the relevant tonal categories in the tune (the pitch pattern) and a way to specify how this tune aligns with the text (the segmental string) of the utterance" (Beckman 1986, 19-24).

Additionally, I assume that the tones High (H) and Low (L) are the "basic units of description for intonation" (Pierrehumbert 1980, 64). These tones are associated with prominent syllables and/or the edges of prosodic domains (Pierrehumbert 1980; (Pierrehumbert and Beckman 1988). These tones combine as "an abstract sequence of tones or the tune according to the finite state grammar" (Heusinger 1999, 66).

H and L tones can align with the text (prosodic domains) in two ways: boundary tones align with the left or right edge of prosodic units, and pitch accents align with metrically-prominent syllables (Pierrehumbert 1980, 10-11). Boundary tones are indicated by a % symbol, and pitch accents, by a * symbol. The tone that leads or tails such pitch accents is marked with a hyphen (e.g. H- or L-) (Pierrehumbert 1980).

An example of the intonational grammar to which Heusinger (1999) refers is that of English intonational tunes proposed by Pierrehumbert (1980). According to Pierrehumbert's grammar for English, a finite set of boundary tones, pitch accents, and phrase accents combine to form the intonational tune of an English phrase. The set of tunes available to English phrases are exemplified in figure 2.1 below[2].

For example, in English, it is possible for a phrase to have a L% H* L- H% intonational tune. Such a tune in English (i.e. one that begins fairly low, and ends with a rising intonation) may occur in a question such as "Do YOU know what it is?" where the *you* is given some emphasis (H*), the tone drops (L-), and ends with rising question intonation at the phrase boundary (H%).

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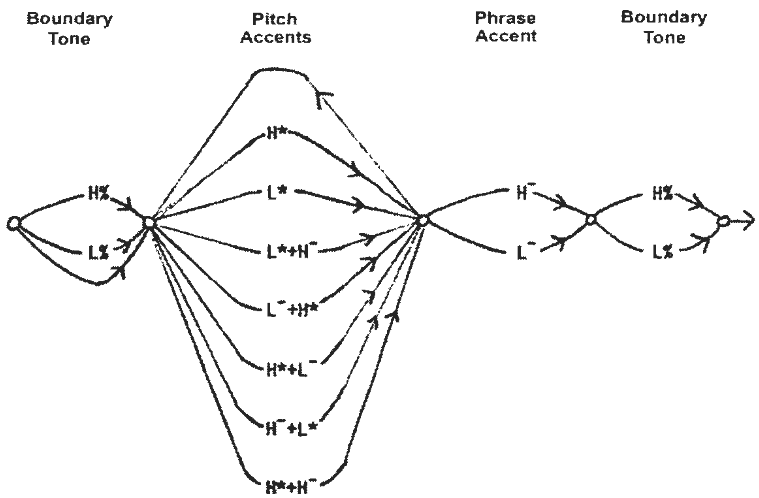
2 The number of possible pitch accents was reduced from seven (as shown in figure 2.1) to six by Beckman and Pierrehumbert (1986). The H* + H pitch accent type was eliminated as it was considered "a categorically contrastive element." (Pierrehumbert 2000, 21)



(Figure 2.1) Grammar of English Intonation Tunes (Pierrehumbert 1980, 29; Ladd 2008, 89)

The prosodic domains relevant to a grammar of intonational tunes are shown in figure 2.2 below. (The mora, a unit of phonological length, is not shown; morae are constituents of syllables.) In addition, the Accentual Phrase, which is intermediate between the Prosodic Phrase and the Prosodic Word, has been posited for languages like Japanese (Beckman 1996, 32-34; 39).

```
( __________________________________________________ ) Utterance
( _________________________________ ) ( ______________ ) Intonational Phrase (IP)
( ______ ) ( _________________________ ) ( ______________ ) Phonological Phrase (PP)
( ______ ) ( _____ ) ( _______________ ) ( ______________ ) Prosodic Word (Pwd)
( __ ) ( ____ ) ( ____ ) ( __ ) ( ______ ) ( ____ ) ( __ ) ( _____ ) Foot (Ft)
( __ ) ( __ ) ( __ ) ( __ ) ( __ ) ( __ ) ( __ ) ( __ ) ( __ ) ( __ ) Syllable
```

(Figure 2.2) The prosodic hierarchy (Adapted from Selkirk 1986)

In my analysis, I divided my data into sections (delineated by pauses in the original sound file), which I defined as prosodic units larger than the Prosodic Word and smaller than the utterance. Dyck (2009) argues that Cayuga 'words' are prosodic phrases. Adopting this position, and given that these units can contain more than one word, they likely correspond to Intonational Phrases. For this reason, I will equate my pause-delineated prosodic units with Intonational Phrases in this thesis. For consistency, I will refer to each of these units by the term phrase from here on.

Prosodic domains tend to coincide with syntactic ones, although they are not identical (Selkirk 1984). Evidence for prosodic domain edges includes the most logical location for pauses (Beckman 1996, 23), and the degree of disjuncture (e.g., the relative presence or lack of co-articulation) between words and phrases (Venditti 1995; 2007).

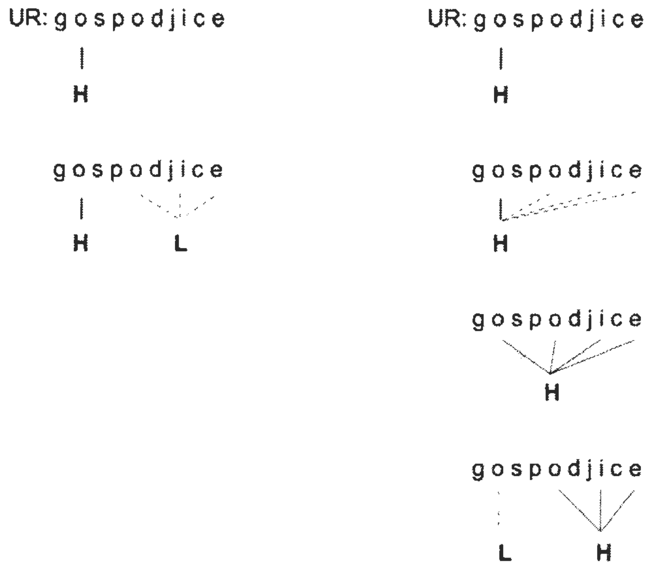
In some languages (including English), pitch accents are contour, rather than level. Such pitch accents are described as consisting of a combination of H and L tones. For example, H* + L- in figure 2.1 represents a contour (falling) pitch accent. While pitch accents always align with metrically-prominent syllables, they can align within two different domains, depending on the language, namely, within a domain larger than the Prosodic Word, or within the Prosodic Word itself. In languages like English, the domain is larger than the word (i.e. it is the Intonational Phrase); for example, two utterances can minimally contrast with regard to the location of the pitch accent (Beckman 1996), as shown by the contrast between 'JOHN is crazy' versus 'John is CRAZY', where the highlighted word contains a syllable to which a pitch accent is associated. The kind of pragmatic meaning denoted by such pitch accents, namely contrastive accent (or stress) exists in English but is not universal. For example, it does not exist in Japanese (Bolinger 1978; Beckman 1996).

Languages in which the pitch accent aligns within the Prosodic Word are the so-called pitch accent languages, which include Japanese and Cayuga.

4. The Realization of Pitch Accent and Intonational Contours

The combination of pitch accents and boundary tones within a given prosodic domain ultimately gives rise to an intonational contour. The following example from Serbo-Croatian shows the interaction of lexical and post-lexical domains of prosody and the resulting accent pattern for two different types of intonation contours.

Declarative Intonation:	Prompting Intonation:
a. Default L Insertion	a. Spread H Rightward
b. Final Lowering	b. Delete Leftmost Link
c. Tone Absorption	c. Default L Insertion



(Figure 2.3) Serbo-Croatian Rules for Assigning Intonation

In the above example, the H tone in the underlying representation (UR) is a lexically-specified pitch accent, assigned within the prosodic word. In the declarative intonation contour, a L tone is inserted on lexically unspecified syllables after the pitch accent. The result, at the level of Phonetic Implementation, is a long-falling intonation contour. In the prompting intonation contour, the lexically-specified H pitch accent spreads to all the remaining syllables, delinks from the first syllable, and is replaced by a default L on the first syllable. The result is a short-rising intonation contour.

There are several other phenomena relevant to intonation, namely 'downstep', 'downdrift', 'declination', and 'pitch reset'. I will not deal with these particular phenomena in my thesis, but they are described briefly below for completeness.

4.1. Downstep and Declination/Downdrift

The terms downstep, downdrift and declination all describe a downward pitch trend within a prosodic unit. Otherwise, however, the terms are not well-defined, and it is unclear how many or what type of phenomena they represent. Tone languages aside, there are minimally two types of downward pitch trend, phonetic and phonological. A phonetic downward pitch trend describes a cumulative lowering of pitch over time; for example, often a H* preceded by another H* (in the same intonational phrase) will have a lower relative pitch (Ladefoged 2006). In contrast, a phonemic downward pitch trend can happen when, for example, a floating L tone (i.e. a L tone that is not associated with a syllable) is realized as downstep of the following H tone (that is, a downstepped !H in a H!H sequence is phonetically identical to a HLH sequence; (Stewart 1965).

[H* !H* !H* !H*L–L%]

Mary's younger brother wanted fifty chocolate peanuts.

(Figure 2.4) Downstep Example; from Ladefoged 2006; 127

For both types, the exclamation mark (!) is used to indicate downstep, as illustrated in figure 2.4.

4.2. Pitch Reset

A final phenomenon relevant to intonation is Pitch Reset. As the name suggests, it is a point at which the declining F0 trend is effectively reset (either partially or fully) between intonational phrases (Ladd 1988; 2008). Ladd describes pitch reset as "the upward modification of the pitch range at the beginning of a new stretch of declination" (2008, 308). It is a phonetic phenomenon.

5. Summary

To describe intonation contours in Cayuga, I will first assume the existence of prosodic units (agnostically referred to as phrases throughout this thesis) which are larger than prosodic words. Within these units, I will determine whether the tones that I find are best described as pitch accents (i.e., associated with metrically-prominent syllables) or as boundary tones (i.e. associated with the edge of phrases). I will also determine the rules governing their location. Example questions include whether the prosodic 'action' in Cayuga typically occurs at the beginning or end of phrases. Preliminary observations suggest that in longer phrases, the pitch contours (i.e. the 'action') occurs near the end. This in turn suggests that boundary tones and pitch accents occur at the right edge of prosodic units.

Chapter 3: Literature Review

In this chapter, I review past findings about intonation contours in pitch accent languages, specifically, about how pitch accent and intonation (or pitch) contours interact. I first describe what is known about Cayuga pitch accent and intonation, and then compare Cayuga to some representative languages, including Japanese, Serbo-Croatian, Korean, and Kalaallisut (Greenlandic).

1. Cayuga

Cayuga has been described as a pitch accent language, because Cayuga words have one metrically-prominent syllable that is realized with H tone. The rules of pitch accent are described below, as is the interaction between pitch accent and intonation.

1.1. Pitch Accent

Word prominence in Cayuga words corresponds to a peak in fundamental frequency (F0) which correlates with the centre of the vowel being accented (Doherty

1993).[3] The F0 peak tends to be longer, have a greater pitch range, and fall lower than the pitch on non-accented vowels (Doherty 1993). Cayuga accent is described and analyzed in Benger (1984); Michelson (1988); Dyck (1997; 2009); Chafe (1977); and Hayes (1995). The accented syllable in Cayuga is either final or non-final. Final accent occurs in words which are utterance-medial (1a). Non-final accent occurs in words that are isolated or at the end of a phrase (1b). In the case of phrase-final words (1b), the accent shifts to non-final as a consequence of extrametricality, whereby the final syllable of a phrase is marked as extrametrical at the end of a phrase (Dyck 1999); see Appendix A for an illustrated summary of the rules of accent placement in Cayuga). Additionally, accentless words can also occur when a word does not meet the conditions for non-final accent (1c); such words have a level pitch, unless they receive a final H tone, which is described next.

(1)	a) *aga:tǫ:dé*ˀ *tsǫ:, tę*ˀ *ni:*ˀ *degé:gę:*ˀ	'I just heard it; I didn't see it'
	b) *aga:tǫ́:de*ˀ	'I heard it'
	c) *hahdo:s*	'He dives'

(Mithun and Henry 2008)

---

3 Cayuga vowels include A [ɑ], E [e], I [i], O [o], U [u] (rare), Ę [ɛ̃], and Ǫ [ɔ̃].

1.2. Intonation in Cayuga

While there is very little literature on intonation in Cayuga, intonation in more informal speech styles is briefly described in Mithun and Henry (2008), and intonation in more formal speech styles is described in Foster (1974).

Regular accent placement (see Appendix A) applies only to citation forms in neutral statements; in contrast, emphatic statements and questions are characterized by non-neutral accent placement. In other words, accent placement is influenced by the intonational contour. When a word in a statement is emphasized, the word can be realized with final accent even if it is utterance-final (Dyck, p.c.)

(2)

Emphasis?	Sample word/phrase:		Accent type:
Yes	*do:gáˀ*	'I don't know!'	Final
No	*dó:gaˀ*	'I don't know.'	Non-final

Unaccented words such as *hahdo:s* 'he dives' can also receive a final accent, as in *hahdó:s*, when non-utterance final. Another way in which accent is influenced by the intonation contour is that pitch accent is suppressed in words at the end of a question, resulting in level intonation in such words (Mithun and Henry 2008). As shown in (3), the WH- phrase *dę*ˀ *ho*ˀ*dę́*ˀ 'what' has a final pitch accent, but the following word, *sya:sǫh*, which normally would have a non-final pitch accent (i.e., *syá:sǫh*) in utterance-final position, but does not in WH- questions. (In example 3, the straight line denotes a level, low-pitched intonation.)

(3) ***Dę*ˀ *ho*ˀ*dę́*ˀ *sya:sǫh?*** 'What is your name?'

(Mithun and Henry 2008)

Finally, a type of double pitch accent can sometimes occur. The conditions under which double-accenting occurs is unknown (Dyck, p.c.).

(4) *aga:tǫ́:dé*ˀ 'I heard it'

(Mithun and Henry 2008)

Foster (1974) observes that while the intonation of colloquial speech is highly variable, intonation in formal speech events is more or less "imposed from the outside" (Foster 1974, 192). (Foster provides no additional clarification of this statement). Formal speech is characterized by lines', or phrases that have predictable pitch and a constant relationship with word accent (Foster 1974). A line may be as short as a noun phrase, or can be made up of several sentences. Because of the inherent difficulty in defining a line grammatically, lines in Cayuga must be defined on intonational grounds rather than strictly grammatical ones (Foster 1974, 188). Foster (1974, 189) proposes that "lines are differentiated by highly regular features of intonation, by pauses, and by the use of the use of certain particles..."

Foster's description of lines is consistent with Selkirk's (1984) view that prosodic units are related to syntactic ones. What Foster terms a 'line' could be equivalent to a phrase (which is, tentatively, an Intonational Phrase).

In summary, the literature on Cayuga intonation shows that Cayuga has several types of intonational tunes: (a) colloquial intonational tunes, which include neutral statements, emphatic statements, WH- questions, and phrases with double pitch accents (which are not yet well-described); and (b) special intonational tunes in formal speeches. Finally, in several cases (neutral statements, WH- questions, phrases with double pitch accents), the pitch accent is affected by the intonational contour. In neutral statements, accent is final when the word is utterance-medial, and non-final when the word is utterance-final. In WH- questions, the pitch accent is suppressed. In yet another type of statement, there are two pitch accents.

2. Other Pitch Accent Languages

In this section, I will describe representative languages that are prosodically similar to Cayuga—namely other pitch accent languages. I will describe accent realization, discuss intonational contours, and look at previous work on the relationship that exists between these two aspects of prosody.

2.1. (Tokyo) Japanese

While Tokyo Japanese is a pitch accent language, pitch accent operates differently in Japanese than in Cayuga, as described below.

2.1.1. Description of Accent and Intonation in Japanese

Words in Japanese can either be accented or unaccented. When a word is accented, it displays a phonologically significant drop in pitch (F0) after the accent. In contrast, words that are unaccented fail to display any such drop in pitch throughout the word (Abe 1998). We can conclude that words that display a drop in pitch after the accent are marked with a H tone accent, which can occur at most once per word. The accent patterns in words are predictable: once the location of the H tone is known, the tones of the remaining syllables are automatically determined based on rules of accentuation such as the following (adapted from Poser 1984); the result is a word with either a falling or rising pitch contour.

(5) a) The pitch accented syllable is HIGH.

b) Syllables up to and including the accented one are also HIGH.

c) Syllables after the accented one are LOW (result: falling pitch contour)

d) However, if the first syllable of the word is light and following mora is pitch accented and therefore HIGH, make the first mora/syllable LOW (result: rising pitch contour).

Intonation contours in Japanese can convey connections or disjunctions between phrases (syntactic information); whether a sentence is declarative or interrogative (grammatical information); and the psychological involvement of the speaker (attitudinal information; Abe 1998). Typical intonational contours in Japanese intonation include falling, level, and rising. A falling contour indicates finality, while a level contour indicates continuation. In addition, a rise in pitch at the end of phrase is the hallmark of interrogative phrases.

Intonation contours also display declination or downstep, where the relative pitch in each succeeding phrase is lower than the pitch of the preceding one.

2.1.2. How Pitch Accent and Intonation Interact in Japanese

There are several ways in which pitch accent and intonation interact in Japanese. First of all, pitch accents in Japanese resist being perturbed by intonation (Abe 1998, 362). However three types of interactions can occur, as summarized below (Abe 1998, 362), presumably, given that pitch accent resists perturbation, some of the patterns described below are less common.)

(6) **Cumulative pattern:** a pitch accent pattern and an intonational pattern interact, and the result is a new pattern. For example, a rising pitch accent pattern (see 5d) and a declarative (falling) intonation pattern merge to form a less-rising pattern.

Copulative pattern: a pitch accent pattern is followed by an intonational pattern. For example, a rising pitch accent pattern is followed by a declarative (falling) intonation contour, resulting in a rising plus falling contour.

Conflictive pattern: a pitch accent pattern is completely obscured by an intonational pattern. For example a rising pitch accent pattern completely disappears in favour of a falling intonational pattern.

The copulative pattern is simply additive, while the other two patterns indicate varying degrees of interaction between pitch accent H tone and intonational tones.

This description of pitch accent and intonation in Japanese helps raise questions about what intonation contours exist in Cayuga and how they interact with pitch accents.

Does Cayuga display contours similar to those in Japanese, or perhaps different patterns?

Other languages with pitch accent (or pitch accent qualities) such as Serbo-Croatian and Korean[4] will also inform my analysis of Cayuga. I will also discuss Kalaallisut (Greenlandic), because it is polysynthetic (like Cayuga) and has sometimes been described as a pitch accent language.

2.2. Serbo-Croatian

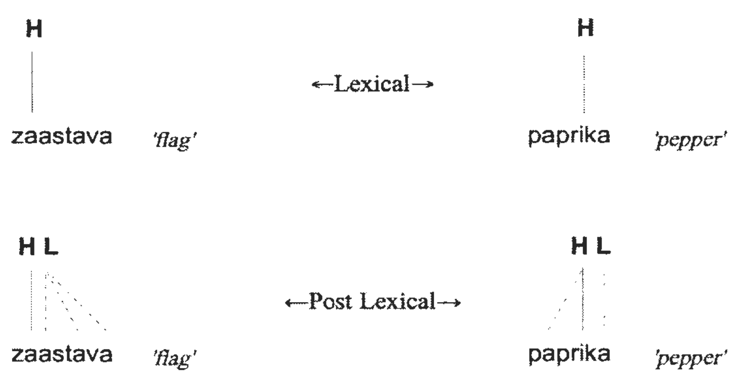
Serbo-Croatian is a pitch accent language from the South Slavic language family (which is part of the larger branch of Indo-European languages—Balto Slavic).

2.2.1. Description of Accent and Intonation

Serbo-Croatian has four lexically-contrastive pitch accent contours in surface representations: long falling, short falling, long rising, and short rising (Inkelas and Zec 1988, 227). These contours are derived from two types of lexically-specified pitch

4 Not all dialects of Korean are considered to be pitch accent.

accent: (a) a default H tone is associated via "initial H insertion", with the first mora; and (b) a H tone is associated with the second-last mora; the latter pattern is lexically specified, while the former pattern is the default one. To account for the pitch contours, a L tone is inserted post-lexically on non-pitch accented vowels. (Adjustments caused by intonation contours then take place.) The following example illustrates the lexical and post-lexical representation of two words in Serbo-Croatian. *Zaastava* 'flag' illustrates the default location of H tone on the initial mora; *paprika* 'pepper' exemplifies the lexically marked occurrence of H tone on the second-to-last mora.



(Figure 3.1) Example of Lexical/Post-Lexical Rules; Inkelas and Zec 1988)

Intonation contours are derived by post-lexical rules. For example, declarative intonational phrases end with a L tone, which ultimately creates a falling intonation contour (referred to as "Final Lowering" figure 2.3, chapter 2). In contrast, other types of intonational phrases do not end with a L tone. One example is the prompting intonation contour, which is used by speakers in an effort to elicit clarification or restatement of some part of a preceding utterance (see figure 2.3, chapter 2; Inkelas and Zec 1988, 241). Words and phrases produced with the "prompting intonation" contour always surface with a LH melody or rising contour.

2.2.2. How Pitch Accent and Intonation Interact in Serbo-Croatian

In Serbo-Croatian, lexical pitch accents interact with intonation contours. For example, when the default pitch accent pattern (a H tone on the first mora of the word) combines with the declarative intonation contour (a L boundary tone), the resulting pattern is the long-falling contour. This pattern is similar in nature to the "cumulative" pattern described by Abe (1998) in relation to Japanese.

Similarly, when a word with lexically-specified H tone on the final mora combines with the declarative intonation contour (a L boundary tone), the word is realized with L tone on the final mora and H tone on the preceding mora instead. For example, *voda* 'water' has underlying H tone on the final vowel, [a], but when the word occurs at the end of a phrase, the final [a] receives L tone and the lexically-specified H appears on the non-final [o] instead; the original short-falling contour changes to a long-rising contour. This pattern is similar to the Cayuga one described in §1, in that a word at the end of a phrase ends with a L tone, whereas a word in the middle of a phrase ends with a H tone.

2.3. North Gyeongsang Korean[5]

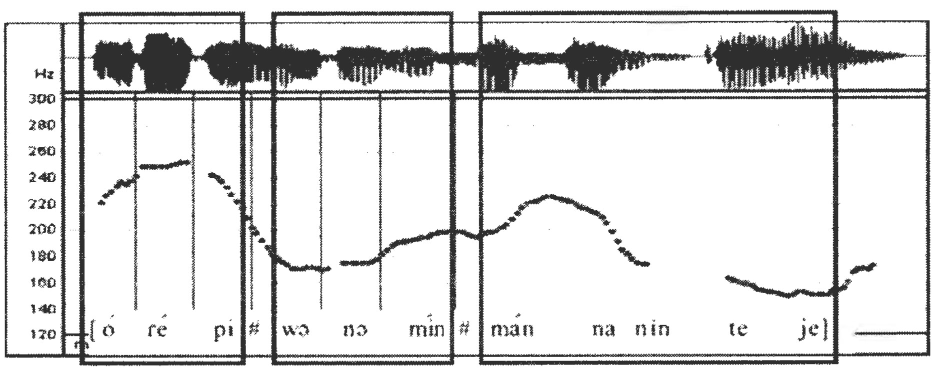
The pitch accent system of Middle Korean (ca. 900-1500AD) has been lost in Standard (Seoul) Korean; however some dialects still employ pitch accent as the marker of prominence (Jun et al. 2006). This section discusses pitch accent and intonation in

5 Due to different Romanization systems the terms Kyungsang, Kyeongsang, Gyeongsang are used in different sources (Lee 2008; Jun et al.). Each term refers to the dialect of Korean spoken in the North Gyeongsang Province of South Korea. I will use the term Northern Gyeongsang Korean (or NG Korean for short).

one of these pitch accent using dialects: Northern Gyeongsang Korean (henceforth NG Korean).

2.3.1. Description of Accent and Intonation

There are at least three distinct lexical tones in NG Korean. These include HL (single H on initial syllable), LH (single H on final syllable), and HH (double high in the first two syllables). Unlike Japanese, NG Korean has no toneless words. The following figure exemplifies each type of tone as present in the phrase meaning 'Brother is meeting a native speaker' (Jun et al. 2006. 293).



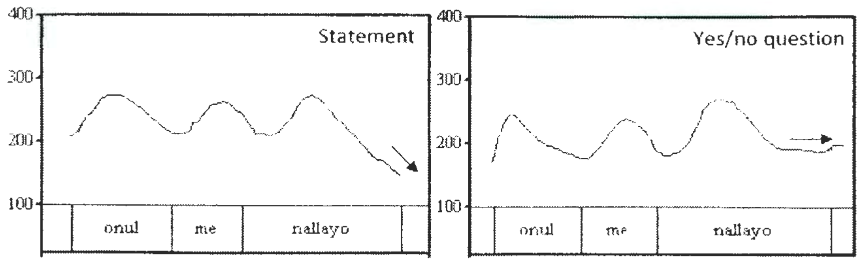
(Figure 3.2) Examples of Lexical Tone in Japanese: Jun. et al 2006, 293.

In both NG Korean and Japanese, the left edge of every accented word is marked by a low boundary tone (L%) which is inserted post-lexically (Jun et al. 2006). One or more prosodic words in a sentence can form an intermediate phrase (ip), which is not marked by a boundary tone. Finally, the right edge of an intonational phrase IP is also marked by a boundary tone, which is often L% (Jun et al. 2006).

2.3.2. Interactions of pitch accent and intonation in NG Korean

NG Korean sentence intonation is specified in the phonological representation and undergoes adjustments as a result of the interactions with lexically-assigned tone (Lee 2008). In other words, pitch accent is affected by, and interacts with, other aspects of the language's prosodic system.

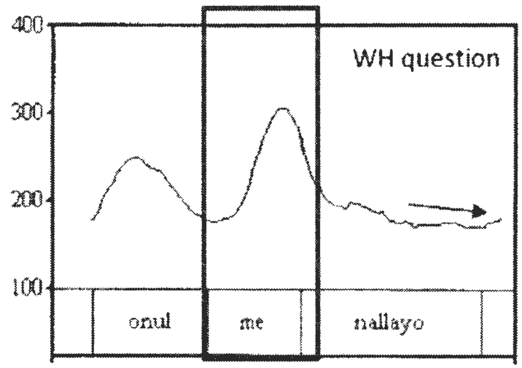
Yes-no questions in NG Korean generally end with a falling contour (L tone) (Lee 2008). In contrast, Bolinger 1978, cited in Lee 2008 claims that over 70% of the world's languages have high or rising intonation in questions). However, although yes-no questions end with a falling contour (L tone), their contours are still relatively higher in pitch than the pitch contours of statements (Lee 2008).



(Fig 3.3) Statement versus Yes-no Question in NG Korean (Lee 2008, 176)

The type of interaction shown above in figure 3.3 is illustrative of Abe's cumulative pattern (1998). In addition, the NG Korean yes-no question intonation is similar to the Cayuga WH-question intonation, in that neither end with rising pitch.

Syntactic Focus in NG Korean often results in the creation of a new phonological (or focus) phrase (Lee 2008). In such cases, the pitch accent (H tone) within the focus phrase becomes more prominent. In addition to making the pitch-accented H more prominent, the effect of focus is to suppress (to some degree) any H tones that follow. In the following example, the final pitch-peak occurs on the word *me* 'what' and is clearly the highest peak present. NG Korean WH- words are typically prominent intonationally because they attract focus in WH- questions (Lee 2008). This type of pattern, again appears to be cumulative in Abe's sense.



(Figure 3.4) WH-question in NG Korean (Lee 2008, 176)

2.4. Kalaallisut (Greenlandic)[6]

Kalaallisut is the standard and official dialect of Greenlandic (Eskimo-Aleut), spoken in Greenland. Kalaallisut is similar to Cayuga in that it is a polysynthetic language. While it does not appear to have lexical accent (see below for explanation), the pitch patterns in Kalaallisut are relevant to the present discussion.

6 Kalaallisut may also be referred to as 'Greenlandic', or 'West Greenlandic'

2.4.1. Description of Accent and Intonation

Kalaallisut does not appear to have lexical accent (Mase and Rischel 1971; Jacobsen 2000); however, speakers often perceive stress on the antepenultimate and/or the final syllable (Mase and Rischel 1971). This is particularly true if these syllables are prosodically heavy (Jacobsen 2000; Fortescue 1984). In addition, "...the impression of [accent] placement seems rather dependent on both the specific weight of the syllables and on the intonation." (Jacobsen 2000, 40).

Kalaallisut has two major types of phrase-final intonation contours (Fortescue 1984). A high-low-(medium)high intonation contour occurs in declaratives, WH-questions, imperatives, and exclamations (Fortescue 1984).

(7)

aasa-kkut ippirna-qar-puq/ippirna-qa-qa-aq

'In the summer there are (many) insects'

In contrast, most speakers pronounce yes-no questions with a high-low nucleus (i.e. pitch accent) in which the high rises above the preceding level tone or continues the already preceding high tone (Fortescue 1984).

(8)

aasakkut ippirnaqarpa

'Are there insects in the summer?'

2.4.2. How Pitch Accent and Intonation Interact in Kalaallisut

Since Kalaallisut does not have lexical pitch accent, the latter cannot interact with intonational contours. Nevertheless, Fortescue (1984) claims that the auditory perception of accent in Kalaallisut is created when a heavy syllable coincides with the nucleus (i.e. pitch peak) of the intonational contour at the end of a word; he suggests that discussion of stress (accent) in Kalaallisut can probably be reduced to the interaction of syllable weight and intonational nuclear tones (Fortescue 1984). The Kalaallisut case is relevant for Cayuga words that lack pitch accent (see (1c), repeated below as (9a); such words have final accent when they are utterance medial (9b); this H tone could be attributed to a post-lexically-assigned H boundary tone.

(9)	a. *hahdo:s*	He dives	(utterance-final and citation form)
	b. *hahdó:s*	He dives	(utterance-medial form)

3. Summary

In context, words with a pitch accent can undergo various kinds of interaction with intonational (post-lexical) contours or tones, ranging from additive (both lexical and post-lexical contours are preserved), to cumulative (lexical and/or post-lexical contours are modified somehow), to conflictive (the lexical contour is overridden by the post-lexical contour). In addition to these patterns appearing in Japanese, we have seen examples of the cumulative pattern in both Serbo-Croatian declaratives and NG Korean questions. Also, toneless words, or words without pitch accent, can gain a pitch contour if they associate with an intonational tone that is post-lexically inserted such as in Kalaallisut where a post-lexical boundary tone may influence the perception of where accent occurs. This is an example of the additive pattern.

Chapter 4: Methodology

In this chapter, I will describe the methodology I have developed for my analysis of Cayuga pitch accent and intonation. I introduce the data in §1; I discuss the acoustic variables in §2-4, and my method for analyzing the information gleaned from these variables in the remainder of this chapter (i.e.§5).

1. The Marg Henry Story

The basis for my analysis is the "Marg Henry Story" (abbreviated MHS from here on), a thirty-nine minute recording from a Cayuga speaker collected in 2005. The story is archived in the CLAN format (MacWhinney 2000), with an accompanying transcription and translation. As an initial step in preparing the data for analysis, I divided the audio recording, transcription and translation into separate phrases. These phrases are prosodic units which are delineated by pauses. In general, phrases appear to correspond to syntactic phrases, and, as mentioned earlier, intonational phrases. However, since my thesis is not about the relationship between syntactic and phonological units, I remain agnostic about the type of unit, and simply refer to them as phrases. To create each piece of data, I exported each pause-delineated phrase from CLAN to create approximately 310 .wav sound files. Each of these phrases constituted an interval (i.e., a unit within which Praat performs measurements). Intervals are recorded on 'tiers'. I then created several tiers to record other types of intervals within phrases. The intervals/tiers are described below:

Tier 1 (Vowels): I delineated each vowel in each word and labelled each with orthographic symbols (i, e, a, o, ǫ, ę). Additionally, I numbered identical vowels in words to avoid confusion (e.g. a1, a2, etc...). The delineation of each vowel constitutes an interval.

Tier 2 (Words): I delineated each word and then labelled it with the appropriate Cayuga spelling of the word. I marked non-linguistic speech events (such as false starts, filled pauses) with an ampersand (&). I separated each particle, and labelled each as a separate word. The delineation of each word constitutes an interval.

Tier 3 (Words2): In this tier, I included the same information as in tier 2 (Words), except that I combined particles into groups. Particles, which are often monosyllabic, constitute syntactic words and tend to group together into clitic-like groups (Dyck 2009). Syntactically, they constitute any word that is not a noun or a verb. For example, I labelled the three intervals |ne| |nih| |ahi| in the Words tier (Tier 2), as a single interval |ne nih ahi| in the Words2 tier. The delineation of each group constitutes an interval.

Tier 4 (Gloss): I included a rough English translation of the Cayuga words in each phrase.

Tier 5 (Miscellaneous): I used this tier for commentary or explanations that could not be accommodated on another tier. For example, while disfluencies are marked elsewhere with an ampersand (&), the miscellaneous tier provides some explanation as to why the interval was marked as a disfluency. For non-linguistic utterances this step may be unnecessary, but for other events such as false starts, it is helpful to understand the reasoning behind a disfluency marking.

I initially also included a syntax tier, to capture information about each phrase's syntactic structure. This tier is relevant for determining the relationship between prosodic and syntactic units. However, there is little information on Cayuga (or Iroquoian) sentence structure. For this reason, I decided to not examine the relationship between prosodic and syntactic units in my thesis.

Once I had defined the intervals and set up tiers, I then used Praat acoustic analysis software (Boersma and Weenink 2011) for my annotation and analysis of the MHS. Within Praat, I set up the above tiers, and others described later in this chapter, in order to implement the Tone and Break Index (ToBI) system described in Chapter 7.

I next carried out acoustic analyses of the MHS; my goal was to provide an evidence base for my ToBI labelling. The variables I examined are described below.

1.1. Data Relevant to ToBI Annotation

I developed a series of Praat scripts to automatically compile data about pitch, intensity, and break indices. I then compiled the data in an Excel spreadsheet, and made several types of calculations in the spreadsheet using the script-extracted values. The calculations were then recorded or reflected in the tiers described previously and later in this chapter. The remainder of this section provides details about the scripts, the information extracted, the calculations, and how this information informed my investigation.

2. Pitch-Related Variables

One of my Praat scripts was designed to gather data about pitch within each interval. (Intervals are units within which Praat performs measurements; the intervals I used were phrases, words, and vowels, as described in Tiers 1-3 in §1 of this chapter). I designed the script to gather information such as the start and end time, label, and duration of each phrase, vowel and word, as well as the following information for variables about pitch:

F0 Maximum: a value obtained by measuring the highest point of F0 in the interval being analyzed. Relatively higher values for F0 peak typically correlate with accented vowels in each phrase.

F0 Minimum: a value obtained by measuring the lowest F0 in the interval. The minimum F0 is measured along with maximum for comparative purposes.

F0 Maximum and Minimum Time: these values equal the point within the interval at which the maximum (and minimum pitch) occurred.

F0 average: this value is an average calculated automatically by Praat; multiple measurements of F0 are added together, then divided by the total number of measurements. The average F0 is predicted to be higher in accented vowels than in unaccented ones.

After collecting the above data, I compiled it all in a spreadsheet document. Using this data, I then made the following additional calculations:

F0 Range: a value calculated by subtracting the lowest F0 value from the highest within an interval. Higher values for this variable, indicating greater pitch movement, will indicate the presence of a pitch accent in Cayuga (Van Der Mark 2003; Doherty 1993).

F0 Peak Time: a value calculated by dividing the time of the F0 peak by the length of the vowel. The F0 peak time is expressed as a ratio where 0 and 1 equal the beginning and end points of the vowel (i.e. values closer to 0 indicate the peak occurs toward the beginning of the vowel; values closer to 1 indicate the peak occurring towards the end). This value allowed me to determine the relative time within a vowel where the F0 peak occurred, and to compare this value across other vowels.

3. Intensity-Related Variables

Intensity is a physical property of the acoustic signal that can be directly related to the perception of loudness (Raphael, Borden, and Harris 2007). The unit of measurement for intensity is the decibel (dB). Intensity is not usually marked in the ToBI system. However, I recorded information about intensity because Cayuga prosody is understudied, and I wanted to see whether intensity played a role in Cayuga prosody. I eventually concluded that the intensity measurements mirrored the pitch measurements, but did not provide additional information.

I used two scripts to collect data on variables relating to intensity: one to measure variables such as maximum and average; and one that calculates the total dB value for the interval.

The first of the two intensity scripts directly measures dB maximum and minimum, dB maximum and minimum time, and dB average. In addition, the scripts collect basic information such as the interval's duration and label. As with the pitch data, the variables "dB range" and "dB peak time" are calculated on the spreadsheet (i.e., not generated by the script itself).

dB maximum/dB minimum: measurements of the highest and lowest dB levels within the interval. If intensity correlates with pitch accent in Cayuga then we expect that accented vowels will likely coincide with a peak in intensity.

dB Average: a value calculated in the same way F0 average (multiple F0 measurements are added together, then divided by the total number of measurements taken). Higher dB averages should correlate with accented vowels, if intensity correlates with pitch accent.

dB range: a value calculated by subtracting the lowest dB value from the highest. A higher range indicates more movement throughout interval. If intensity correlates with pitch accent, the dB range value in accented vowels will be higher than in unaccented vowels.

dB peak time: a value calculated by dividing the time of the peak by the duration of the vowel overall. Values near 0 correspond to an early peak, while values near 1 correspond to a late peak.

dB total: a value composed of measurements collected at 10ms intervals and added together. Because the total dB value consists of values taken every 10ms, the longer the vowel being measured, the higher the value for total dB. Higher values for dB total should be found in accented vowels in each interval analyzed.

4. Variables Related to Duration and Pause

Finally, I calculated the duration of the pause between the words in each phrase. These values are relevant to Tone and Break Index annotation (described in chapter 7), specifically, to the calculation of "Break Index" values. "Break Index" values are relative numbers assigned to represent the degree of disjuncture between two words in a phrase (Beckman and Elam 1997). To calculate the length of pause between words, I subtracted the start time of a given interval from the end time of the preceding interval (Beckman and Elam 1997).

5. Annotation Derived from Variables and Scripts

After compiling the information described above, I added additional tiers in Praat, and annotated them based on the results in the Excel spreadsheet, using a fourth script in Praat. This type of annotation provides the foundation for the development of ToBI annotations. The new tiers that I added in Praat as a result are as follows:

Intensity and Gloss Intensity: These tiers record calculations performed on the intervals in the Words tier (where each orthographic word represents a separate interval). The script used to annotate each of these tiers assigns the * diacritic to the point of maximum intensity in the word (intensity tier), and *! to the maximum intensity of the entire phrase (gloss intensity tier).

Total Intensity: I used a script to assign relative values for intensity on this tier based on the dBTotal variable for vowels (see §3). The script assigns a numerical value to each interval based on its total intensity value (following the parameters presented in Table

4.1). In general, intervals that were longer in duration and louder had a higher intensity value.

Table 4.1: Parameters for Assigning Intensity Values

dB Total[7]	**Intensity value assigned**
0-499	1
500-999	2
1000-1499	3
1500-1999	4
> 2000	5

Break Index and Break Index2: On the Break Index tier I recorded calculations that were performed between intervals on the Words tier (where each orthographic word is a separate interval); on the Break Index tier2, I recorded calculations that I performed within the intervals defined on the Words2 tier, where the intervals are words and particle groups. I used a script to assign break index values, to represent the duration of

7 Recall, this value is calculated by adding together 10ms interval measurements of dB values for each phrase.

pause (or disjuncture) between the end of one interval and the beginning of the next. Negative values for break index indicate the end of a phrase[8]; the pauses between phrases were the longest, and so I assigned them a break index value of 4. See table 4.2 for examples. In general, the higher the break index value, the greater the degree of disjunction or pause between intervals.

Table 4.2: Parameters for Assigning Break Index Values

Length of Pause (ms)	**Break Index value assigned**
0	0
1-333	1
334-666	2
667-999	3
> 1000	4
Negative Values[9]	4

8 These negative values are the values returned automatically by the script and correspond to the passage of time between the final word in the phrase and the end of the file being analyzed.

9 Negative values for a length of pause indicate the end of the *phrase* and as such, a strong BI value of 4 is assigned.

Accent and Accent2: On the Accent tier I recorded calculations that I performed within the original Words tier (where particles are not grouped); on the Accent2 tier, I recorded calculations that I performed within the intervals defined on the Words2 tier, where the intervals are words and particle groups. Because pitch accent is somewhat difficult to hear, I developed a script that automatically labelled the location of pitch accent within words. The script operated on a two-vowel window, calculating the difference in average pitch between each vowel and the vowel that preceded it. Although the script operated on every vowel interval within a word, I used only the calculations relevant for the antepenult, penult, and final vowel of each word.

To annotate the Accent (and Accent2) tiers, I used Excel to calculate what I will refer to as the 'pitch difference'. This calculation was done in two steps. First, I divided the maximum pitch of each vowel by the average of each vowel. The results of this first calculation formed the basis of the pitch difference variable, which the script uses to mark accent in intervals. The final value for pitch difference is calculated by subtracting the pitch difference value of any given vowel from the pitch difference of the preceding vowel. This calculation resulted in one of three outcomes, defined in the script: a negative value (pitch difference is < 0), a low-positive value (pitch difference is between 0.1 and 5), and a high-positive value (pitch difference is > 5). The script looks at the results for pitch difference, and automatically annotates the interval for one of these outcomes. Some examples of these potential outcomes are given below.

If the pitch difference between the two vowels (V1 and V2) in the two-vowel window was negative, then V2 was labelled as accented. Depending on where the window is located, the two vowels in question could be the antepenult and penult, or the penult and ultima. The calculation in (10) is relevant for the type of accent pattern described in (1a).

(10) Negative Pitch Difference (value <0)

	V_1		V_2	Result	Label
Calculation:	100Hz	-	150Hz	-50Hz	$v_1\acute{v}_2$

If the pitch difference of between the two vowels (V1 and V2) in the two-vowel window was positive, then V1 was labelled as accented. Depending on where the window is located, the two vowels in question could be the antepenult and penult, or the penult and ultima. The calculation in (11) is relevant for the type of accent pattern described in (1b).

(11) High-positive Pitch Difference (value >5)

	V_1		V_2	Result	Label
Calculation:	100Hz	-	50Hz	50Hz	$\acute{v}_1 v_2$

If the pitch difference of the penult (V1) and final vowel (V2) was approximately equal (specifically, between 0.1 and 5 Hz), then both penult and ultima were labelled as accented. The calculation in (12) is relevant for the remaining type of accent pattern attested in the data, double accent. For example, *niyóníshé*ʔ 'a certain amount of time'.

(12) Low-positive Pitch Difference (value is 0.1-5)

	V_1		V_2	Result	Label
Calculation:	100Hz	–	97Hz	3Hz	$\acute{v}_1 \acute{v}_2$

6. Summary

My methodology, described above, resulted in tiers or intervals, data based on calculations performed within tiers or intervals, and calculations designed to inform the C_ToBI labelling of tiers or intervals. These are summarized below.

Tier 1 (Vowels) – delimits vowel intervals

Tier 2 (Words) – delimits word intervals

Tier 3 (Words2) – delimits intervals consisting of words and particle groups.

Tier 4 (Gloss) – delimits the boundaries of the entire length of speech in the phrase. Contains the English gloss for the Cayuga speech in the phrase.

Tier 5 (Misc) – used to record information to explain gaps in intervals and types of disfluencies that may be present in the recording.

Tier 6 (Intensity) – records an annotation (*) that indicates the point dB total calculation performed within the intervals defined on the Words2 tier, where the intervals are each orthographic word (i.e. particles are not grouped as they are in Tiers 3, 7, and 11).

Tier 7 (Intensity2) – records a dB total calculation performed within the intervals defined on the Words2 tier, where the intervals are words and particle groups

Tier 8 (Gloss Intensity) – indicates, using *!, the maximum intensity for the phrase.

Tier 9 (Total Intensity) – records the value for relative intensity total (as described in §5).

Tier 10 (Break Index) – records a calculation that reflects the length of pause between the interval in question and the following one; this measurement is based on the intervals of the Words tier (where each individual word is a separate interval).

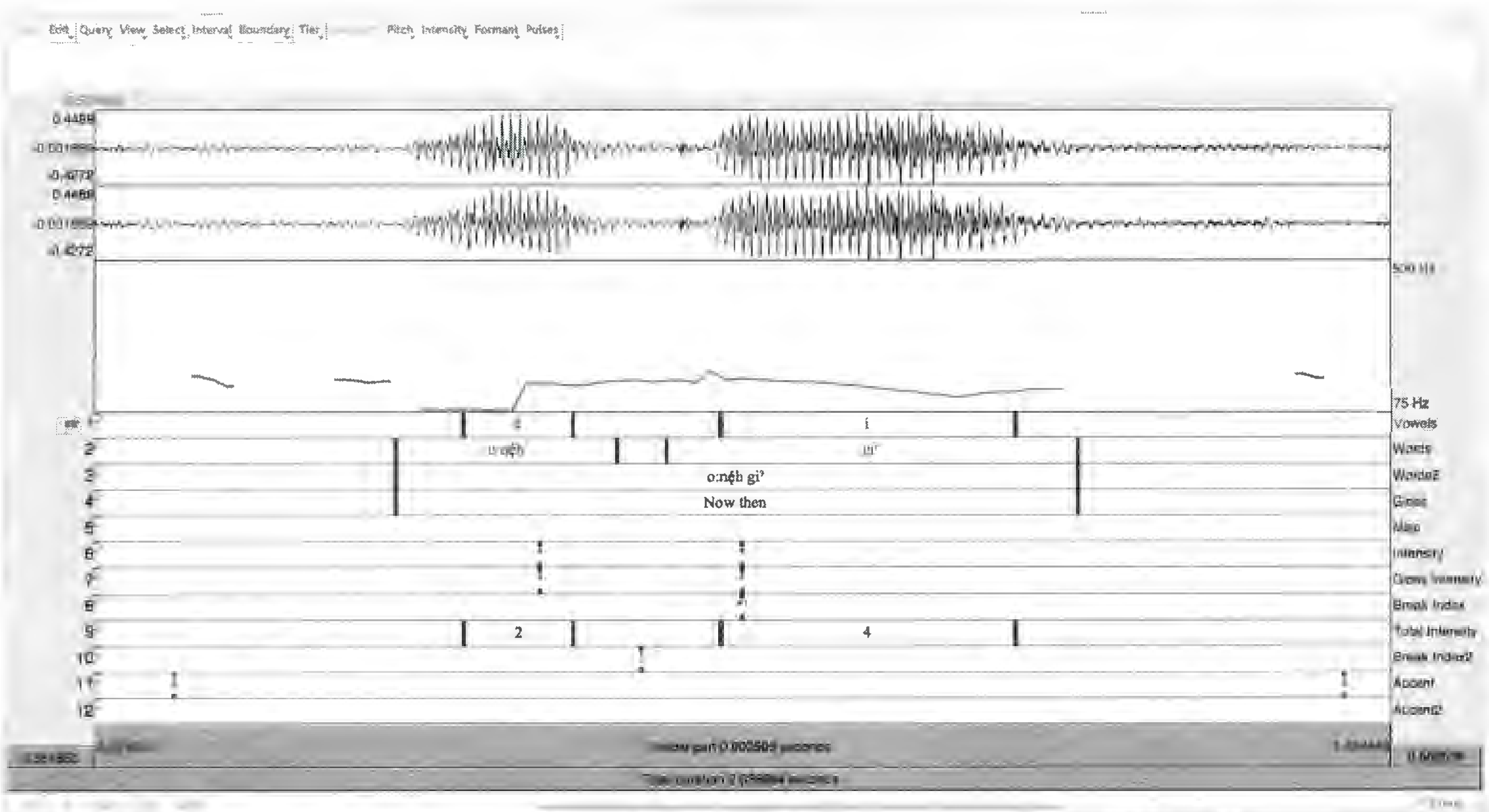
Tier 11 (Break Index2) – records a calculation that reflects the length of pause between the interval in question and the following one; this measurement is performed within the intervals defined on the Words2 tier, where the intervals are words and particle groups

Tier 12 (Accent) – records the results of the calculation discussed in (10), (11), and (12) above as performed within the intervals defined on the Words tier (each orthographic word is a separate interval). The results of the calculations for this script-predicted accent (as described in §5) are indicated by the annotation PEN, ULT, or PEN+ULT.

Tier 13 (Accent 2) – records the results of the calculation discussed in (10), (11), and (12) above as performed within the intervals defined on the Words2 tier.

Figure 4.1 below is an example TextGrid as it would result from the running of my Praat scripts.[10] As you can see, each of the tiers summarized above appears in the TextGrids already annotated. These grids provide valuable information that informed the decisions and recommendations for the prosodic labelling described in Chapter 7 (Toward a C_ToBI).

10 For clarity, I have removed the spectrogram from the TextGrid screenshots to make the pitch track stand out and be easier to read.



(Figure 4.1) Sample TextGrid after script run

Chapter 5: Results

1. Introduction

To address the question as to whether there are interactions between word prosody and phrase prosody in Cayuga, I carried out a statistical analysis of the prosodic properties of intonational phrases, and of words in context, using the data described in Chapter 4.

I performed a statistical analysis of the acoustic characteristics of phrases. I divided the collection of phrases into several functional categories of phrases — exclamations, narratives, quotatives, WH- questions, and yes-no questions. I found that, overall, WH- questions were prosodically different from other phrase types.

I then carried out a statistical analysis of the acoustic characteristics of words in context, to see if their prosodic properties were different from words in isolation. I found that words in context were similar to words in isolation. This finding suggests that the prosodic properties of words are somewhat independent of the prosodic properties of phrases.

My statistical analysis provided the basis for characterizing the prosodic 'blueprints' of typical phrases and words in Chapter 6. I used a one-way between subjects ANOVA to examine the relationships between (a) variables such as pitch range, dB peak time, and duration (including break-indexes); (b) type of phrase or phrase (exclamations, narratives, quotatives, WH- questions, and yes-no questions); and (c) type of word, categorized according to the word's accent pattern (unmarked or unaccented words; words with double accent, final-accent, penultimate-accent, and antepenultimate accent).

2. Phrase-Level Results

I divided phase-level data into five types based on the primary content of each: exclamations, narratives, quotatives, WH- questions, and yes-no questions. I conducted a one-way between-subjects ANOVA for each sub-variable of pitch, intensity, and duration, with the dependent variable being phrase primary type (e.g. narrative, exclamation, etc...). I found that only one variable relating to pitch was statistically significant, as discussed below.

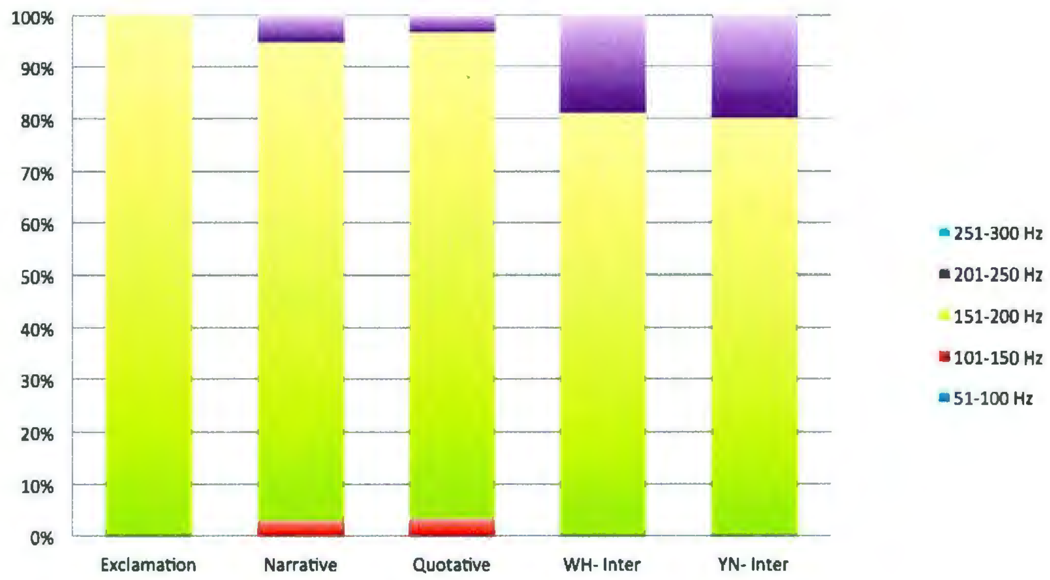
2.1. Pitch Variables

I conducted a one-way between-subjects ANOVA for each sub-variable, with phrase type as the dependent variable. The pitch sub-variables were pitch range, pitch average, pitch peak time, and pitch maximum. These are the same variables that I use for word-level analysis in §3. I examined the relationship between these sub-variables and phrase type simply because it was possible to do so, and because the results could have revealed trends that needed to be explained.

2.1.1. Average Pitch

The only statistically significant relationship for phrases was between its average pitch and its primary type ($F(4, 305) = 3.433$, $p = .009$). As shown in figure

5.1, values for average pitch are concentrated in the mid ranges, between 151-200Hz. Narratives and quotatives appear to pattern similarly, as do the two interrogative constructions.



(Figure 5.1) phrase Level, Average Pitch

However, a post hoc Tukey HSD[11] test only revealed a statistically significant difference between quotatives and the two types of interrogatives; in contrast, the difference between the two interrogative phrase types was not statistically significant.

11 Tukey HSD (honest significant difference) test [http://www.ehow.com/info_8766337_tukey-hsd-test.html]

Table 5.1: Tukey HSD Results; phrase Level, Average Pitch

	Exclamation	Narrative	Quotative	WH- Inter	YN Inter
Exclamation		1.0	.88	.70	.41
Narrative			.51	.28	.16
Quotative				**.05**	**.04**
WH- Inter					.95
YN Inter					

These findings illustrate that WH- and yes-no interrogatives pattern together and that they are at least different from quotatives.

3. Word Level Results

At the word level, I divided the data into five accent types; the classification was based on the Cayuga transcript of the MHS, which was transcribed by native speakers. The accent types are unmarked, double-accented, final-accented, and non-finally accented; non-finally accented words were further divided into antepenultimately-accented and penultimately-accented.

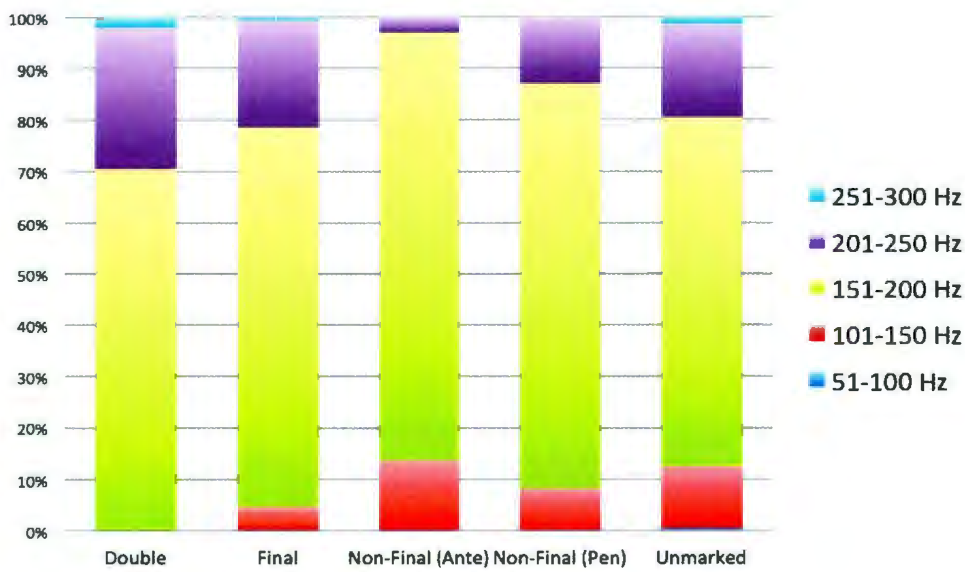
I conducted a one-way between-subjects ANOVA for each the sub-variables of pitch, intensity, duration, and break index values, with the dependent variable being accent type. All variables were in a statistically significant relationship with accent type in Cayuga, which indicates that the variables I examined in this thesis are indeed playing a role in the accent (and intonation) system in Cayuga. The extent of this role will be looked at further in Chapter 6 where I discuss the interpretation of the results presented here and how they can be used to establish blueprints for phrase and word-accent types for the language. At this point however, I will discuss each variable I examined (and the statistical findings) in the subsections below.

3.1. Pitch Variables

3.1.1. Average Pitch

The results of the ANOVA show a significant relationship between average pitch and accent type: ($F(4, 3131) = 14.754$, $p < .001$)

Figure 5.2 shows the majority of words fall into the middle 151-200Hz range. However, double accented and final accented words have a higher percentage of values in the high 201-250Hz range, compared to other accent types.



(Figure 5.2) Word Level, Average Pitch

A post hoc Tukey HSD test shows that there is no significant difference between words with unmarked vs. penultimate accent ($p = .094$), double vs. final accent ($p = .502$), and antepenultimate vs. penultimate accent ($p = .084$). In contrast, the other pairwise comparisons are statistically distinct, as shown in the following table.

Table 5.2: Tukey HSD Results; Word Level, Average Pitch

	Unmarked	Double	Antepenultimate	Penultimate	Final
Unmarked		.05	.00	.09	.00
Double			.00	.00	.50
Antepenultimate				.08	.00
Penultimate					.00
Final					

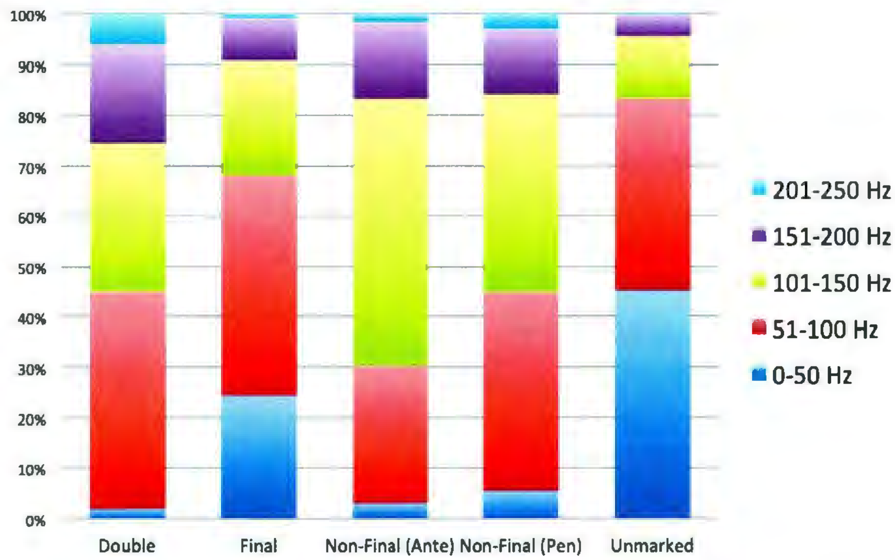
In general, then, the various accent types are distinct with respect to average pitch.

3.1.2. Pitch Range

Pitch range is calculated by subtracting the lowest from highest pitch value in a given word. An ANOVA showed a significant relationship between pitch range and accent type ($F(4, 3131) = 128.647$, $p < .001$).

As shown in figure 5.3, pitch range values tend to be lower than 200Hz. Words unmarked for accent have the lowest range values (with 85% being below 100Hz);

while 70% of antepenultimate accented phrases have a pitch range value greater than 100Hz.



(Figure 5.3) Word Level, Pitch Range

A post hoc Tukey HSD test shows that final-accented and unmarked words are significantly different from any other word category (with p-values of < .000 across the board). The reason for this can be seen in the mean values: the mean for unmarked words is only 63.3Hz and for final words, it is 84.9Hz; these are both quite different from the remaining categories which have means of 110.1Hz (penult), 112.9Hz (antepenult), and 114.5Hz (double).

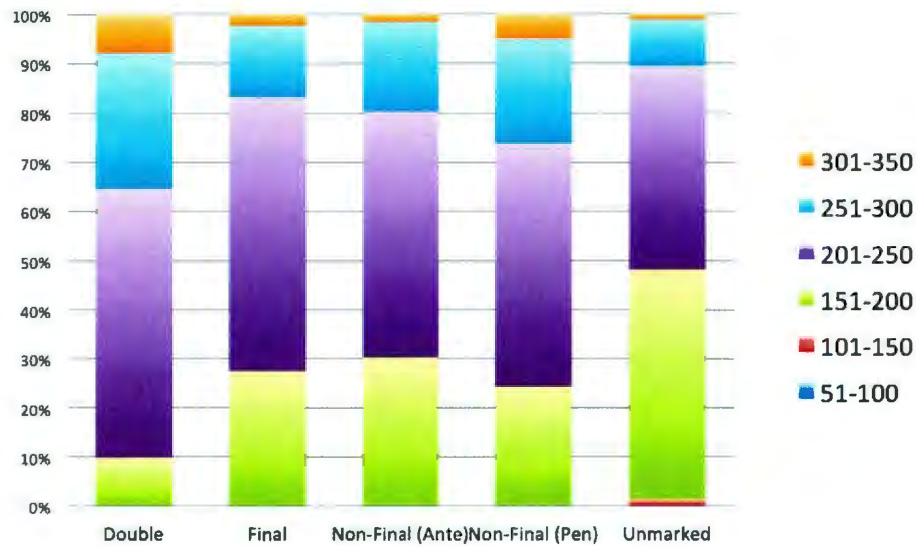
Table 5.3: Tukey HSD Results; Word Level, Pitch Range

	Unmarked	Double	Antepenultimate	Penultimate	Final
Unmarked		.00	.00	.00	.00
Double			1.0	.95	.00
Antepenultimate				.99	.00
Penultimate					.00
Final					

3.1.3. Maximum Pitch

The maximum pitch variable is the value of the highest pitch in an interval. An ANOVA revealed a significant relationship between maximum pitch and accent type ($F(4,3131) = 57.254$, $p < .001$).

As shown in figure 5.4, aside from the unmarked category, all other categories have at least 50% of the maximum pitch values in the mid range of 201-250Hz. In contrast, words unmarked for accent seem to have a much higher portion of values in the lower 151-200Hz range (47% for unmarked, compared to 10-30% for all other types). Additionally, with 90% of values above 201Hz, the double accent category has higher overall values for max pitch; in comparison, the other accent types have at least twice the number of values falling below the 200Hz mark.



(Figure 5.4) Word Level, Maximum Pitch

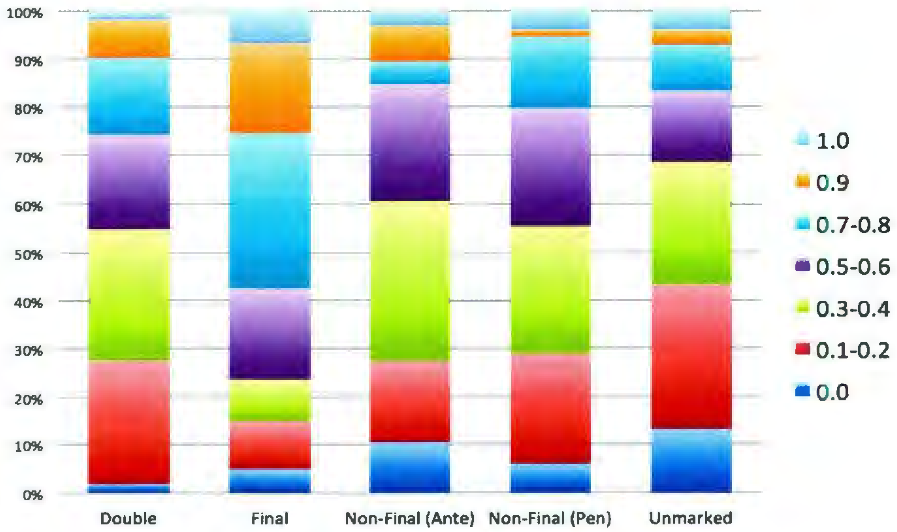
A post hoc Tukey HSD test confirms that the unmarked category is statistically distinct from other accent types. Similarly, each accent type is generally distinct from other accent types. However, the difference between antepenultimate versus final accent; and the difference between antepenultimate versus penultimate accent was not statistically significant.

Table 5.4: Tukey HSD Results: Word Level, Maximum Pitch

	Unmarked	Double	Antepenultimate	Penultimate	Final
Unmarked		.00	.00	.00	.00
Double			.00	.01	.00
Antepenultimate				.73	1.0
Penultimate					.01
Final					

3.1.4. F0 Peak Time

The F0 Peak Time variable is calculated by dividing the time at which the peak occurs by the overall duration of the word. The resulting value (a number between zero and one) is a relative number that gives an indication of where the pitch peak occurs in Cayuga words. An ANOVA revealed a significant relationship between the peak time variable and accent type ($F(4, 3131) = 175.184$, $p < .001$), as discussed below. This result is meaningful overall because it confirms the categorization of words into various accent types.



(Figure 5.5) Word Level, F0 Peak Time

As figure 5.5 shows, words with final accent had peak-time values towards the end of the word, with 69% of values at, or later, than the middle. In contrast, words with antepenultimate and penultimate accent have peak times closer to the beginning of the word. Over 65% of values in the antepenultimate and penultimate categories have peak times that are at or below mid-interval.

A post hoc Tukey HSD test for peak time shows that unmarked words are distinct from final-accent words, whereas penultimate and antepenultimate words do not differ significantly in terms of peak time.

Table 5.5: Tukey HSD Results; Word Level, F0 Peak Time

	Unmarked	Double	Antepenultimate	Penultimate	Final
Unmarked		.05	.62	.00	.00
Double			.79	.93	.00
Antepenultimate				.96	.00
Penultimate					.00
Final					

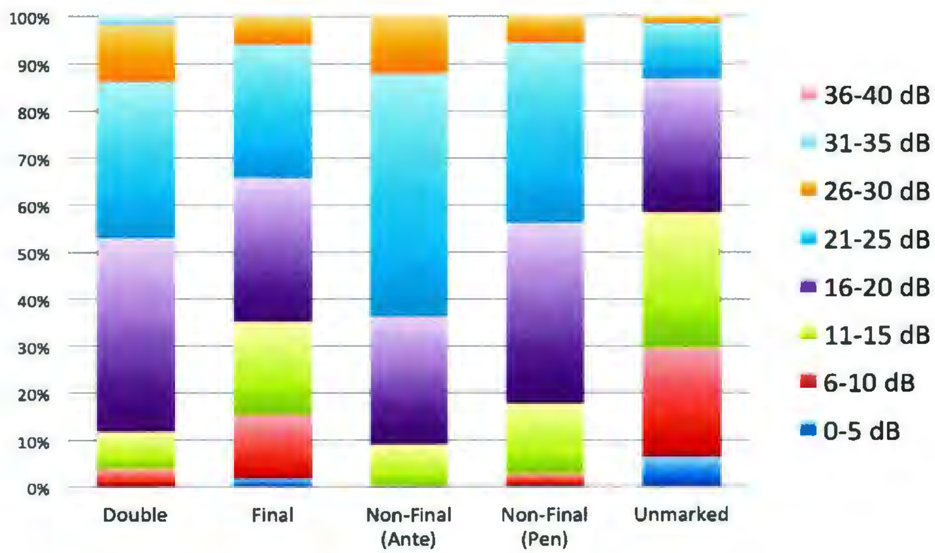
Peak time appears to correspond closely with speaker intuitions about accent placement.

3.2. Intensity Variables

In this section, I discuss the relationship between intensity variables and word accent type.

3.2.1. Intensity Range

An ANOVA revealed a significant relationship between intensity range and accent type ($F(4,3131) = 124.540$, $p < .001$).



(Figure 5.6) Word Level, Intensity Range

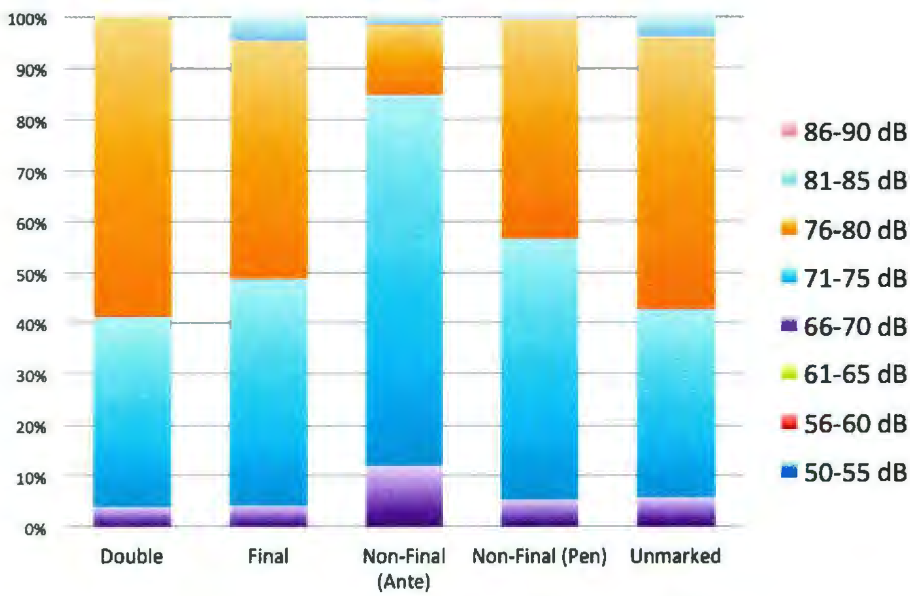
The results of the Tukey HSD test reveal that unmarked and final accent types are statistically different from other accent types.

Table 5.6: Tukey HSD Results; Word Level, Intensity Range

	Unmarked	Double	Antepenultimate	Penultimate	Final
Unmarked		.00	.00	.00	.00
Double			.94	.78	.00
Antepenultimate				.13	.00
Penultimate					.00
Final					

3.2.2. Average Intensity

An ANOVA revealed a significant relationship between average intensity and word accent type: ($F(4,3131) = 15.857$, $p < .001$). As shown in figure 5.7, most values for average intensity fall within two ranges: 71-75dB and 76-80dB. The greatest deviation is seen with the antepenultimate accent type where 85% of the values are below 75dB. In contrast, the percentage of values below 75dB is much smaller for other word types (41%-double; 49%-final; 55%-penultimate; and 43%-unmarked).



(Figure 5.7) Word Level, Average Intensity

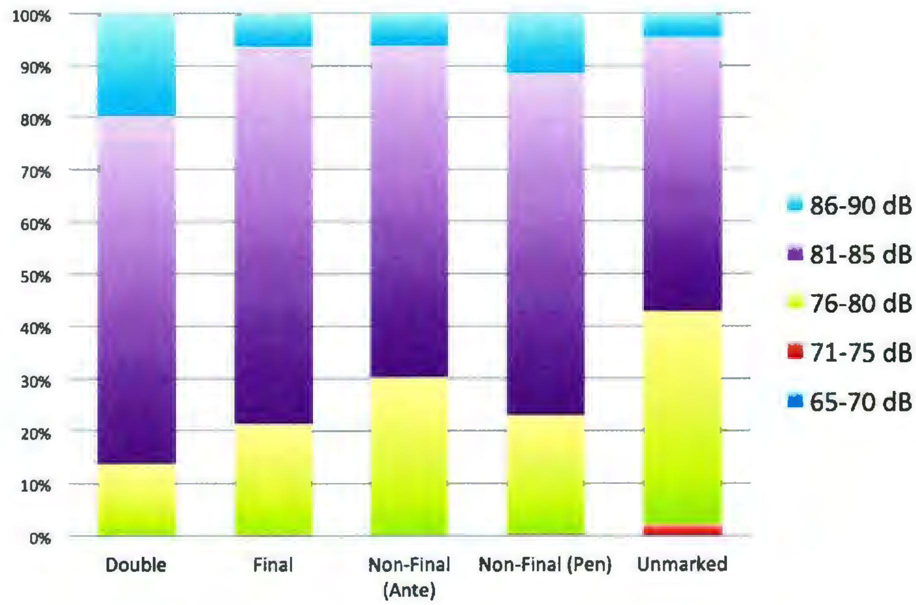
The results of the Tukey HSD test for average intensity shows that statistically significant relationships exist between the antepenultimate accent type and all other types; and between penultimate accent, when compared with unmarked, final, and antepenultimate accent.

Table 5.7: Tukey HSD Results: Word Level, Average Intensity

	Unmarked	Double	Antepenultimate	Penultimate	Final
Unmarked		1.0	.00	.00	.81
Double			.00	.29	1.0
Antepenultimate				.00	.00
Penultimate					.00
Final					

3.2.3. Maximum Intensity

An ANOVA revealed a statistically significant relationship between the maximum intensity of a word and its accent type ($F(4,3131) = 76.468$, $p < .001$). As shown in figure 5.8, both antepenultimate-accent and unmarked words have a higher proportion of values in the lower 76-80dB range.



(Figure 5.8) Word Level, Maximum Intensity

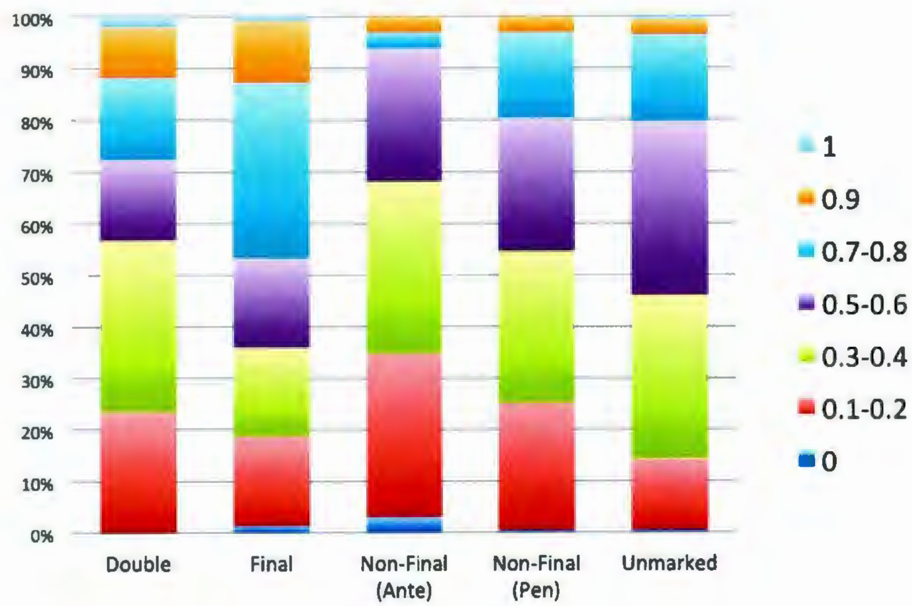
The Tukey HSD test shows that the unmarked category is statistically distinct from the other accent types. In addition, the antepenultimate accent words are distinct from unmarked and double accent words.

Table 5.8: Tukey HSD Results; Word Level, Maximum Intensity

	Unmarked	Double	Antepenultimate	Penultimate	Final
Unmarked		.00	.00	.00	.00
Double			.02	.02	.00
Antepenultimate				.94	1.0
Penultimate					.85
Final					

3.2.4. dB Peak Time

This variable is a calculated similarly to pitch peak time, where a value of 0 denotes the beginning of the word, and 1 denotes the end of the word. An ANOVA revealed a statistically significant relationship between dB peak time and accent type ($F(4,3131) = 37.58$, $p < .001$). The results of this ANOVA are meaningful in that they they confirm the categorization of words into the various accent types.



(Figure 5.9) Word Level, dB Peak Time

The results of the Tukey HSD test and the descriptive statistics for dB peak time show that the dB peaks for words unmarked for accent and for double-accented words are at .47, or close to the middle of the word. Similarly, the penultimate accent type has a mean peak time of .43, indicating that the dB peak occurs near to the middle of the word. The dB peak time for words with antepenultimate accent is closer to the beginning of the word, with a mean value of .35. Finally, for final-accent words, the dB peak time is the highest at .56.

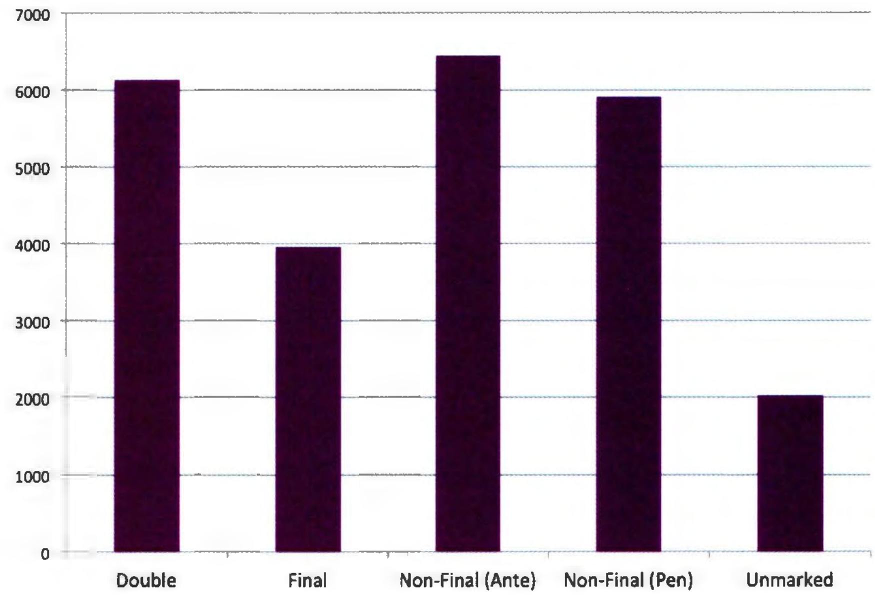
Table 5.9: Tukey HSD Results; Word Level, dB Peak Time

	Unmarked	Double	Antepenultimate	Penultimate	Final
Unmarked		1.0	.00	.01	.00
Double			.06	.78	.08
Antepenultimate				.11	.00
Penultimate					.00
Final					

These results show that the dB peak time corresponds to speaker intuitions about accent placement.

3.2.5. Intensity Total

The Intensity Total (dB Total) variable is a calculation achieved by adding together measurements of intensity taken at 10ms intervals throughout the length of the word. An ANOVA revealed a significant relationship between intensity total and accent type ($F(4,3131) = 545.778$, $p < .001$).



(Figure 5.10) Word Level Intensity Total (dB)

Results of the Tukey test show that unmarked and final accent types are distinct from all other accent types. Figure 5.10 shows that the statistical difference found is likely due to the comparatively low values for intensity total in relation to final and unmarked accent (i.e. compared to the other types, they are outliers).

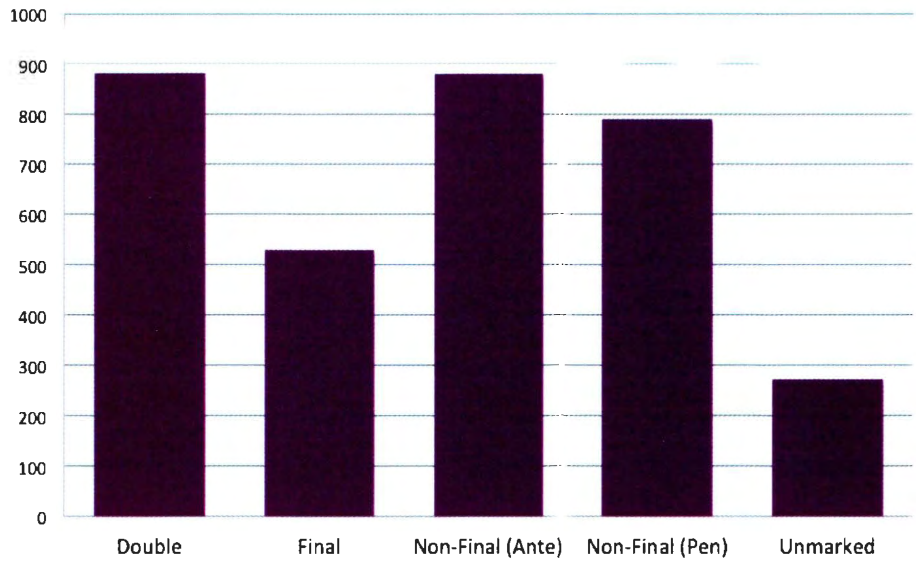
Table 5.10: Tukey HSD Results; Word Level Intensity Total

	Unmarked	Double	Antepenultimate	Penultimate	Final
Unmarked		.00	.00	.00	.00
Double			.85	.90	.00
Antepenultimate				.11	.00
Penultimate					.00
Final					

Because the values for this variable are calculated by adding together measurements throughout the word, the duration of a word will contribute to the intensity total. This suggests that words with a low intensity total, such as unmarked and final accent words, tend to be short in duration. Particles tend to have either unmarked or final accent.

3.3. Duration (word length) Results

As mentioned previously, in addition to pitch and intensity variables, I looked at word length and length of pauses to determine whether it plays a role in the prosodic system of Cayuga. An ANOVA revealed a significant relation between word length and accent type ($F(4,3131) = 532.599$, $p < .001$).



(Figure 5.11) Word Level Mean Duration (dB)

As shown in figure 5.11, the mean word length for unmarked and final accent types is lower than for other types. The Tukey HSD test confirms that words with final accent and unmarked words are distinct from other accent types.

Table 5.11: Tukey HSD Results; Word Level Mean Duration

	Unmarked	Double	Antepenultimate	Penultimate	Final
Unmarked		.00	.00	.00	.00
Double			.50	.97	.00
Antepenultimate				.03	.00
Penultimate					.00
Final					

The low mean word length for unmarked words can be explained by the fact that words in this category are most often monosyllabic particles. Similarly, words with final accent are typically located phrase-medially, (whereas non-finally accented words are found at the end of phrases). Phrase-medial words also tend to be particles. It may be possible, in a future study, to tease apart whether duration is more influenced by the location of accent, or the location of the word in a phrase.

3.3.1. Break Index Values (length of pause)

An ANOVA revealed a significant relationship between the break index value (the length of pauses between words) and accent type ($F(4,2824) = 17.233$, $p < .001$).

The Tukey HSD test shows that the break index value for the unmarked category is significantly different from the break index value for words with penultimate ($p < .001$) and final ($p < .001$) accent. In other words, the length of the pause after unmarked words is significantly different from the length of the pause after penultimately- or finally-accented words.

Table 5.12: Tukey HSD Results; Break Index Values

	Unmarked	Double	Antepenultimate	Penultimate	Final
Unmarked		.71	.32	.01	.00
Double			1.0	1.0	.15
Antepenultimate				1.0	.02
Penultimate					.00
Final					

Words of the unmarked category have the lowest break index value at 150.92ms, meaning that they are quickly followed by other words. Typically, unmarked words are particles. In contrast to other words types, particles are clitic-like, and tend to occur non-phrase-finally.

This chapter has presented the findings that resulted from my analysis. Here I have presented and discussed the results acquired from running of scripts (as described in Chapter 4: Methodology), and of the statistical analysis conducted on my annotated files. The following chapter presents my interpretation of these results including what they mean for accent and intonation, and establishes various blueprints that characterize Cayuga phrase types and word-accent type in light of the results.

Chapter 6: Interpretation

1. Introduction

In the preceding chapter, I reported on the results of my statistical analysis of the Marg Henry Story data. In this chapter, I will summarize the characteristics of both phrases and words in terms of their primary phrase type and word accent type, respectively. These descriptions will answer questions like "what does a narrative phrase type look like in Cayuga?" or "what does a word with double accent look like in Cayuga?". I will compile a set of blueprints for Cayuga prosody based on the data collected from the Marg Henry Story. I begin with phrase types first, and then move on to discuss the make-up of accent types found in the data.

2. Phrase Blueprints

As discussed in Chapter 5, only average pitch was a significant factor in distinguishing phrase-type. The results of the ANOVA and descriptive statistics (see

Appendix B) for average pitch show that with the exception of WH- questions, all phrase-types behave similarly. This finding indicates that Cayuga speakers do not employ the modulation of pitch to define phrase-types, except for WH- questions, for which the pitch is significantly higher than for any other phrase-type. This finding suggests that WH- questions have a special type of intonation contour, which should be reflected in the ToBI annotation.

3. Word-Level Blueprints

As discussed in Chapter 6, all the variables shown in Table 6.1 were statistically significant for accent-type. I interpret this finding below.

Table 6.1: Variable mean values by word accent type

		Accent Type				
		Unmarked	Double	Final	Antepenultimate	Penultimate
Variable	Maximum Pitch	**207.08**Hz	**244.86**Hz	**221.90**Hz	**222.73**Hz	**228.24**Hz
	F0 Peak Time	**0.35**s	**0.46**s	**0.63**s	**0.40**s	**0.42**s
	Average Pitch	**179.71**Hz	**189.47**Hz	**183.78**Hz	**167.53**Hz	**176.01**Hz
	Pitch Range	**63.27**Hz	**114.46**Hz	**84.91**Hz	**112.95**Hz	**110.08**Hz
	Maximum Intensity	**81.38**dB	**84.14**dB	**82.84**dB	**82.74**dB	**82.99**dB
	dB Peak Time	**0.47**s	**0.47**s	**0.56**s	**0.35**s	**0.43**s
	Average Intensity	**76.15**dB	**76.17**dB	**76.03**dB	**73.71**dB	**75.33**dB
	Intensity Range	**14.42**dB	**20.86**dB	**17.86**dB	**21.66**dB	**19.92**dB
	Intensity Total	**2031.92**dB	**6129.55**dB	**3957.65**dB	**6446.65**dB	**5902.89**dB
	Break Index	**150.92**ms	**199.09**ms	**280.95**ms	**282.20**ms	**255.42**ms
	Duration	**272.65**ms	**811.95**ms	**528.59**ms	**880.07**ms	**791.07**ms

3.1. Unmarked Accent

Words in the unmarked category are outliers in many respects. Unmarked words have lower average values for all variables. Unmarked words are, on average, both short in duration (272.65ms) and closely linked to other words, with the shortest break index value (150.92ms). Unmarked words have the lowest maximum pitch (207.08Hz), and the lowest average pitch range (63.27Hz). They also have the lowest average peak time value (at 0.35sec).

Unmarked words also have lower values for the intensity variables; the results for intensity mirror those of average pitch.

Most unmarked words are particles. Cayuga particles are monosyllabic; they tend to group together, in which case, they share a single accent (Dyck p.c). The other category of unmarked words are certain disyllabic words which fail to meet the conditions for accentuation (see Appendix A for details). In general, then, words unmarked for accent are non-prominent.

3.2. Double Accent

In contrast to unmarked words, double-accented words tended to have the highest values for all the pitch variables. Double-accented words have the highest average pitch, suggesting the possibility that such words have two high tones. Similarly, double-accented words have the highest pitch range, supporting the idea that such words have exceptionally salient prominence marking.

Double-accented words tend to occur closer to following words than most other types (with the exception of unmarked words), and they tend to be fairly long (in second place, behind the antepenultimate accent category). For double-accented words, the intensity variables pattern similarly to the pitch variables.

3.3. Single Accent

Words with a single accent include words with final, antepenultimate, or penultimate accent. Pitch peak time tends to correspond with speaker intuitions about where accent is placed: the values for pitch peak increase as the accent in question gets closer to the end of the word; for example, the pitch peak time is 0.40s for antepenultimately-accented words, 0.42s for penultimate words, and 0.63s for final words. This result is mirrored by the results for intensity peak time with values of 0.35s, 0.43, 0.56 respectively. This indicates that pitch and intensity are working together to signal metrical prominence in words.

As shown in table 6.2 below, the average pitch and intensity values increase as the accent becomes closer to the end of the word. In contrast, the pitch and intensity ranges decrease as the accent becomes closer to the word end.

Table 6.2: Average pitch and intensity values in single accent types

		ACCENT TYPE (WHICH VOWEL IS ACCENTED)		
		Antepenultimate (3rd-last vowel)	Penultimate (2nd-last vowel)	Final (last vowel)
VARIABLE	Average Pitch	**167.53**Hz	**176.01**Hz	**183.78**Hz
	Average Intensity	**73.71**dB	**75.33**dB	**76.03**dB
	Pitch Range	**112.95**Hz	**110.08**Hz	**84.91**Hz
	Intensity Range	**21.66**dB	**19.92**dB	**17.86**dB

The greater prominence on words with final accent suggests that the right edge of words with final accent is marked by a special type of high tone. The narrower range of pitch and intensity on final-accent words suggests that such words are not followed by a L tone.

In summary, WH- questions and words with double accents appear to have extra prominence. In contrast, unaccented words are non-prominent. The remaining phrase and word types tend to be distinct from one another, but are not exceptionally prominent or non-prominent. Distinctiveness and (non-)prominence should be reflected in the ToBI labelling, described in the following chapter.

Chapter 7: Toward a C_ToBI

In this chapter I present some preliminary guidelines for ToBI annotation in Cayuga phrases (i.e. the foundations for a C_ToBI). I provide background about the ToBI labelling system in §1, describe how to label H tones in words and in particle groups in §2; how to label L tones in §3; and how to label boundary tones (%) and pitch accents (*) in §4. In §5, I discuss the labelling of break indices. Finally, §6 provides fully annotated examples, demonstrating C_ToBI in action.

1. Tone and Break Index (ToBI) Annotation

The Tone and Break Index or ToBI system is a collection of conventions developed (originally for English) to transcribe and analyze the prosody of human speech (Beckman and Elam 1997). In addition to a system for English, one well established system for a pitch accent language is J_ToBI, a ToBI system developed by Venditti (1995; 2005) for analyzing Japanese prosodic structure. This system is relevant for analyzing Cayuga, because Cayuga's prosodic system more closely resembles that of Japanese than English. ToBI annotations record information relevant to intonation, including tones (pitch), intensity, and break indexes. Below, I explain the type of information that is captured in a ToBI system.

1.1. Tone

The basic components of any ToBI labelling system include the labelling of high (H) and low (L) tones, as well as the marking of break index values (Beckman and Elam 1997). I describe how I labelled phrasal tones and pitch accents next.

1.1.1. Phrasal Tones

Phrasal tones are pitch events that occur near boundaries within a phrase. There may be several phrasal tones in a single phrase; the number depends on the phrase's internal prosodic structure. Minimally, I marked boundary tones, which are indicated using the symbol % with the tone label (e.g. H% denotes a final, high boundary tone)

(Beckman and Elam 1997). Boundary tones are realized near the edge of a prosodic unit.

1.1.2. Pitch Accents

In contrast to phrasal tones, pitch accents are events in the pitch contour which correspond to accented syllables of words in the phrase and not to intonational phrase boundaries. Each accented syllable in a phrase was labelled with one of the two labels presented below; the lack of label on a syllable denotes a non-accented syllable (Beckman and Elam 1997). Minimally, each accented syllable in a phrase is marked by either a H* or L* label indicating peak accent or low accent respectively (Beckman and Elam 1997). H* or L* labels are placed within the nucleus of the syllable which is accented.

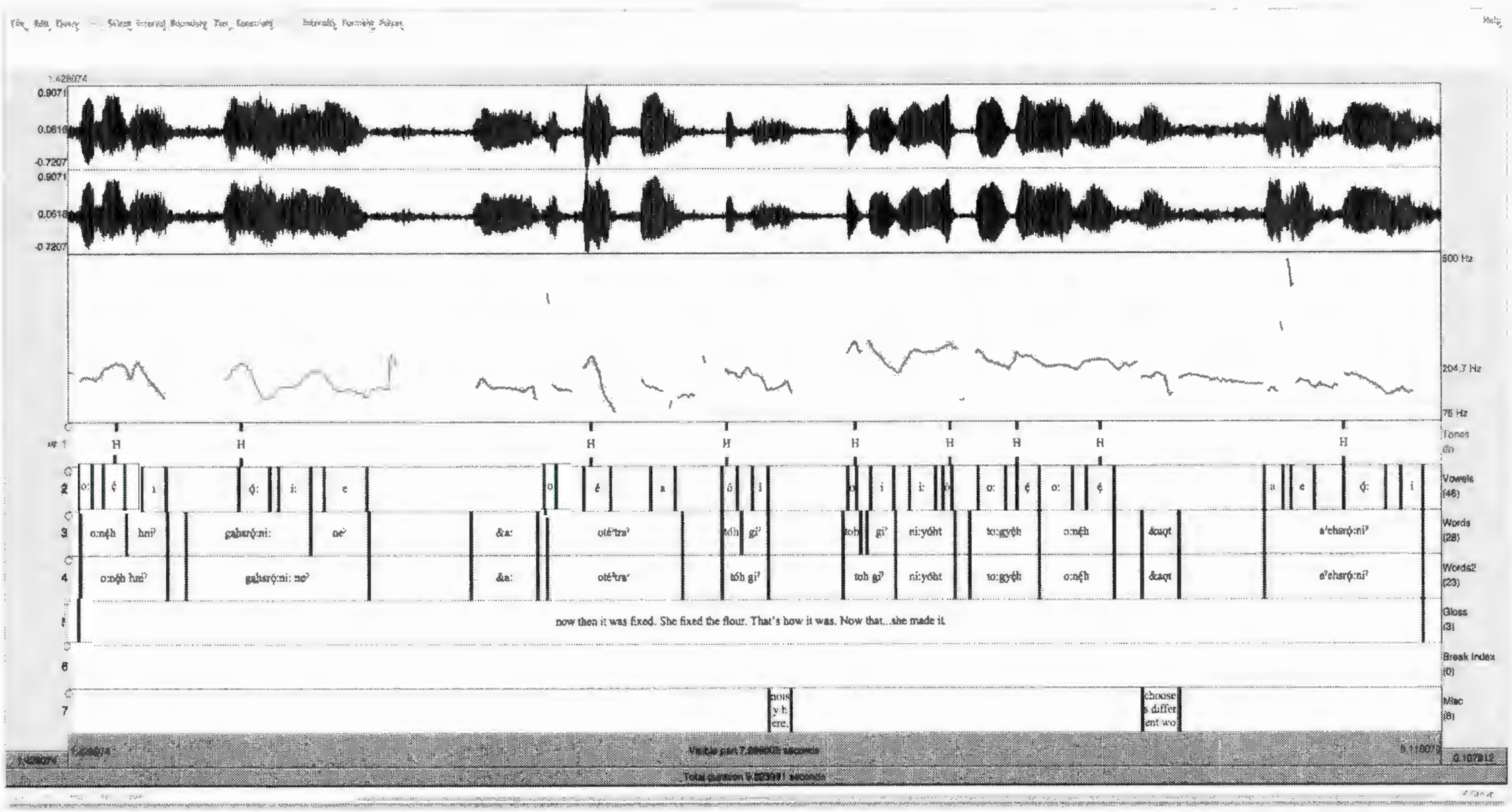
1.2. Break Indices

Break indices are relative values assigned to the pauses between intervals; they indicate "the degree of prosodic association between adjacent words or phrases in an utterance" (Venditti 2005, 184). Values used on the break index tier range from 0 (no disjuncture) to 4 (indicating finality, or a strong sense of disjuncture typical of that found phrase finally). While break index values are an integral part of ToBI annotation, they are generally subjective in nature— they are relative values assigned to pause duration (Venditti 2005). To avoid subjectivity, I created a script to automatically assign break-index values; see §6 of Chapter 4).

2. Labelling H tone

Annotating TextGrids begins with labelling the H tones. To do this, I first located the maximum value for F0 within each word and labeled it (on a point tier) with H (this was accomplished with a Praat script). This H tone denotes the word's pitch accent; and in general, its location coincides with the orthographic accent marks provided by native speaker transcribers.

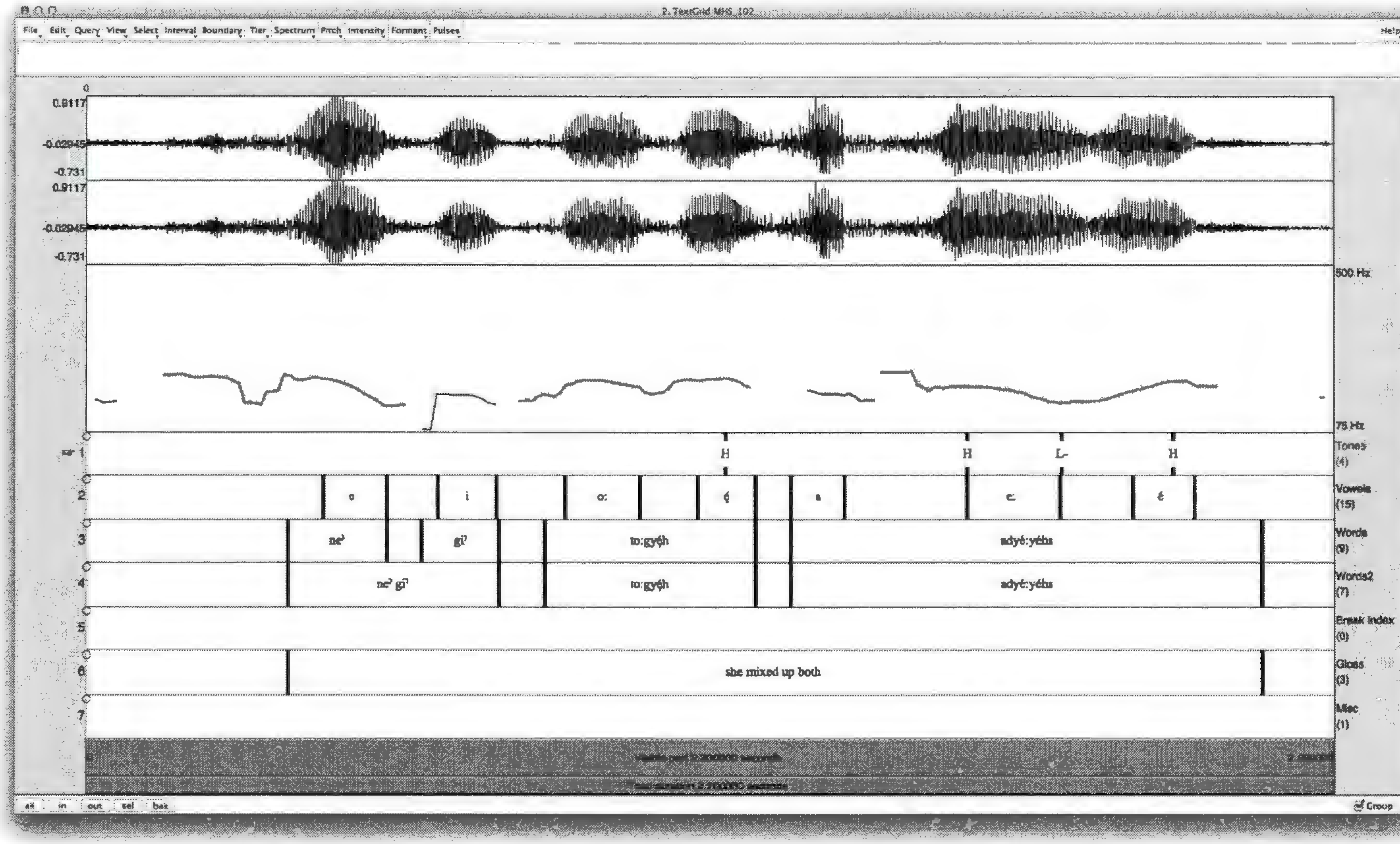
In figure 7.1 I illustrate the labelling of H tones for words with single (or no accent). This includes words with final accent (e.g. *ni:yóht* and *to:gyę́h*), and penultimate accent (e.g. *oté*ˀ*tra*ˀ and *a*ˀ*ehsrǫ́:ni*ˀ).



(Figure 7.1) Labelling H Tones (single accented words)

Figure 7.2 illustrates labelling of tones for words with double accent (e.g. *adyé:yéhs*). Native speaker transcribers mark such words with double accents. Finally, my statistical analysis (Chapter 5 and 6) also supports this double-accent analysis: such words tend to have the highest values for pitch, including the highest values for average pitch. Similarly, the pitch track shows that such words appear to have multiple pitch peaks.

My algorithm for adding the H label, will allow for only one H label per interval. Note, however that the first peak is followed by a trough. For this reason, I adjusted the label for the first accent to H-L. In addition, in order to mark the second pitch peak in such words, which isn't followed by a trough, I manually measured the area surrounding the second visual peak for maximum F0 and labelled it as H as well.

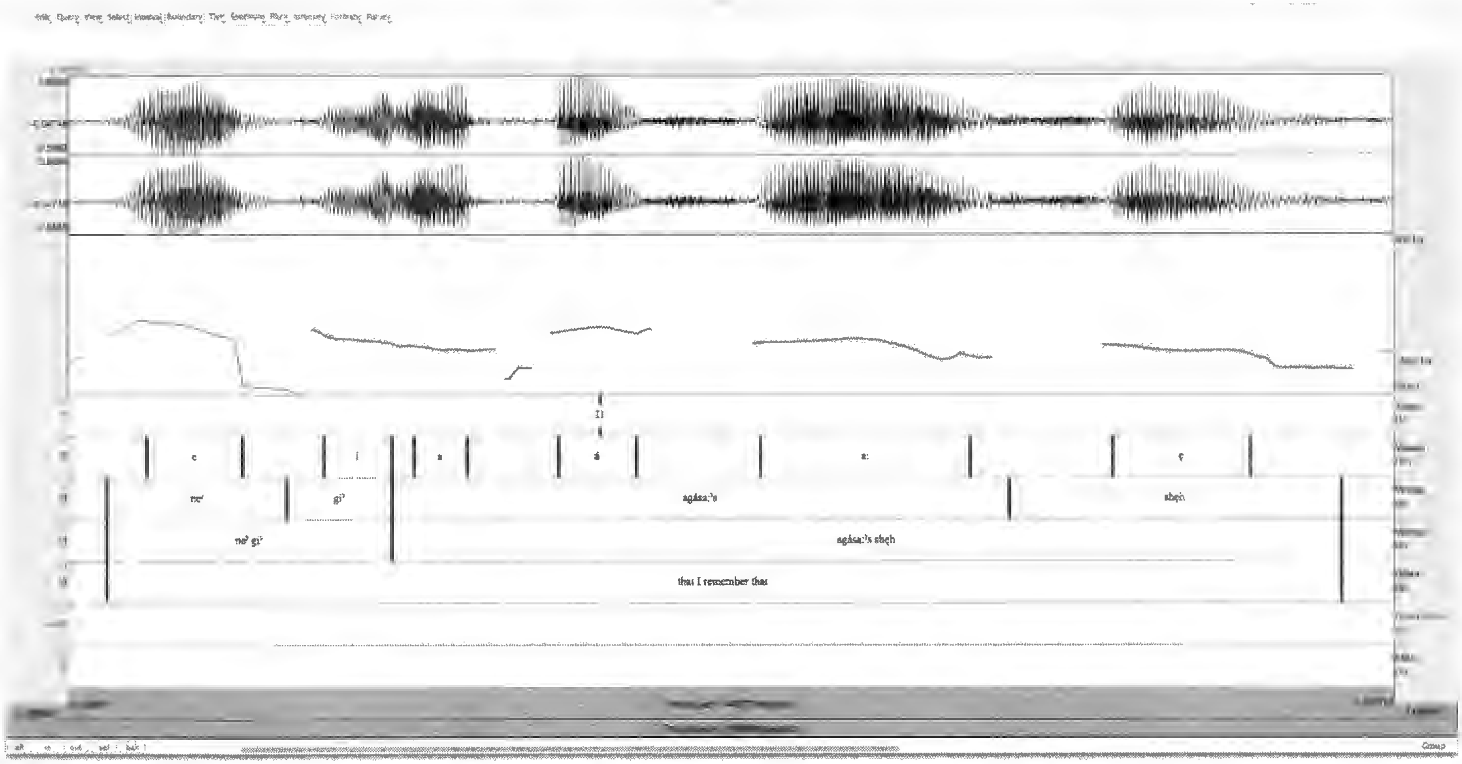


(Figure 7.2) Labelling H Tones (double accented words)

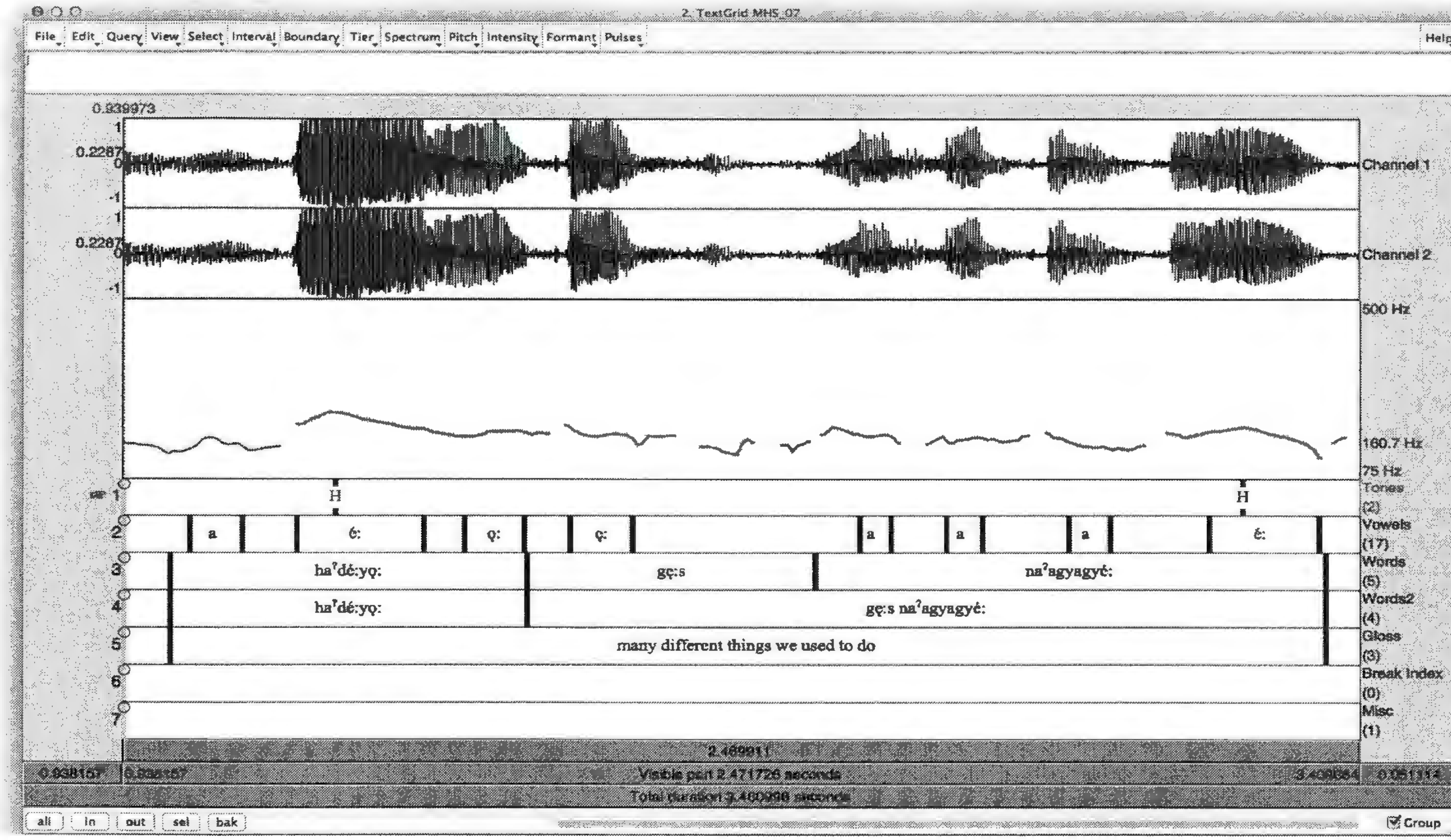
I illustrate the labelling of particles in the TextGrids found in figures 7.3-7.6. Recall that on the Words2 tier, single particles were grouped with the proceeding word, unless the particle was phrase-final, in which case I grouped it with the preceding word. Groups of particles occurring together were combined into a single interval. For example, the three particles *néˀ ni:ˀ ahí:ˀ* were grouped into one unit on the Words2 tier. These groupings correspond to speaker intuitions about particle groupings, as reflected in typical spelling patterns.

When particles occur alone, they tend to remain unaccented; in contrast, particles that occur in groups tend to be accented as if they were a single word (i.e. via the rules of accent placement, described in Appendix A). The following figures illustrate the labelling of unaccented particles, as well as particle groups that have either final or non-final accent.

Figures 7.3 and 7.4 include examples of unaccented particles, both as proclitics and as enclitics. For example, the phrase *agáhsa:ˀs shę̨h* (figure 7.3) illustrates an unaccented enclitic particle where *shę̨h* is not accented; in figure 7.4, *gę̨:s naˀagyagyé:* illustrates an unaccented proclitic particle when *gę̨:s* is unaccented.

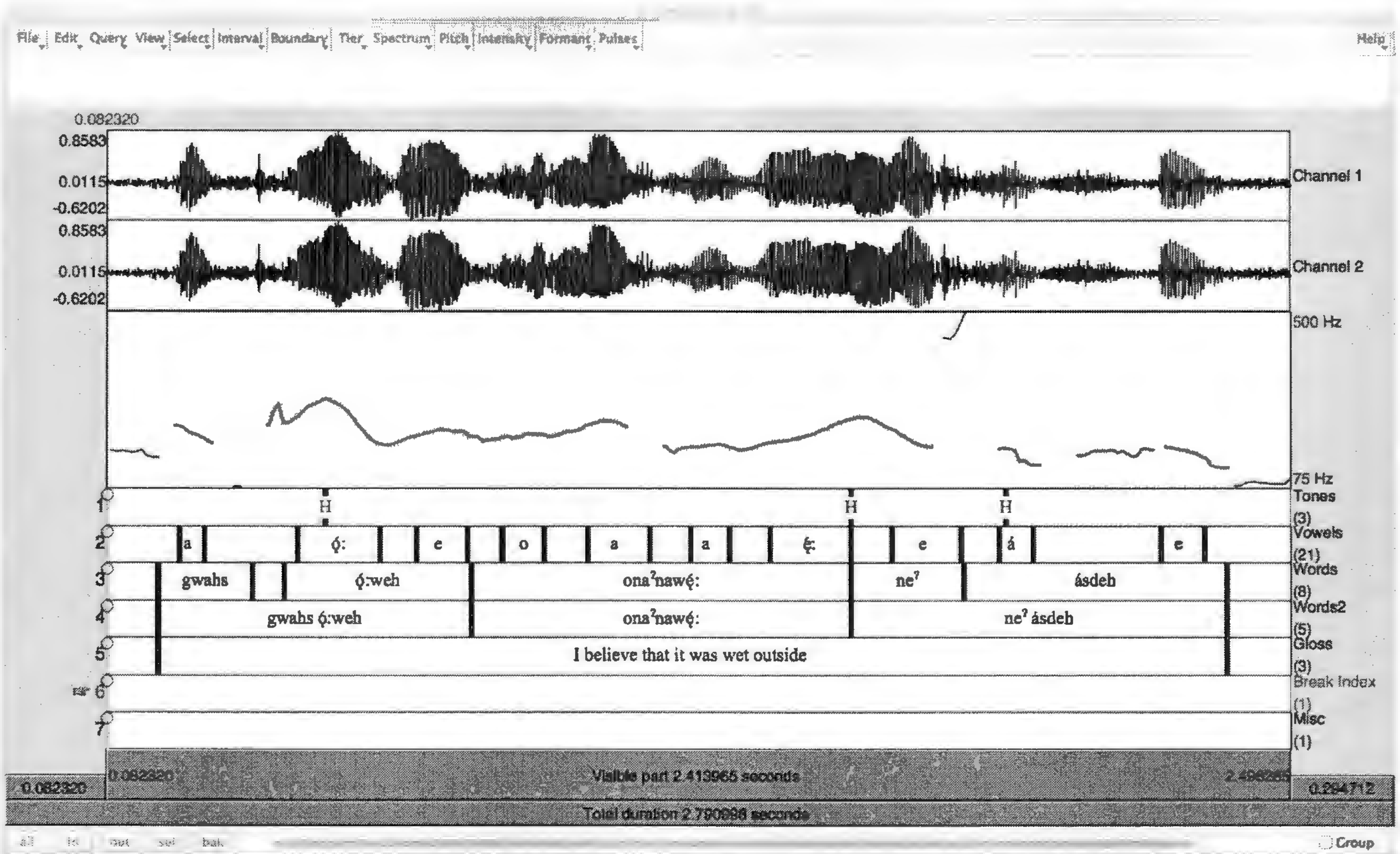


(Figure 7.3) Labelling H Tones (Unaccented Particle—Enclitic)

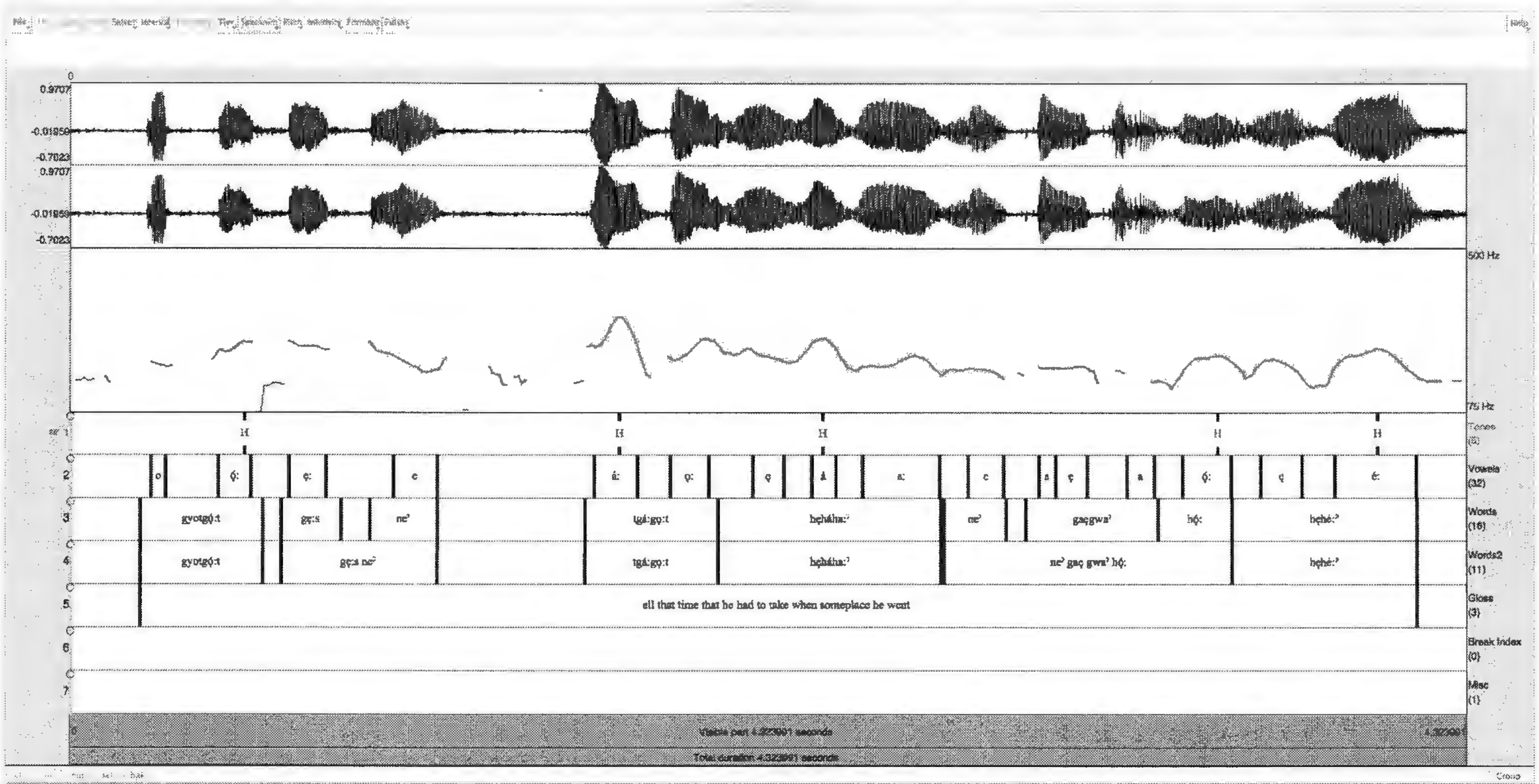


(Figure 7.4) Labelling H Tones (Unaccented Particle—Proclitic)

Figures 7.5 and 7.6 illustrate the accenting of particle groups that behave like single words. In figure 7.5, the phrase *gwahs ǫ́:wch* is accented non-finally (i.e. it is accented on the penultimate vowel), while in figure 7.6 we see final accent occurring on *hǫ́:* in the particle group *neˀ gaę gwaˀ hǫ́:*.



(Figure 7.5) Labelling H Tones (Particle Group—Non-Final Accent)



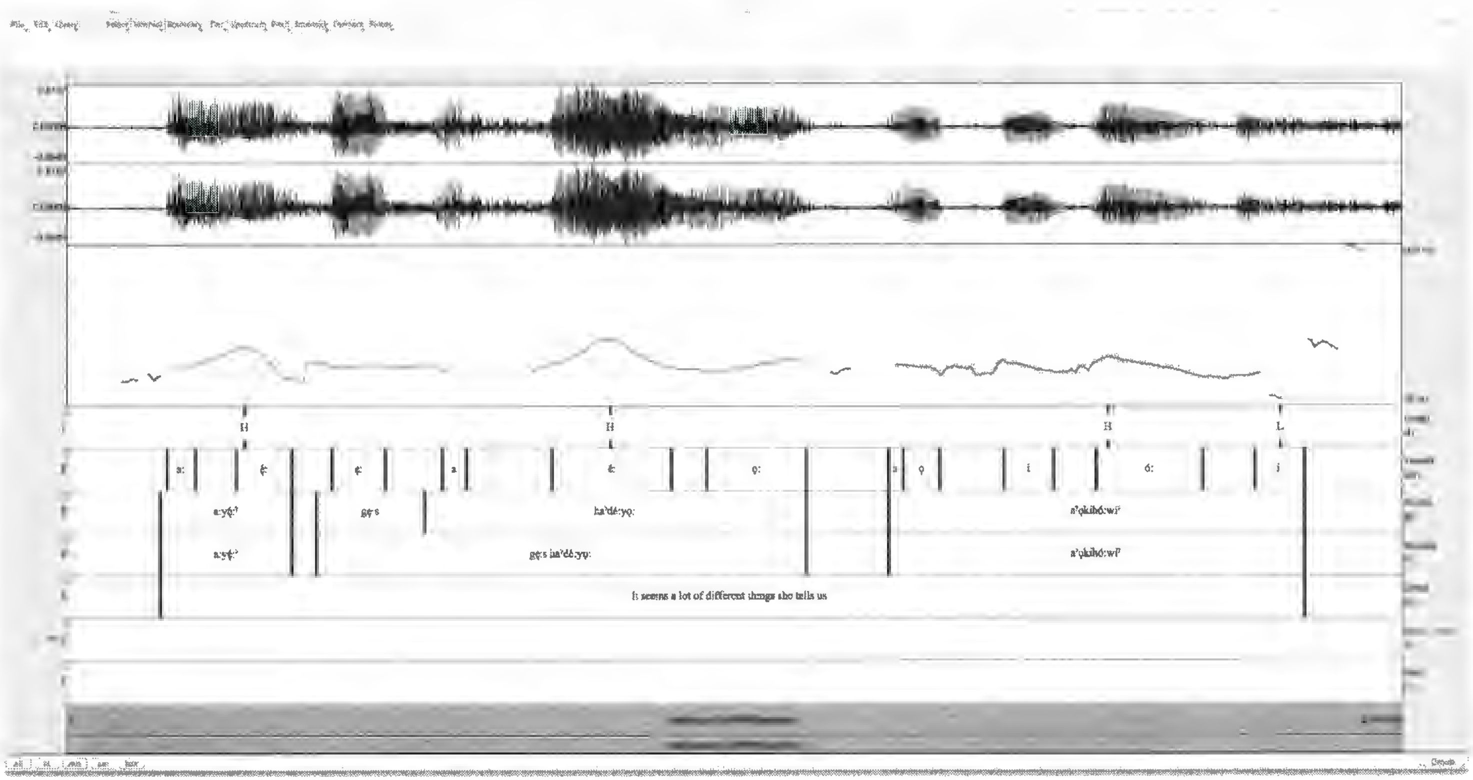
(Figure 7.6) Labelling H Tones (Particle Group—Final Accent)

3. Labelling L Tone

In addition to labelling pitch peaks for H tone, we must also mark prosodically salient L tones as well. Note that the assignment of L tones is different in the case of intonational contours than in tone languages. For intonational contours, L tones are target pitches, whereas for tone languages, L tones can be default tones, assigned in the absence of any other tone. As well, for intonation, it is not the case that all vowels are assigned a tone, whereas in tone languages, all vowels must generally be assigned a tone. For Cayuga intonation, there are two instances in particular where it is important to indicate a L in order to capture the intonation contour.

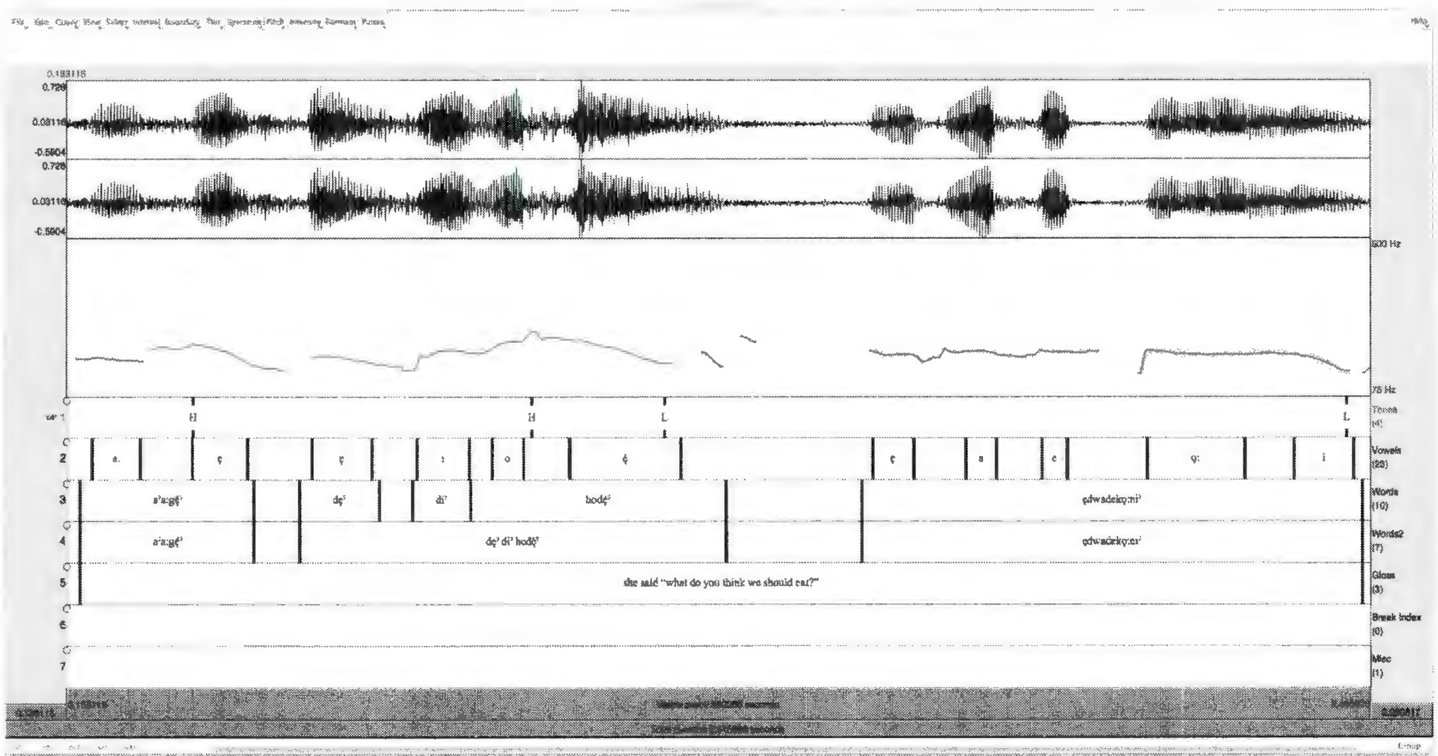
The first case consists of non-finally accented words that appear at the end of phrases. In such cases, we see a pitch peak followed by low-toned vowel. I attribute this pattern to a L tone occurring on the final syllable in a phrase (see figure 7.7 below).

The second case consists of WH- questions, where, the typical pattern is to have a pitch accent (H) occurring on the WH-word, followed by a drop in pitch (i.e. a L tone) that continues to the end of the phrase. This creates a contour in which the pitch peak occurs much further to the left in the phrase than it would ordinarily; in particular, the last word of the phrase has no pitch peak. An example of this H L L pattern is shown in figure 7.8 below.



(Figure 7.7) Labelling L Tones (Non-Final Accent; phrase Final Word)

A second occasion where we see L tones occurring is in WH- questions. In such cases, the typically pattern is to have a pitch accent (H) occurring on the WH-word which is followed by a precipitous drop in pitch (i.e. a L tone) that continues on a L tune to the end of the phrase. Note that the word following the WH-word, which would normally receive a H tone accent, is low-toned throughout. (This is in contrast to English, where intonation rises at the end of WH- questions). Note that this continued L tone on a span of vowels following the WH-word is different from the realization of tone in a span of untoned vowels: in long intonation contours, untoned vowels before the pitch accent receive a mid tone, not a low tone. An example of this pattern is shown in figure 7.8 below, where we see a H peak occurring on the last word of the WH-phrase, a following L tone, and a continuation of that L tone through the end of the phrase. Since the metrical prominence on *ędwadekǫ:niˀ* in this example does not receive a H* pitch accent, I assume that it receives a L tone instead. The intonational tune for Cayuga questions will be discussed further in the following section as well.

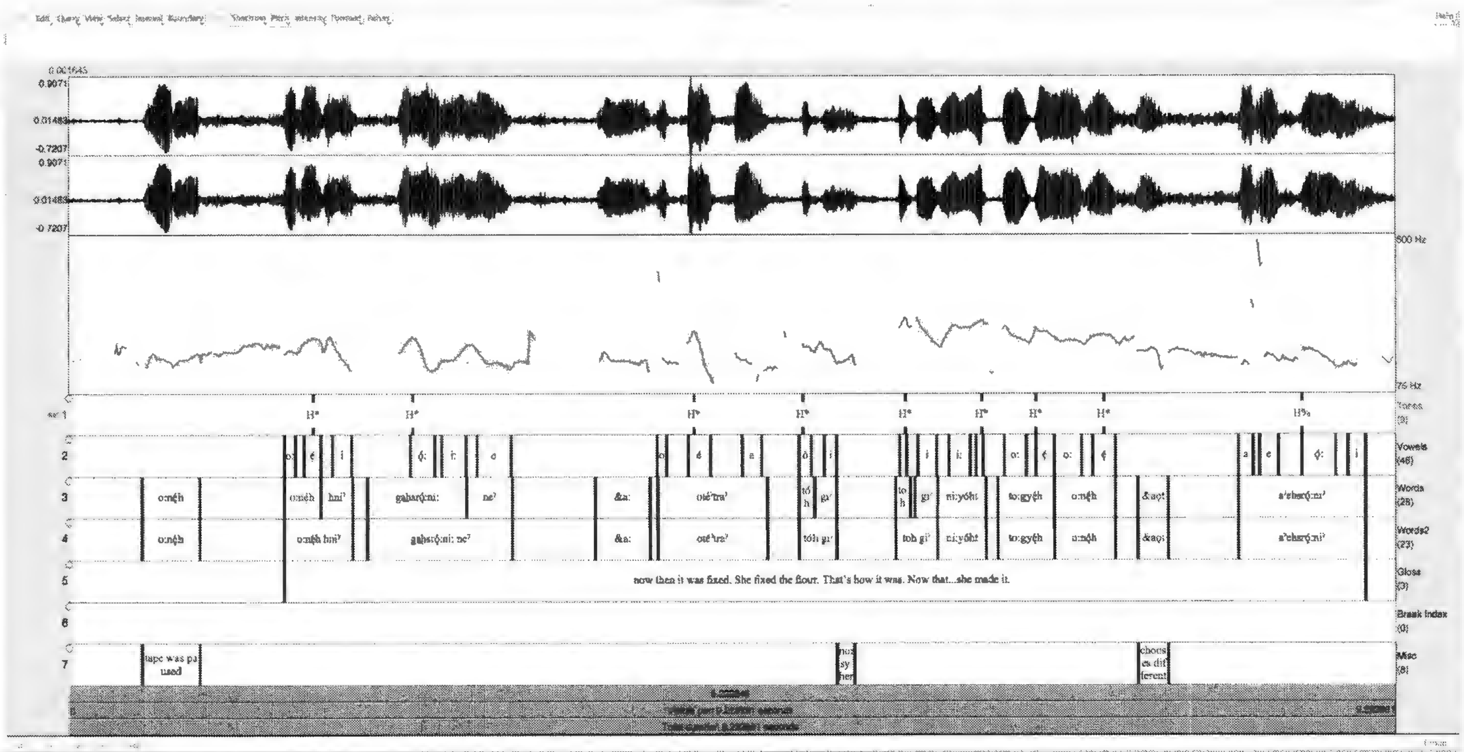


(Figure 7.8) Labelling L Tones (WH-question H L L Pattern)

4. Adding Diacritics (%, *, –)

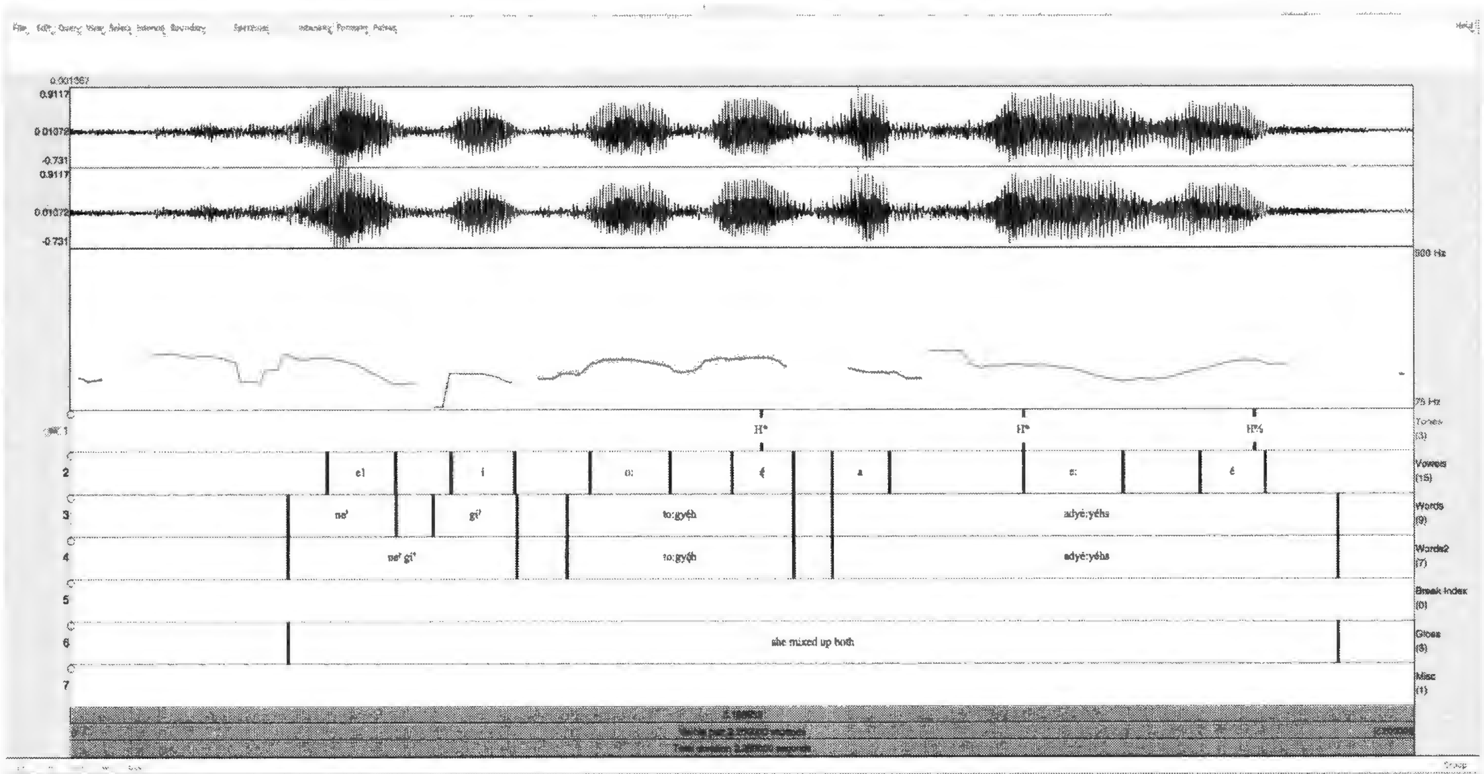
In this section, I describe how I labelled tones as either boundary tones (%), or as pitch accents (*). Phrase-final tones are marked as boundary tones (using the symbol %), while H tones that occur non-phrase finally are marked as pitch accents (by addition of *). Additionally, when pitch accents do not occur phrase-finally, as with WH-questions, the '–' diacritic indicates an extended low-toned tail.

To illustrate the use of these diacritics, I have further annotated the TextGrids presented in §1 and §2 (which are repeated below). In figure 7.9, we see a pitch accent (indicated using H*) associates with one vowel per word (or particle group) in the phrase. For example, the particle group *o:nę́h hniˀ* receives only one pitch accent (H*), and likewise, *otéˀtraˀ* also receives only one pitch accent.



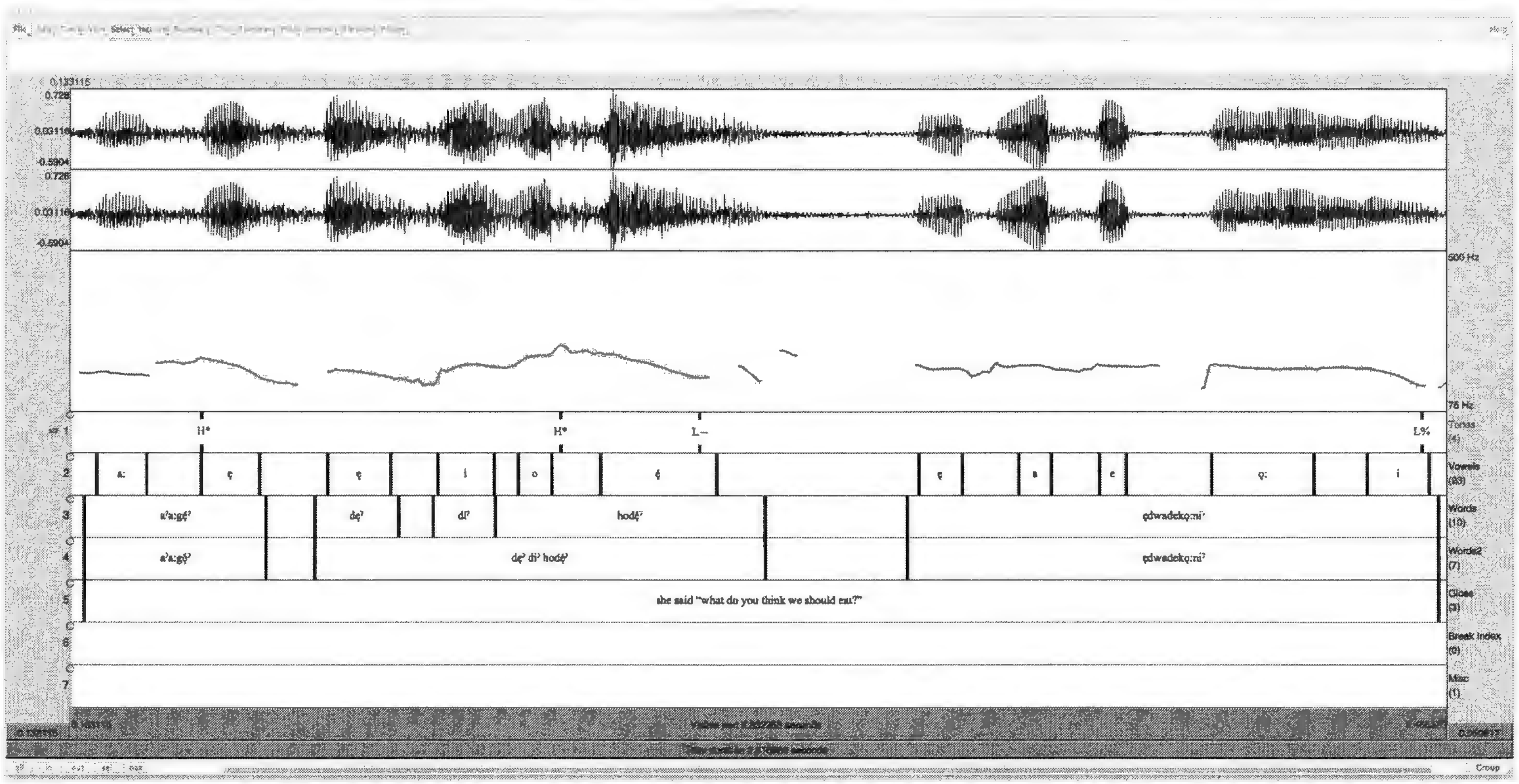
(Figure 7.9) Adding Diacritics (single accent types)

Figure 7.10 repeats the example of double accent above. Additionally, this figure identifies the second accent on *adyé:yéhs* as being a H boundary tone as it coincides with the edge of the phrase.



(Figure 7.10) Adding Diacritics (double accent type)

Finally, the example WH-question from §1 is re-presented in figure 7.11. We see the WH- phrase pattern H* L- L% indicated on *dę*ˀ *di*ˀ *hodę́*ˀ *ędwadekǫ:ni*ˀ which is preceded by *a*ˀ*a:gę́*ˀ, which receives a typical pitch accent (H*) marking on the final vowel (i.e. as it should given the rules for accent placement). The L– tail associates to the metrical prominence of the final word of the phrase, instead of a H* pitch accent. The L% boundary tone associated to the final vowel of *ędwadekǫ:ni*ˀ. The result is that the last word of the phrase is completely low-toned.



(Figure 7.11) Adding Diacritics (WH-question Pattern)

5. Labelling Break Index Values

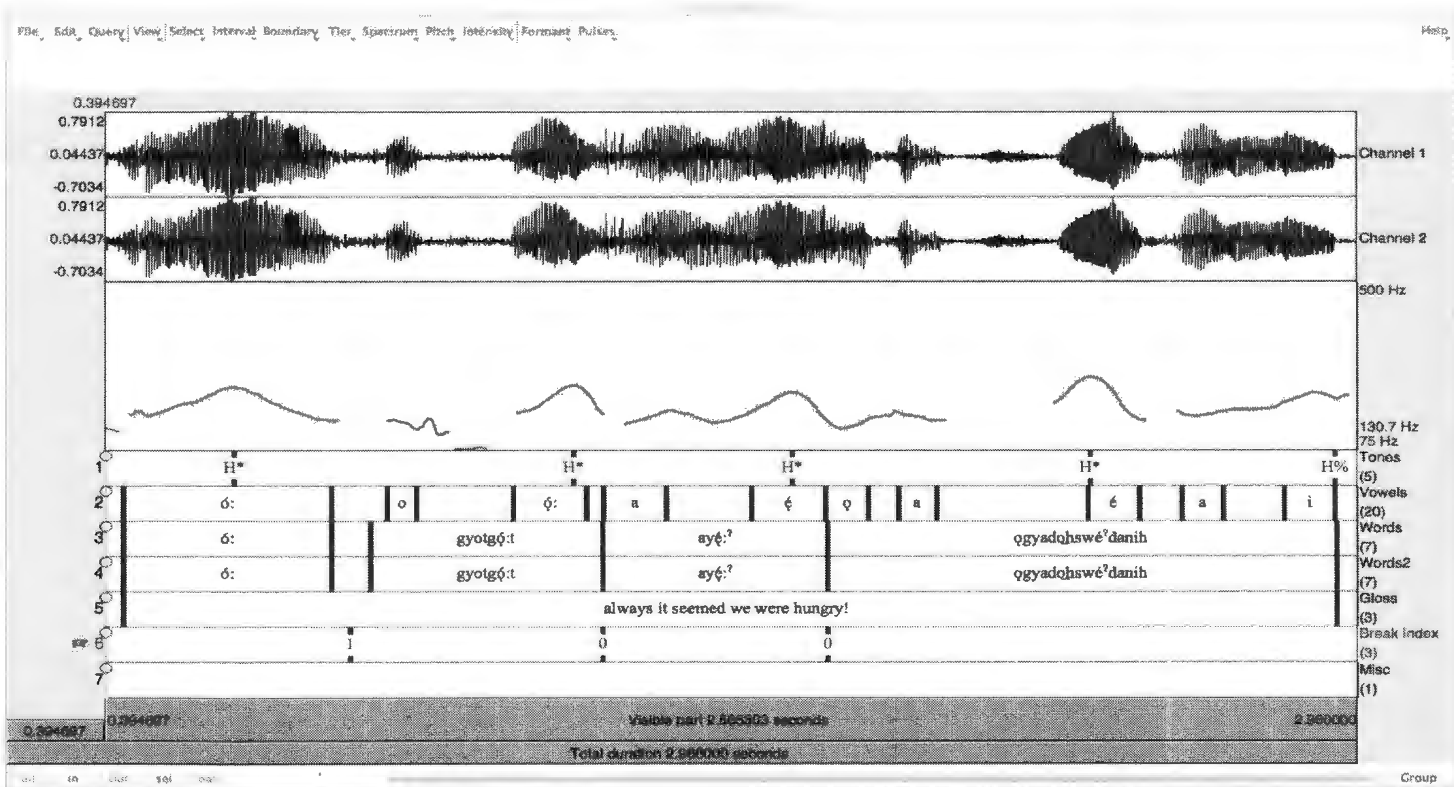
To label break indexes, I used a Praat script to insert a number between zero and four on a separate tier of the TextGrid to indicate the relative degree of disjuncture between each pair of words in a phrase. (See Chapter 4: Methodology) For example, a value of zero indicates no disjuncture (as we are likely to see within particle groups); while a value of four indicates the largest level of disjuncture (such as that found between two separate phrases). In my examples (provided in the following section), break index values of 0-3 are shown; however, break index values of 4 not are shown as they would occur between phrases (which constitute separate sound files and TextGrids for me).

6. Annotated Examples

In this section, I provide examples of typical intonation contours for each phrase type (exclamation, narrative, etc...). Additionally, I show how each phrase type would be annotated according to the conventions presented in this chapter. This includes the indication of H and L tones and addition of any diacritics on the Tones tier; and the inclusion of break index values on the Break Index tier.

6.1. Exclamation

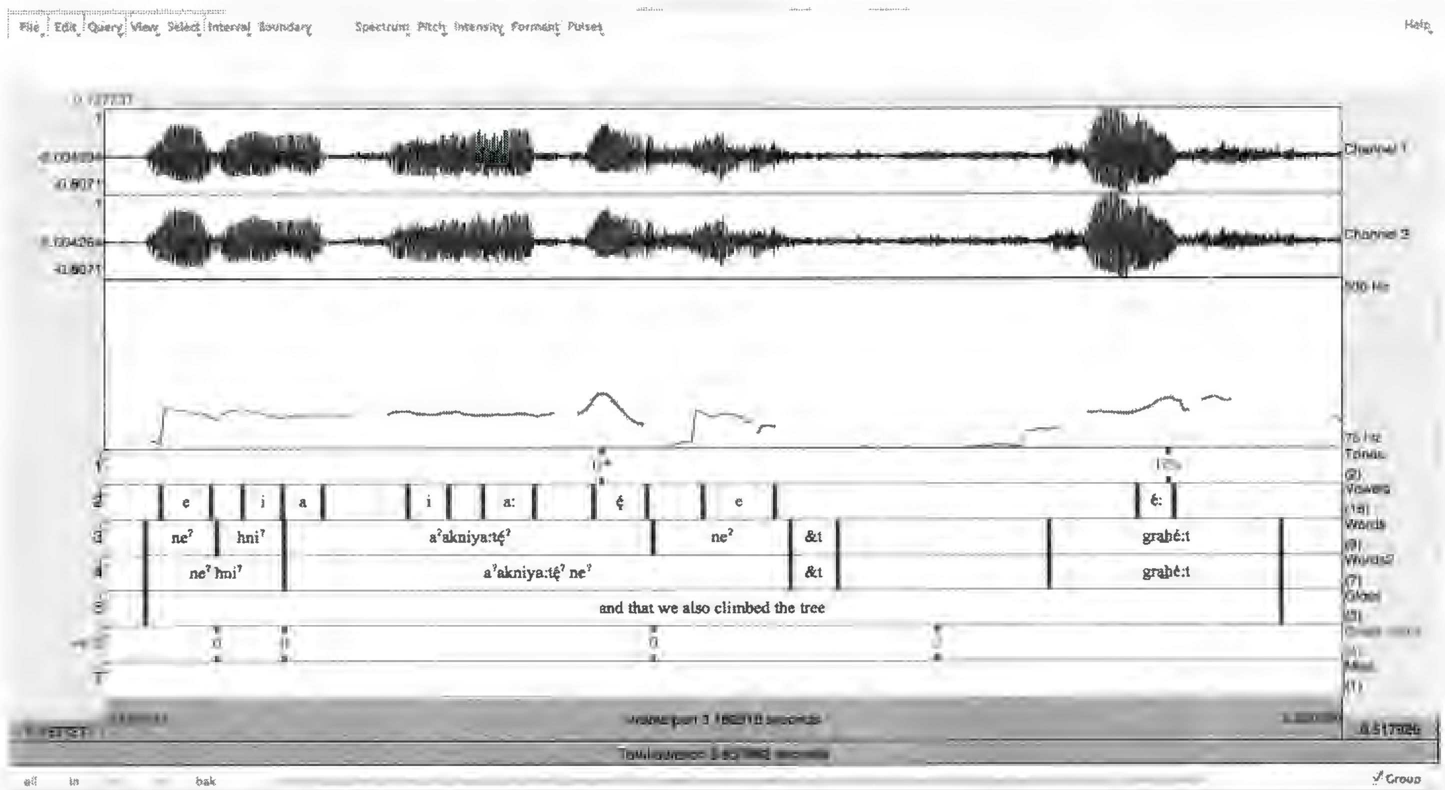
The following example illustrates an exclamative phrase. As we can see, the rules of accent placement are obeyed, words that are phrase medial are accented on the final vowel; and, as expected, the phrase final word is accented non-finally. Indicative of exclamations (as seen in figure 7.12) are the H pitch accents found. In this case, we can see that the accented vowels are being emphasized as they receive a well defined, and significantly sized, pitch peak. Additionally, we see that this phrase ends on a high tone. These features are indicative of this phrase type as they indicate a particular degree of emphasis that is expected when a speaker is surprised, or emotionally involved in the phrase.



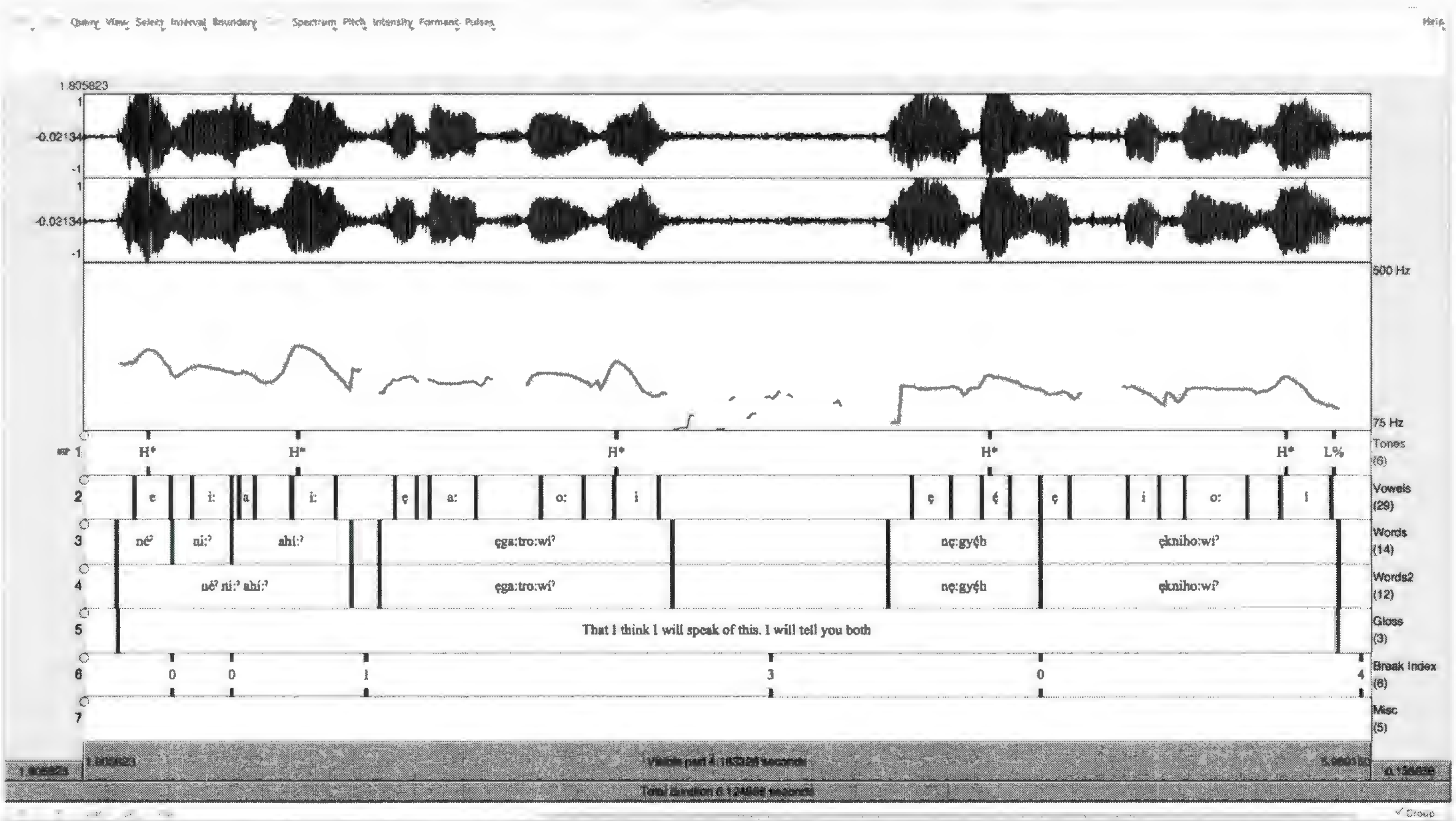
(Figure 7.12) Exclamation

6.2. Narrative

Narrative phrase types result as the speaker is describing a situation or narrating a story. Prosodically speaking, narrative phrases take two main forms: ones that end in a high boundary tone (H%) and ones that end with a low boundary tone (L%). These two ending tones appear to indicate continuation and finality respectively. An example of each boundary tone type in a narrative phrase is provided in figures 7.13 and 7.14 below.



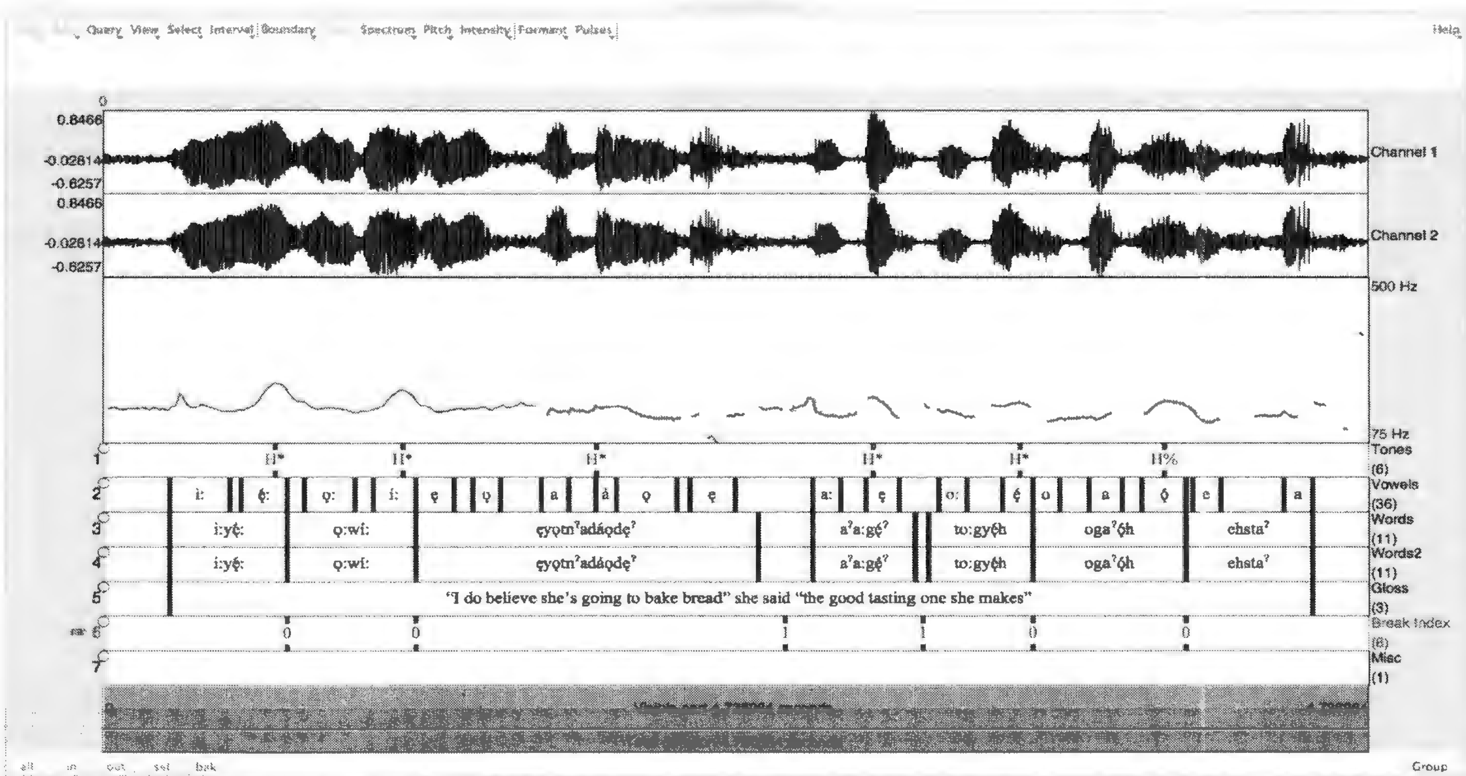
(Figure 7.13) Narrative (H%)



(Figure 7.14) Narrative (L%)

6.3. Quotative

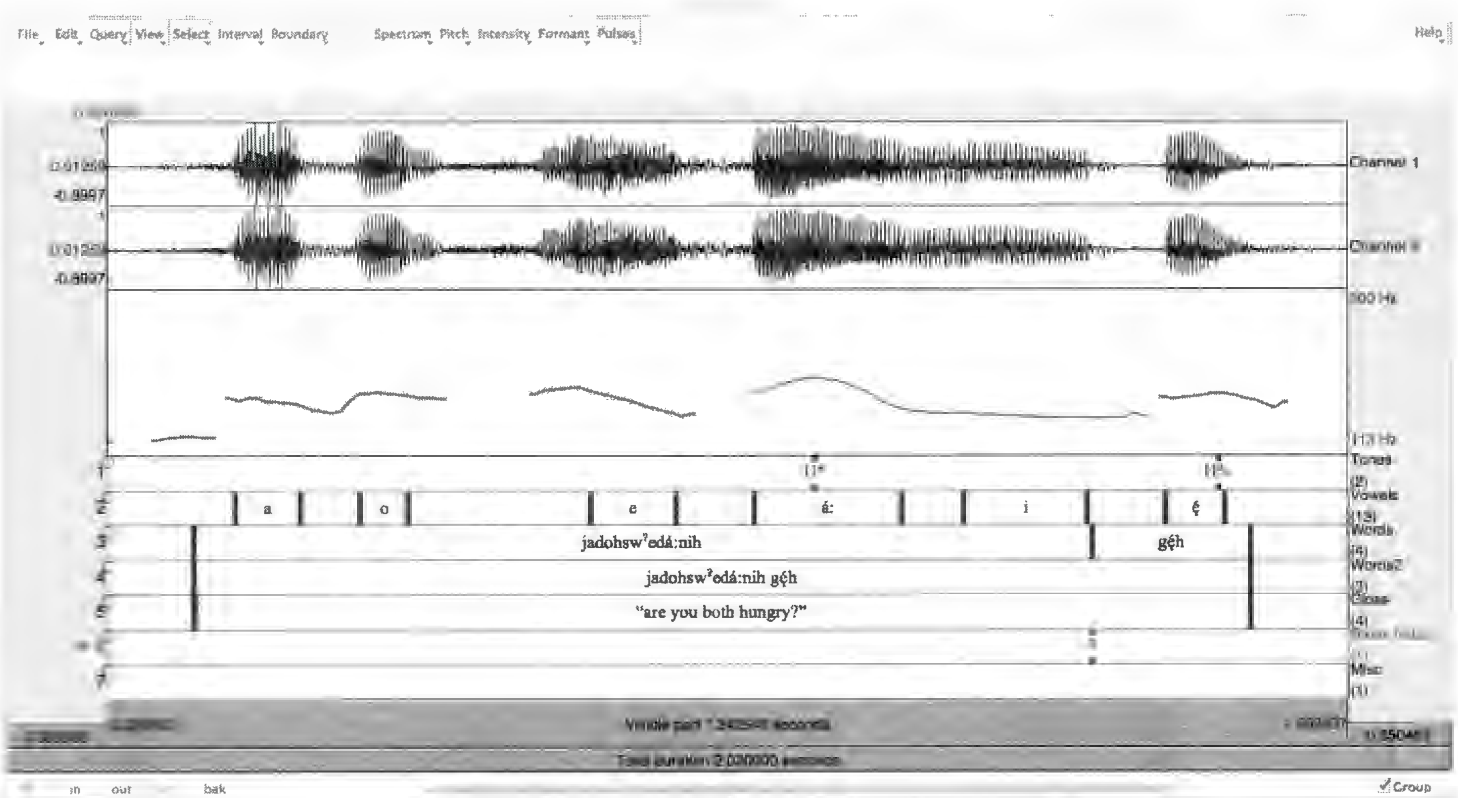
While quotatives appear to have a prosodic structure similar to that of narrative phrases, the actual quotation portion of the phrase (i.e. other than the 'she said') tends to be marked by pitch reset (see Chapter 2, §4.2), which signals that the current portion of the phrase is distinct in some way (e.g. it is a quote of something another person has said).



(Figure 7.15) Quotative

6.4. Yes-no Question

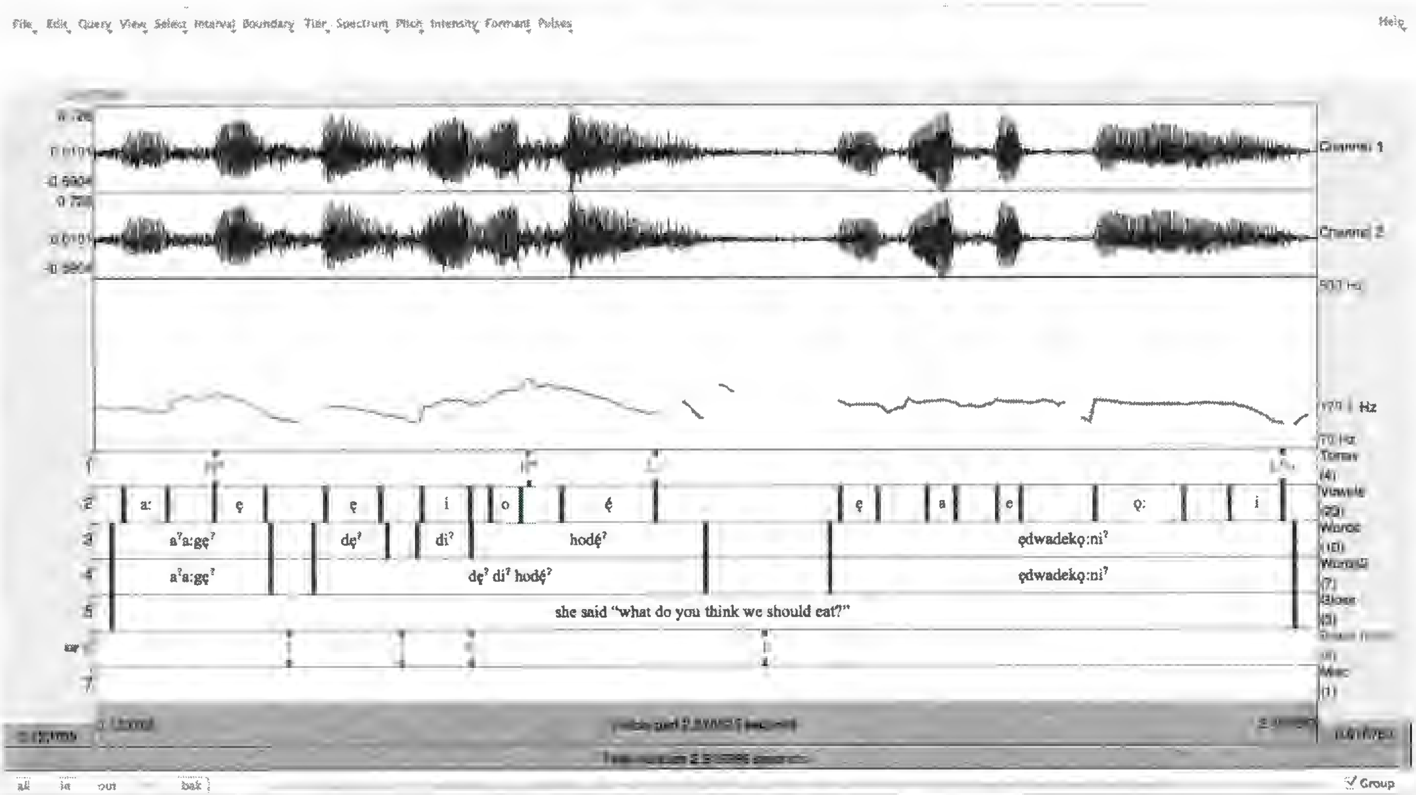
Yes-no questions in Cayuga are indicated using of the particle *gęh*. Normally, isolated particles would receive a L% tone at the end of the phrase; however, the following example ends with a H% boundary tone as a result of the H* H% intonation contour present in the particular phrase (This is an example of the interaction of pitch and intonation: a word that is normally without a tone when it is in context, is in this case produced with a tone contributed by the H% boundary tone.



(Figure 7.16) Yes-no Question

6.5. WH-Question

Figure 7.16 below illustrates a fully annotated WH-question, which I discussed in more detail above. Again, in this phrase we see that overall, there is a higher overall pitch than in other phrase types. In this particular example, the intonation contour of the WH- phrase is H* L- L%, with a pitch accent (H*) on the WH-word, followed by a L that continues to the phrase end, where there is a low boundary tone.



(Figure 7.17) WH-question

7. Interactions of Pitch Accent and Intonation

In this section, I will point out some of the interactions that arise between pitch accent and intonation patterns in Cayuga phrases. I base my discussion Abe's description of accent-intonation interaction patterns for Japanese (1998), as described in Chapter 3 (§2.1).

Most Cayuga clause types display a copulative interaction: they have a H* pitch accent, that is followed by a L% or H% boundary tone on the final vowel of the word. For example, words with a double accent (see figure 7.10) have a H* pitch accent (realized on a non-final syllable), followed by a final H% boundary tone (realized on the last syllable). As another example, accentless words receive a H% boundary tone on their final vowel when such words are at the end of certain types of phrases. As explained in Chapter 3, §1.1, words in isolation (which are also in neutral phrases) receive a non-final accent when phrase-final, and a final-accent when non-phrase-final. The accent shifts to final as a consequence of Extrametricality; the final syllable of a phrase is marked as extrametrical, resulting in non-final accent on words that are at the end of phrases (Dyck 2009).

In the case of WH- phrases, like that in figure 7.11 above, the intonational contour in Cayuga is: H* L- L%. The pattern of interaction here appears to be conflictive, since a pitch accent pattern on the final word of the phrase is obscured by the intonational pattern.

This chapter has presented a preliminary set of conventions around the annotation of Cayuga phrases for tones and breaks in relation to a ToBI-style annotation system I call C_ToBI (in line with the term J_ToBI to describe the system developed for annotating Japanese). The content of this chapter has been established based on both the results (Chapter 5) and their interpretation (Chapter 6) of my analysis of the MHS. After proposing various annotation conventions for a C_ToBI system, I also provided examples of each phrase type annotated based on them. Finally, I discussed the interactions of accent and intonation that present in the phrases.

Chapter 8: Conclusion

Over the course of this thesis I have laid out the background knowledge needed (Chapter 3), my methodology for examining Cayuga prosody (Chapter 4), and the results of statistical analysis (Chapter 5). I interpret the results of my analysis in Chapter 6 and propose a framework to annotate the language's prosodic system in Chapter 7.

My goal in writing this thesis was to make a significant contribution to both the field of linguistics as a whole, and to the Cayuga community.

Specific to the Cayuga language, my work provides the first acoustic analysis of the prosodic properties of words in context, and of phrases in the language. This acoustic analysis provided the groundwork for a description of Cayuga intonation (Chapter 7: Toward a C_ToBI). Additionally, I have shown that Cayuga intonation can be described in terms of the interaction of word-level pitch accents with phrasal boundary tones. Finally, I have endeavoured to write this thesis in a manner that would be accessible to more people in an attempt to provide speakers (and teachers) with a better understanding of the language's accent system and intonational patterns.

In terms of the field of linguistics, these findings add to a growing body of literature that deals with the interactions of pitch accents and intonation. In particular, it adds to our understanding of so-called 'pitch accent' languages.

While I believe this thesis provides a much needed look into the accentual and intonational systems of Cayuga prosody, I also feel there there is much more work to be done. The prosodic system of the Cayuga language (and frankly, the prosodic systems of pitch accent languages in general) still present many mysteries that would benefit from future research. An example of such research is to examine the often peculiar nature of particles in Cayuga. As I have mentioned in this thesis on several occasions, particles often behave in groups, and act like single words for accent. It would be beneficial for future researchers to perhaps tease apart particles further and attempt to determine why they behave the way they do, how they function more specifically in terms of prosody, and also, examine whether the role of syntax contributes to the role of prosody. This last point, the role of syntax, is of great importance in my view. The examination of syntax and its role(s) in Cayuga prosody would be an invaluable addition to our knowledge, and I think, a natural extension of the work presented here.

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Appendix A: Rules for Accent Placement

The decision tree on the following page provides a clear and visual illustration of the rules guiding accent placement in Cayuga words. While the rules depicted here account for most words, there are, of course, exceptions.

Does word X occur utterance finally?

(i.e. at the end of a phrase, or said in isolation?)

NO

ACCENT FINAL VOWEL
(ultima)

YES

Counting from the **left** edge, is the second last vowel EVEN- numbered??

YES

ACCENT IT
(penult)

NO

Is it an < a >?

YES

ACCENT PRECEEDING VOWEL
(antepenult)

NO

Is it followed by a consonant cluster?

YES

ACCENT PRECEEDING VOWEL
(antepenult)

NO

Is it followed by even a one of the following consonants:
<t, k, j, h, or ʔ > ?

YES

ACCENT PRECEEDING VOWEL
(antepenult)

NO

ACCENT IT
(penult)

Appendix B: Statistical Analysis

(Descriptive Statistics, ANOVA, and Tukey HSD results)

PITCH & INTENSITY VARIABLE RESULTS (CHUNK LEVEL - BY PRIMARY PHRASE TYPE)

Descriptives

MaxPitch

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Bound	Bound		
Exclamation	17.00	268.14	28.17	6.83	253.65	282.62	215.40	313.30
Narrative	171.00	261.54	34.03	2.60	256.41	266.68	186.30	316.60
Quotative	91.00	264.84	30.07	3.15	258.57	271.10	200.30	316.10
WHInter	21.00	266.41	26.56	5.80	254.32	278.50	216.00	310.60
YNInter	10.00	284.52	25.34	8.01	266.39	302.65	237.10	316.90
Total	310.00	263.94	32.01	1.82	260.37	267.52	186.30	316.90

ANOVA

MaxPitch

	Sum of Squares	df	Mean Square	F	Sig.
Between	5717.71	4.00	1429.43	1.40	0.23
Within	310862.37	305.00	1019.22		
Total	316580.08	309.00			

Multiple Comparisons

Dependent Variable: MaxPitch

Tukey HSD

(I) PrimaryType		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Exclamation	Narrative	6.59	8.12	0.93	-15.69	28.87
	Quotative	3.30	8.44	1.00	-19.85	26.45
	WHInter	1.73	10.42	1.00	-26.86	30.31
	YNInter	-16.38	12.72	0.70	-51.30	18.53
Narrative	Exclamation	-6.59	8.12	0.93	-28.87	15.69
	Quotative	-3.29	4.14	0.93	-14.66	8.07
	WHInter	-4.87	7.38	0.96	-25.12	15.39
	YNInter	-22.98	10.39	0.18	-51.48	5.53
Quotative	Exclamation	-3.30	8.44	1.00	-26.45	19.85
	Narrative	3.29	4.14	0.93	-8.07	14.66
	WHInter	-1.57	7.73	1.00	-22.78	19.64
	YNInter	-19.68	10.64	0.35	-48.87	9.50
WHInter	Exclamation	-1.73	10.42	1.00	-30.31	26.86
	Narrative	4.87	7.38	0.96	-15.39	25.12
	Quotative	1.57	7.73	1.00	-19.64	22.78
	YNInter	-18.11	12.27	0.58	-51.77	15.55
YNInter	Exclamation	16.38	12.72	0.70	-18.53	51.30
	Narrative	22.98	10.39	0.18	-5.53	51.48
	Quotative	19.68	10.64	0.35	-9.50	48.87
	WHInter	18.11	12.27	0.58	-15.55	51.77

Descriptives

AveragePitch

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Bound	Bound		
Exclamation	17.00	177.25	9.32	2.26	172.46	182.04	160.50	194.70
Narrative	171.00	176.71	13.93	1.07	174.60	178.81	139.30	224.30
Quotative	91.00	173.96	11.78	1.23	171.51	176.41	144.60	209.40
WHInter	21.00	182.82	16.12	3.52	175.48	190.16	157.60	209.40
YNInter	10.00	186.50	14.93	4.72	175.82	197.18	165.90	212.40
Total	310.00	176.66	13.52	0.77	175.15	178.17	139.30	224.30

ANOVA

AveragePitch

	Sum of Squares	df	Mean Square	F	Sig.
Between	2434.92	4.00	608.73	3.43	0.01
Within	54083.99	305.00	177.32		
Total	56518.91	309.00			

Multiple Comparisons

Dependent Variable: AveragePitch

Tukey HSD

(I) PrimaryType		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Exclamation	Narrative	0.55	3.39	1.00	-8.75	9.84
	Quotative	3.29	3.52	0.88	-6.36	12.95
	WHInter	-5.57	4.34	0.70	-17.49	6.36
	YNInter	-9.25	5.31	0.41	-23.81	5.32
Narrative	Exclamation	-0.55	3.39	1.00	-9.84	8.75
	Quotative	2.75	1.73	0.51	-2.00	7.49
	WHInter	-6.11	3.08	0.28	-14.56	2.34
	YNInter	-9.79	4.33	0.16	-21.68	2.09
Quotative	Exclamation	-3.29	3.52	0.88	-12.95	6.36
	Narrative	-2.75	1.73	0.51	-7.49	2.00
	WHInter	-8.85971*	3.22	0.05	-17.71	-0.01
	YNInter	-12.54066*	4.44	0.04	-24.71	-0.37
WHInter	Exclamation	5.57	4.34	0.70	-6.36	17.49
	Narrative	6.11	3.08	0.28	-2.34	14.56
	Quotative	8.85971*	3.22	0.05	0.01	17.71
	YNInter	-3.68	5.12	0.95	-17.72	10.36
YNInter	Exclamation	9.25	5.31	0.41	-5.32	23.81
	Narrative	9.79	4.33	0.16	-2.09	21.68
	Quotative	12.54066*	4.44	0.04	0.37	24.71
	WHInter	3.68	5.12	0.95	-10.36	17.72

*. The mean difference is significant at the 0.05 level.

Descriptives

F0PeakTime

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Bound	Bound		
Exclamation	17.00	0.44	0.29	0.07	0.29	0.59	0.00	1.00
Narrative	171.00	0.43	0.30	0.02	0.39	0.48	0.00	1.00
Quotative	91.00	0.37	0.30	0.03	0.31	0.44	0.00	1.00
WHInter	21.00	0.42	0.22	0.05	0.32	0.52	0.00	0.70
YNInter	10.00	0.59	0.19	0.06	0.45	0.73	0.30	0.90
Total	310.00	0.42	0.29	0.02	0.39	0.45	0.00	1.00

ANOVA

F0PeakTime

	Sum of Squares	df	Mean Square	F	Sig.
Between	0.51	4.00	0.13	1.49	0.21
Within	26.09	305.00	0.09		
Total	26.60	309.00			

Multiple Comparisons

Dependent Variable: F0PeakTime

Tukey HSD

(I) PrimaryType		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Bound	Bound
Exclamation	Narrative	0.01	0.07	1.00	-0.20	0.21
	Quotative	0.07	0.08	0.91	-0.15	0.28
	WHInter	0.02	0.10	1.00	-0.24	0.28
	YNInter	-0.15	0.12	0.71	-0.47	0.17
Narrative	Exclamation	-0.01	0.07	1.00	-0.21	0.20
	Quotative	0.06	0.04	0.55	-0.05	0.16
	WHInter	0.01	0.07	1.00	-0.17	0.20
	YNInter	-0.16	0.10	0.46	-0.42	0.10
Quotative	Exclamation	-0.07	0.08	0.91	-0.28	0.15
	Narrative	-0.06	0.04	0.55	-0.16	0.05
	WHInter	-0.04	0.07	0.97	-0.24	0.15
	YNInter	-0.22	0.10	0.18	-0.48	0.05
WHInter	Exclamation	-0.02	0.10	1.00	-0.28	0.24
	Narrative	-0.01	0.07	1.00	-0.20	0.17
	Quotative	0.04	0.07	0.97	-0.15	0.24
	YNInter	-0.17	0.11	0.55	-0.48	0.14
YNInter	Exclamation	0.15	0.12	0.71	-0.17	0.47
	Narrative	0.16	0.10	0.46	-0.10	0.42
	Quotative	0.22	0.10	0.18	-0.05	0.48
	WHInter	0.17	0.11	0.55	-0.14	0.48

Descriptives

PitchRange

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Bound	Bound	Minimum	Maximum
Exclamation	17.00	185.25	40.59	9.85	164.38	206.12	62.00	241.60
Narrative	171.00	179.26	41.38	3.16	173.01	185.50	67.50	250.30
Quotative	91.00	186.88	34.57	3.62	179.68	194.08	79.10	248.50
WHInter	21.00	184.51	36.78	8.03	167.77	201.26	94.00	233.60
YNInter	10.00	201.13	38.04	12.03	173.91	228.35	124.40	239.90
Total	310.00	182.89	39.10	2.22	178.52	187.26	62.00	250.30

ANOVA

PitchRange

	Sum of Squares	df	Mean Square	F	Sig.
Between	7184.70	4.00	1796.17	1.18	0.32
Within	465108.63	305.00	1524.95		
Total	472293.33	309.00			

Multiple Comparisons

Dependent Variable: PitchRange

Tukey HSD

(I) PrimaryType		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Exclamation	Narrative	5.99	9.93	0.97	-21.26	33.24
	Quotative	-1.64	10.32	1.00	-29.95	26.68
	WHInter	0.73	12.74	1.00	-34.23	35.69
	YNInter	-15.88	15.56	0.85	-58.59	26.82
Narrative	Exclamation	-5.99	9.93	0.97	-33.24	21.26
	Quotative	-7.63	5.07	0.56	-21.53	6.28
	WHInter	-5.26	9.03	0.98	-30.04	19.52
	YNInter	-21.87	12.70	0.42	-56.74	12.99
Quotative	Exclamation	1.64	10.32	1.00	-26.68	29.95
	Narrative	7.63	5.07	0.56	-6.28	21.53
	WHInter	2.37	9.45	1.00	-23.57	28.31
	YNInter	-14.25	13.01	0.81	-49.95	21.45
WHInter	Exclamation	-0.73	12.74	1.00	-35.69	34.23
	Narrative	5.26	9.03	0.98	-19.52	30.04
	Quotative	-2.37	9.45	1.00	-28.31	23.57
	YNInter	-16.62	15.00	0.80	-57.79	24.56
YNInter	Exclamation	15.88	15.56	0.85	-26.82	58.59
	Narrative	21.87	12.70	0.42	-12.99	56.74
	Quotative	14.25	13.01	0.81	-21.45	49.95
	WHInter	16.62	15.00	0.80	-24.56	57.79

Descriptives

MaxIntensity

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Bound	Bound	Minimum	Maximum
Exclamation	17.00	85.48	1.61	0.39	84.66	86.31	82.40	87.40
Narrative	171.00	85.72	1.48	0.11	85.49	85.94	79.40	90.00
Quotative	91.00	85.37	1.63	0.17	85.03	85.71	78.40	87.80
WHInter	21.00	85.37	1.14	0.25	84.85	85.89	82.40	87.00
YNInter	10.00	85.84	0.79	0.25	85.27	86.41	85.00	87.20
Total	310.00	85.58	1.50	0.09	85.41	85.75	78.40	90.00

ANOVA

MaxIntensity

	Sum of Squares	df	Mean Square	F	Sig.
Between	9.05	4.00	2.26	1.01	0.40
Within	685.68	305.00	2.25		
Total	694.72	309.00			

Multiple Comparisons

Dependent Variable: MaxIntensity
Tukey HSD

(I) PrimaryType		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Exclamation	Narrative	-0.23	0.38	0.97	-1.28	0.81
	Quotative	0.12	0.40	1.00	-0.97	1.20
	WHInter	0.12	0.49	1.00	-1.23	1.46
	YNInter	-0.36	0.60	0.98	-2.00	1.28
Narrative	Exclamation	0.23	0.38	0.97	-0.81	1.28
	Quotative	0.35	0.19	0.38	-0.19	0.88
	WHInter	0.35	0.35	0.85	-0.60	1.30
	YNInter	-0.12	0.49	1.00	-1.46	1.21
Quotative	Exclamation	-0.12	0.40	1.00	-1.20	0.97
	Narrative	-0.35	0.19	0.38	-0.88	0.19
	WHInter	0.00	0.36	1.00	-1.00	1.00
	YNInter	-0.47	0.50	0.88	-1.84	0.90
WHInter	Exclamation	-0.12	0.49	1.00	-1.46	1.23
	Narrative	-0.35	0.35	0.85	-1.30	0.60
	Quotative	0.00	0.36	1.00	-1.00	1.00
	YNInter	-0.47	0.58	0.92	-2.05	1.11
YNInter	Exclamation	0.36	0.60	0.98	-1.28	2.00
	Narrative	0.12	0.49	1.00	-1.21	1.46
	Quotative	0.47	0.50	0.88	-0.90	1.84
	WHInter	0.47	0.58	0.92	-1.11	2.05

Descriptives

dBPeakTime

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Bound	Bound	Minimum	Maximum
Exclamation	17.00	0.43	0.26	0.06	0.30	0.56	0.10	0.80
Narrative	171.00	0.44	0.30	0.02	0.39	0.48	0.00	1.00
Quotative	91.00	0.44	0.29	0.03	0.38	0.50	0.00	0.90
WHInter	21.00	0.44	0.28	0.06	0.31	0.56	0.00	0.90
YNInter	10.00	0.44	0.28	0.09	0.24	0.64	0.00	0.80
Total	310.00	0.44	0.29	0.02	0.41	0.47	0.00	1.00

ANOVA

dBPeakTime

	Sum of Squares	df	Mean Square	F	Sig.
Between	0.00	4.00	0.00	0.01	1.00
Within	25.72	305.00	0.08		
Total	25.73	309.00			

Multiple Comparisons

Dependent Variable: dBPeakTime
Tukey HSD

(I) PrimaryType		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Bound	Bound
Exclamation	Narrative	-0.01	0.07	1.00	-0.21	0.20
	Quotative	-0.01	0.08	1.00	-0.22	0.20
	WHInter	-0.01	0.09	1.00	-0.27	0.25
	YNInter	-0.01	0.12	1.00	-0.33	0.31
Narrative	Exclamation	0.01	0.07	1.00	-0.20	0.21
	Quotative	0.00	0.04	1.00	-0.11	0.10
	WHInter	0.00	0.07	1.00	-0.19	0.18
	YNInter	0.00	0.09	1.00	-0.26	0.26
Quotative	Exclamation	0.01	0.08	1.00	-0.20	0.22
	Narrative	0.00	0.04	1.00	-0.10	0.11
	WHInter	0.00	0.07	1.00	-0.19	0.20
	YNInter	0.00	0.10	1.00	-0.26	0.27
WHInter	Exclamation	0.01	0.09	1.00	-0.25	0.27
	Narrative	0.00	0.07	1.00	-0.18	0.19
	Quotative	0.00	0.07	1.00	-0.20	0.19
	YNInter	0.00	0.11	1.00	-0.31	0.30
YNInter	Exclamation	0.01	0.12	1.00	-0.31	0.33
	Narrative	0.00	0.09	1.00	-0.26	0.26
	Quotative	0.00	0.10	1.00	-0.27	0.26
	WHInter	0.00	0.11	1.00	-0.30	0.31

Descriptives

average intensity

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Bound	Bound	Minimum	Maximum
Exclamation	17.00	73.48	1.97	0.48	72.46	74.49	70.30	78.10
Narrative	171.00	73.08	1.84	0.14	72.80	73.35	68.40	80.00
Quotative	91.00	72.86	1.53	0.16	72.54	73.18	69.30	78.50
WHInter	21.00	72.96	2.02	0.44	72.04	73.88	69.70	78.40
YNInter	10.00	73.08	1.85	0.59	71.76	74.40	71.40	77.60
Total	310.00	73.03	1.77	0.10	72.83	73.22	68.40	80.00

ANOVA

average intensity

	Sum of Squares	df	Mean Square	F	Sig.
Between	6.41	4.00	1.60	0.51	0.73
Within	959.41	305.00	3.15		
Total	965.82	309.00			

Multiple Comparisons

Dependent Variable: average intensity
Tukey HSD

(I) PrimaryType		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Exclamation	Narrative	0.40	0.45	0.90	-0.84	1.64
	Quotative	0.61	0.47	0.69	-0.67	1.90
	WHInter	0.51	0.58	0.90	-1.07	2.10
	YNInter	0.40	0.71	0.98	-1.54	2.34
Narrative	Exclamation	-0.40	0.45	0.90	-1.64	0.84
	Quotative	0.21	0.23	0.89	-0.42	0.84
	WHInter	0.11	0.41	1.00	-1.01	1.24
	YNInter	0.00	0.58	1.00	-1.59	1.58
Quotative	Exclamation	-0.61	0.47	0.69	-1.90	0.67
	Narrative	-0.21	0.23	0.89	-0.84	0.42
	WHInter	-0.10	0.43	1.00	-1.28	1.08
	YNInter	-0.22	0.59	1.00	-1.84	1.40
WHInter	Exclamation	-0.51	0.58	0.90	-2.10	1.07
	Narrative	-0.11	0.41	1.00	-1.24	1.01
	Quotative	0.10	0.43	1.00	-1.08	1.28
	YNInter	-0.12	0.68	1.00	-1.99	1.75
YNInter	Exclamation	-0.40	0.71	0.98	-2.34	1.54
	Narrative	0.00	0.58	1.00	-1.58	1.59
	Quotative	0.22	0.59	1.00	-1.40	1.84
	WHInter	0.12	0.68	1.00	-1.75	1.99

Descriptives

intensity range

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Bound	Bound	Minimum	Maximum
Exclamation	17.00	28.53	4.79	1.16	26.07	30.99	18.70	36.10
Narrative	171.00	29.43	3.82	0.29	28.85	30.01	16.30	37.00
Quotative	91.00	29.52	3.28	0.34	28.83	30.20	17.10	36.60
WHInter	21.00	29.75	3.26	0.71	28.26	31.23	20.80	34.60
YNInter	10.00	30.54	2.69	0.85	28.62	32.46	24.30	34.40
Total	310.00	29.46	3.66	0.21	29.05	29.87	16.30	37.00

ANOVA

intensity range

	Sum of Squares	df	Mean Square	F	Sig.
Between	28.58	4.00	7.14	0.53	0.71
Within	4102.30	305.00	13.45		
Total	4130.88	309.00			

Multiple Comparisons

Dependent Variable: intensity range

Tukey HSD

(I) PrimaryType		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Bound	Bound
Exclamation	Narrative	-0.90	0.93	0.87	-3.46	1.66
	Quotative	-0.99	0.97	0.85	-3.65	1.67
	WHInter	-1.22	1.20	0.85	-4.50	2.07
	YNInter	-2.01	1.46	0.64	-6.02	2.00
Narrative	Exclamation	0.90	0.93	0.87	-1.66	3.46
	Quotative	-0.09	0.48	1.00	-1.39	1.22
	WHInter	-0.32	0.85	1.00	-2.64	2.01
	YNInter	-1.11	1.19	0.88	-4.38	2.16
Quotative	Exclamation	0.99	0.97	0.85	-1.67	3.65
	Narrative	0.09	0.48	1.00	-1.22	1.39
	WHInter	-0.23	0.89	1.00	-2.67	2.21
	YNInter	-1.02	1.22	0.92	-4.38	2.33
WHInter	Exclamation	1.22	1.20	0.85	-2.07	4.50
	Narrative	0.32	0.85	1.00	-2.01	2.64
	Quotative	0.23	0.89	1.00	-2.21	2.67
	YNInter	-0.79	1.41	0.98	-4.66	3.07
YNInter	Exclamation	2.01	1.46	0.64	-2.00	6.02
	Narrative	1.11	1.19	0.88	-2.16	4.38
	Quotative	1.02	1.22	0.92	-2.33	4.38
	WHInter	0.79	1.41	0.98	-3.07	4.66

Descriptives

intensitytotal

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Bound	Bound	Minimum	Maximum
Exclamation	17.00	35614.07	28296.01	6862.79	21065.60	50162.54	4887.80	94010.50
Narrative	171.00	48023.03	28919.52	2211.53	43657.43	52388.63	3458.90	148231.70
Quotative	91.00	51497.56	26736.06	2802.70	45929.51	57065.62	8773.50	134488.90
WHInter	21.00	49839.99	26055.57	5685.79	37979.64	61700.34	5936.30	97016.70
YNInter	10.00	34943.41	17406.61	5504.45	22491.47	47395.35	8922.70	63365.60
Total	310.00	48063.64	27934.41	1586.57	44941.80	51185.49	3458.90	148231.70

ANOVA

intensitytotal

	Sum of Squares	df	Mean Square	F	Sig.
Between	5495866445 05	4.00	1373966611.26	1.78	0.13
Within	235626494136 01	305.00	772545882.41		
Total	241122360581 07	309.00			

Multiple Comparisons

Dependent Variable: intensitytotal

Tukey HSD

(I) PrimaryType		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Exclamation	Narrative	-12408.96	7068.36	0.40	-31805.72	6987.79
	Quotative	-15883.49	7343.94	0.20	-36036.48	4269.49
	WHInter	-14225.92	9068.17	0.52	-39110.50	10658.66
	YNInter	670.66	11076.93	1.00	-29726.30	31067.62
Narrative	Exclamation	12408.96	7068.36	0.40	-6987.79	31805.72
	Quotative	-3474.53	3606.57	0.87	-13371.55	6422.49
	WHInter	-1816.96	6426.95	1.00	-19453.59	15819.67
	YNInter	13079.62	9042.81	0.60	-11735.36	37894.60
Quotative	Exclamation	15883.49	7343.94	0.20	-4269.49	36036.48
	Narrative	3474.53	3606.57	0.87	-6422.49	13371.55
	WHInter	1657.57	6728.85	1.00	-16807.51	20122.66
	YNInter	16554.15	9259.81	0.38	-8856.32	41964.62
WHInter	Exclamation	14225.92	9068.17	0.52	-10658.66	39110.50
	Narrative	1816.96	6426.95	1.00	-15819.67	19453.59
	Quotative	-1657.57	6728.85	1.00	-20122.66	16807.51
	YNInter	14896.58	10679.07	0.63	-14408.57	44201.73
YNInter	Exclamation	-670.66	11076.93	1.00	-31067.62	29726.30
	Narrative	-13079.62	9042.81	0.60	-37894.60	11735.36
	Quotative	-16554.15	9259.81	0.38	-41964.62	8856.32
	WHInter	-14896.58	10679.07	0.63	-44201.73	14408.57

PITCH & INTENSITY VARIABLE RESULTS (WORD LEVEL - BY ORTHOGRAPHIC ACCENT TYPE)

Descriptives

MaxPitch

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
Unmarked	1353.00	207.08	33.83	0.92	205.27	208.88	0.00	316.20
Double	51.00	244.86	33.59	4.70	235.42	254.31	188.40	313.70
NFante	66.00	222.73	31.05	3.82	215.10	230.36	171.20	311.70
NFpen	357.00	228.24	36.35	1.92	224.45	232.02	150.50	316.90
Final	1309.00	221.90	31.46	0.87	220.19	223.60	117.90	316.30
Total	3136.00	216.62	34.27	0.61	215.42	217.82	0.00	316.90

ANOVA

MaxPitch

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	250959.31	4.00	62739.83	57.25	0.00
Within Groups	3430998.34	3131.00	1095.82		
Total	3681957.65	3135.00			

Multiple Comparisons

Dependent Variable: MaxPitch
Tukey HSD

(I) OrthoAccent	(J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Unmarked	Double	-37.78732*	4.72	0.00	-50.68	-24.90
	NFante	-15.65292*	4.17	0.00	-27.04	-4.26
	NFpen	-21.15847*	1.97	0.00	-26.53	-15.78
	Final	-14.81834*	1.28	0.00	-18.32	-11.32
Double	Unmarked	37.78732*	4.72	0.00	24.90	50.68
	NFante	22.13440*	6.17	0.00	5.29	38.98
	NFpen	16.62885*	4.96	0.01	3.10	30.15
	Final	22.96898*	4.72	0.00	10.07	35.86
NFante	Unmarked	15.65292*	4.17	0.00	4.26	27.04
	Double	-22.13440*	6.17	0.00	-38.98	-5.29
	NFpen	-5.51	4.44	0.73	-17.61	6.60
	Final	0.83	4.18	1.00	-10.56	12.23
NFpen	Unmarked	21.15847*	1.97	0.00	15.78	26.53
	Double	-16.62885*	4.96	0.01	-30.15	-3.10
	NFante	5.51	4.44	0.73	-6.60	17.61
	Final	6.34013*	1.98	0.01	0.95	11.73
Final	Unmarked	14.81834*	1.28	0.00	11.32	18.32
	Double	-22.96898*	4.72	0.00	-35.86	-10.07
	NFante	-0.83	4.18	1.00	-12.23	10.56
	NFpen	-6.34013*	1.98	0.01	-11.73	-0.95

*. The mean difference is significant at the 0.05 level.

Descriptives

F0peaktime

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
Unmarked	1353.00	0.35	0.28	0.01	0.33	0.36	0.00	1.00
Double	51.00	0.46	0.26	0.04	0.38	0.53	0.00	1.00
NFante	66.00	0.40	0.26	0.03	0.33	0.46	0.00	1.00
NFpen	357.00	0.42	0.25	0.01	0.40	0.45	0.00	1.00
Final	1309.00	0.63	0.28	0.01	0.61	0.64	0.00	1.00
Total	3136.00	0.48	0.31	0.01	0.47	0.49	0.00	1.00

ANOVA

F0peaktime

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	53.68	4.00	13.42	175.18	0.00
Within Groups	239.86	3131.00	0.08		
Total	293.54	3135.00			

Multiple Comparisons

Dependent Variable: F0peaktime

Tukey HSD

(I) OrthoAccent		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Unmarked	Double	-.10779*	0.04	0.05	-0.22	0.00
	NFante	-0.05	0.03	0.62	-0.14	0.05
	NFpen	-.07473*	0.02	0.00	-0.12	-0.03
	Final	-.27957*	0.01	0.00	-0.31	-0.25
Double	Unmarked	.10779*	0.04	0.05	0.00	0.22
	NFante	0.06	0.05	0.79	-0.08	0.20
	NFpen	0.03	0.04	0.93	-0.08	0.15
	Final	-.17179*	0.04	0.00	-0.28	-0.06
NFante	Unmarked	0.05	0.03	0.62	-0.05	0.14
	Double	-0.06	0.05	0.79	-0.20	0.08
	NFpen	-0.03	0.04	0.96	-0.13	0.08
	Final	-.23016*	0.03	0.00	-0.33	-0.13
NFpen	Unmarked	.07473*	0.02	0.00	0.03	0.12
	Double	-0.03	0.04	0.93	-0.15	0.08
	NFante	0.03	0.04	0.96	-0.08	0.13
	Final	-.20484*	0.02	0.00	-0.25	-0.16
Final	Unmarked	.27957*	0.01	0.00	0.25	0.31
	Double	.17179*	0.04	0.00	0.06	0.28
	NFante	.23016*	0.03	0.00	0.13	0.33
	NFpen	.20484*	0.02	0.00	0.16	0.25

*. The mean difference is significant at the 0.05 level.

Descriptives

averagepitch

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Unmarked	1353.00	179.71	27.94	0.76	178.22	181.20	0.00	291.60
Double	51.00	189.47	19.01	2.66	184.12	194.82	155.90	251.30
NFante	66.00	167.53	15.06	1.85	163.82	171.23	135.00	202.30
NFpen	357.00	176.01	20.45	1.08	173.88	178.14	116.50	246.40
Final	1309.00	183.78	23.47	0.65	182.51	185.06	96.10	287.80
Total	3136.00	180.89	25.22	0.45	180.01	181.77	0.00	291.60

ANOVA

averagepitch

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	36902.68	4.00	9225.67	14.75	0.00
Within Groups	1957804.18	3131.00	625.30		
Total	1994706.86	3135.00			

Multiple Comparisons

Dependent Variable: averagepitch

Tukey HSD

(I) OrthoAccent		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Unmarked	Double	-9.76238*	3.57	0.05	-19.50	-0.03
	NFante	12.18245*	3.15	0.00	3.58	20.79
	NFpen	3.70	1.49	0.09	-0.36	7.76
	Final	-4.07667*	0.97	0.00	-6.72	-1.43
Double	Unmarked	9.76238*	3.57	0.05	0.03	19.50
	NFante	21.94483*	4.66	0.00	9.22	34.67
	NFpen	13.46022*	3.74	0.00	3.24	23.68
	Final	5.69	3.57	0.50	-4.06	15.43
NFante	Unmarked	-12.18245*	3.15	0.00	-20.79	-3.58
	Double	-21.94483*	4.66	0.00	-34.67	-9.22
	NFpen	-8.48	3.35	0.08	-17.63	0.66
	Final	-16.25912*	3.15	0.00	-24.87	-7.65
NFpen	Unmarked	-3.70	1.49	0.09	-7.76	0.36
	Double	-13.46022*	3.74	0.00	-23.68	-3.24
	NFante	8.48	3.35	0.08	-0.66	17.63
	Final	-7.77451*	1.49	0.00	-11.85	-3.70
Final	Unmarked	4.07667*	0.97	0.00	1.43	6.72
	Double	-5.69	3.57	0.50	-15.43	4.06
	NFante	16.25912*	3.15	0.00	7.65	24.87
	NFpen	7.77451*	1.49	0.00	3.70	11.85

*. The mean difference is significant at the 0.05 level.

Descriptives

pitchrange

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Unmarked	1353.00	63.27	39.36	1.07	61.17	65.37	0.00	222.40
Double	51.00	114.46	45.23	6.33	101.74	127.18	38.10	223.50
NFante	66.00	112.95	36.41	4.48	104.00	121.90	31.90	210.50
NFpen	357.00	110.08	42.85	2.27	105.62	114.54	28.30	241.00
Final	1309.00	84.91	42.14	1.16	82.62	87.19	10.80	230.70
Total	3136.00	79.51	44.20	0.79	77.96	81.06	0.00	241.00

ANOVA

pitchrange

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	864407.01	4.00	216101.75	128.65	0.00
Within Groups	5259452.73	3131.00	1679.80		
Total	6123859.74	3135.00			

Multiple Comparisons

Dependent Variable: pitchrange

Tukey HSD

(I) OrthoAccent		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Unmarked	Double	-51.18469*	5.85	0.00	-67.14	-35.23
	NFante	-49.67435*	5.17	0.00	-63.78	-35.57
	NFpen	-46.80178*	2.44	0.00	-53.46	-40.15
	Final	-21.63274*	1.59	0.00	-25.97	-17.30
Double	Unmarked	51.18469*	5.85	0.00	35.23	67.14
	NFante	1.51	7.64	1.00	-19.35	22.37
	NFpen	4.38	6.14	0.95	-12.36	21.13
	Final	29.55195*	5.85	0.00	13.59	45.52
NFante	Unmarked	49.67435*	5.17	0.00	35.57	63.78
	Double	-1.51	7.64	1.00	-22.37	19.35
	NFpen	2.87	5.49	0.99	-12.12	17.86
	Final	28.04161*	5.17	0.00	13.93	42.15
NFpen	Unmarked	46.80178*	2.44	0.00	40.15	53.46
	Double	-4.38	6.14	0.95	-21.13	12.36
	NFante	-2.87	5.49	0.99	-17.86	12.12
	Final	25.16903*	2.45	0.00	18.49	31.85
Final	Unmarked	21.63274*	1.59	0.00	17.30	25.97
	Double	-29.55195*	5.85	0.00	-45.52	-13.59
	NFante	-28.04161*	5.17	0.00	-42.15	-13.93
	NFpen	-25.16903*	2.45	0.00	-31.85	-18.49

*. The mean difference is significant at the 0.05 level.

Descriptives

maxintensity

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
Unmarked	1353.00	81.38	2.68	0.07	81.24	81.52	68.90	90.00
Double	51.00	84.14	2.26	0.32	83.51	84.78	79.50	88.80
NFante	66.00	82.74	2.42	0.30	82.14	83.33	77.10	87.50
NFpen	357.00	82.99	2.47	0.13	82.73	83.24	75.20	89.70
Final	1309.00	82.84	2.24	0.06	82.72	82.96	75.70	88.80
Total	3136.00	82.25	2.59	0.05	82.15	82.34	68.90	90.00

ANOVA

maxintensity

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1868.40	4.00	467.10	76.47	0.00
Within Groups	19125.45	3131.00	6.11		
Total	20993.84	3135.00			

Multiple Comparisons

Dependent Variable: maxintensity

Tukey HSD

(I) OrthoAccent		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Unmarked	Double	-2.76106*	0.35	0.00	-3.72	-1.80
	NFante	-1.35625*	0.31	0.00	-2.21	-0.51
	NFpen	-1.60728*	0.15	0.00	-2.01	-1.21
	Final	-1.45785*	0.10	0.00	-1.72	-1.20
Double	Unmarked	2.76106*	0.35	0.00	1.80	3.72
	NFante	1.40481*	0.46	0.02	0.15	2.66
	NFpen	1.15378*	0.37	0.02	0.14	2.16
	Final	1.30321*	0.35	0.00	0.34	2.27
NFante	Unmarked	1.35625*	0.31	0.00	0.51	2.21
	Double	-1.40481*	0.46	0.02	-2.66	-0.15
	NFpen	-0.25	0.33	0.94	-1.15	0.65
	Final	-0.10	0.31	1.00	-0.95	0.75
NFpen	Unmarked	1.60728*	0.15	0.00	1.21	2.01
	Double	-1.15378*	0.37	0.02	-2.16	-0.14
	NFante	0.25	0.33	0.94	-0.65	1.15
	Final	0.15	0.15	0.85	-0.25	0.55
Final	Unmarked	1.45785*	0.10	0.00	1.20	1.72
	Double	-1.30321*	0.35	0.00	-2.27	-0.34
	NFante	0.10	0.31	1.00	-0.75	0.95
	NFpen	-0.15	0.15	0.85	-0.55	0.25

*. The mean difference is significant at the 0.05 level.

Descriptives

dBpeaktime

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Unmarked	1353.00	0.47	0.20	0.01	0.46	0.49	0.00	1.00
Double	51.00	0.47	0.26	0.04	0.40	0.54	0.10	1.00
NFante	66.00	0.35	0.21	0.03	0.30	0.40	0.00	0.90
NFpen	357.00	0.43	0.22	0.01	0.41	0.45	0.00	0.90
Final	1309.00	0.56	0.27	0.01	0.54	0.57	0.00	1.00
Total	3136.00	0.50	0.24	0.00	0.49	0.51	0.00	1.00

ANOVA

dBpeaktime

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8.35	4.00	2.09	37.58	0.00
Within Groups	173.97	3131.00	0.06		
Total	182.32	3135.00			

Multiple Comparisons

Dependent Variable: dBpeaktime

Tukey HSD

(I) OrthoAccent		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Unmarked	Double	0.00	0.03	1.00	-0.09	0.10
	NFante	.12154*	0.03	0.00	0.04	0.20
	NFpen	.04460*	0.01	0.01	0.01	0.08
	Final	-.08249*	0.01	0.00	-0.11	-0.06
Double	Unmarked	0.00	0.03	1.00	-0.10	0.09
	NFante	0.12	0.04	0.06	0.00	0.24
	NFpen	0.04	0.04	0.78	-0.06	0.14
	Final	-0.09	0.03	0.08	-0.18	0.01
NFante	Unmarked	-.12154*	0.03	0.00	-0.20	-0.04
	Double	-0.12	0.04	0.06	-0.24	0.00
	NFpen	-0.08	0.03	0.11	-0.16	0.01
	Final	-.20404*	0.03	0.00	-0.29	-0.12
NFpen	Unmarked	-.04460*	0.01	0.01	-0.08	-0.01
	Double	-0.04	0.04	0.78	-0.14	0.06
	NFante	0.08	0.03	0.11	-0.01	0.16
	Final	-.12709*	0.01	0.00	-0.17	-0.09
Final	Unmarked	.08249*	0.01	0.00	0.06	0.11
	Double	0.09	0.03	0.08	-0.01	0.18
	NFante	.20404*	0.03	0.00	0.12	0.29
	NFpen	.12709*	0.01	0.00	0.09	0.17

*. The mean difference is significant at the 0.05 level.

Descriptives

averageintensity

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
Unmarked	1353.00	76.15	3.02	0.08	75.99	76.31	63.90	84.50
Double	51.00	76.17	2.18	0.30	75.56	76.79	70.80	80.40
NFante	66.00	73.71	2.52	0.31	73.09	74.33	69.00	82.30
NFpen	357.00	75.33	2.48	0.13	75.07	75.59	68.10	81.60
Final	1309.00	76.03	2.92	0.08	75.87	76.19	67.70	84.40
Total	3136.00	75.96	2.93	0.05	75.85	76.06	63.90	84.50

ANOVA

averageintensity

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	534.53	4.00	133.63	15.86	0.00
Within Groups	26386.78	3131.00	8.43		
Total	26921.31	3135.00			

Multiple Comparisons

Dependent Variable: averageintensity

Tukey HSD

(I) OrthoAccent		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Unmarked	Double	-0.02	0.41	1.00	-1.15	1.11
	NFante	2.44113*	0.37	0.00	1.44	3.44
	NFpen	.82345*	0.17	0.00	0.35	1.29
	Final	0.12	0.11	0.81	-0.18	0.43
Double	Unmarked	0.02	0.41	1.00	-1.11	1.15
	NFante	2.46390*	0.54	0.00	0.99	3.94
	NFpen	0.85	0.43	0.29	-0.34	2.03
	Final	0.15	0.41	1.00	-0.98	1.28
NFante	Unmarked	-2.44113*	0.37	0.00	-3.44	-1.44
	Double	-2.46390*	0.54	0.00	-3.94	-0.99
	NFpen	-1.61769*	0.39	0.00	-2.68	-0.56
	Final	-2.31766*	0.37	0.00	-3.32	-1.32
NFpen	Unmarked	-.82345*	0.17	0.00	-1.29	-0.35
	Double	-0.85	0.43	0.29	-2.03	0.34
	NFante	1.61769*	0.39	0.00	0.56	2.68
	Final	-.69997*	0.17	0.00	-1.17	-0.23
Final	Unmarked	-0.12	0.11	0.81	-0.43	0.18
	Double	-0.15	0.41	1.00	-1.28	0.98
	NFante	2.31766*	0.37	0.00	1.32	3.32
	NFpen	.69997*	0.17	0.00	0.23	1.17

*. The mean difference is significant at the 0.05 level.

Descriptives

intensityrange

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Unmarked	1353.00	14.42	5.58	0.15	14.12	14.72	1.70	30.40
Double	51.00	20.86	4.69	0.66	19.54	22.18	8.90	32.30
NFante	66.00	21.66	4.02	0.49	20.67	22.65	11.60	28.50
NFpen	357.00	19.92	4.34	0.23	19.47	20.37	5.20	30.00
Final	1309.00	17.86	5.75	0.16	17.55	18.17	2.50	34.80
Total	3136.00	16.74	5.90	0.11	16.53	16.95	1.70	34.80

ANOVA

intensityrange

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	14993.26	4.00	3748.32	124.54	0.00
Within Groups	94234.73	3131.00	30.10		
Total	109227.99	3135.00			

Multiple Comparisons

Dependent Variable: intensityrange

Tukey HSD

(I) OrthoAccent		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Unmarked	Double	-6.43680*	0.78	0.00	-8.57	-4.30
	NFante	-7.23555*	0.69	0.00	-9.12	-5.35
	NFpen	-5.49954*	0.33	0.00	-6.39	-4.61
	Final	-3.44024*	0.21	0.00	-4.02	-2.86
Double	Unmarked	6.43680*	0.78	0.00	4.30	8.57
	NFante	-0.80	1.02	0.94	-3.59	1.99
	NFpen	0.94	0.82	0.78	-1.30	3.18
	Final	2.99656*	0.78	0.00	0.86	5.13
NFante	Unmarked	7.23555*	0.69	0.00	5.35	9.12
	Double	0.80	1.02	0.94	-1.99	3.59
	NFpen	1.74	0.74	0.13	-0.27	3.74
	Final	3.79531*	0.69	0.00	1.91	5.68
NFpen	Unmarked	5.49954*	0.33	0.00	4.61	6.39
	Double	-0.94	0.82	0.78	-3.18	1.30
	NFante	-1.74	0.74	0.13	-3.74	0.27
	Final	2.05931*	0.33	0.00	1.17	2.95
Final	Unmarked	3.44024*	0.21	0.00	2.86	4.02
	Double	-2.99656*	0.78	0.00	-5.13	-0.86
	NFante	-3.79531*	0.69	0.00	-5.68	-1.91
	NFpen	-2.05931*	0.33	0.00	-2.95	-1.17

*. The mean difference is significant at the 0.05 level.

Descriptives

intensitytotal

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Unmarked	1353.00	2031.92	1262.41	34.32	1964.59	2099.25	468.10	11066.40
Double	51.00	6129.55	2060.97	288.59	5549.89	6709.20	2358.70	10790.80
NFante	66.00	6446.65	1446.31	178.03	6091.10	6802.19	2219.60	11292.70
NFpen	357.00	5902.89	1927.39	102.01	5702.27	6103.50	1972.00	12515.30
Final	1309.00	3957.65	1958.16	54.12	3851.47	4063.82	727.80	12790.90
Total	3136.00	3435.96	2187.77	39.07	3359.36	3512.56	468.10	12790.90

ANOVA

intensitytotal

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6164335242.61	4.00	1541083810.65	545.78	0.00
Within Groups	8840832409.02	3131.00	2823644.97		
Total	15005167651.63	3135.00			

Multiple Comparisons

Dependent Variable: intensitytotal

Tukey HSD

(I) OrthoAccent	(J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Unmarked	Double	-4097.62632*	239.69	0.00	-4751.84	-3443.42
	NFante	-4414.72820*	211.82	0.00	-4992.87	-3836.58
	NFpen	-3870.96750*	99.98	0.00	-4143.85	-3598.08
	Final	-1925.72859*	65.15	0.00	-2103.54	-1747.92
Double	Unmarked	4097.62632*	239.69	0.00	3443.42	4751.84
	NFante	-317.10	313.29	0.85	-1172.17	537.97
	NFpen	226.66	251.55	0.90	-459.90	913.22
	Final	2171.89773*	239.84	0.00	1517.29	2826.51
NFante	Unmarked	4414.72820*	211.82	0.00	3836.58	4992.87
	Double	317.10	313.29	0.85	-537.97	1172.17
	NFpen	543.76	225.15	0.11	-70.75	1158.27
	Final	2488.99961*	211.99	0.00	1910.40	3067.60
NFpen	Unmarked	3870.96750*	99.98	0.00	3598.08	4143.85
	Double	-226.66	251.55	0.90	-913.22	459.90
	NFante	-543.76	225.15	0.11	-1158.27	70.75
	Final	1945.23891*	100.33	0.00	1671.40	2219.08
Final	Unmarked	1925.72859*	65.15	0.00	1747.92	2103.54
	Double	-2171.89773*	239.84	0.00	-2826.51	-1517.29
	NFante	-2488.99961*	211.99	0.00	-3067.60	-1910.40
	NFpen	-1945.23891*	100.33	0.00	-2219.08	-1671.40

*. The mean difference is significant at the 0.05 level.

DURATION (CHUNK LEVEL - BY PRIMARY PHRASE TYPE)

Descriptives

Duration

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Bound	Bound	Minimum	Maximum
Exclamation	17.00	4903.52	3924.96	951.94	2885.49	6921.55	640.80	12986.50
Narrative	171.00	6636.40	4071.53	311.36	6021.78	7251.03	475.60	20756.10
Quotative	91.00	7097.93	3707.27	388.63	6325.86	7870.01	1130.00	18332.20
WHInter	21.00	6868.96	3629.32	791.98	5216.91	8521.01	790.10	13675.20
YNInter	10.00	4822.97	2441.85	772.18	3076.17	6569.77	1150.00	8810.00
Total	310.00	6634.11	3909.63	222.05	6197.19	7071.04	475.60	20756.10

ANOVA

Duration

	Sum of Squares	df	Mean Square	F	Sig.
Between	104452003.49	4.00	26113000.87	1.72	0.14
Within	4618682954.17	305.00	15143222.80		
Total	4723134957.66	309.00			

Multiple Comparisons

Dependent Variable: Duration

Tukey HSD

(I) PrimaryType		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Exclamation	Narrative	-1732.88	989.61	0.40	-4448.55	982.78
	Quotative	-2194.41	1028.20	0.21	-5015.95	627.13
	WHInter	-1965.43	1269.60	0.53	-5449.43	1518.56
	YNInter	80.55	1550.84	1.00	-4175.21	4336.31
Narrative	Exclamation	1732.88	989.61	0.40	-982.78	4448.55
	Quotative	-461.53	504.94	0.89	-1847.17	924.12
	WHInter	-232.55	899.81	1.00	-2701.79	2236.68
	YNInter	1813.43	1266.05	0.61	-1660.81	5287.68
Quotative	Exclamation	2194.41	1028.20	0.21	-627.13	5015.95
	Narrative	461.53	504.94	0.89	-924.12	1847.17
	WHInter	228.97	942.08	1.00	-2356.25	2814.20
	YNInter	2274.96	1296.43	0.40	-1282.66	5832.58
WHInter	Exclamation	1965.43	1269.60	0.53	-1518.56	5449.43
	Narrative	232.55	899.81	1.00	-2236.68	2701.79
	Quotative	-228.97	942.08	1.00	-2814.20	2356.25
	YNInter	2045.99	1495.13	0.65	-2056.91	6148.89
YNInter	Exclamation	-80.55	1550.84	1.00	-4336.31	4175.21
	Narrative	-1813.43	1266.05	0.61	-5287.68	1660.81
	Quotative	-2274.96	1296.43	0.40	-5832.58	1282.66
	WHInter	-2045.99	1495.13	0.65	-6148.89	2056.91

DURATION (WORD LEVEL - ACCENT TYPE)

Descriptives

Duration

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Bound	Bound	Minimum	Maximum
Unmarked	1353.00	272.65	170.50	4.64	263.56	281.74	68.40	1476.90
Double	51.00	811.95	278.15	38.95	733.72	890.18	312.30	1408.60
NFante	66.00	880.07	193.19	23.78	832.58	927.56	303.50	1490.10
NFpen	357.00	791.07	263.66	13.95	763.63	818.51	250.70	1731.60
Final	1309.00	528.59	265.80	7.35	514.18	543.01	98.10	1706.10
Total	3136.00	460.06	295.36	5.27	449.71	470.40	68.40	1731.60

ANOVA

Duration

	Sum of Squares	df	Mean Square	F	Sig.
Between	110741809.35	4.00	27685452.34	532.60	0.00
Within	162755083.70	3131.00	51981.82		
Total	273496893.05	3135.00			

Multiple Comparisons

Dependent Variable: Duration

Tukey HSD

(I) OrthoAccent		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Unmarked	Double	-539.29721*	32.52	0.00	-628.06	-450.53
	NFante	-607.42092*	28.74	0.00	-685.86	-528.98
	NFpen	-518.41766*	13.57	0.00	-555.44	-481.39
	Final	-255.94208*	8.84	0.00	-280.07	-231.82
Double	Unmarked	539.29721*	32.52	0.00	450.53	628.06
	NFante	-68.12	42.51	0.50	-184.14	47.89
	NFpen	20.88	34.13	0.97	-72.27	114.03
	Final	283.35513*	32.54	0.00	194.54	372.17
NFante	Unmarked	607.42092*	28.74	0.00	528.98	685.86
	Double	68.12	42.51	0.50	-47.89	184.14
	NFpen	89.00326*	30.55	0.03	5.63	172.38
	Final	351.47884*	28.76	0.00	272.97	429.98
NFpen	Unmarked	518.41766*	13.57	0.00	481.39	555.44
	Double	-20.88	34.13	0.97	-114.03	72.27
	NFante	-89.00326*	30.55	0.03	-172.38	-5.63
	Final	262.47558*	13.61	0.00	225.32	299.63
Final	Unmarked	255.94208*	8.84	0.00	231.82	280.07
	Double	-283.35513*	32.54	0.00	-372.17	-194.54
	NFante	-351.47884*	28.76	0.00	-429.98	-272.97
	NFpen	-262.47558*	13.61	0.00	-299.63	-225.32

*. The mean difference is significant at the 0.05 level.

BREAK INDEX (WORD LEVEL - ACCENT TYPE)

Descriptives

breakindex

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Bound	Bound		
Unmarked	1353.00	-385.57	2184.55	59.39	-502.07	-269.06	-19536.90	2428.50
Double	51.00	49.13	814.99	114.12	-180.09	278.35	-4102.30	1242.60
NFante	66.00	188.25	916.82	112.85	-37.14	413.63	-5918.60	2131.90
NFpen	357.00	107.64	1273.79	67.42	-24.94	240.22	-13573.20	2536.90
Final	1309.00	-739.29	2903.85	80.26	-896.75	-581.84	-21136.00	3419.20
Total	3136.00	-457.93	2423.48	43.28	-542.78	-373.07	-21136.00	3419.20

ANOVA

breakindex

	Sum of Squares	df	Mean Square	F	Sig.
Between	265576134.37	4.00	66394033.59	11.46	0.00
Within	18147093359.74	3131.00	5795941.67		
Total	18412669494.11	3135.00			

Multiple Comparisons

Dependent Variable: breakindex

Tukey HSD

(I) OrthoAccent		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Unmarked	Double	-434.70	343.41	0.71	-1371.99	502.59
	NFante	-573.81	303.48	0.32	-1402.13	254.50
	NFpen	-493.20650*	143.24	0.01	-884.17	-102.24
	Final	353.72657*	93.34	0.00	98.98	608.47
Double	Unmarked	434.70	343.41	0.71	-502.59	1371.99
	NFante	-139.12	448.85	1.00	-1364.18	1085.95
	NFpen	-58.51	360.39	1.00	-1042.15	925.13
	Final	788.42	343.62	0.15	-149.44	1726.28
NFante	Unmarked	573.81	303.48	0.32	-254.50	1402.13
	Double	139.12	448.85	1.00	-1085.95	1364.18
	NFpen	80.61	322.57	1.00	-799.81	961.02
	Final	927.53988*	303.72	0.02	98.58	1756.50
NFpen	Unmarked	493.20650*	143.24	0.01	102.24	884.17
	Double	58.51	360.39	1.00	-925.13	1042.15
	NFante	-80.61	322.57	1.00	-961.02	799.81
	Final	846.93308*	143.75	0.00	454.60	1239.27
Final	Unmarked	-353.72657*	93.34	0.00	-608.47	-98.98
	Double	-788.42	343.62	0.15	-1726.28	149.44
	NFante	-927.53988*	303.72	0.02	-1756.50	-98.58
	NFpen	-846.93308*	143.75	0.00	-1239.27	-454.60

*. The mean difference is significant at the 0.05 level.