An autosegmental/metrical model of Chickasaw intonation

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12.1 Introduction

This chapter presents a formal model for transcribing the intonational properties of Chickasaw, a Western Muskogean language spoken in south-central Oklahoma by perhaps a few hundred speakers. The proposed model adopts many elements and assumptions of the autosegmental/metrical (AM) framework originally developed to analyse English intonational structure (Pierrehumbert 1980, Silverman et al. 1992, Beckman and Hirschberg 1994, Pitrelli et al. 1994) and subsequently extended to other languages, such as Japanese (Beckman and Pierrehumbert 1986, Pierrehumbert and Beckman 1988, Venditti 1995, this volume, Campbell and Venditti 1995), Korean (Jun 1993, this volume), French (Jun and Fougeron 1995), and other languages described in this volume. Because its prosodic system differs rather substantially from most other languages analysed within the AM paradigm, Chickasaw is an interesting test case for establishing the ability of the AM framework to model a broad range of intonation systems (see also Bishop and Fletcher this volume for analysis of the intonation of Bininj Gun-wok, another language prosodically quite different from others modelled within the AM framework). Although the Chickasaw data require modifications of certain aspects of the AM systems employed by investigators of other languages, this chapter will show that the AM framework is ultimately well suited to the analysis of Chickasaw intonation.

The structure of this chapter is as follows. Section 2 provides an overview of Chickasaw prosody. Section 3 focuses more narrowly on Chickasaw intonation and its interactions with other aspects of the prosodic system. Section 4 examines the hierarchical prosodic structure of Chickasaw utterances. Section 5 proposes an AM model for transcribing Chickasaw intonation. Finally, section 6 summarizes the principal findings and suggests areas for future research in Chickasaw prosody and intonation.

12.2 Chickasaw prosody

Chickasaw has a relatively complex prosodic system combining aspects of a stress system with those of a lexical pitch accent system. Furthermore, a process of rhythmic vowel lengthening contributes an additional layer of durational prominence. Sections 2.1-2.3 introduce these prosodic features, all of which interact with the intonation system. Rhythmic lengthening is discussed in section 2.1, word-level stress is examined in section 2.2, and the system of morpholexical pitch accents is covered in section 2.3.

12.2.1 Rhythmic lengthening

One of the more salient characteristics of Chickasaw prosody is its pattern of rhythmic lengthening whereby the second in a sequence of two vowels in adjacent open syllables is phonetically lengthened (see Munro and Ulrich 1984, Munro and Willmond 1994, Munro 1996, Munro 1999 for discussion). Thus, for example, the underlying string /pisalitok/ 'I looked at it' is realized phonetically as [pisaˑlitok], where the rhythmically lengthened [aˑ] is

indicated by a half-length IPA symbol. (Rhythmically lengthened vowels are not differentiated from unlengthened vowels in the orthography.) Rhythmic lengthening does not affect vowels in final position of the morphological word; thus, the word /pisa/ 's/he looks at it' is realized simply as [pisa] without lengthening of the final vowel. Rhythmic lengthening is generally non-neutralizing; lengthened vowels are usually slightly shorter than phonemic long vowels, though certain speakers do neutralize the two length categories for certain vowel qualities (see Gordon et al. 2000 for phonetic measurements).

Certain prefixes and suffixes belonging to the morphological word fall outside the domain of rhythmic lengthening. For example, in the word /im-apila-li-tok/ 'I helped him/her for him/her' the dative prefix im- falls outside of the rhythmic lengthening domain which initiates with the second syllable, the first syllable of the root –apila-; the result is lengthening of the third and fifth and not the second and fourth vowels, i.e. [imapiˈlaliˈtok]. There are certain other complications regarding rhythmic lengthening which will not concern us here (see the aforementioned works for discussion).

A basic understanding of rhythmic lengthening is necessary in discussing Chickasaw intonation, since the lengthened vowels behave identically to phonemic long vowels for purposes of nuclear pitch accent placement. Rhythmically lengthened vowels also behave parallel to phonemic long vowels with respect to other prosodic and morphological phenomena in Chickasaw (see Munro and Willmond 1994 for details).

12.2.2 Stress

Stress is not phonemic in Chickasaw; rather, the Chickasaw stress system is weight-sensitive, in the sense that certain "heavy" syllable types preferentially attract stress. Chickasaw observes a three-way hierarchy of weight which manifests itself in both the stress and nuclear pitch accent system (see section 12.3.2): long and lengthened vowels (CVV) are heaviest, followed by closed syllables (CVC), which, in turn, are heavier than open syllables containing a short vowel (CV). With respect to stress, Munro (1996) observes that the final syllable of a word is prominent, as are closed syllables and syllables containing long vowels (including phonemic long vowels, rhythmically lengthened vowels, and nasalized vowels, all of which are phonetically long). Thus, CVV and CVC are heavier than CV, which is unstressed unless in final position. Primary stress falls on the rightmost long (or lengthened vowel) in a word, indicating that CVV is heavier than CVC. In the absence of any long vowels, the primary stress falls on the final syllable of a word. The words in (1) illustrate word-level stress patterns.

(1) a. ˌbakʃiˈjaˌmaʔ 'diaper'
b. aˈboːkoˌʃiʔ 'river'
c. tʃaˌlakˈːiʔ 'Cherokee'
d. ˌokˌfokˈːol 'type of snail'
e. ˈnaːɬtoˌkaʔ 'policeman'

Primary stressed syllables are often associated with heightened fundamental frequency and increased intensity and duration; these properties are exaggerated when realized on a long or lengthened vowel. Secondary stress, which falls on CVV and CVC and on final syllables not carrying primary stress, is often associated with increased duration and intensity, though the presence of these properties is inconsistent. Perhaps the most reliable diagnostic for distinguishing between secondary stressed and unstressed syllables is a series of syncope processes which affect light, unstressed syllables, i.e. non-final CV. Munro and Willmond

(1994) and Munro (1996) describe a number of these processes, which include deletion of word-medial –li– containing a non-rhythmically lengthened, i.e. unstressed, vowel at the end of a verb stem (2a), and syncope of a non-lengthened (unstressed) vowel between a strident and a coronal (2b) (see Munro and Willmond 1994 for discussion of other syncope rules).

(2) a. maˈliˑli-ˌtok → [maˈliˌtok] ‘S/he ran.’

b. piˈlaˑtʃiˌtok → [piˈlaˑʃˌtok] ‘S/he sent it.’ (tʃ → ʃ / __ [+coronal] by regular rule)

12.2.3 Morpholexical pitch accents

In Chickasaw, a subset of verbs are marked as carrying a morpholexical pitch accent, phonetically a high tone, on a particular syllable. Unlike in prototypical pitch accent languages like Japanese (Venditti this volume) and Serbo-Croatian (Godjevac this volume), verbs carrying one of these morpholexical pitch accents are often (though not always) semantically and phonologically related to a base word from which they are derived, though the precise semantic relationship between the base and the morpholexically accented form is not transparent in many cases; hence the term “morpholexical” pitch accent used here. Morpholexically accented forms, termed verb “grades” by scholars of Chickasaw and related Muskogean languages, convey aspectual information, such as intensification, active and stative changes, habitual action, among other properties. There are various classes of verb grades which differ in their semantic and phonological relationship with the base from which they are derived (see Munro and Willmond 1994:lv-lxii for detailed discussion of Chickasaw grades). Crucially for present purposes, morpholexically pitch accented forms contain one syllable which carries a high tone, the penult in most unsuffixed grade forms, but the antepenult or preantepenult in certain grades. In addition, there are other segmental changes accompanying grade formation, such as gemination, nasalization, or laryngeal insertion, which are irrelevant for purposes of the present discussion. Some examples of morpholexically pitch accented forms and their related bases appear in (3). Morpholexical pitch accents are indicated by a circumflex accent.

	Grade form	***gloss***	***Base***	***gloss***
(3) a.	hîkːiʔja	be standing	hika	stand up
	tʃofânta	be cleaner	tʃofaˑta	be clean
b.				
c.	itːibâkːakliʔtʃi	make a knocking sound	bakaʔtʃi	make a noise with wood
	maf̂ːli	to start, run (car engine)	maliˑli	run
d.				
e.	totʃːîʔna	be three	None	

An interesting property of morpholexically pitch accented syllables is that they are always heavy (either CVV or CVC), either because they are closed, as in (3a-c) and (3e) above or because they contain a long vowel, as in (3d).

12.3 Intonational phonology

Three types of phonological tones are relevant for analysing Chickasaw intonation. The first type of tone is the boundary tone which occurs at the right edge of the largest intonational constituent, the Intonational Phrase, or IP (see section 12.4.1 for discussion of the Intonational Phrase). Boundary tones are discussed in section 3.1. The second category of

tones includes the pitch accents, which occur in two varieties: phonological pitch accents and morpholexical pitch accents associated with certain lexically marked syllables, as described in section 2.3. Pitch accents are discussed in section 3.2. Finally, the smallest intonational constituent, the Accentual Phrase, is characterized by a series of phrasal tones linked to certain positions within the Accentual Phrase. Discussion of the Accentual Phrase tones is deferred until section 4.2.1 after analysis of the prosodic organization of Chickasaw.

12.3.1 Boundary tones

Contrary to the dominant cross-linguistic pattern, Chickasaw speakers usually end a statement with a final rise in fundamental frequency. In fact, the highest fundamental frequency in a Chickasaw statement typically occurs at the right edge of the statement, indicating the presence of a H% boundary tone. A statement ending in a H% boundary tone is illustrated in Figure 12.1.

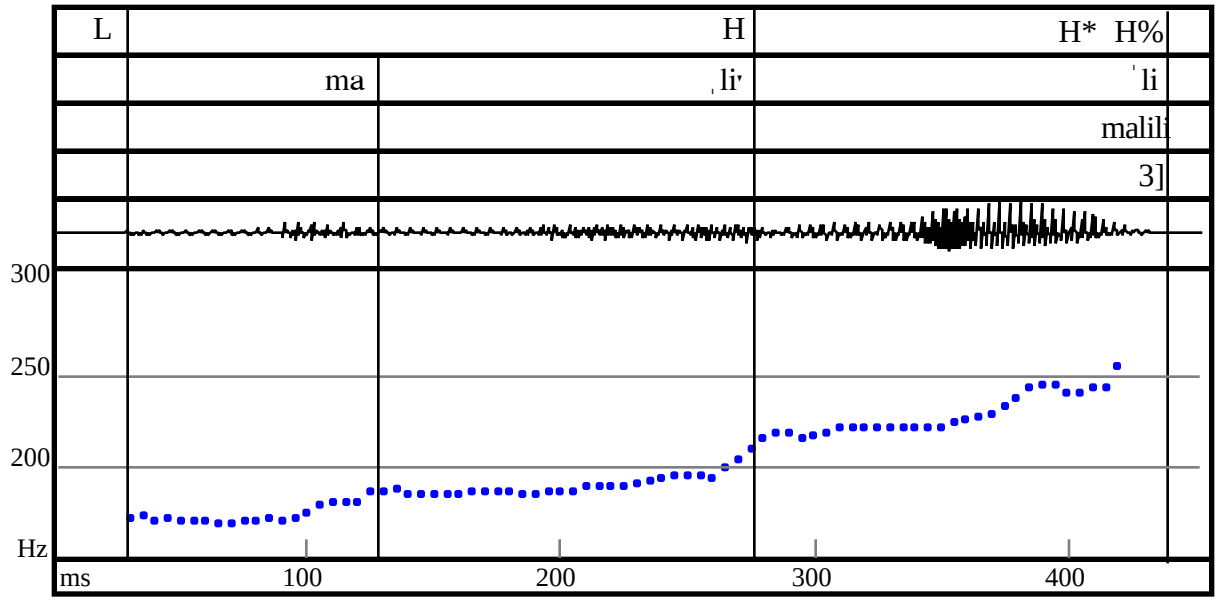


Figure 12.1. Final H% boundary tone in statement IP "Malili." 'S/he runs.' (female speaker) Note that an IPA transcription of the utterance appears in the transcription tier below the tones and above the orthographic transcription (see section 12.5 for transcription guidelines).

Echo questions characteristically also end in a H% boundary tone, with the principal difference in intonation between an echo question and a statement residing in the overall increase in fundamental frequency characteristic of an echo question. This increase in pitch level is apparent throughout a echo question, such that all low tones and high tones, including boundary tones, are higher in a echo question than in a statement.

Unlike echo questions, both wh- and yes/no- questions in Chickasaw end in a pitch fall commencing immediately after the nuclear pitch accent (see section 12.3.2 for discussion of nuclear pitch accents) and persisting until the end of the question. The lowest pitch in a question is found at the end, indicating a L% boundary tone. The L% boundary tone is also

found in exclamations expressing surprise or disbelief. A question exemplifying the L% boundary tone appears in Figure 12.2.

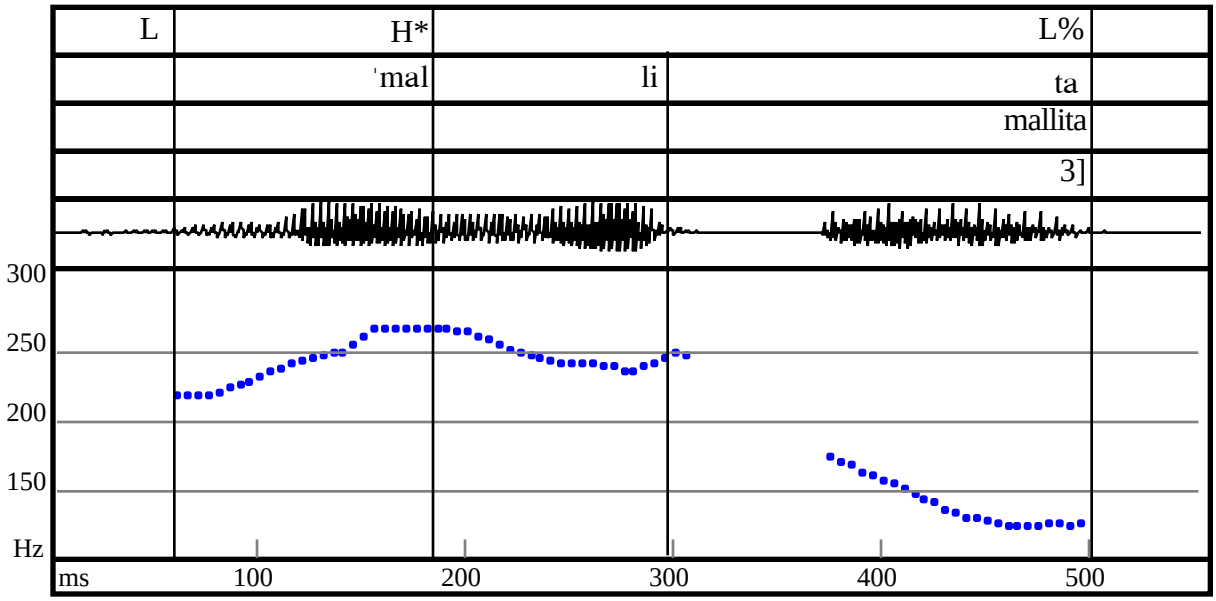


Figure 12.2. Nuclear pitch accent in question IP "Mallita?" 'Does she/he jump?' (female speaker). Note that the slight f0 increase before the /t/ is a segmental effect.

A L% boundary tone is also found in sentences in which SVO and OVS word orders are employed rather than the more standard SOV order. In SVO and OVS sentences, the first noun and the verb form one Intonational Phrase (see section 12.4.1 for the Intonational Phrase), whose intonational properties, including boundary tones, mirror those found in SVO sentences. The postverbal noun, on the other hand, constitutes a separate Intonational Phrase which ends in a L% boundary tone, even in statements. The postverbal noun is also characterized by an overall lower and compressed pitch range, meaning that the L% boundary tone at the end of the postverbal noun is the point of lowest fundamental frequency in the utterance. This compression of the pitch range affects the realization of pitch accents within the postverbal noun; they are realized as downstepped accents (see discussion in section 3.2).

A L% boundary tone is also found at the end of non-main clauses, some of which are translated as subordinate clauses in English and others of which are coordinate clauses (see Munro and Willmond 1994 for discussion). In case the non-main clause follows (but not when it precedes) the main clause, the non-main clause is associated with the same overall lowered and compressed pitch range characteristic of postverbal nouns. Figure 12.3 illustrates the intonation associated with a biclausal sentence in which the second clause is a non-main clause. In Figure 12.3, the first clause [maˌliˈli] in the utterance [maˌliˈli ˌnambiˌlaˈmaːt ˈalaˌkãː] 'S/he runs, when there's perfume here' is realized with the H% characteristic of main clauses, while the second clause [ˌnambiˌlaˈmaːt ˈalaˌkãː] has a L% final boundary tone and also a reduced and lowered pitch range relative to the main clause.

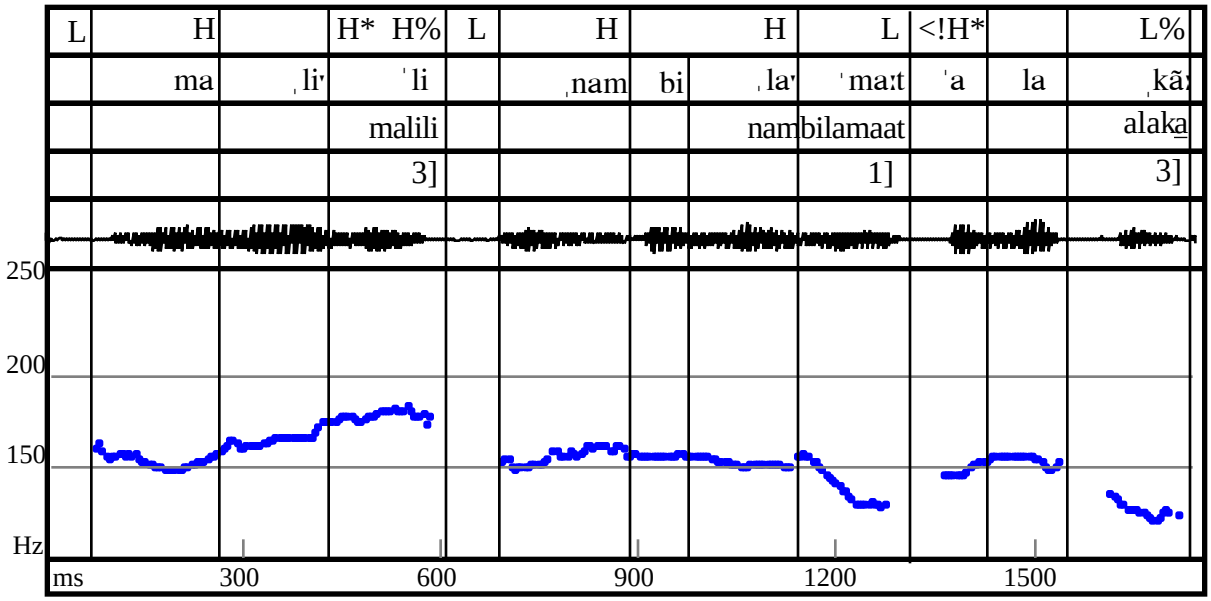


Figure 12.3. Utterance containing a main clause followed by a non-main clause: "Malili nambilamaat alaka." 'S/he runs, there's perfume here.' (female speaker)

In addition to the H% and L% boundary tones, a HL% boundary tone is occasionally found in statements and is consistently found in imperatives. The use of the HL% boundary as an alternative to the H% boundary tone in statements appears to be to a large extent a speaker specific matter. Certain speakers use the HL% boundary tone with regularity in statements, but most employ it only rarely. The HL% boundary tone appears to be a more consistent feature of imperatives, although this observation should be regarded with some caution, since imperatives have only been elicited from two speakers. These two speakers regularly use the HL% boundary tone in imperatives but almost never in statements.

The fall from the H to the L phase of the HL% boundary tone occurs relatively late in the final syllable. This pitch fall is often imperceptible and, in many cases, can be regarded as a by-product of non-modal phonation associated with final position. However, in other tokens, the fall commences as early as the middle of the syllable and is quite perceptible. A clear example of the HL% boundary tone is provided by the statement IP in Figure 12.4.

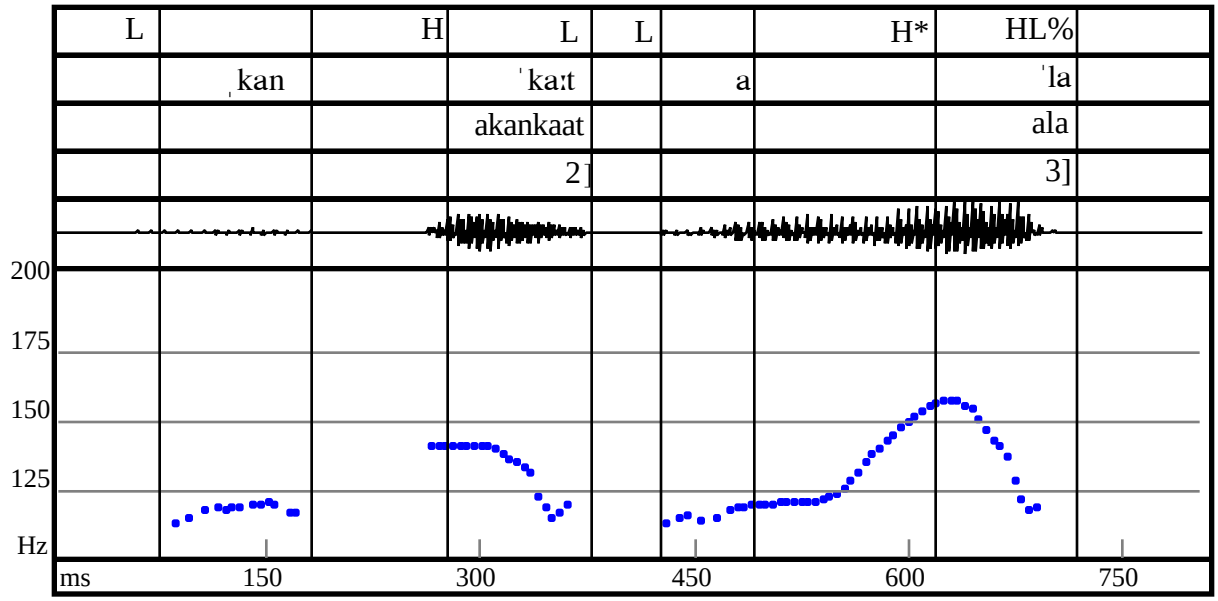


Figure 12.4. Final HL% boundary tone in statement IP **"**(A)kankaat ala." 'The skunk is here.' (male speaker)

The inventory of boundary tones and the semantic contexts in which each arises are summarized in Table 1.

Table 1. Inventory of boundary tones

Boundary Tone	***Semantic context***
H%	• Statements, echo questions
HL%	• Imperatives (occasionally statements)
L%	• Wh- and yes/no questions
	• Exclamations
	• Non-main clauses, postposed nouns

12.3.2 Pitch accents

Chickasaw has two types of pitch accents. The first of these accents is the morpholexical pitch accent, indicated as H^{λ}, which falls on a single syllable in certain verb forms (see section 12.2.3). The second type of pitch accent is the nuclear pitch accent which is consistently (even in different semantic contexts) realized as a high tone, H*, falling on a syllable within the last word of an Intonational Phrase. The location of the nuclear pitch accent is predictable and generally (with some exceptions to be discussed below) falls on either a final syllable or a heavy syllable, syllables which carry some degree of stress at the word level (see section 12.2.2). The conditions governing nuclear pitch accent placement, however, are complex and depend on an intricate balance of phonological and morphological factors.

In statements, the final syllable of the Intonational Phrase carries the H*. In statements, the phonetic evidence for the nuclear pitch accent is less robust due to the high boundary tone

at the end of statements (section 3.1). However, in support of the nuclear pitch accent on the final syllable, the final syllable also characteristically carries not only the highest pitch but also the greatest intensity in a statement, although long vowels (including rhythmically lengthened vowels) may rival the nuclear pitch accent for having the greatest amplitude.

The H* nuclear pitch accent is more transparent in questions than in statements, due to the low boundary tone found at the end of questions (section 3.1). The syllable associated with the pitch peak serving as the origination point for the fall to the final low boundary tone carries the nuclear pitch accent. Often the pitch peak itself falls late in the syllable carrying the pitch accent, sometimes even during the onset of the following syllable, as in Figure 12.5, in which the pitch accent falls on the antepenult. The syllable carrying the nuclear pitch accent also has the greatest intensity in the IP.

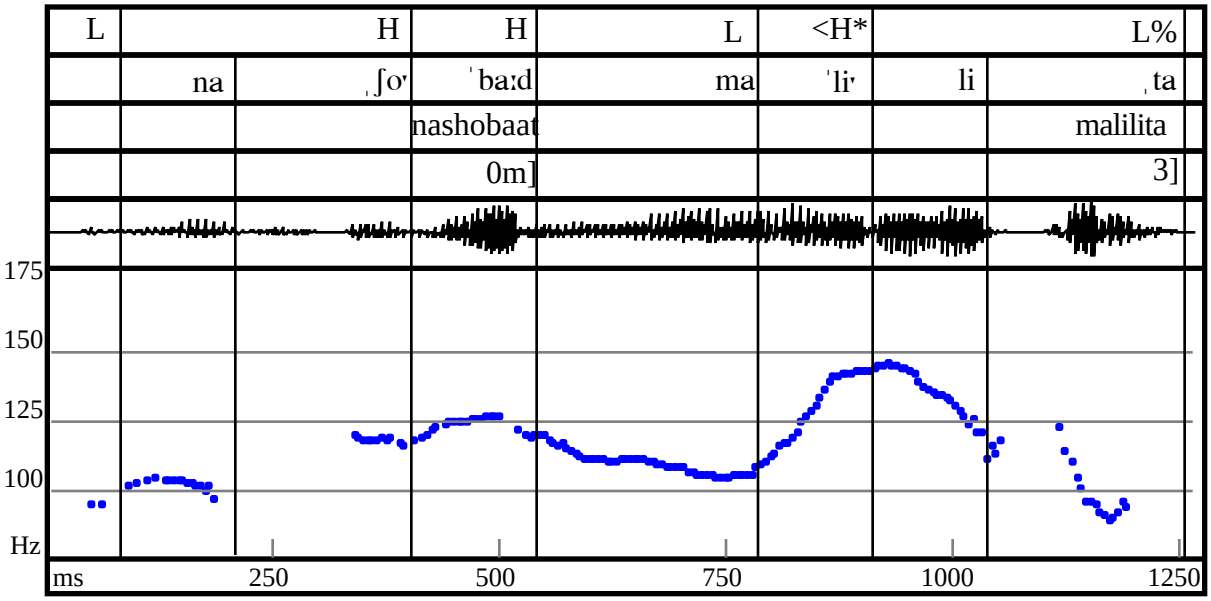


Figure 12.5. Nuclear pitch accent in question IP "Nashobaat malilita" 'Does the wolf run?' (male speaker)

(i) Phonological conditions governing pitch accents in questions

With respect to pitch accent placement, two types of questions must be distinguished. The first type of question, which is less complex in its pitch accent patterns, involves the suffixing of the interrogative marker –tõː to nouns under focus (Munro and Willmond 1994), e.g. [akankáʔtõː] 'Is it a *chicken*?'. In questions formed with –tõː, the pitch accent falls on the syllable immediately preceding the suffix and is followed by a steep fall in f0 to the low boundary tone associated with the suffix. If the syllable before the suffix is open and contains a short vowel, an /h/ is typically inserted after the root-final vowel before the suffix: /falatõː/ → [faláhtõː] 'Is it a *crow*?'. The addition of the /h/ has the effect of ensuring that the final (and pitch accented) syllable of the root is heavy (see Munro 1996:7-8 for further discussion of final /h/ in Chickasaw and closely related Choctaw).

Basic wh- and yes/no questions not formed with the noun suffix –tõː are sensitive to a more complex set of conditions governing pitch accent placement. It is these complications which we address now. We begin with the purely phonological factors and then turn to morphological factors.

A useful generalization for characterising the location of the nuclear pitch accent in standard wh- and yes/no questions is that the transition from high pitch accent to low boundary tone minimally requires two vocalic moras, i.e. either a long vowel or two short vowels. A result of this restriction is that the only final syllable which can carry the nuclear pitch accent in a question is one containing a long vowel (CVV). Examples of final CVV carrying the nuclear pitch accent (indicated by an acute accent) appear in (4).

(4) a. (katiˈmihtã) sahaˈʃáː 'Why am I angry?'
b. (nantaːt) oktáːk 'What is a prairie?'
c. (kataːt) maliˈtːóːk 'Who ran (distant past)?'

Phonetically, a pitch accented CVV final syllable in a question IP is characterized by a pitch peak followed by a steep pitch fall to the end of the IP. The timing of the pitch peak is crucial in distinguishing a tautosyllabic sequence of H*L% from a HL% boundary tone which can arise in statements or imperatives (see section 12.3.1). The H* in a H*L% sequence is realized early in the final vowel, whereas the H in a HL% boundary tone is realized in the middle or toward the end of the final vowel. The early realization of the H* in H*L% is illustrated in Figure 12.6. A further difference between H*L% and HL% lies in their distributions: H*L% may not occur on a syllable containing a short vowel, whereas HL% may, as seen earlier in Figure 12.4. In addition, a L% boundary tone following H* is realized at a lower fundamental frequency than the L forming part of a HL% boundary tone. Thus, the end of the HL% boundary tone in the statement in Figure 12.4 is not associated with the lowest f0 of the utterance, unlike the L% boundary tone in the questions in Figure 12.6.

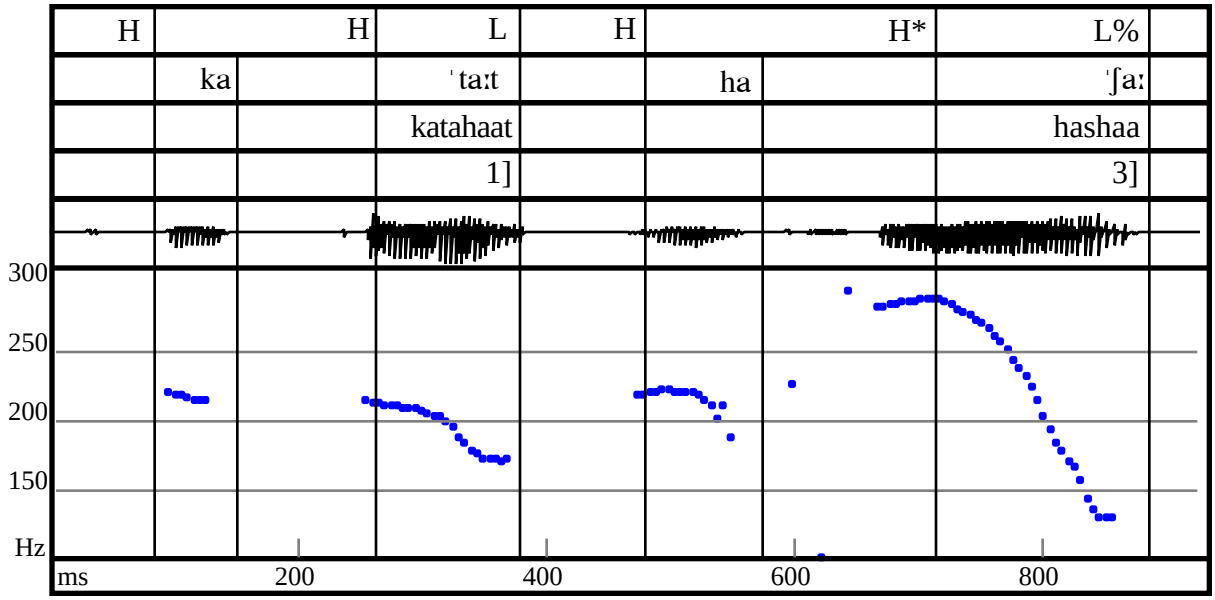


Figure 12.6. Final H*L% sequence in "Katahaat hashaa?" 'Who is angry?' (female speaker)

If the final syllable does not contain a long vowel, the nuclear pitch accent falls on the penultimate syllable if it is heavy, i.e. CVV or CVC (5).

(5) a. malíːtam 'Did s/he run?'
b. (nantaːt) hatáːt͡ʃim 'What turned color?'
c. (kataːt) malíˈli 'Who is running?'
d. (nantaːt) tʃilákbi 'What is dry and cracked?'
e. (kataːt) tokfóhli 'Who's mouth is watering?'
f. (nantaːt) istóktʃank 'What's a watermelon?'

If the final syllable is not CVV and the penultimate syllable is neither CVV nor CVC, the nuclear pitch accent falls on the antepenultimate syllable (6). Because the rhythmic lengthening process (section 2.1) ensures that there are not more than two consecutive syllables which are neither CVV or CVC in questions, an antepenultimate syllable carrying the nuclear pitch accent in questions will either be closed or contain a long vowel (with one morphological exception discussed in the next paragraph). Thus, any syllable carrying the nuclear pitch accent in a question IP (subject to certain exceptions discussed below) is either CVV or CVC.

(6) a. málːitam 'Did s/he jump?'
b. ʃíːpata 'Is it stretchy?'
c. (nantaːt) abóːkoʃiʔ 'What's a river?'

An interesting feature of the nuclear pitch accent in questions is that, unless the final syllable is CVV, it falls on a syllable which does not carry primary stress at the word-level. Thus in examples (5d-f), the pitch accent falls on a non-final syllable, even though the final syllable carries primary stress in words in phrase-medial position which lack a non-final long

vowel (see section 12.2.2). In (5d-f), the nuclear pitch accent falls on a syllable carrying secondary stress at the word-level. There are also cases in which the nuclear pitch accent falls on a syllable predicted to be unstressed at the word level. This scenario arises in phrase-final disyllabic words of the form CVCV, where the first syllable carries the nuclear pitch accent even though it is unstressed at the word-level (see section 12.3.2). Because the nuclear pitch accented syllable is the phonetically most prominent syllable in the word in which it occurs, the pitch accented syllable is marked with primary stress in the figures throughout this paper. A relevant example of this convention is found in Figure 12.5, where the antepenult of the phrase-final words carries the nuclear pitch accent and is thus marked with primary stress.

(ii) Morphological conditions governing pitch accents in questions

There are also morphological conditions which interact with the purely phonological conditions governing nuclear pitch accent placement. One morphological restriction is that the nuclear pitch accent does not fall to the left of the first syllable of the root. In other words, the nuclear pitch accent is restricted from falling on prefixes, even if syllable weight conditions predict that a prefix should carry the nuclear pitch accent. For example, the verb [iliˑ-pí́sa] in the sentence [kataːt iliˑ-pí́sa] 'Who looks at herself/himself?' consists of the reflexive prefix iliˑ- plus the root pisa. In this form, the nuclear pitch accent falls on the penultimate syllable, /pi/, the first of the root, even though purely phonological conditions would predict that the heavy antepenultimate syllable rather than the light penult should take the nuclear pitch accent.

The nuclear pitch accent also is limited to the final word in a compound, even if this restriction means that the pitch accent falls on a syllable not predicted to carry the pitch accent on phonological grounds. For example, in the question [nantaːt akank-óʃiʔ] 'What is a chicken egg?/What is a chick?', which consists of the nouns [akankaʔ] 'chicken' and [oʃiʔ] 'baby, little one', the nuclear pitch accent falls on a syllable in the second noun of the compound, even though this syllable is light and the preceding syllable is heavy.

The nuclear pitch accent is not restricted from falling on suffixes, as the accent pattern in the question [kataːt haʃaː-tːóːk] 'Who was angry (distant past)?' indicates. In this form, the nuclear pitch accent falls on the remote past suffix -tːoːk. In fact, it is a requirement in suffixed verbs that the nuclear pitch accent fall on a syllable in the suffixal complex. Thus, in the question /pisa-li-tam/ 'Was I looking at her/him', which consists of the root [pisa] plus the 1st person singular suffix -li plus the question marker -tam, the nuclear pitch accent falls on the 1st person suffix -li rather than the syllable /sa/ which would be expected to take the pitch accent if strictly phonological conditions were observed, given that -li is a light syllable. In cases where a CV suffix carries a nuclear pitch accent against purely phonological predictions, the vowel is phonetically lengthened; thus /pisa-li-tam/ is realized as [pisaˑ-líˑ-tam]. This lengthening of the accented vowel has the effect of ensuring satisfaction of the phonological requirement that a nuclear pitch accented penult be phonologically heavy. The lengthening of the pitch accented vowel in a suffixal CV syllable contrasts with the failure of lengthening to effect vowels in root-internal CV syllables carrying a pitch accent, e.g. [kataːt tʃíːˑ-hójo]'Who's looking for it for you?, in which the accented vowel in the root [hojo] remains short.

An exception to the requirement that a verbal suffix be pitch accented is provided by word-final suffixes ending in a syllable containing a short vowel: a word-final syllable must contain a long vowel to be accented. For example, in the question [katahtãː pisáˑ-li] 'Who

am I looking at?', the 1st person singular suffix -li fails to attract the pitch accent because it is the final syllable and contains a short vowel. In addition to the phonological blocking of pitch accents on final non-CVV syllables, the two exclamatory suffixes, -kãː and –hV, where V is a nasalized (and therefore long) copy of the preceding vowel, reject the nuclear pitch accent in questions even though they contain a long vowel. Since the exclamation suffixes only occur as the final syllable of a word, their rejection of the pitch accent does not contradict the earlier generalization that *non-final* suffixes attract the nuclear pitch accent. It does, however, mean that we cannot know whether the absence of a pitch accent on the question markers -tam and –ta, (see examples (5a) and (6a) above) which also always occur word-finally, is due to a lexically marked restriction against accented question markers or to the more general restriction against pitch accents on final short vowels. This restriction must be maintained independently as a generalization, however, since it is also observed in words lacking an overt suffix, as in (5c-f).

There is one circumstance under which two nuclear pitch accents may surface in a single IP. In an IP containing two verbs, each verb contains a syllable with a pitch accent. An example of this phenomenon is provided by the last two words in the question IP [kataːt iskáːnoʔst iʃtájːa] 'Who's beginning to be short?' in Figure 12.7. In this example, the first verb [iskáːnoʔst] 'be short' carries a pitch accent on the penult, as does the second verb [iʃtájːa] 'begin'.

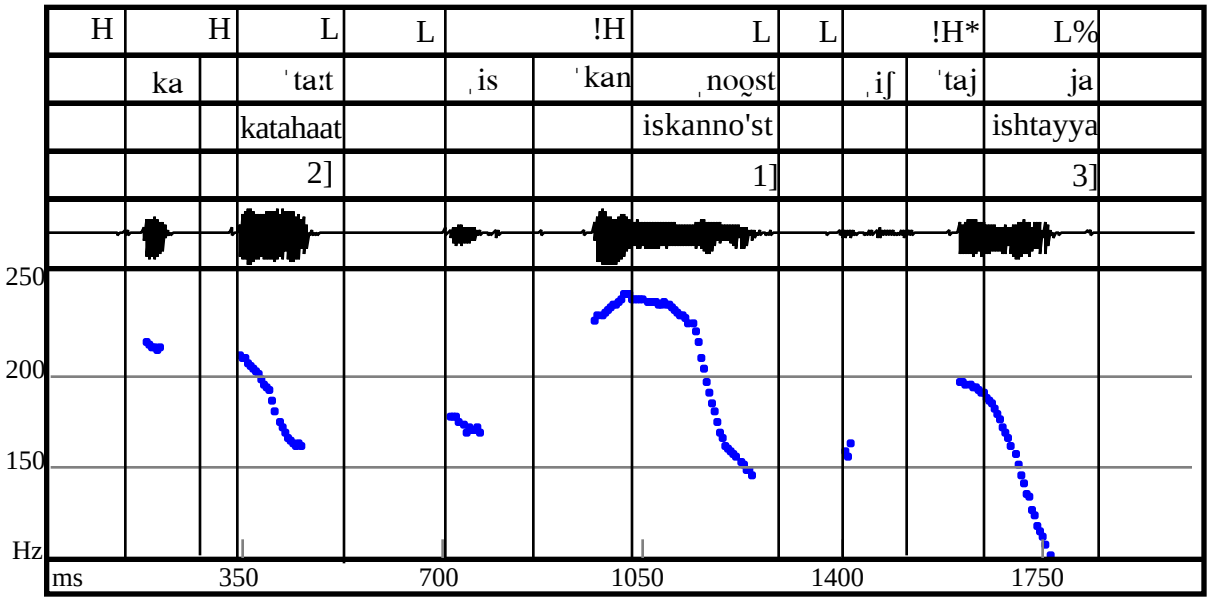


Figure 12.7. Two pitch accents in question IP "Katahaat iskanno'st ishtayya" 'Who's beginning to be short?' (female speaker)

Typically, in cases in which two pitch accents occur in a single IP, the first pitch accent is realized with a phonetically higher pitch than the second one, as in Figure 12.7, though it is also possible for the second one to be higher. This latter scenario seems to arise frequently when the first pitch accented syllable falls on a short vowel followed by a coda obstruent.

(iii) Interaction between morpholexical pitch accents and nuclear pitch accents

Recall from section 2.3 that certain Chickasaw words carry a morpholexical pitch accent on one syllable. These morpholexical pitch accents are phonetically realized as high tones parallel to the phonologically predictable nuclear pitch accents.

A single word may have both a morpholexically pitch accented syllable and another syllable with a nuclear pitch accent. In practice, however, this situation occurs rarely, since there is a restriction against a high tone (whether due to nuclear pitch accents, morpholexical pitch accents, or boundary tones) on a syllable adjacent to a morpholexically accented syllable. In case phonological (or morphological) conditions would predict that a H* nuclear pitch accent or a H% (or HL%) boundary tone would fall on a syllable immediately adjacent to the morpholexically pitch accented syllable, this other high tone is not realized. This restriction only pertains to high tones adjacent to morpholexically pitch accented syllables, since, as we have already seen, tautosyllabic sequences of H* and H% are permissible, in fact, commonplace in statements.

Figure 12.8 contains an example of a statement, [tʃofânta] 'S/he is cleaner' n-grade, in which the only high tone is the morpholexical pitch accent on the penultimate syllable. The H* pitch accent normally found on final syllables in statements is suppressed and the terminus of the statement is marked by a relatively flat mid-level fundamental frequency plateau through the final syllable. To differentiate morpholexical pitch accents from phonological ones, morpholexical ones are transcribed in figures with a superscripted Greek letter lambda following the high tone.

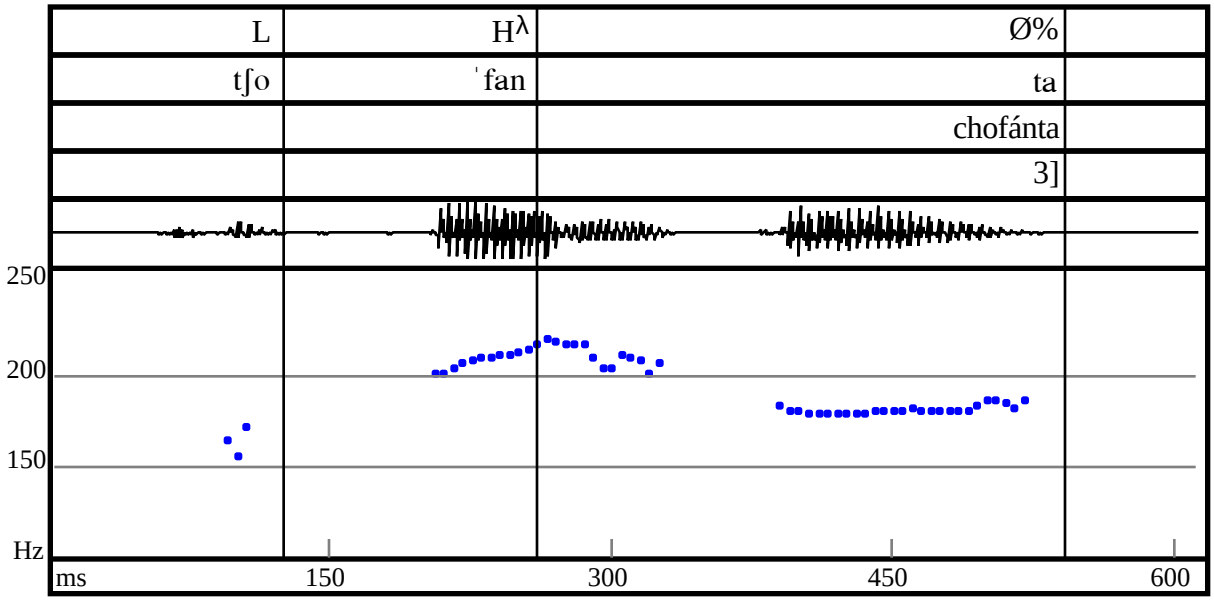


Figure 12.8. Morpholexical pitch accent in IP "chofánta" 'S/he is cleaner.' (female speaker)

The phonological analysis of the final pitch plateau following a morpholexically accented penult is somewhat problematic, since it differs substantially from the realization of the three

boundary tones posited thus far: L%, H%, and HL%. In fact, statements and questions ending in a verb containing a morpholexical pitch accent on the penult are differentiated solely on the basis of the final pitch excursion. Statements have a flat mid level plateau, whereas questions have a fall.

One possible analysis of the level plateau found in statements would assume that the plateau in Figure 12.8 reflects the absence of a boundary tone, i.e. %, where a boundary lacking a phonological tone is phonetically realized as a mid tone. Another possibility is to analyse the final mid tone as the phonetic manifestation of a downstepped H%, i.e. !H%, though one might expect !H% to be realized with slightly higher fundamental frequency than is typical in examples like the one in Figure 12.8. I will tentatively adopt the % boundary tone transcription here with the caveat that future research may argue for an alternative analysis.

The nuclear pitch accent also does not fall on a syllable adjacent to a morpholexically accented syllable in questions. For example, in the question IP [tʃofâjːaʔtata] 'Is she/he really clean?' y-grade, the presence of the morpholexical pitch accent on the preantepenult precludes a nuclear pitch accent on the antepenult, as illustrated in Figure 12.9.

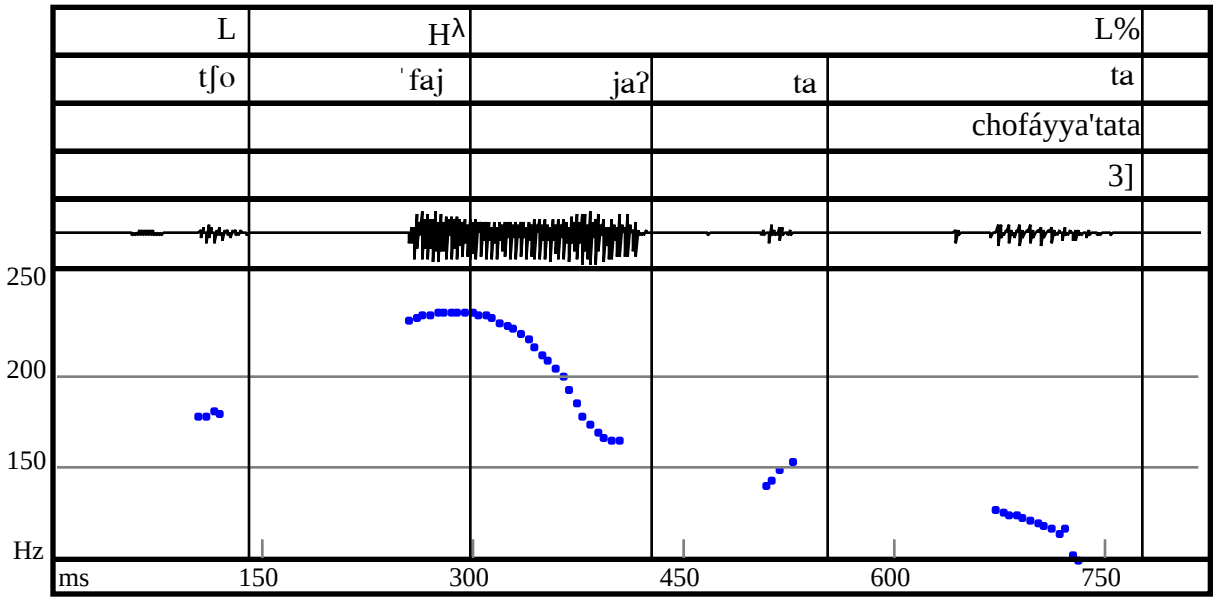


Figure 12.9. Morpholexical pitch accent in "chofáyya'tata" 'Is s/he really clean?' (female speaker)

If, however, there is at least one syllable separating the morpholexically pitch accented syllable from the potential docking site for the nuclear pitch accent and/or the final boundary tone, then both the morpholexical pitch accent and the nuclear pitch accent and/or boundary tone are realized. For example, in the statement IP consisting of the word [hîkːiʔjá] 'S/he is standing', the morpholexical pitch accent falls on the initial syllable and the nuclear pitch accent and boundary tone falls on the final syllable. Figure 12.10 illustrates the question [hôjːoʔloĺˈta] 'Am I wearing shoes?', in which the first syllable carries the morpholexical

pitch accent while the penultimate syllable attracts the nuclear pitch accent. In this particular example, the nuclear pitch accent falls on a suffix, -li 1sg subject. The nuclear pitch accent is realized with a much lower fundamental than the morpholexical pitch accent; this lowering of the nuclear pitch accent is reflected in the transcription of the nuclear pitch accent as a downstepped !H* (see section 12.5.1 for discussion of downstep). It is also worth noting that there is characteristically a sag in pitch between a morpholexical pitch accent and a following nuclear pitch accent in the same word.

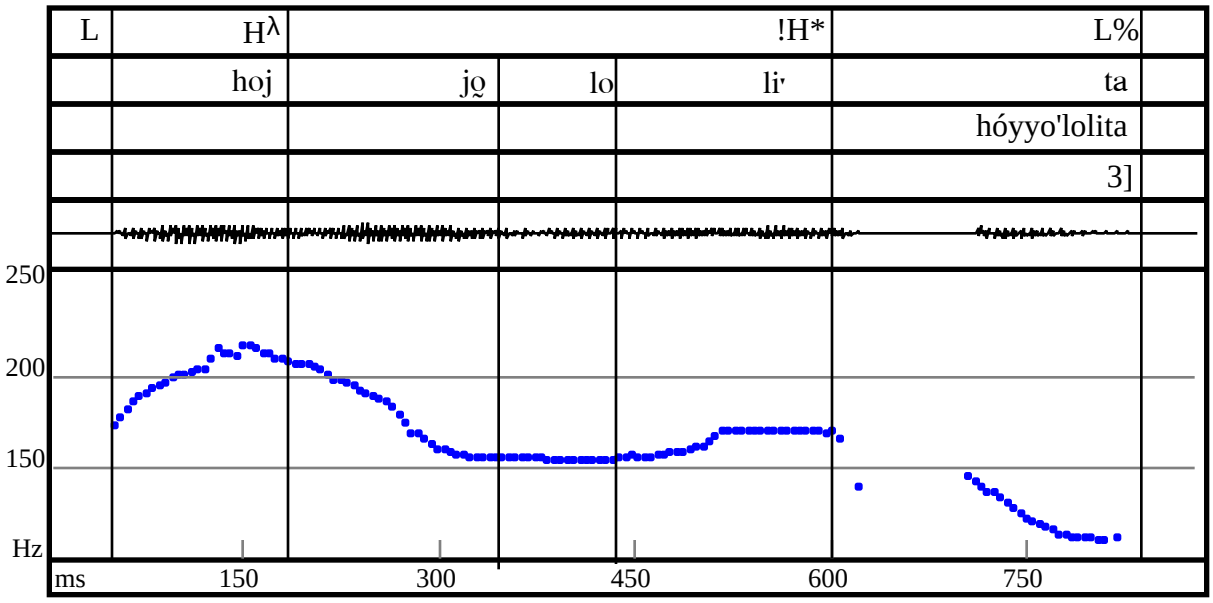


Figure 12.10. Morpholexical and nuclear pitch accents in “hóyyo’lolita” ‘Am I wearing shoes?’ (female speaker).

12.4 Prosodic structure

Evidence suggests the existence of at least three constituents at or above the level of the prosodic word in Chickasaw: the Intonational Phrase (section 4.1), the Accentual Phrase (section 4.2), and the Prosodic Word (section 4.3). In addition, there is a morphologically defined domain smaller than the Prosodic Word in which the phonological process of rhythmic lengthening applies (section 4.4).

12.4.1 Intonational Phrase

In Chickasaw, the largest prosodic constituent which is defined intonationally is the Intonational Phrase (IP). Most sentences consist of a single IP which contains one or more nuclear pitch accented syllables (see section 12.3.2) and a boundary tone at its right edge (see section 12.3.1). The right edge of the Intonational Phrase is also often associated with non-modal phonation, either breathiness or creakiness. Creakiness is particularly common as a by-product of the L% boundary tone in questions (see Figures 12.2, 12.5, 12.6, 12.9).

An exception to the generalization that a sentence consists of a single IP is provided by sentences in which the canonical Chickasaw SOV word order is substituted with an order in

which a noun rather than a verb appears in sentence final position. In such sentences, the verb ends the first IP and any postposed noun phrases form a separate IP (see section 12.5.1). A similar splitting of an utterance into two IPs is found in biclausal utterances, in which each clause characteristically constitutes its own IP (see section 12.3.2).

12.4.2 Accentual Phrase

A single IP is in turn composed of one or more intonational units, which may be termed Accentual Phrases (AP). Each AP is defined tonally by a series of tones aligned with different prosodic positions within the AP. The degree of perceived disjuncture at an AP boundary is smaller than at an IP boundary.

An AP may consist of more than one morphological word, where a morphological word refers to a root plus all bound affixes. Conversely, a long morphological word may consist of more than one AP. Thus, in Chickasaw the Accentual Phrase can be either smaller or larger than the morphological word. (see section 12.4.5 for further discussion). There is a strong preference for AP boundaries to coincide with morphological word boundaries. Thus, each morphological word characteristically is a single AP and each AP typically consists of a single morphological word. A by-product of this strong tendency toward alignment of AP and morphological word boundaries is that a sequence of two CVCV words is characteristically treated as two separate APs rather than one. The likelihood of two morphological words being produced as a single AP is greater for words which are constituents. For example, a sequence of object followed by a verb is more likely to be realized as a single AP than a sequence of subject plus verb or subject plus object. An example of two morphological words forming a single IP appears in Figure 12.11, in which the subject [minkaːt] and the verb [ala] coalesce to form a single AP. The final stop of the noun is flapped in this example, a phenomenon affecting word-final alveolar stops in AP-medial position at fast speech rates (see section 12.4.2 for segmental diagnostics for AP-phrasing).

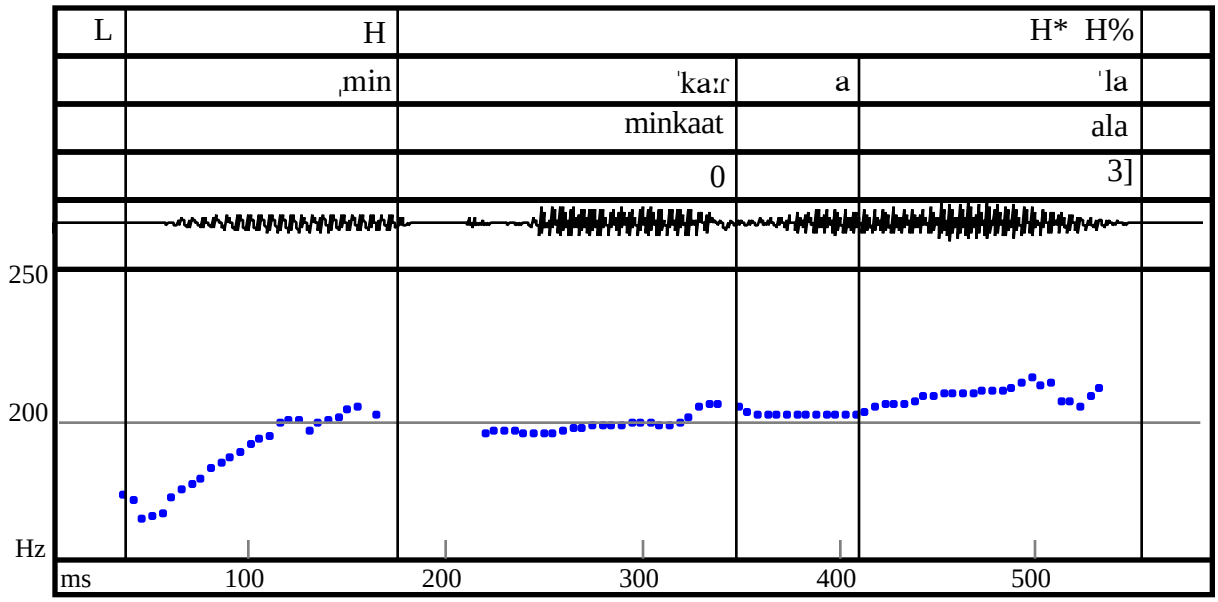


Figure 12.11. Two morphological words forming a single Accentual Phrase in "Minkaat ala" 'The chief is here.' (female speaker).

In general, the likelihood of any sequence of two morphological words being uttered as a single AP is small. In cases of multiple morphological words forming a single AP, there are typically segmental correlates associated with the intonational parse, as in Figure 12.11 (see section 12.4.2).

On the other hand, long morphological words (those greater than seven syllables) may optionally consist of more than one AP, where the likelihood of the morphological word being divided into multiple APs increases commensurately with the length of the word. For example, the nine syllable word /akitːimanompoʔlokitok/ 'I didn't speak to him' may be divided into two APs consisting of a six syllable AP followed by a three syllable AP, i.e. [akitːimaˈnompoʔ]$_{AP}$[lokiˈtok]$_{AP}$. The division of longer morphological words into multiple APs appears to be sensitive to the morphological composition of a word, though the details of this influence of morphology on the intonational parse require further investigation.

(i) Tonal realization of the Accentual Phrase

In describing the tonal realization of the AP, it is useful to invoke the notion of the mora, where, in Chickasaw, a short vowel or a sonorant coda consonant are each associated with one mora and a long vowel is associated with two moras. Onset consonants and coda obstruents are non-moraic for purposes of Accentual Phrase tonal alignment in Chickasaw (though coda obstruents contribute to the weight of a syllable for purposes of pitch accent placement in non-final position). The canonical realization of the AP pattern is [LHHL], a pattern which is typical of APs containing at least three moras. The [LHHL] pattern is also a marked option in shorter APs, where the likelihood of all tones being realized decreases as the duration of the word shortens. The realization of the AP tones in a short AP is discussed below. Syllables carrying H AP tones are not reliably associated with greater intensity and duration than other syllables; this separation of intensity and duration from fundamental

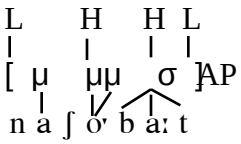
frequency is thus diagnostic in distinguishing between AP tones and both IP level morpholexical and phonological pitch accents.

In APs in which all four tones are realized, the initial low is associated with the left edge of the AP. The first high tone occurs fairly early in the AP; it is generally realized on the second mora. Thus, if the first syllable of a word contains a long vowel or is closed by a consonant, i.e. if the first syllable is bimoraic, the first high tone is usually realized on the first syllable. If, however, the first syllable contains only one mora, the high is delayed until the first mora of the second syllable. The actual timing of the first high tone is only loosely linked to the number of sonorant moras. If, for example, a long vowel in the first syllable is phonetically shortened, as at a faster speech rate, the high tone may actually fall on the second syllable rather than the first one, as in Figure 12.4.

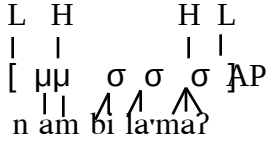
The second high tone is loosely associated with the beginning of the final syllable of the AP. Syllables intervening between the two high tones are realized with high tone by interpolation. The final high tone is usually followed by a sharp fall in pitch to the final low tone associated with the right edge of the AP. The realization of the AP tones is shown in schematic form in (7). An AP with a canonical tonal realization, including a lengthy high-toned plateau, is illustrated in Figure 12.12.

(7)

a. Monomoraic First Syllable



b. Bimoraic first syllable



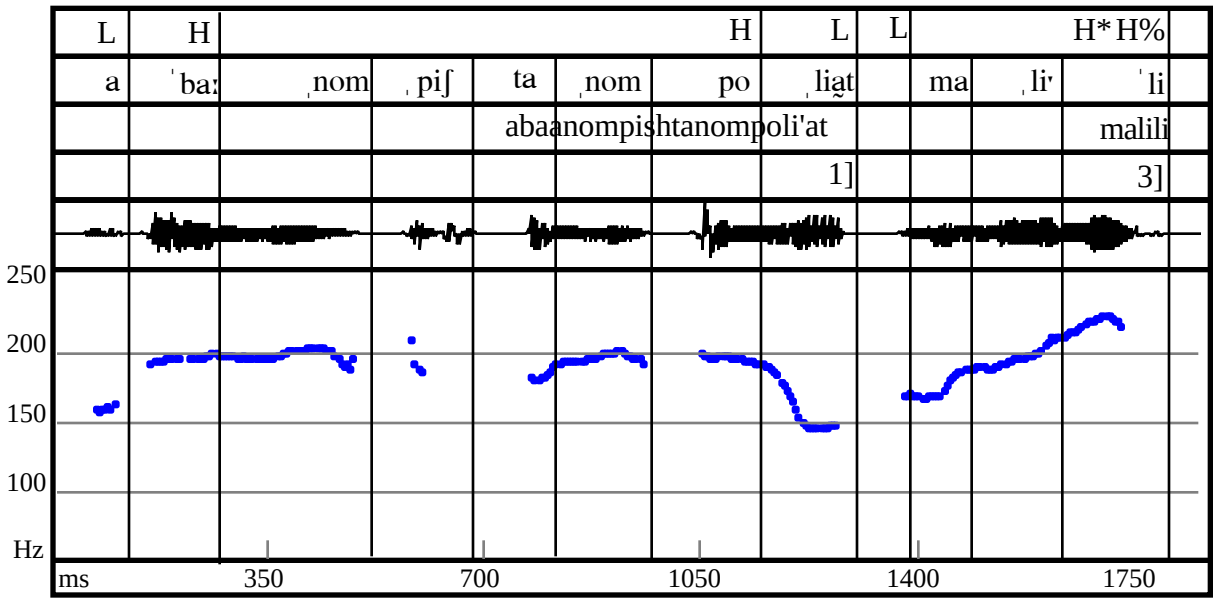


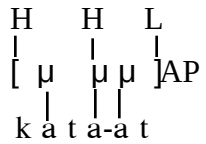
Figure 12.12. Accentual phrase tones in “Abaanompishtanompoli’at malili” ‘The preacher runs.’ (female speaker)

The final pitch fall is not an invariant property of the AP. If the final syllable contains a long vowel, which carries primary word-level stress (see section 12.2.2), the pitch fall on the final syllable may optionally be absent and replaced with a high level plateau, which may be interrupted by a local f0 peak. The boost in f0 and the suppression of the AP final L tone often triggered by word-final long vowels is evident in Figure 12.5 on the primary stressed syllable /baːd/ in the first word [naˌʃoˈbaːd].

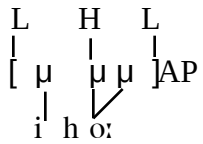
The canonical AP tonal pattern is often truncated in an AP which contains fewer than three moras. The most common tonal pattern in a short AP is [HL] with the H realized at the beginning of the AP and the L at the right edge of the AP. The result is a steady fall in pitch throughout the AP. This [HL] intonation pattern is consistent with the observation that many disyllabic words may be realized with prominence on the first rather than the final syllable (Munro 1996). The tonal realization of the AP is sensitive to the morphological structure of words, albeit in different ways than IP-level pitch accents. For purposes of determining the ability of a word to manifest the full tonal realization of the AP, suffixes are ignored. This contrasts with IP-level pitch accents which are attracted by suffixes (section 3.2.2). The null contribution of suffixes to the mora count of the AP is illustrated in Figures 12.6 and 12.7 in which the word [kata-at] 'who' consists of a bimoraic root kata- plus a monomoraic suffix -at. In these examples, the AP [kataːt] fails to realize the initial L even though the AP contains a total of three moras, as shown schematically in (8a). This contrasts with a monomorphemic trimoraic AP, which realizes the initial L, as in the AP [ihoː] 'woman' (8b).

(8)

a.



b.



The initial L may also be suppressed or realized at a slightly higher level if there is H* or a morpholexical pitch accent in the immediate vicinity, either on the initial syllable or early in the peninitial syllable. In Figure 12.6, the initial low tone of the second AP consisting of the word [haʃaːi] does not surface due to the realization of the H* at the beginning of the second vowel. This contrasts with Figure 12.7 in which the initial L of the AP [iʃtajːa] is realized despite the H* realized early in the peninitial syllable.

Another more marked option in a short AP is to not realize either of the AP high tones; the result is a level low toned AP with a L linked to the beginning of the AP and a L associated with the end of the AP.

The various realizations of the AP are summarized in Table 2.

Table 2. Tonal realizations of the Accentual Phrase

Tonal pattern	***Condition***
LHHL	AP ≥ 3 moras (excluding suffix)
HL	AP < 3 moras
LL	AP < 3 moras (less common)
LHH	Last σ is CVV (optional)

(ii) Segmental diagnostics for the Accentual Phrase

Certain segmental phenomena applying in rapid speech are typically bounded by the Accentual Phrase and thus can be employed as diagnostics for determining whether Accentual Phrase boundaries are present or not. Some of these segmental diagnostics include the following. An intervocalic alveolar stop before a stressless vowel optionally undergoes flapping at fast speech rates in AP medial position, including across word boundaries, as in Figure 12.11 (9a). An intervocalic consonant may resyllabify with a following vowel across a word-boundary, with accompanying aspiration in the case of stops (9b). An intervocalic stop consonant may undergo voicing between sonorants (9c, d). In addition, vowels, particularly high vowels, optionally syncopate in hiatus contexts across word boundaries in AP medial position (9e).

(9) a. ˌminˈkaːt aˈla → ˌminˈkaːr aˈla 'The chief is here.'

b. ˌhatˈːak. aˌpiˈla → ˌhatˈːakʰ aˌpiˈla 'S/he helps the man.'

c. ˌminˈkaːt aˈla → ˌminˈkaːd aˈla 'The chief is here.'

d. tʃiˌpoˈtaːt ˈjaː → tʃiˌpoˈtaːd ˈjaː 'The child is crying.'

e. faˈla ˌiʃˈkin → faˈla ʃˈkin 'the crow's eye'

It should be noted that these diagnostics, though relatively reliable in diagnosing whether an AP boundary is present or not, are not foolproof. Thus, there are instances of the processes exemplified in (9) occurring across an AP boundary (see section 12.5.4 for transcription guidelines for these mismatches between segmental diagnostics and prosodic constituency).

12.4.3 Prosodic word

The Prosodic Word is coextensive with the morphological word and is the domain of word-level stress assignment. The need to separate the Prosodic Word, the domain of stress assignment, from the rhythmic lengthening domain (sections 2.1, 4.4), a domain smaller than the Prosodic Word, becomes apparent under two circumstances. First, prefixes which fall outside of the domain of rhythmic lengthening are eligible to carry primary stress if they possess the requisite phonological properties, i.e. if they contain the rightmost long (or lengthened) vowel in a word. Second, in compounds in which rhythmic lengthening is blocked across the boundary between the two words forming the compound, the primary stress for the compound as a whole still falls on a syllable in the first word of the compound provided it contains the rightmost long (or lengthened) vowel in the compound.

12.4.4 Rhythmic lengthening domain

Like nuclear pitch accent placement, rhythmic lengthening is also sensitive to morphology. The domain of rhythmic lengthening is discussed in considerable detail in Munro and Willmond (1994) and Munro (1996) and is smaller than the domain defined in section 4.3 as the Prosodic Word. Certain prefixes fall outside the domain of rhythmic lengthening and are disregarded in the syllable count used to determine which vowels are lengthened. Thus, in the word [t͡ʃim-abiˈtok] 'S/he killed her/him for you', the prefix tʃim- falls outside the rhythmic lengthening domain, which commences with the first vowel of the root. Certain suffixes, including all noun suffixes, also fall outside of the rhythmic lengthening domain

and, for still other (disyllabic) prefixes, the second but not the first syllable is part of the rhythmic lengthening domain (see Munro and Willmond 1994 for discussion of these complications and others).

12.4.5 Summary of the hierarchical organization of prosodic constituents

In summary, there are at least four hierarchically arranged prosodic constituents in Chickasaw: from largest to smallest, the Intonational Phrase, the Accentual Phrase, the Prosodic Word, and the Rhythmic Lengthening Domain. Examples illustrating the relationship between these constituents and the morphological word appear in (10).

(10) Examples of prosodic constituency in Chickasaw

a.

Intonation Phrase	{	}
Accentual Phrase	{ }{	}
Morphological Word	{	}
Prosodic Word	{	}
Rhythmic Length	{	}
	aː t͡ʃ i m a b iˈ k a t͡ʃ iˈ l i t o k	'I made him sick for you there.'
	aː- t͡ʃim- abika- t͡ʃi- li- tok	
	there you sick caus 1sg past	

b.

Intonation Phrase	{ }{	}
Accentual Phrase	{ }{	}
Morphological Word	{ }{ }{	}
Prosodic Word	{ }{ }{	}
Rhythmic Length	{ }{ }{ }	
	naʃoˈba pisa tʃipoˈtaːt	'The child looks at the wolf.'
	naʃoba pisa tʃipoˈta-at	
	wolf sees child-subj.	

The form in (10a) consists of a single Morphological Word isomorphic to the Prosodic Word. There are two prefixes aː- and t͡ʃim- outside the rhythmic lengthening domain, which consists of the root plus the suffixes. The form in (10a) also contains two tonally defined Accentual Phrases whose boundaries coincide with those of neither the Prosodic nor the Morphological Word. Finally, the two Accentual Phrases are grouped into one Intonational Phrase.

The SVO sentence in (10b) groups the first two Morphological Words, the object and the verb, each of which is coextensive with a Prosodic word and a Rhythmic Lengthening Domain, into a single Accentual Phrase, exactly the opposite of (10a) in which one Morphological Word is divided into two Accentual Phrases. The postposed subject in (10b) forms an Intonational Phrase independent of the object and verb, which together constitute a Intonational Phrase. The subject suffix in the postposed noun falls outside the Rhythmic Lengthening Domain comprising the root. Although the examples in (10) do not exhaust all possible constituencies in Chickasaw, they serve to illustrate some of the range of variation in Chickasaw prosodic structure.

12.5 A transcription system

The system proposed here makes use of four tiers for transcribing Chickasaw intonation. These tiers, from top to bottom, are as follows. The Tone Tier provides an intonational analysis of an utterance (section 5.1). The Phonetic Transcription Tier provides an IPA transcription of the utterance (section 5.2). The Orthographic Tier gives the orthographic version of the utterance (section 5.3). Finally, the Break Index Tier provides numerals indicating the relative level of disjuncture between constituents (section 5.4).

12.5.1 The Tone Tier

The tone tier consists of the intonational analysis of an utterance, including the pitch accents, both phonological and morpholexical, the Accentual Phrase tones, and the Intonational Phrase boundary tones. The tonal transcription may be supplemented with diacritics in certain cases. There are two circumstances discovered thus far in which diacritics are useful in providing a detailed transcription of the phonetic realization of the tones. First, placing the diacritic < before a pitch accent indicates that the pitch peak associated with the accent is realized after the syllable which is phonologically associated with the accent, as in Figure 12.5.

Another important diacritic is the downstep diacritic associated with downstepped pitch accents. There are a number of circumstances in which downstepped pitch accents are likely to be transcribed. First, the downstep diacritic ! may be used before a phonological pitch accent which is phonetically lower than a preceding pitch accent in the same Intonational Phrase, as in Figure 12.7. It is also possible to use the downstep diacritic when a phonological pitch accent is preceded by a phonetically higher morpholexical pitch accent in the same IP, as in Figure 12.10. A final context in which a downstepped pitch accent commonly occurs is in an IP associated with tonal lowering and compression, as in postverbal nouns and postposed non-main clauses, as in Figure 12.3.

12.5.2 The Phonetic Transcription Tier

The phonetic transcription tier contains information about the segmental properties of an utterance, as well as prosodic features other than intonation, including stress. Because the transcription is phonetic rather than strictly phonological, it includes information about stress as well as allophonic segmental information, such as the processes discussed in section 4.2.2.

12.5.3 The Orthographic Tier

The orthographic tier provides a transcription of the Chickasaw orthographic system, which encodes phonemic contrasts at the segmental level, including length, and also morpholexical pitch accents (typically indicated by an acute accent). The letter to sound correspondences in Chickasaw closely resemble their counterparts in English with certain exceptions: the symbol “lh” represents a voiceless lateral fricative, an apostrophe indicates a glottal stop, and an underlined vowel stands for a nasalised vowel. Long vowels are written double. The interested reader is referred to Munro and Willmond (1994:ix-xi) for discussion of the orthography.

12.5.4 The Break Index Tier

The break index tier provides information about the level of disjuncture between adjacent elements. The perception of disjuncture may be cued by several properties, such as pauses, non-modal phonation at prosodic boundaries, segmental effects such as final lengthening or initial fortition, among other acoustic features. At this stage in the investigation of Chickasaw, it is useful to invoke four break indices expressed as numerals ranging from "0" to "3" where a higher number is associated with a greater degree of perceived disjuncture. Thus, the boundary of a large intonational constituent such as an IP is marked with a higher break index value than the boundary of a smaller intonational constituent such as an AP or Prosodic Word.

Because of the large number of Accentual Phrase tones transcribed in most Chickasaw utterances, boundaries between Accentual Phrases are indicated by brackets in the Break Index Tier in order to facilitate interpretation of the membership of individual tones. If an AP boundary coincides temporally with a numerical break index, this is indicated by a bracket immediately following the break index.

(i) The Break Indices

The lowest break index is 0 which indicates a very close juncture between two prosodic elements. Prosodic constituents separated by 0 are perceived to be prosodically a single unit though intonational evidence may indicate that the two constituents are distinct. A break index of 0 may be used to mark the boundary between two Accentual Phrases forming a single Morphological Word, as in the example in (31a). In the latter case, a diacritic would be used to indicate the mismatch between the close segmental juncture between the two Accentual Phrases and the relatively large intonationally defined AP break (see section 12.5.4 for diacritics).

A break index of 1 indicates a greater degree of disjuncture than 0. The value 1 is usually associated with at least a small pause between prosodic elements. A break index of 2 indicates a greater degree of disjuncture than 1, often cued by a small amount of final lengthening and a longer pause between constituents. Break indices of 1 and 2 are typically associated with the boundary between two APs belonging to different morphological words. The difference between a break index of 1 and 2 is rather subtle, but seems warranted given the difference in perceived level of disjuncture between a subject and the object in an SOV sentence compared to the disjuncture between an object and the verb in a SOV sentence. The perceived level of disjuncture between the subject and object is characteristically greater than the degree of disjuncture perceived between an object and verb. In the proposed system, this difference is transcribed primarily as a difference in break indices: 1 for the object-verb boundary and 2 for the subject-object boundary. It is conceivable that this difference in disjuncture reflects an additional level of prosodic constituency which would group the object and verb together to the exclusion of the subject, following the expected syntactic constituency. Determination of the exact prosodic properties defining this hypothesized constituent must await further research.

The final break index is 3, which is almost always associated with an IP boundary. A number of prosodic properties signal a break index of 3. The fundamental frequency range is reset, there is a lengthy pause following the boundary, and the segment before the boundary is lengthened to some extent and may be realized with non-modal phonation.

(ii) Diacritics in the Break Index Tier

In general, there is a close match between intonationally defined constituents and break indices. The value of 0 is usually used for constituents belonging to the same AP, the values of 1 and 2 are typically associated with the boundary between two APs, and the value of 3 characteristically corresponds to an IP boundary. Given this link between break indices and intonationally defined constituents, it is useful to have a notation to indicate exceptional cases in which the break index typically found at an intonationally defined boundary is substituted with another index. Such mismatches between intonational constituent and break indices might arise under several circumstances. For example, an IP boundary might be associated with a break index of 2 rather than 3. Similarly, an AP boundary might associated with a break index of 3 in case of an unusually long pause after the AP, or 0 in case of a AP break within a Morphological Word. In such mismatch cases, a lower case 'm' can be used after the break index value to signal a mismatch between intonational constituency and constituency defined in terms of more general perceived degree of disjuncture, including segmental diagnostics. An example of the mismatch diacritic appears in Figure 12.5, in which there is a mismatch between the AP boundary, usually associated with a 1 or 2 break index value but here marked with a 0 value, and the perceived close degree of juncture between the words [naʃoˈbaːd] and [maliˈlita], attributed in large part to the application of intersonorant voicing to the final alveolar stop in first word.

12.6. Summary and conclusions

In summary, this chapter has provided a description of and means for transcribing the principal features of Chickasaw intonation. The present study is clearly not an exhaustive study of Chickasaw intonation; such a study would require investigation of many other features, such as the use of intonation to convey various types of semantic and pragmatic information, quantitative aspects of the timing of fundamental frequency events, and the effects of speech rate on intonation. Investigation of these properties and others will doubtless necessitate modifications and additions to the model proposed here. It is hoped, however, that this study provides a general framework for describing the intonational system of a language whose prosodic system differs rather substantially from others whose intonational systems have been formally modelled.

Acknowledgments

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References

Beckman, M and Hirschberg, J. 1994. *The ToBI annotation conventions*. Ms. Ohio State University.

Beckman, M. and J. Pierrehumbert. 1986. Intonational structure in Japanese and English. *Phonology Yearbook* **3**, 255-309.

Beckman, M, Hirschberg, J., and Shattuck-Hufnagel, S. this volume. The original ToBI system and the evolution of the ToBI framework.

Bishop, Judith and J. Fletcher. this volume.

Campbell, N. and Venditti, J. 1995. *J-ToBI: an intonational labelling system for Japanese.* Paper presented at the Fall 1995 meeting of the Acoustical Society of America, St. Louis.

Godjevac, A. this volume. Serbo-Croatian ToBI.

Gordon, M. 1999. The intonational structure of Chickasaw. *Proceedings of the 14th International Congress of Phonetic Sciences*, 1993-1996

Gordon, M., Munro, P. and Ladefoged, P. 2000. Some phonetic structures of Chickasaw. *Anthropological Linguistics* 42, 366-400.

Jun, S-A. this volume. Korean intonation and prosodic transcription.

Munro, P. 1996. *The Chickasaw sound system*. Ms. UCLA.

Munro, P. 1999. *Chikashshanompa' Kilanompoli'*. Los Angeles: UCLA Academic Publishing Service.

Munro, P. to appear. Chickasaw. In Hardy, H. and Scancarelli, J. (eds.), *Native Languages of the Southeastern United States*. Lincoln: University of Nebraska Press.

Munro, P. and Ulrich, C. 1984. Structure-preservation and Western Muskogean rhythmic lengthening. *West Coast Conference on Formal Linguistics* 3,191-202.

Munro, P. and Willmond, C. 1994. *Chickasaw: An Analytical Dictionary*. Norman: University of Oklahoma Press.

Munro, P., Gordon, M. and Ladefoged, P. to appear. The phonetics and phonology of Chickasaw rhythmic lengthening. *UCLA Working Papers in Phonetics*.

Pierrehumbert, Janet. 1980. *The phonology and phonetics of English intonation*. MIT Ph.D. dissertation. [Distributed by Indiana University Linguistics Club].

Pierrehumbert, Janet & Mary Beckman. 1988. *Japanese tone structure*. Cambridge, Mass.: MIT Press

Pitrelli, J., Beckman, M. and Hirschberg, J. 1994. Evaluation of prosodic transcription labelling reliability in the ToBI framework. *Proceedings of the 1992 International Conference on Spoken Language Processing*, vol. 1, 123-6.

Silverman, K., Beckman, M., Pitrelli, J., Ostendorf, M, Wightman, C., Price, P., Pierrehumbert, J., and Hirschberg, J. 1992. ToBI: a standard for labelling English prosody. *Proceedings of the 1992 International Conference on Spoken Language Processing*, vol. 2, 867-70.

Venditti, J. 1995. *Japanese ToBI labeling guidelines*. Ms. Ohio State University.

Venditti, J. this volume. The J_ToBI model of Japanese intonation.