SOME ASPECTS OF THE TONAL PHONOLOGY OF BODO

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Abstract

This dissertation is an attempt to answer the basic questions regarding the tonal phonology of Bodo.

Chapter I gives a general introduction to the Bodo language, the existing research work in Bodo and summarizes the framework followed in the present work. This chapter also gives a brief explanation of the term ‘Tone Language’ and tries to exemplify how tonal contrasts occur in tone languages.

Since the literature on Bodo (specifically tones) is confusing as contradictory claims are made, we planned to establish the phonetics and phonology of Bodo tones with the help of digitally recorded data.

Chapter 2 explains how tone assignment takes place in Bodo non-derived monosyllabic lexical entries. This chapter also looks into the segmental interferences in realization of pitch. It also gives an overview of the method followed for data collection and analysis in this research work.

Chapter 3 looks at the tone assignment in Bodo non-derived disyllabic lexical entries. Like the previous chapter this chapter also looks into the segmental effects in the realization of pitch in disyllables.

Chapter 4 examines the tone assignment pattern in derived polysyllabic entries. It looks at the alterations that suffixes go through in a derivation. It is also an attempt to identify and explain different morphophonemic patterns observed in Bodo.

Chapter 5 gives an overview of the OT (Optimality Theory), and an OT account of the tonal phenomenon including tonal alteration in Bodo.

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Chapter I
Introduction

1.1 Introduction

1.1.1 The Bodo Language

Bodo is one of the major Tibeto-Burman tone languages, spoken in many parts of the North-Eastern states of India as well as in parts of West Bengal and Nepal. In Assam, Bodo is predominantly spoken in the districts of Goalpara, Nalbari, Barpeta, Dhuburi, Kamrup, Kokrajhar, Darrang, Sonitpur, Lakhimpur, Nagaon, Marigaon, North Cachar and Karbi Anglong. The fact that it is now included in the eighth schedule of the Indian constitution, demonstrates its socio-political importance. According to recent Indian government census Bodo is spoken by almost a million speakers. But these figures are highly unreliable as even during this research we found many people, who report to the census authorities that they speak Bodo, do not actually speak or in worst cases know the language. They just use the term “Bodo” to secure their ethnic identity.

As reported by Bhattacharya (1977) Bodo has at least four varieties:

1. North Goalpara variety, spoken in the northern regions of Goalpara and Kamrup districts. However the North Goalpara and the North Kamrup variety have salient differences.
2. A variety spoken in South Goalpara, Garo Hills and South Kamrup.
3. A variety spoken in Darrang, Lakhimpur and a few places of Arunachal Pradesh, Called the north central Assam dialect.
4. Another variety spoken in the Nowgong, North Cachar and Karbi Hills.

During this research we saw possibilities of assimilation between these varieties. Hence it is pertinent to conduct a research to identify the varieties of Bodo anew.

1.1.2 Phonemes in Bodo

There are 16 consonants and 6 vowels in Bodo. One striking feature of Bodo is the existence of a rather large phoneme inventory, which is rare in the North-Eastern Tibeto-Burman tone languages. The consonants and vowels of Bodo are described as below:

1.1.2.1 Consonants

Writing convention in this thesis	Description *(Bhattacharya, 1977)*
ph	Voiceless bilabial aspirated plosive
b	Voiced bilabial plosive
th	Voiceless denti-alveolar aspirated plosive
d	Voiced denti-alveolar plosive
kh	Voiceless aspirated velar plosive
g	Voiced velar plosive
m	Voiced bilabial nasal
n	Voiced denti-alveolar nasal
ng	Voiced velar nasal
s	Voiceless alveolo-palatal fricative
z	Voiced alveolo-palatal fricative
r	Voiced denti-alveolar tremulant
l	Voiced denti-alveolar lateral
h	Frictional semivowel
y	Frictionless palatal semivowel
w	Frictionless rounded velar semivowel

Table 1.1

1.1.2.2 Vowels

Writing convention in this thesis	Description (Bhattacharya, 1977)
i	Front, high, unrounded
u	Back, high, unrounded
e	Front, mid, unrounded
ō	Central, mid, rounded
o	Back, mid, rounded
a	Central, low, unrounded

Table 1.2

1.1.3 Tone languages

If the pitch of a word can change the meaning of a word, that language is called a tone language. The pitch not only changes the nuances of the language but also changes the core meaning of the language. It is worth mentioning that according to some studies 60-70 percent of world's languages are tone languages!

Yip (2002) mentions Hyman (in press) as a plausible definition of a tone language:

> *'A language with tone is one in which an indication of pitch enters into the lexical realization of at least some morphemes'*

To see how pitch change results in differences of meaning we can look at an example from Cantonese, where the syllable [yau] can be produced in six different pitches, which has six different meanings as shown below:

[yau]

high level	'worry'
high rising	'paint (noun)'
mid level	'thin'
low level	'again'
very low level	'oil'
low rising	'have'

In some languages, tonal distinction in polysyllabic words is obtained by contrastive positioning of restricted tones in different syllables. For example in Dagaare, a Gur language spoken in Ghana, a disyllabic word can be specified with two tones, H(igh) and L(ow) in the following ways:

a. σ σ
| |
L H

b. σ σ
| |
H L

In case of a disyllabic entry [yuori], tonal distinction is noticed in the following way:

LH [yuori] 'penis'
HL [yuori] 'name'

In many other languages, the positioning of the lexical tone does not matter much. It may appear anywhere in the lexical entry. The exact location of the tone may change according to the morphological or phonological environment.

1.1.4 Tones and the Bodo language

Like many other Tibeto-Burman languages, Bodo is also a tone language. However dearth of proper research of its tonal phenomenon has left many questions about the language unanswered. There have been conflicting views about the number of tones (ranging from zero to four!), tone assignment system and morpho-phonemics of the language. The only agreement most of the researchers have about the language is that it is a tone language. This thesis tries to settle many issues regarding the tonal phonology of Bodo definitely.

1.1.5 Studies on Bodo tones

In spite of being spoken by almost a million speakers, Bodo is not a well-researched language. The articles and books I had access to are Halvorsrud (1959), Burling (1959) Bhattacharya (1977), Weidert (1987), Boro (1991) and Joseph and Burling (2001). However, it is very disturbing that to come across contradictory claims regarding Bodo tonology in the research cited above. Our initial task was to go through the literature and establish the facts to our satisfaction. Since we consider the details of previous research as a point of departure for our own in the following chapters, we do not intend to give a detailed summary of the previous findings at this point.

1.2 The present study

Since Bhattacharya (1977) claimed the maximum number of tones in Bodo, we thought that his data would be the best starting point for our work. We gathered 128 words with distinct tonal features according to Bhattacharya (1977) and crosschecked them with the native speakers to further refine the set. This set constituted our database. We made two speakers of Goalparia dialect, use the words in the sentence frame (2) and digitally recorded the utterances.

(2) *Anjalua*______ *bungdungmon*

Anjalu ______ said

Initially we had the idea to substitute the proper name *Anjalu* with the first person singular pronoun /aŋ/. But later we realized that [ŋ] has a tendency to raise the tone of ethe following sequence. Therefore we chose a proper name so that the nominative marker /a/ would be word final. We give further details of our methodology in Chapter II.

1.3 Theoretical Background

1.3.1 Optimality Theory

Though the II, III and IV chapter of this work are mostly descriptive, the findings regarding the tonal pattern of Bodo is analysed in the framework of Optimality Theory (Henceforth OT) in Chapter V. OT is a linguistic theory proposed by Prince and Smolensky (1993) McCarthy and Prince (1993 a, b). It is an extension of the Generative Grammar. OT assumes that the surface forms or the outputs are the results of conflicts between different constraints. A constraint in OT is a rule that applies pressure to a phonological system. The constraints may induce pressure to change things (markedness constraints) or to preserve things (faithfulness constraints). In principle, constraints are violable in OT. These constraints are present in every language but they are ranked differently. Language specific ranking of the constraints explain the differences between languages. The core issues of OT are discussed in Chapter 5 of this work.

Though OT is an extension of the UG, its assumptions about UG are radically different from the rule based derivational theories. OT addresses several problematic issues. Archangeli and Langedon (1997) summarise some of the issues cited below:

- It defines a clear and limited role for constraints.
- It eliminates the rule component entirely.
- It focuses research directly on language universals
- It resolves the “non-universality of universals” problem.

1.3.2 The Autosegmental nature of Tones and the Optimality Theory

Goldsmith (1976) dealt with the problems of expressing tones suprasegmentally. Autosegmental representation of tones takes the form of a segmental representation of the vocalic and consonantal matrices linked by association lines to tonal features.

In the autosegmental model, tone is represented separately from the segmental base of an utterance but the tonal features are associated with segments. Goldsmith establishes the general conditions of the wellformedness:

1. All vowels are associated with at least one tone.

2. All tones are associated with at least one vowel.

3. Association lines do not cross.

The first two constrains of the wellformedness condition see to it that there are no stranded unpronounceable tones or vowels. However, it does not restrict the number of ways in which tones and Tone Bearing Units (TBU) are associated. In order to limit these possibilities some scholars take up the principle that tones and TBUs should be associated from left to right (Goldsmith, (1976), Williams (1976), Haraguchi (1977), Clements and Fort (1979), Goldsmith and Clements (1984)).

This principle came to be known as the Universal Association Convention. Later scholars noticed that though UAC is appropriate in many languages, there are cases where the final TBU is associated with several tones but the default situation is not to have such multiple associations. The convention can be reformulated as in (1):

(1) Map a sequence of tones on to a sequence of tone bearing units,

(a) from left to right

(b) in a one-to-one relation.

Condition (1)b precludes multiple associations of tones to tone bearing units. The convention is only the default case. It may be overridden if so stipulated for specific languages.

However, condition (1)a is not always appropriate. There are cases in which it s not possible to associate them from any direction. In these cases the tones are lexically determined and hence, not predictable. Only the remainder will be assigned by rule. Goldsmith brings in a particular formal device for the initial lexically determined association, i.e. the star notation. By marking the particular tone and the TBU to be associated, with a '*', and by associating these first, the desired alignment is achieved. This device identifies a particular TBU as the center of the tone pattern.

It is assumed that identical tones in sequence constitute a single occurrence of a tone on the tonal tier: sequences of similar tones on this tier are not permitted. This is known as the Obligatory Contour Principle (OCP). The principle was put forward by Leben (1973a) and then formulated by Goldsmith (1976:36) as follows:

OCP

At the melodic level of the grammar, any two adjacent tonemes must be distinct. Thus HHL is not a possible melodic pattern: it automatically simplifies to HL.

The implication of the model for the place of tone in prosodic structure is more important than the use as a descriptive tool. Yip (2002) proposes a general theory of tonology in the OT framework, which can account for all the autosegmental representations. This set of constraints is discussed in Chapter 5 of this work. The inherent strength of OT in dealing with typology makes it the most favourable framework to account for a system as complex and varied as tone.

1.4 The plan of the dissertation

This dissertation is an attempt to definitively answer the questions regarding tonal phonology of Bodo. This dissertation is in five chapters.

Chapter 2 explains how tone assignment takes place in Bodo non-derived monosyllabic lexical entries. This chapter also looks into the segmental interferences in realization of pitch. It also gives an overview of the method followed for data collection and analysis in this research work.

Chapter 3 looks at the tone assignment in Bodo non-derived disyllabic lexical entries. Like the previous chapter this chapter also looks into the segmental effects in realization of pitch in disyllables.

Chapter 4 finds out the tone assignment pattern in derived polysyllabic entries. It looks at the alterations that suffixes go through in a derivation. It is also an attempt to identify different morphophonemic patterns observed in Bodo.

Chapter 5 gives an overview of the OT (Optimality Theory), and an OT account of the tonal phenomenon in Bodo.

Chapter II

Tonal Patterns in Monosyllables

2.1 Introduction

While talking about the tonal properties of Bodo, Weidert (1987) is of the opinion that the tone patterns in Bodo are dependent on the syllable types and the consonantal specification of the syllable coda. According to him the ‘smooth’ and the ‘stopped’ syllable types give rise to different pitch patterns on the following syllables. He presents the smooth syllables as of /CV/ and /CVR/ types where R represents the resonants /m, n, ŋ, r, u, i/. The stopped syllables are of /CVʔ/, /CVRʔ/, /CVP/ types where P represents the obstruents /p, t, rʔ, k/. According to him monosyllables do not show any pitch difference but the voice level differs in terms of broad mid or normal (it is not quite clear what exactly he means by that). However, in the case of connected speech, the pitch of the word in the second position depends on the pitch of the first word, which is utterly predictable from its coda consonant. If the first syllable has an underlying glottal stop, the glotallization is lost but it gives rise to a high pitch on the following syllable. But high pitch is NOT noticed on the second syllable if the first syllable is a smooth one. The main generalizations regarding tones in Bodo, according to Weidert, are

1) tone contrasts are not present in monosyllables and
2) tones are to be derived from syllables codas which may or may not be realized on the surface.

The implication is that Bodo is not a full-fledged tone language but a case of tonogenesis. We show, in this chapter, that both these generalizations are untenable in the contemporary dialect of Bodo that we analyzed (Goalpara dialect). However, Weidert himself gives examples where the predictable pitch phenomena show exceptions. There are instances of a first syllable having a glottal stop, but failing to produce a high pitch on the second syllable. He marks the compounds with /doiʔ / as irregular. He says, "Such an interpretation produces the (structurally unwanted) effect of underlying allomorphy under unpredictable conditions and thus tends to blur the morphological-cum-tonogenetic unity of the system" (Weidert, 1987: 422)

As we said earlier, we will illustrate with spectrographic evidence our claim pertaining to contrastive tones in Bodo. We will demonstrate that monosyllables with the same C and V specification can have different, underlying, lexical tones, which are not attributable to any consonantal margin of the syllable. However, when we examine polysyllables in Chapter IV, we will show that Weidert's claim that the tonal specification of the preceding syllable is realized on the following syllable is partially correct in certain types of morphologically derived forms.

Baro (1991) says that Bodo has a two-tone system, which he describes as the rising and the falling tones. The syllable with a falling tone, according to him, has a lengthened vowel without any glottal check. The glottal stop, according to him, occurs only in syllables with a rising tone with one of the consonants /r, m, n, ŋ/ as a coda. We can infer from Baro's observation that, he too, like Weidert, associates a glottal stop or a glottalic consonant with high tones. His conclusion is that Bodo has unpredictable i.e., lexical tone and that every lexical entry must be specified for tone as well.

We will show in the course of this chapter and the next, that as claimed by Baro, Bodo does have lexical tone even on monosyllables and that only high tone is associated with the glottal phenomenon. However, when we consider disyllables, in Chapter III, we will show that not every syllable of a lexical entry may be specified for tones.

Bhattacharya (1977) claims that Bodo has a four-tone system, with three tones available in different positions and a neutral tone, which is dependant on either the preceding or the following non-neutral, toned syllable (Bhattacharya, 1977). According to Bhattacharya the three tones in Bodo are high, mid and low (indicated by /1/, /2/ and /3/ respectively). He identifies tone1 as having a level or a rising pitch pattern. Tone2 as a level or a falling and tone 3 as having a falling pitch pattern.

Halvorsrud (1959) also identifies three tones, in his early account of the Bodo language, as high, medium and low. He observes that the difference between the high and the low tone is very evident. But he does not talk much about the mid tone, as it lacks perceptual salience. In the absence of any data exemplifying the “third” tone we must come to the conclusion that Bodo has only two lexical tones according to Halvorsrud.

Joseph and Burling (2001) come to the same conclusion when they say that Bodo has only a two-tone system. Earlier in Burling (1959), evidence for only two tones was found, i.e. high and low. He even postulates that the high tone ends with a glottal stop but at the same time he speculates the possibility of a high tone not associated with a glottal stop.

Our findings based on extensive data lead us to concur with the findings in Burling (1959) as well as Joseph and Burling (2001). There are only two tones in Bodo and the glottal stop is only idiosyncratically associated with the high tone in the synchronic variety of Bodo.

2.2 The Data and The Method

The analysis in this thesis is based on the data collected from two male, educated, adult native speakers of Bodo (the Goalparia dialect). The data of 59 sets of words were constructed using Bhattacharya (1977) as the resource work, assuming a three-way tonal contrast. The native speakers were then asked to pronounce the words placing them in the blank position of the sentence frame- "Anjalu[1]____ said"[2]. The data was recorded on a portable Digital Audio Tape (DAT) recorder, which ensures recording with minimum distortion.

The words that were selected had contrastive tones, as claimed by Bhattacharya (1977). For example a set of words like the following was used for the experiment (see Appendix 1):

Set 1

^{1}bar *v.* jump *with a high tone*
^{2}bar *n.* wind *with a mid tone*
^{3}bar v.bloom *with a low tone.*

Set 2

^{1}dōy	*v.* lay eggs, place; on a head	*with a high tone*	
^{2}dōy	*n.* water	*with a mid tone*	
^{3}dōy	*v.* sweeten, feel sweet	*with a low tone.*	

Set 3

^{1}ray	*v.* harm by magical power	*with a high tone*	
^{2}ray	*v.* abuse	*with a mid tone*	
^{3}ray	*v.* speak	*with a low tone.*	*(Bhattacharya, 1977)*

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1 A proper name.
2 The sentence in Bodo is "*Anjalua______ bungdungmon*."

The informants were given a list of Bodo monosyllables in Roman script and also in Devanagari, which is the official script for Bodo now, along with the gloss to disambiguate homophones. They were required to insert the given word in the sentence frame given above. The data were recorded with a digital recorder for optimum clarity and were analyzed by speech analysis software called PRAAT 4.0.26. Each word was pronounced four times and out of the four iterations three were selected for analysis. The data were then fed into the computer with an analog interface cable. With the help of PRAAT 4.0.26 the words were segmented from the sentence. With the help of the different graphic representations created by the software, the pitch and the sound quality were determined.

2.3 The Hypotheses

In this study we find support for two hypotheses:

1. Though it was claimed that Bodo has four tones (Bhattacharya, 1977), there are actually only two tones available in Bodo monosyllables. We will look into the characteristics of the tones as we put forth our arguments for our hypothesis. Our hypothesis is contrary to Weidert, who claims that Bodo tones are predictable and that tonal distinctions do not show up in monosyllabic words.

^{1}**eo** *'cut the jungle to make it clear'* ^{3}**eo** *'plough'*

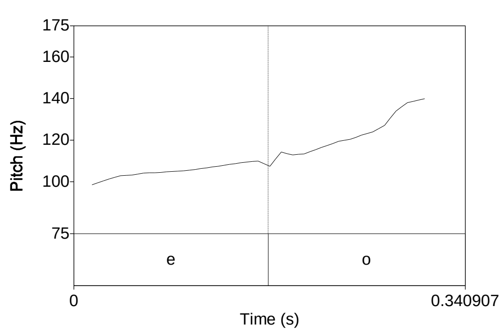


Fig 2.1

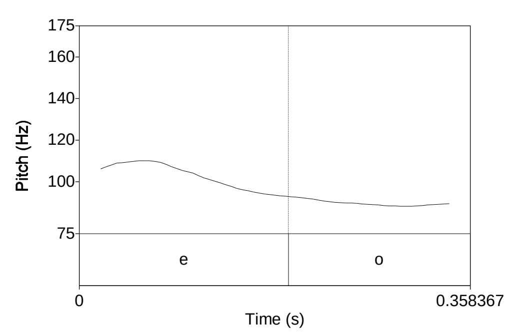


Fig 2.2

[1]**lao** *'be long'*

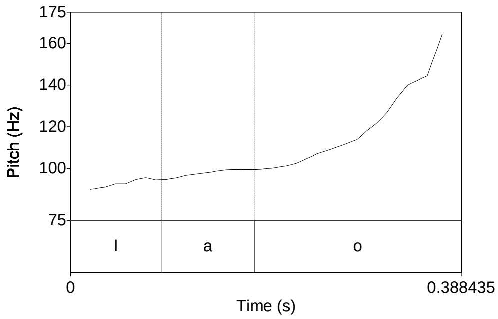


Fig 2.3

[2]**lao** *'gourd'*

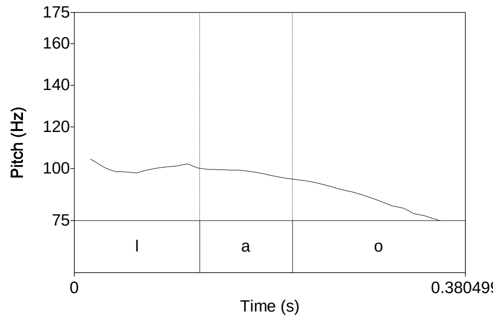


Fig 2.4

Contrary to the claims of Weidert, the pitch tracks noticed in the pictures above clearly show that an unpredictable tonal difference exists in Bodo monosyllables.

[1]**hor** *'send'*

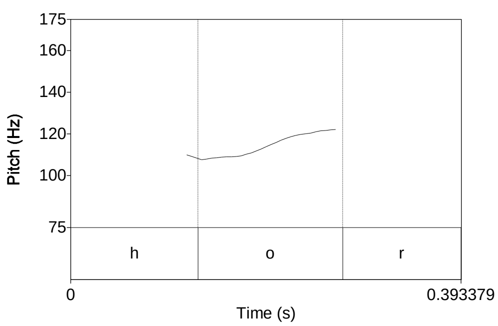


Fig 2.5

[2]**hor** *'night'*

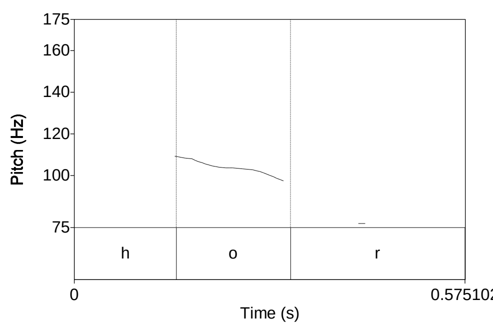


Fig 2.6

[3]**hor** *'bent'*

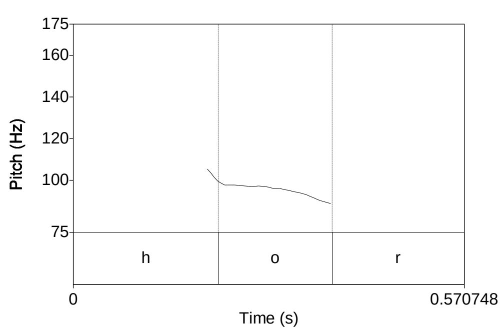


Fig 2.7

However, a look at the pictures above clearly shows that *hor* does not have a three-way distinction of tones as postulated by Bhattacharya. We observe only a two-tone system in Bodo even in our analyses of the other monosyllables. The system we postulate has only a high tone and a low tone.

2. There may be a glottal stop at the end of an open syllable carrying a high tone. If the syllable is closed then the consonant may be glottalized. It challenges Weidert (1987), who proposes that some of the Bodo monosyllables acquire the high tone due to a glottal stop that occurs in case of open syllables. We will try to show that the tone is not affected by the glottal phenomenon but the glottal phenomenon is associated only with the high-toned syllables.

^{1}**za** *'eat'*

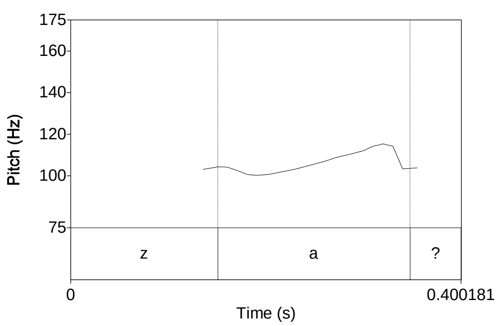


Fig 2.8

^{3}**za** *'be, become'*

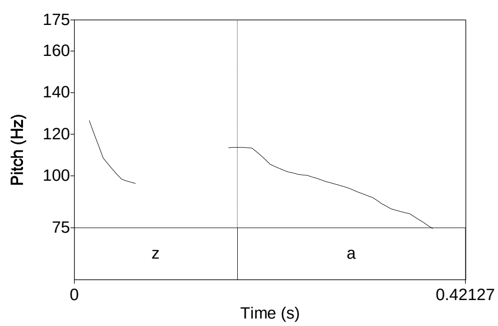


Fig 2.9

^{1}**no** *'house'*

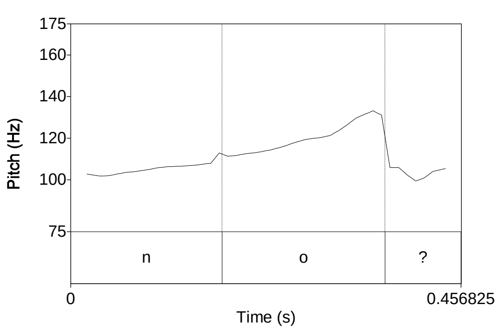


Fig 2.10

^{3}**no** *'offer'*

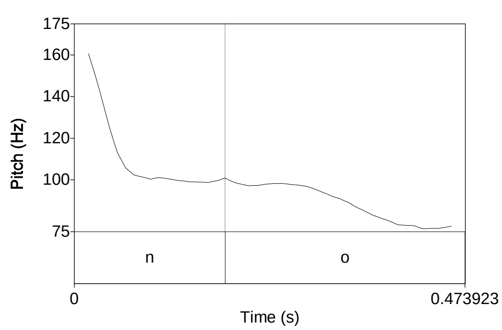


Fig 2.11

^{1}**gong** *'horn'*

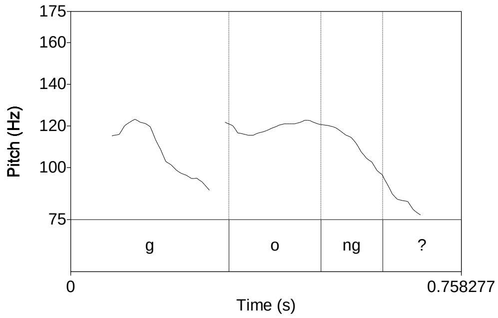


Fig 2.12

^{3}**gong** *'bent, bend'*

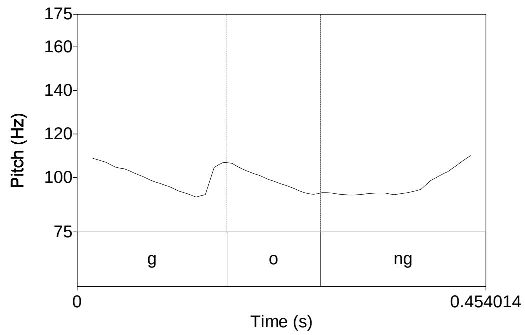


Fig 2.13

The pictures above clearly show that the glottal stop may occur with an open or a closed syllable, but only in the context of high tones.

2.4 The Findings

While analyzing the data it was noticed that monosyllables follow a particular pattern as far as the tone distinction is concerned. In monosyllables, the pitch pattern (if any) on the onset was ignored, and the pitch pattern on the nucleus and the coda (if any) was considered to be the tone pattern of the word. The pitch, which showed a frequency of 100-110 Hz (for both the male speakers), was considered to be of a ***medium*** tone (which we call 'm') and the any pitch pattern above and below it is considered to be of a ***high*** (+H) and ***low*** (L) tone respectively.

^{1}**ha** *'land'*

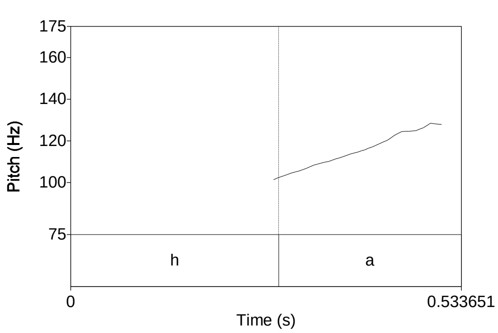


Fig 2.14

^{3}**ha** *'cut by pressing'*

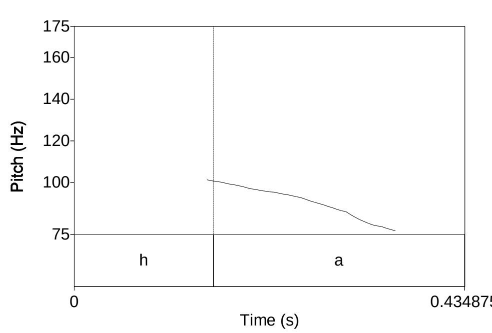


Fig 2.15

In the pictures above we see the two-tone patterns we describe to be high and low. Figure 2.14 shows an instance of a high tone, whereas figure 2.15 shows a low tone associated with the word *ha*. We observe that both the pitch initiations are almost at the same position. We associate this position with the mid tone. Hence we come to the conclusion that all the tones start from a default tone, which we call in our analysis the mid tone from thereon it either rises or falls to assign a distinct tonal identity to the syllable.

2.4.1 The Onset Effect

The analysis also showed that the initial pitch level on the analyzed part of the word differed depending on the consonant in the onset position. In case of an aspirated onset the pitch started at a high position and if it is associated with a high tone it moved to a further high position. Whereas, the onsets having other consonants, i.e. voiced obstruents and sonorants started at a slightly lower mid position and moved to a relatively higher position for the lexically specified higher and to a lower pitch for the other tone.

[1]**phung** *'morning'*

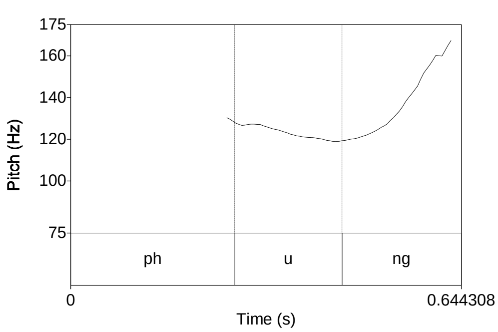


Fig 2.16

[1]**gab** *'colour'*

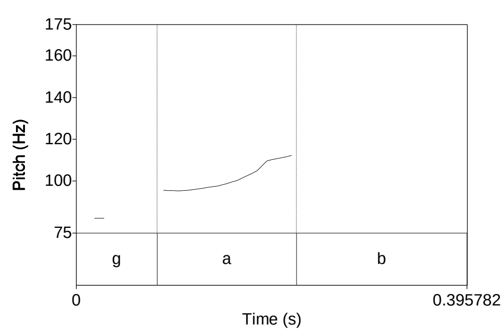


Fig 2.17

^{3}**phung** *'be fat and fleshy'*

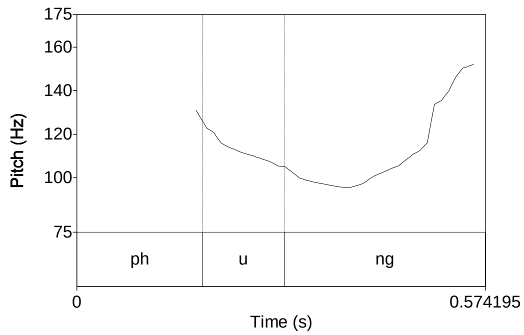


Fig 2.18

^{3}**gab** *'weep'*

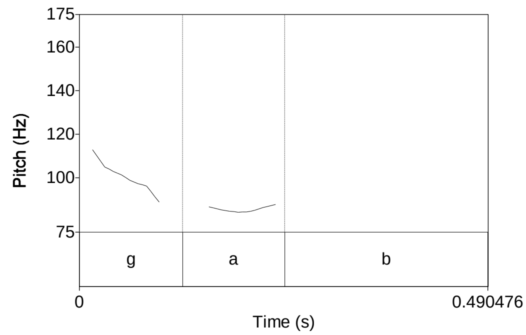


Fig 2.19

It can be concluded from this observation that the pitch initiation is affected by the consonant quality of the onset that is extremely predictable. This predictable raising/lowering effect is ignored in the rest of the dissertation.

2.4.2 The Tones

It is observed that the pitch pattern rises from mid to high in Tone 1 as seen in the picture below. Tone 1 may be accompanied by a glottal stop or a glottalized consonant in the coda position.

^{1}**gao** *'tear, split'*

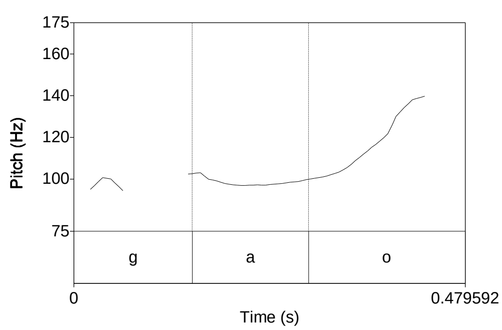


Fig 2.20

To reiterate the point we have made earlier, we could not find out any systematic difference between tones 2 and 3 of Bhattacharya. A look at the pictures below makes this claim evident.

²ray **³ray**

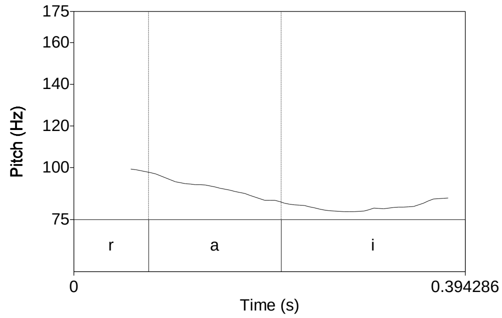


Fig 2.21

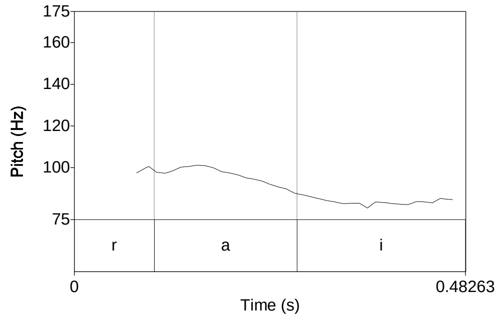


Fig 2.22

A detail look at the CVG pattern of monosyllables (where G is a glide) clearly shows a two-way distinction between the tones. The low fall observed in some of the words having supposedly Tone 2 and Tone 3 systematically failed to show any difference (as in the pictures above).

2.4.3 The Nasal Coda

In our analysis we observed that whenever a nasal consonant occupies the coda position, it takes the rising pitch when the word is associated with a high tone. In the words with a low tone, the pitch on the nasal coda shows a tendency to rise towards the end of the consonant. The pictures below show that the nasal coda continues to rise in the context of

¹beng *'watch'* **³beng** *'agree'*

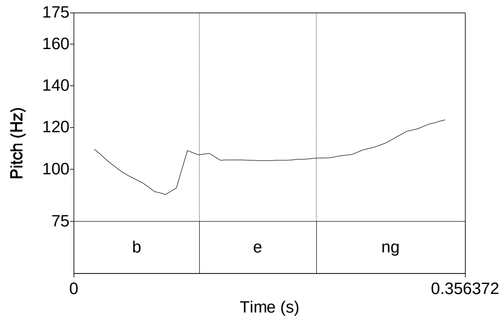


Fig 2.23

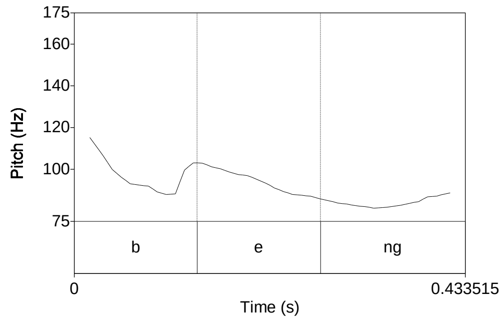


Fig 2.24

^{1}**ham** *'be lean and thin'*

^{3}**ham** *'come around'*

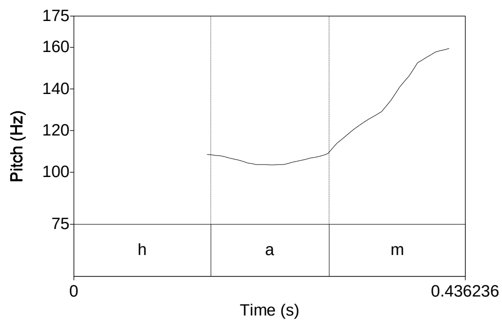


Fig 2.25

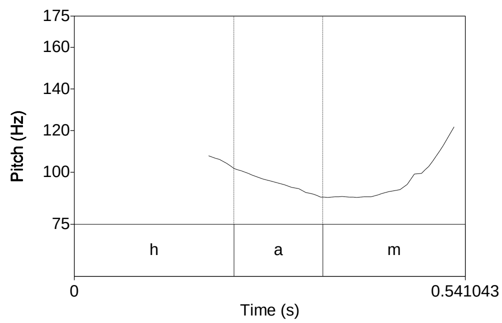


Fig 2.26

^{1}**khon** *'arrange clothes'*

^{2}**khon** *'sing, occasion'*

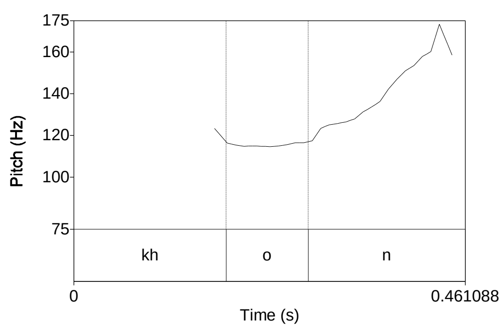


Fig 2.27

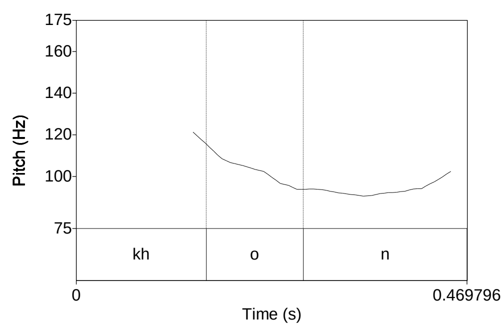


Fig 2.28

a high tone and even in the context of a low tone it induces a slight rise towards the end. We therefore assume that whereas nasal codas have the property of raising the tone, nasal onsets do not have that property as they induce a lowering of the initial 'mid' tone on the vowel.

2.4.4 Vowel Length in Contrastive Tones

We observe a particular pattern of vowel duration in open syllables. The pictures below make it evident that the vowel length is affected by the tonal specification. It is

[1]**bu** *'strike, beat'* [3]**bu** *'swell'*

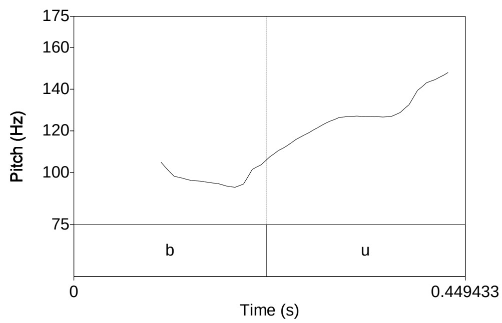


Fig 2.29

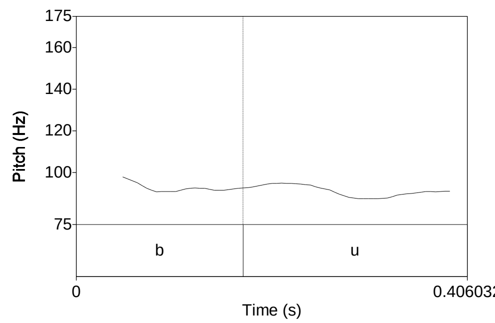


Fig 2.30

seen from the pictures that the vowel in the word with a low tone is distinctively longer than the vowel in the word with a high tone. This is the case uniformly present in all the open syllables as Fig. 2.31 and Fig. 2.32 illustrate:

[1]**ha** *'land'* [2]**ha** *'be able'*

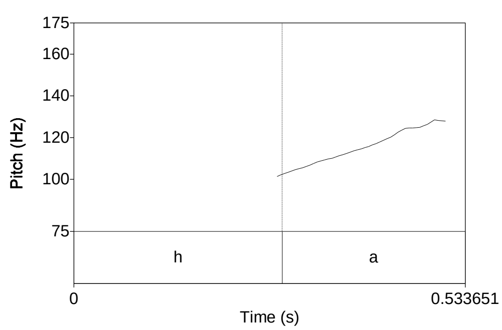


Fig 2.31

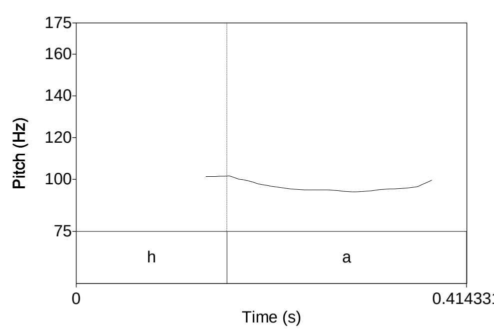


Fig 2.32

2.4.5 The Glottal Stop Phenomenon

In case of Tone 1 we sometimes see a glottal stop or a glottalized consonant at the end of the syllable. Whereas, low toned syllables do not ever show a syllable final glottal stop. Spectrographic analysis of monosyllables with high tone shows random presence of a glottal stop. We call it random presence as it fails to show up regularly even in the same lexical entry. In Fig. 30 and 31 we see two different iterations of the same lexical entry **[1]gong** *'horn'*

[1]gong *'horn'*

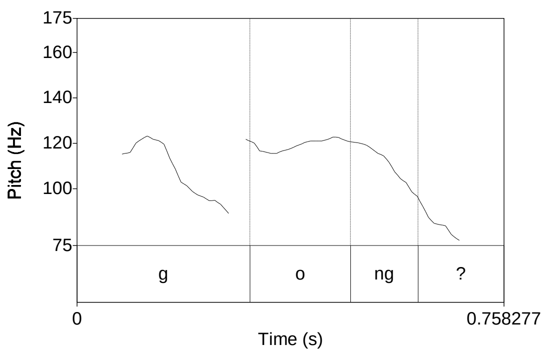


Fig 2.33

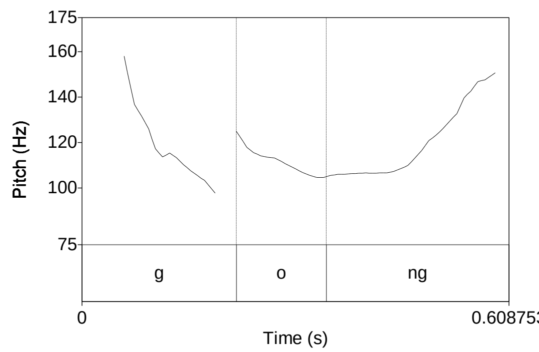


Fig 2.34

by the same speaker differs in terms of the presence of a glottal stop[3].

The glottal stop induces a sharp fall in pitch as it does in Mizo (Lalrindiki, 1989). But the basic difference between the occurrence of the glottal stop in Mizo and Bodo is that in the former it occurs in a low tone syllable, where it makes the low tone an extra low tone actually realized as a very sharp fall. Whereas in case of the latter the glottal stop occurs in high tone syllables. Among the set of data collected the following words have a glottal stop as a coda in a high tone syllable:

/hu/ *'land'* /kha/ *'pluck'*

/khu/ *'make naked* /ro/ *'leak out'*

[3] It is clear that a nasal coda has a tendency to raise the tone and the glottal stop 'ʔ' to depress the tone. The presence of a ʔ actually pushes the H tone to the left (as seen in Fig 2.30) and if the nasal is in the final position, the H tone is free to move to the right. Of course, this is just a tentative observation. More work needs to be done in this area.

/si/ *'cloth'* /song/ '*cook*'

/sa/ *'north/make rope'* /su/ '*wash/saw/thorn'*

/za/ *'eat'*

It seems to us that some high tones lexical entries have an idiosyncratic ʔ underlyingly. The deletion of the glottal stop (which seems to be in free variation) is optional depending on factors yet to be established.

2.4.6 The /r/ in the Coda

In our analysis of the Bodo data we found some abnormalities in the pitch associated with the consonant /r/ in the coda position. It was noticed that in some cases the pitch track

[1]**er** *'move by finger or handle'*

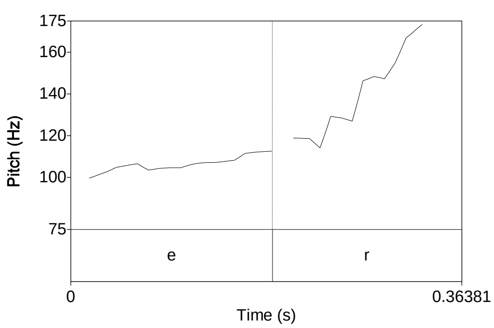


Fig 2.35

[3]**er** *'grow, increase'*

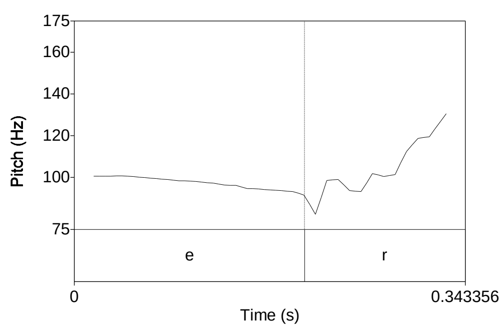


Fig 2.36

[3]**bar** *'bloom'*

[3]**bar** *'bloom'*

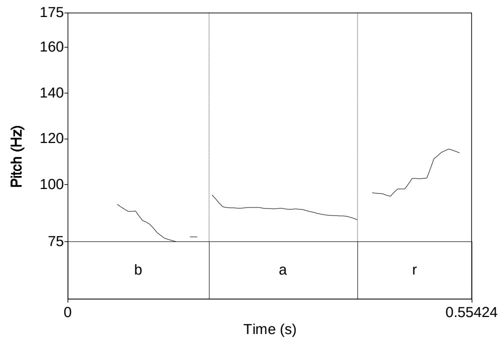


Fig 2.37

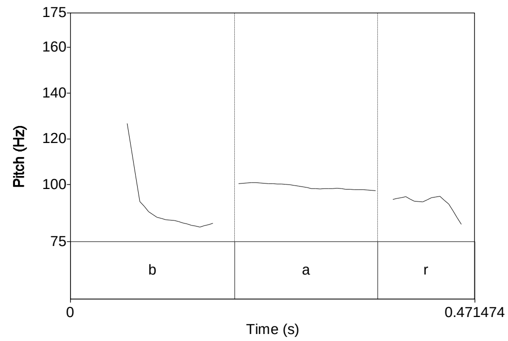


Fig 2.38

associated with the /r/ is rising and in a few cases it is actually falling. We notice that the pitch on 'r' rises in an unsteady manner in both high and low toned syllables; e.g. Fig 2.35, 2.36, 2.37 and 2.38. However, to our dismay we found the pitch falling, in a tone syllable with 'r' in one of the utterances of *bar*^{L} *'wind/bloom'*. We then took a look at all the instances of 'r' in the coda in our recording in both high and low toned syllables. The irregular rise in tone was observed in 60% of the iterations. However the pattern remained consistent (unlike the glottal stops) in specific items. We are open to the idea that there could be two 'r' s in Bodo with distinct phonetic patterns of realization. We leave the issue for future research.

2.5 Conclusion

We conclude that in Bodo the tonal phenomenon is lexical. In case of monosyllables we see that they have a tonal distinction, however it is not a three-way distinction, as claimed by Bhattacharya, but only a two-way distinction.

It is clear that the right edge of the rhyme is associated with the lexically specified tone (+H or –H) and the default pitch on the left of the lexical tone is a mid tone which we depict as 'M'.

It could be argued that the lack of distinction between Bhattacharya's Tone 2 and Tone 3 is actually a case of mistaken homophony, i.e. the lexical item with Tone 2 is taken to be a lexical item with Tone 3 and vice-versa. Our answer to this objection is that this interpretation does not explain why, then, the informants did not systematically mistake lexical items with Tone 1 to be homophones with Tone 2 or Tone 3. Moreover, as we said earlier, our set of words for determining the tonal distinction is fairly large, i.e. 59 set. Hence we can safely say that our findings are quite robust.

Having found no evidence for a three way tonal distinction, but sufficient evidence for consonantal effects on the pitch pattern (see section 2.4.1), we then selected words with the pattern VG in the rhyme to avoid any consonantal effect in the tone. We avoided selecting monosyllables with a short vowel to weed out checked syllables at the initial pass. Then we examined 9 sets of monosyllables with the VG rhyme sequence to see whether our hypothesis regarding a two-tone system was robust or not. We are happy to conclude that of the 9 sets of the tokens examined we had 100% success in isolating the two types of tonal pattern in Bodo.

The pictures below show the pitch pattern with the VG rhyme sequence:

gao^{+H} *'tear or split'*

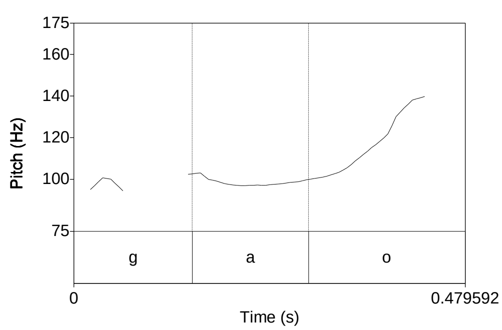


Fig 2.39

gao^{L} *'shoot by arrow or gun'*

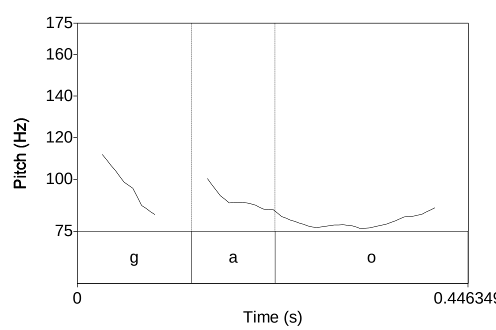


Fig 2.40

law^{+H} *'be long'*

law ^{L} *'gourd'*

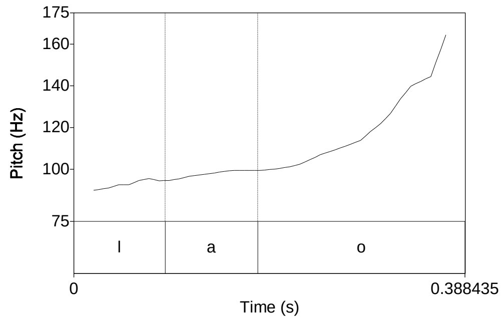


Fig 2.41

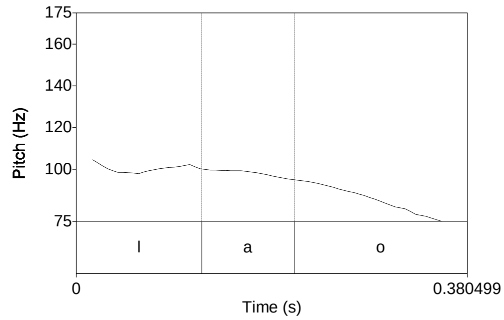


Fig 2.42

Figure 2.39 and 2.41 clearly show a rise in the pitch as it represents the +high tone. In figure 2.40 and 2.42 we can notice a fall that can be associated with a –high or a low tone.

We have shown that the glottal stop is associated only with high-toned syllables. However we have also shown that not all high-toned syllables end in a glottal stop. Whereas some lexical items do not have a final glottal stop in any of the iterations, some lexical items exhibit a final glottal stop at least in some of the iterations (Figure 2.33). There are two explanations to this phenomenon.

(1) One can postulate a glottal stop underlyingly with all overtly high-toned syllables (on the lines of Weidert). Then an optional rule of glottal stop deletion is postulated to account for the absence of glottal stops in some words. This explanation makes Bodo out to be a non-tone language underlyingly requiring a rule of +H tone insertion in the context of a glottal stop, supporting Weidert. But the problem with this explanation is that even for lexical items that do not have a final glottal stop overtly in any of the iterations, we end up postulating an abstract, final glottal stop. The second problem with this solution is that an abstract glottal stop requires to be postulated only at the right edge of some lexical items. If the glottal stop is a legitimate segment in synchronic Bodo, why is it confined to the morpheme final position?

(2) The second explanation, to which we are sympathetic, is to assume that Bodo is a pro-tone language with every lexical item associated with one of the two tones. Further, some high tonal syllables may have an underlying glottal stop that may or may not be realized overtly. It requires an optional rule of glottal deletion. In answer to the criticism that only +H syllables should be associated with a glottal stop, we suggest that only a detailed investigation of the effects of tones on segments and their allophones will yield an answer to this question.

It will be recalled that high-toned syllables induce a shortening of the vowel. This could be one of the realizations of a 'tense' articulation associated with the high tone (Bhattacharya, 1977). However, more research is required before we can definitely claim that high tones induce other specific segmental effects in Bodo.

Chapter III

Tonal Pattern in Disyllables

3.1 Introduction

Some facts that are noticed in Chapter II can be reiterated in the analysis of disyllables. For example, as in monosyllables we notice no difference between Tone 2 and Tone 3 in case of the disyllables. Contrary to Bhattacharya (1977), we will try to show in this chapter that even in disyllables Tone 2 and Tone 3 are not distinct.

Weidert (1987) claims that the tonal specification of the preceding syllable is realized on the following syllable. In relation to his claims we will show in this chapter that the preceding syllable of a disyllabic word, in fact, does not take any tone at all. It is the final syllable where the tone is realized.

3.2 The Hypothesis

The hypotheses in this chapter regarding disyllables will be:

1. There are only two tones in Bodo disyllables – the high and the low tone.
2. Disyllables cannot take tones in both the syllables.

   *T_iT_j (when *i* and *j* are distinct)

   *T_iT_i (when both the syllables take identical tonal pattern)
3. Only the final syllable is specified for tone.

3.3 The Findings

3.3.1 Tone Assignment in Disyllables

In the tone assignment of disyllables we observe an interesting system. Contrary to Bhattacharya we see that the pitch of the first syllable of a disyllabic word always remains between 100-110 Hz, this according to us is the mid tone. As this system of tone assignment is uniformly followed, it is pertinent to say that in Bodo the first syllable of a disyllabic non-derived word does not take any lexical tone. The mid tone, which is assigned to the first syllable of the word, is actually the default or the unmarked tone. We present below spectrographic evidence that we found while analyzing the data. However, the transcription of the words from 3.1 to 3.4 is as found in Bhattacharya (1977).

^{1}bi^{1}dōy [$^{+H}$bi^{+H}dōy] *'juice'*

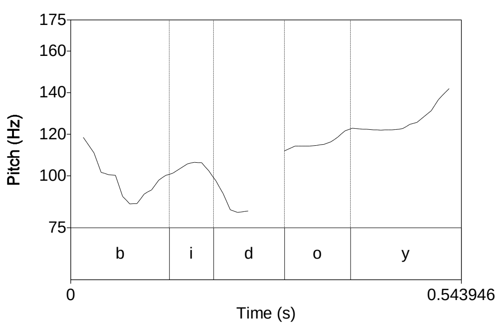


Fig. 3.1

^{2}da^{1}lang [^{L}da^{+H}lang] *'do not take'*

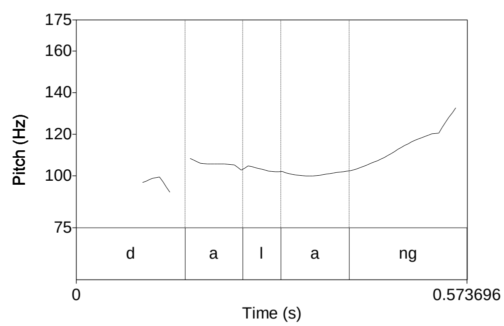


Fig. 3.2

^{2}bi^{3}dōy [^{L}bi^{L}dōy] *'egg'*

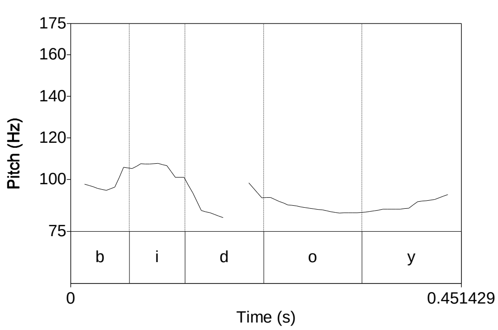


Fig. 3.3

^{3}da^{3}lang [^{L}da^{L}lang] *'bridge'*

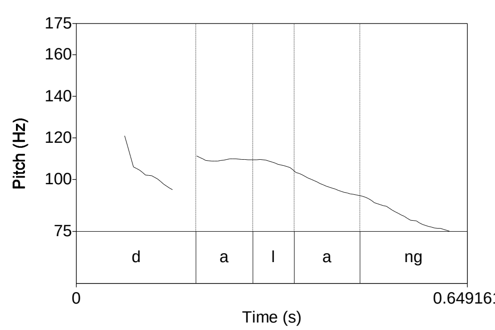


Fig. 3.4

Consider the pictures in fig. 3.1 and fig. 3.2, where the first syllable in $^{+H}$*bi*$^{+H}$*dōy* (fig.3.1) is supposed to have a high tone and the first syllable in *[*^{L}*da*$^{+H}$*lang]*(fig. 3.2) is supposed to have a 'mid' tone according to Bhattacharya. What we, in fact, see is our mid tone in both the initial syllables. Had the first syllable been associated with a high tone, the pitch track would have been like as it is shown in fig. 3.5, which, of course, is manipulated for the purpose:

^{1}bi^{1}dōy [$^{+H}$bi^{+H}dōy] *'juice'*

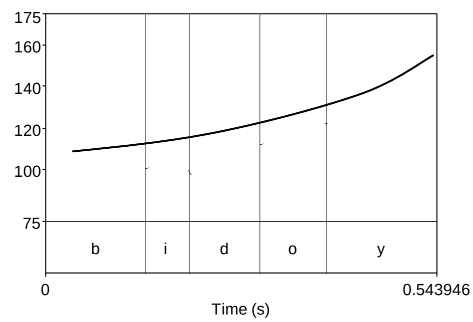


Fig. 3.5

Similarly, take the case ^{L}*bi*^{L}*dōy* (fig. 3.3) and ^{L}*da*^{L}*lang* (fig. 3.4). Had the tonal specification on the first syllable been low, the pitch pictures would have looked like fig. 3.6 and fig. 3.7 respectively.

^{2}bi^{3}dōy [^{L}bi^{L}dōy] *'egg'*

^{3}da^{3}lang [^{L}da^{L}lang] *'bridge'*

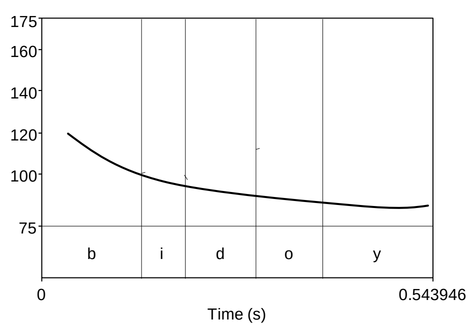


Fig. 3.6

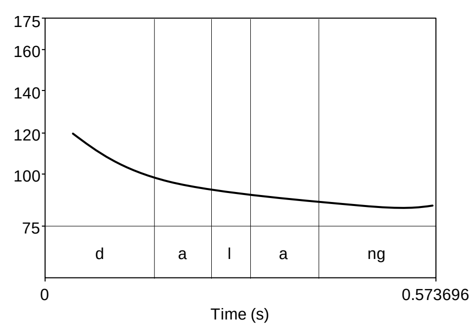


Fig. 3.7

The fall should have been initiated in the first syllable itself and the pitch should have kept falling as in the 'corrected' pictures show. But this is not what happens in the language (fig. 3.3 and fig.3.4).

Looking at 3.1, 3.2, 3.3 and 3.4 we can say that only the final syllable is associated with a lexically specified tone. The first syllable in all these cases is the default mid tone. Therefore our claim is that in Bodo, each word must have one and only tonal specification which is associated with the syllable on the right. The preceding syllables get a default mid tone. Therefore the transcription of the words is modified hereafter. Henceforth, we follow the practice of indicating lexical tone only on the final syllable.

3.3.2 The Onset Effect on the First Syllable

In Chapter II we observed that the pitch of the syllable is influenced by the consonant in the onset position. Similarly in case of the disyllables the default tone of the first syllable is influenced by the consonant in the onset position. It accounts for the pitch variation in the mid tone from 100 Hz to 110 Hz. As observed in Chapter II, the pitch of a TBU is raised by an aspirated onset. As seen in the picture below the aspirated consonant in the onset position raises the pitch. The fall seen in the pitch can be interpreted as a process of lowering the pitch to the unmarked position.

kha^{L}lay *'do, perform'*

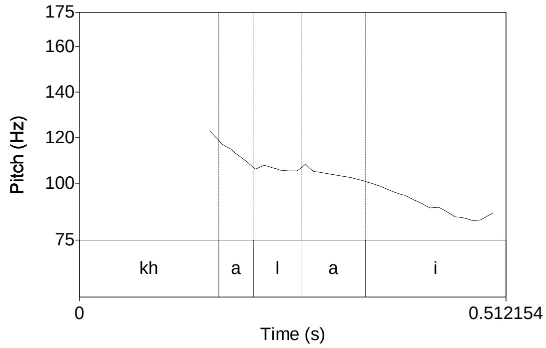


Fig. 3.8

Similarly we notice in case of the sonorants /s/ and /h/, that the initial pitch is raised by these consonants in the onset position. But the consonants /l/ and /m/ in the onset do not induce a high tone. They carry the default mid tone.

lu^{+H}khang *'finish work'*

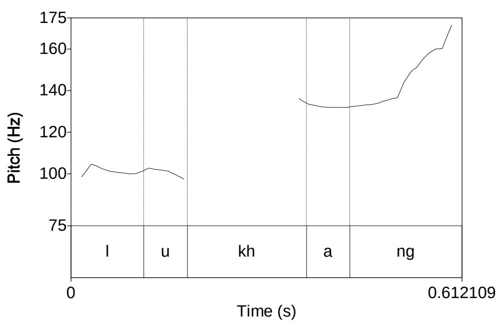


Fig 3.9

mō^{L}dōm *'sweet smelling'*

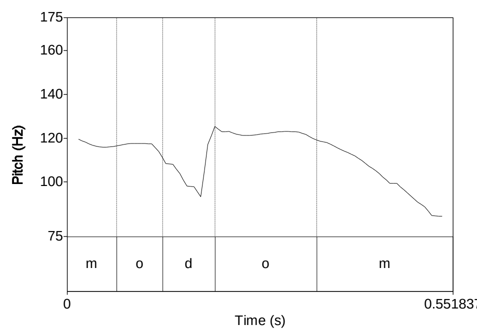


Fig 3.10

^{M}hō$^{+H}$sō *'drive'*

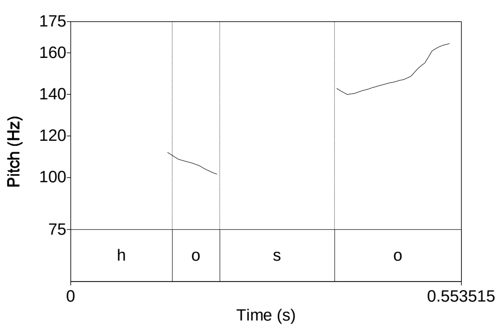


Fig 3.11

so^{L}may *'decorate'*

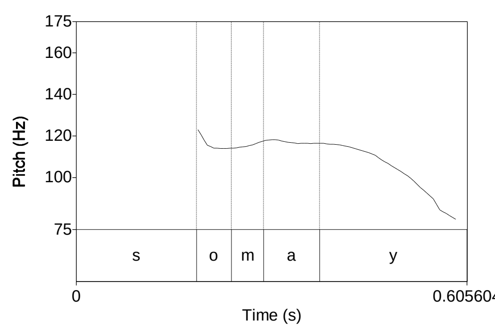


Fig 3.12

Figure 3.9 and 3.10 show that the onset does not induce a high or a low tone, rather it associates itself with the default 'mid' tone. Hence they do not induce a fall in the mid tone. Whereas figure 3.11 and 3.12 show a drop in the pitch, which indicates that the consonants /h/ and /s/ in the onset induce a high pitch.

The tone of the second syllable of a disyllabic word is constructed in comparison with the default tone in the first syllable. So any pitch pattern higher than the default tone can be interpreted as the high tone, conversely any tone lower than that of the default tone can be seen as a low tone.

3.3.3 Tone Distribution and Onset Effect on the Second Syllable

It was observed in our analysis that the initial pitch of the second syllable of the disyllabic word is the pitch of the default tone. In the latter part of the utterance the word the pitch changes according to the tone that the second syllable is linked to.

ga^{+H}hay *'short'*

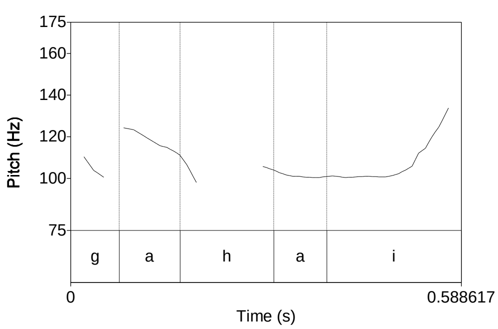


Fig. 3.13

ga^{L}hay *'main,head'*

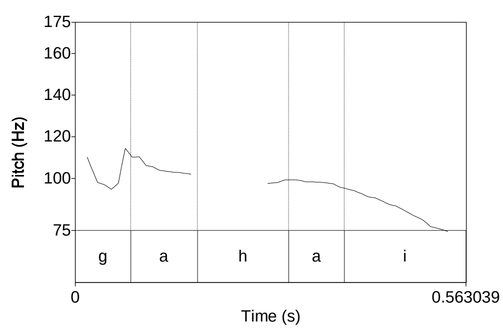


Fig. 3.14

gu^{+H}dung] *'hole'*

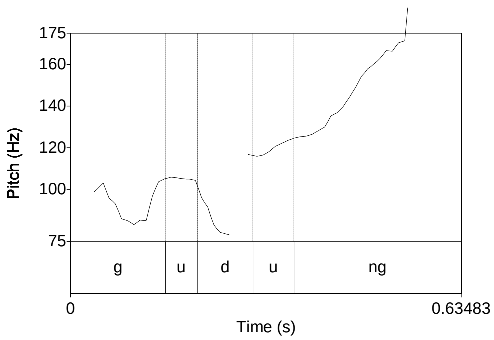


Fig. 3.15

gu^{L}dung *'hot'*

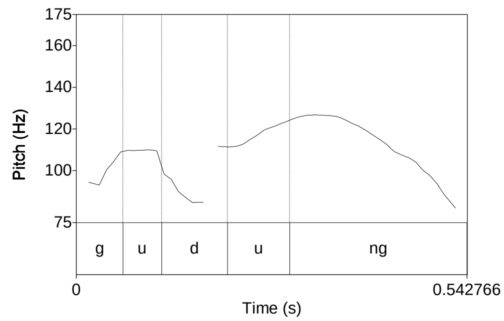


Fig. 3.16

A close look at the second syllables of the pictures above shows that the second syllable starts at around 110 Hz. If it is a high tone, as in ga^{+H}hay and gu^{+H}dung (figure 3.13 and 3.15), the pitch rises. Whereas in case of a low tone, as in ga^{L}hay and gu^{L}dung (figure 3.14 and 3.16), the pitch falls downwards from the default mid tone. Whereas medial /h/ is completely voiceless and the pitch of the second vowel takes off from where it left off in the preceding vowel, we notice that voiced stops actually induce a drop in pitch from the first vowel. However, the pitch on the second vowel takes off almost where it ended on the first vowel. More research needs to be done on the consonantal effects on pitch before we can say anything with certainty.

The sonorant onsets in the second syllable do not show any influence on the pitch pattern. The pitch on those syllables systematically rises from the default mid tone. However the onset /s/ in the second syllable with a high tone, shows a peculiar pitch pattern. We observe that /s/ induces high pitch in the second syllable in the context of high tone. As seen in figure 3.17, the onset makes the initial pitch of the second syllable higher, it moves to a higher pitch, as it is associated with the high tone.

hō$^{+H}$sō *'drive'*

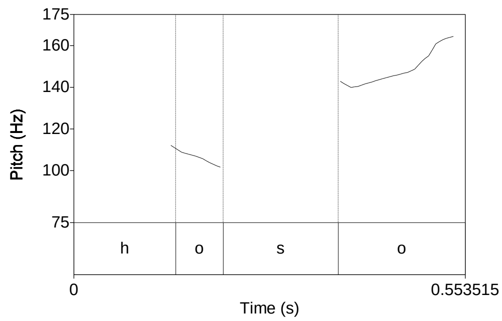


Fig 3.17

After the analysis of the tones in disyllables in the previous sections we can postulate that in Bodo disyllables, it is not possible to have tones in both the syllables. In a disyllable there can be only one Tone Bearing Unit and that is always the second syllable. Thus Baro's claim that every syllable of a lexical entry may be specified for tones is not substantiated. Other northeastern languages of the same language family have been reported to show tonal contrasts in both the syllables of a disyllabic lexical entry. But, having re examined Bodo, we feel that, further research in these languages is absolutely necessary before we can make any broad generalization.

The related languages of this family are Bodo, Garo, Dimasa and Tiwa. Among these Burling (2001) shows convincingly that in *Tiwa,* tone is a feature of the whole disyllabic word. According to Burling (2001) Tiwa has a two-tone system and either tone can occur on any syllable. Hence Tiwa words are not only distinguished by the contrastive tones, but also by the position in which they occur. If the tone occurs in the first syllable of the disyllabic lexical entry, tone is spread on to the syllable on the right. If the tone on the first syllable is high then it uniformly induces a high tone across the word. But if the high tone is associated to the second syllable, then the first syllable gets a mid tone or a neutral pitch. The presence of a similar tonal patterns in most of the northeastern tone languages persuade us to believe that the ‘mid’ tone found in these languages might actually be a default tone and that in the disyllables we consistently see only a single lexical tone assignment.

If this indeed is the picture, then the areal feature for the language family is that each lexical entry allows only one lexical tone to be assigned. The parametric variations, then, would be:

a) Bodo, with rightmost lexical tone,
b) Tiwa, with lexically associated tone,
c) Whereas Bodo does not allow lexical tone to spread, Tiwa allows a rightward spread of lexical tone.

More research needs to be done before a detailed analysis is possible.

3.3.4. ‘0’ Tone in Disyllables

Our findings till now are contrary to Bhattacharya (1977). Bhattacharya claims that there is a 0 tone in Bodo which copies the tone of the adjoining syllable. He gives certain examples which show that the 0 tone is present in non-derived disyllables. Such as ^{0}khu^{1}ser (sugarcane) and ^{0}khu^{3}ser (to prick with nails). However, according to our analysis the first vowel of the disyllabic word always takes the default, mid tone, hence there is no possibility there that any tone is copied from the neighboring syllables. Let us consider ^{0}khu^{3}ser first. Ignoring the effect of /r/, we see a low tone with final vowel (figure 3.18). The first vowel carries a mid tone, which exhibits a fall because of the

khu^{L}ser *'to prick with nails'*

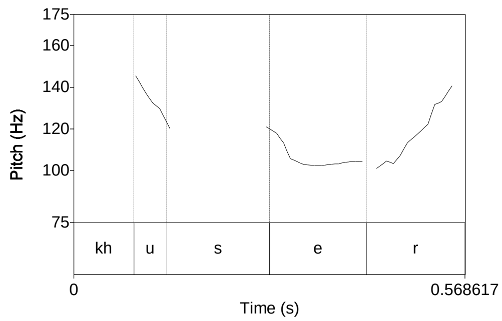


Fig 3.18

khu^{+H}ser *'sugarcane'*

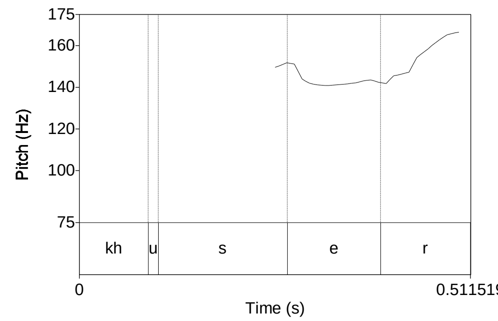


Fig 3.19

initial aspirate. Clearly there is no copying of the low tone of the second syllable onto the first. The first syllable has only a default mid tone, contrary to Bhattacharya. Unfortunately, we are not in a position to say much about the so-called '0' pattern in ^{0}khu^{1}ser. The first vowel is too short to carry any tone (figure 3.19), and we assume, once again that there is no question of tone copying. Like the distinction between Tone 2 and Tone 3, Tone 0 could also be redundant.

But if, as Bhattacharya claims, the 0 tone is in the final position of the syllable as it is

^{1}zen^{0}nay[^{M}zen^{+H}nay] *'to be defeated'*

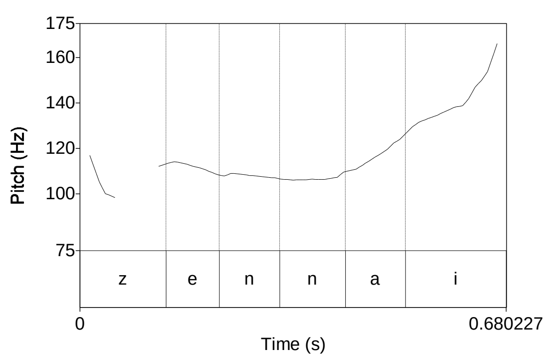


Fig 3.20

^{3}zen^{0}nay[^{M}zen^{L}nay] *'to begin'*

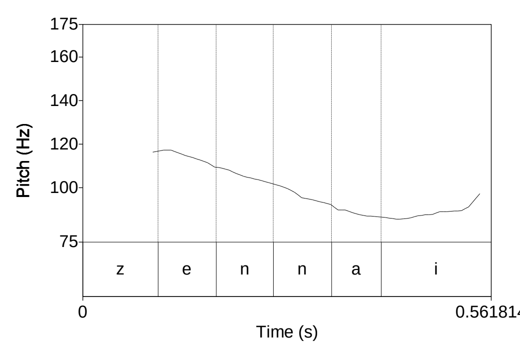


Fig 3.21

supposed to be in ^{1}zen^{0}nay and ^{3}zen^{0}nay, what we see is tone transfer, not copy, as shown in the pictures above. In the picture of ^{1}zen^{0}nay we see that the first syllable does not have a tone, rather it is neutralized with a default mid tone, but the syllable bearing the supposedly 0 tone takes the high tone. We see a rise on the second syllable with the supposedly 0 tone. Similarly in case of ^{3}zen^{0}nay we see a low tone on the second syllable, whereas the tone of the first syllable is neutralized and assigned a default tone.

If we stick on to Bhattacharya's account (ignoring his tonal specifications), we would have the following derivation:

i)	^{H}zen^{0}nay	^{L}zen^{0}nay	
ii)	zen^{H}nay	zen^{L}nay	Tone Transfer
iii)	^{M}zen^{H}nay	^{M}zen^{L}nay	Default Mid Tone

However our derivation is simpler. Following an assumption that Bodo words have only one lexical tone, there is no question of tone transfer (we did not find *nay* to be one of the lexical suffixes in the language). What happens is tone association to the rightmost and the insertion of a default tone. Hence we state our derivation as below:

i) [zennay] [zennay]

ii)
```
 M   H           M   L
 |   |           |   |
[zennay]        [zennay]      Tone Assignment
```

3.3.5 The Tones

In case of monosyllables, we were unable find any distinction between Tone 2 and Tone 3. In our analysis of disyllables we were again unable to gather any spectrographic evidence showing difference between Tone 2 and Tone 3. Contradictory to the claims of Bhattachrya (1977), we see that Tone 2 and Tone 3 are one and the same and it is actually a falling tone. In the pictures below there are not any tangible feature present which can set both of them apart in terms of pitch. From now onwards, we shall not make any distinction between Bhattacharya's Tone 2 and tone 3.

mō^{L}dōm *'body'*

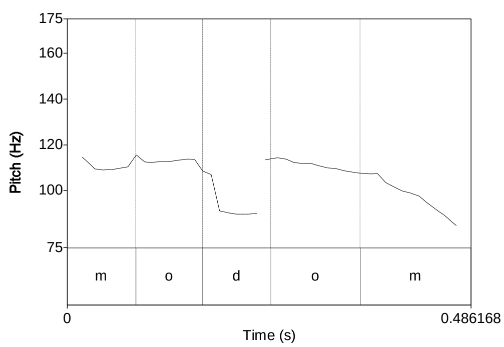


Fig 3.22

mō^{L}dōm *'sweet smelling'*

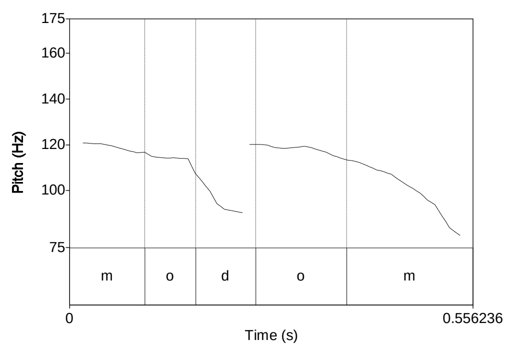


Fig 3.23

3.4 Conclusion

We arrive at the conclusion that even in disyllabic words we do not see a systematic difference between tone 2 and Tone 3. However, in a disyllabic word also, we assume that a single lexical tone is assigned to the word. Answering the question asked by Burling (2001) about the number of tones assigned to disyllabic words, we could say that only one tone is assigned to the disyllabic word and that too is restricted to the second syllable. The first syllable always takes the default mid tone.

Our conclusion is that every non-derived lexical entry in Bodo is assigned one and only one tonal specification. We then require a rule of tone association to the rightmost syllable and a rule of default mid tone insertion, to apply in that order.

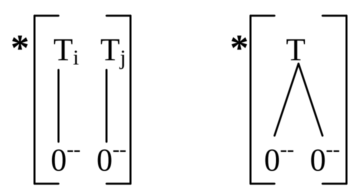
i) $[\text{zennay}]^{H}$ $[\text{zennay}]^{L}$

ii) H — zennay L — zennay Tone Association

iii) M H — zennay M L — zennay Default Mid Tone Insertion

Though we have not looked at larger sequence of non-derived words, we hope further research will fully confirm our findings.

We must also add that our account now is able to explain the absence of such tonal patterns as given below in non derived words:



Finally, we have also been able to show that Bodo may not have a 0 tone as claimed by Bhattacharya.

Chapter IV

Some Issues in Bodo Morphophonemics

4.1 Introduction

Bhattacharya (1977) shows that, in Bodo, morphology and phonology interacts with each other in an interesting way. Assuming that Bodo has a three way tonal contrast he postulates a regular morphophonemic pattern in Bodo. According to him, the high tone is lowered to the next lower tone (hence, tone 1 > tone 2)[1] in close junctures and low tone is raised to the immediate higher tone (tone 3>tone 2) in close junctures. He claims these alterations to be very regular. Weidert (1987) shows that the high tone in Bodo arises due to a glottal segment in the lexical entry. Hence according to Weidert the high tone in the second syllable of the word /dōikorʔ/ 'a well' is due to the glottal stop present in the word /dōiʔ/ 'water'. Therefore when the plural suffix /por/ (transcribed as /phōr/ in our study) is attached to the stem /dōikorʔ/ we see that the suffix is specified with a high tone as the preceding syllable has a glottal stop at the end. Following Weidert we can represent it as:

dōiko$^{/}$rʔ+ por→dōiko$^{/}$rpo$^{/}$r

4.2 The Hypothesis

Contrary to Bhattacharya and Weidert, we assume a more complex system of morphophonemics in Bodo. We assume that there are at least three different types of tonal patterns in Bodo.

(1) In some types of alteration the tone of the stem is neutralized to a mid default tone and the inherent tonal properties of the clitics are preserved. This alteration can be exemplified as below:

[1] We follow Bhattacharya (1977)'s transcription convention here, though we do not quite agree to his convention of marking the tones in Bodo.

^{M}man^{+H}si+^{M}gō$^{+H}$bang → ^{M}man^{M}si^{M}gō$^{+H}$bang

"Man + many → many men"

(2) Causative prefixes show another distinct kind of tonal alteration. When the prefix is attached to a root it takes the default tone whereas the tonal specification of the stem is retained. In the following example this type of alteration is shown:

pho+^{L}thang→ ^{M}pho^{L}thang

"pho+sow seeds → "to make sow seeds"

(3) Plural suffixes like *–sōr* and *–phōr* do not have inherent tonal specifications. But when they are attached to a stem, the stem is neutralized. The tonal specification of the stem is transferred to the suffixes. This type of alteration can be exemplified as below:

$^{+H}$nōng+sōr→^{M}nōng^{+H}sōr

"You (hon, singular)+sōr→you (hon, plural)"

(4) Another type of alteration occurs with the plural suffixes, such as *-mōn*. In this type the tone of the last segment of the stem spreads to the suffix. The *–mōn* type of alteration can be shown as following:

^{M}nōng^{+H}thang+mōn →^{M}nōng^{+H}thang^{+H}mōn

"you (hon.)+ mōn →you (hon., plural)"

(5) The causative suffix –ho shows another kind of alteration. In this type of alteration both the stem and the suffix retain their inherent tonal specifications.

This affixation can be shown as below:

$^{+H}$kham+^{L}ho→$^{+H}$kham^{L}ho

"burn+ho → "to make burn"

Hence the working hypothesis, we start with in this chapter is as below:

- Bodo derived words will follow the tone assignment pattern of disyllables. In Chapter II we have noticed that in Bodo disyllables the rightmost syllable is specified with a tone, whereas, the initial syllable is assigned a mid default tone (as shown in Figures 4.1 and 4.2).

a^{+H}**doy** *'calf of the leg'* **ga**^{L}**hay** *'main, principal, head'*

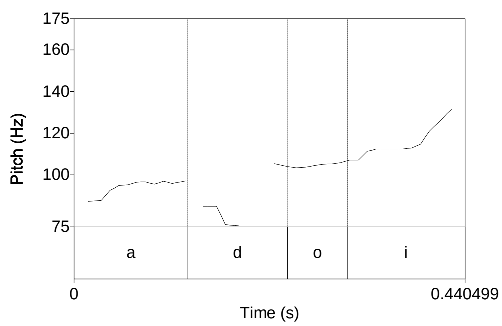


Fig. 4.1

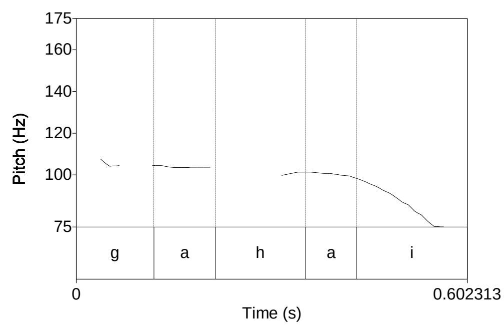


Fig. 4.2

- Since tones are neutralized in non-final syllables we predict the following:

a) under prefixation, the prefix will acquire the default mid tone

b) under suffixation, there are two possibilities:

   i) if the suffix is not inherently specified with a tone, the tonal specification of the stem will be transferred to the suffix and the stem will be assigned default, mid tone

   ii) if the suffix is inherently specified, the tone on the stem will be neutralized to the default mid tone.

We will see in the following section that our working hypothesis is not fully borne out.

4.3 The Findings

4.3.1 Plural Clitics Manōy, Burza and Gōbang

Tonal alteration is observed in the plural clitics like *manōy, burza* and *gōbang*. We observed that *gōbang* is specified with a high tone that is retained even if it is affixed to the stem *mansi 'man'*. *Mansi* is specified with a high tone as the pitch picture of its bare form shows in 4.3. When attached to the clitic *gōbang 'many'* the stem *mansi* loses its tonal specification and gets the default tone. Figure 4.4 clearly shows that the tone-bearing unit of the stem *mansi* getting a default tone. The pitch of the default tone is

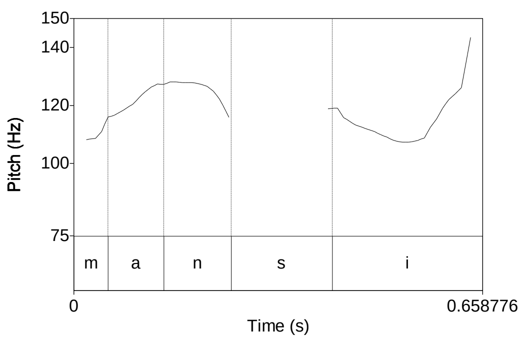


Fig.4.3

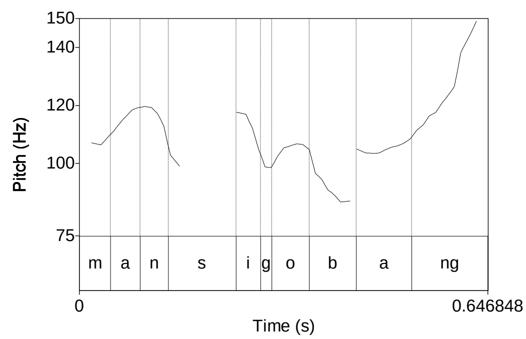


Fig.4.4

falling as the stop consonant /g/ makes the pitch lower. The pitch of the clitic *gōbang* is observed to be rising in figure 4.4. This makes us conclude that:

1. Clitics have their own tonal specification.
2. When attached to words clitics neutralize the tone of the stem, whereas their own tonal specification remain intact. Hence it shows a right aligned tonal specification as in disyllables.

4.3.2 Alteration In Ph-, Bv-, Sv *Type of Causative Prefixes*

We find that our working hypothesis is correct regarding the tonal pattern of prefix form phV-, bV-, sV type of causative prefixes. The ph- type of causative prefixes includes the prefixes *phi-*, *phe*-, *phu*-, *pha*-and *pho*-[2]. In bV- and sV type of causatives, V is the vowel copied from the first syllable of the stem. *phi*-, *phe*-, *phu*- *and* *pha*- type of causatives occur if the first syllable of the stem has the vowels /i/, /e/, /u/ and /a/ respectively as nuclease. Examine the tonal specification of the prefix phV-:

^{L}**sem** *'decrease'* ^{M}**phe**^{L}**sem** *'to make something decrease'*

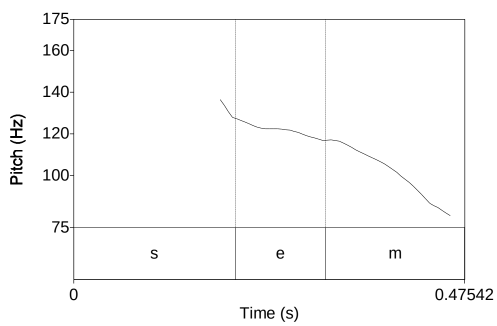


Fig. 4.5

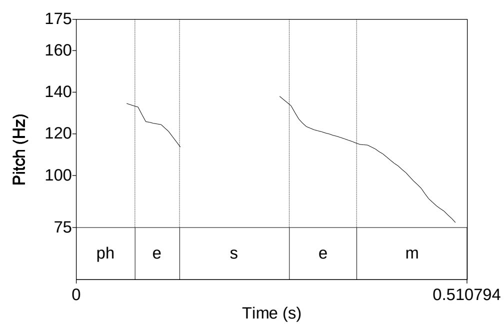


Fig. 4.6

^{L}**rung** *'to become mild'* ^{M}**phu**^{L}**rung** *'to make something mild'*

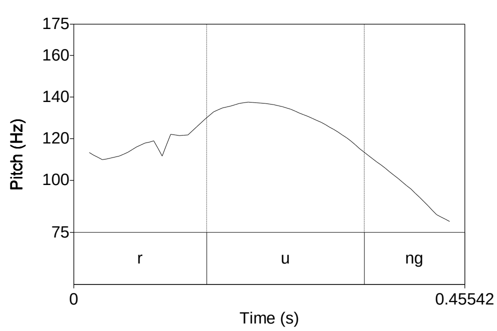


Fig. 4.7

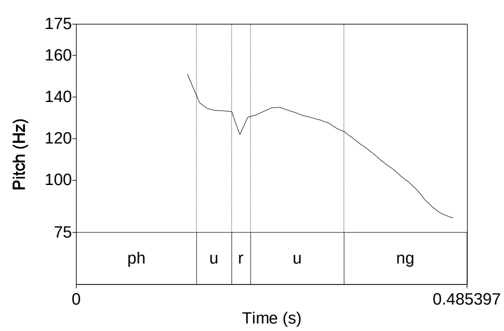


Fig. 4.8

^{L}**thao** *'be tasteful'* ^{M}**pho**^{L}**thao** *'make something tasteful'*

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[2] Unlike bV- and sV prefixes, the ph- prefix does not attest total copy of the stem vowel. We do not go into the details of the vocalic pattern of the prefix here.

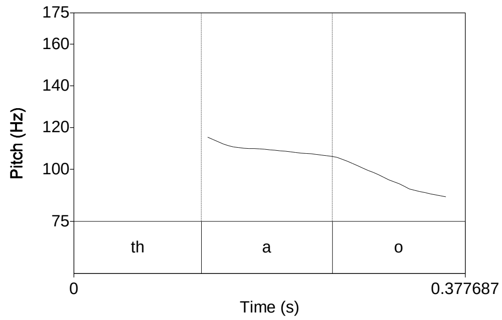


Fig. 4.9

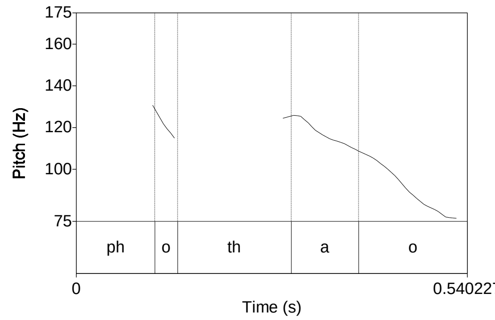


Fig. 4.10

Figure 4.5, 4.7 and 4.9 show that the stems sem, rung and thao are specified for a low tone. When the causative prefix of phV- is added to these stems the tonal specification of the stem does not change. However, the causative prefix takes the default mid tone as shown in figure 4.6, 4.8 and 4.9. It is seen that the default tone in the figures 4.6, 4.8 and 4.10 start at a high pitch. It can be explained with the help of our earlier observation that aspirated consonants always result in the raising of the mid tone.

^{L}**geo** *'open'* ^{M}**be**^{L}**kheo** *'to make somebody open'*

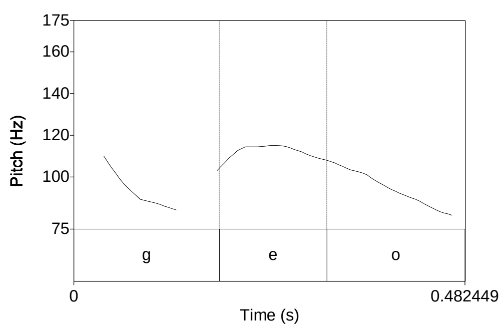


Fig. 4.11

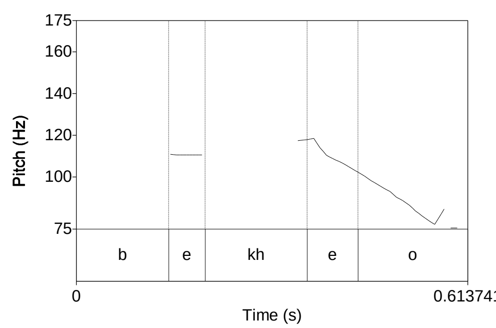


Fig. 4.12

Similarly, in figure 4.10 we observe that the stem *geo* is specified with a low tone. When the bV- causative prefix is attached to the stem, the stem does not attest in any tonal alteration and it preserves its inherent tonal specification (figure 4.12).

^{M}**gu**^{L}**bung** *'fill'* ^{M}**su** ^{M}**gu**^{L}**bung** *'to make something fill up'*

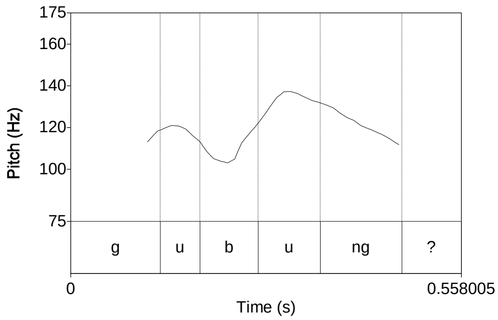


Fig.4.13

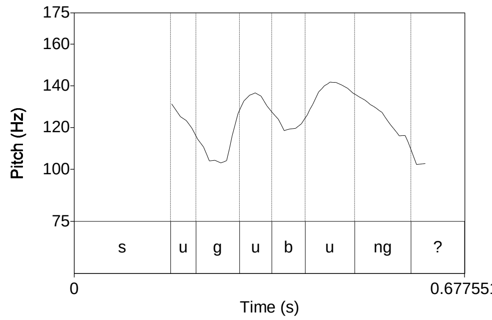


Fig. 4.14

In figure 4.13 we see that the stem *gubung* is specified for a low tone. When the sV- causative prefix is affixed to the stem, the stem does not undergo any alteration. But the prefix is specified with a default mid tone.

In this type of alteration, we assume that the causative prefixes do not have an inherent tonal specification. But as soon as they are affixed to a stem they acquire a mid and default tone and result in a left-aligned default tonal specification. We conclude that the causative prefix does not have ant lexically specified tone and gets a mid tone by default.

Once again we see that our working hypothesis is vindicated. Notice that according to our hypothesis, prefixes cannot be realized with any tone other that the default, mid tone. Even if they did have a lexically specified tone, the tone on the prefix would always be suppressed and a default, mid tone would replace it. So far our working hypothesis has proved to be correct.

4.3.3 –sōr and *–phōr type suffixes*

Let us now examine another type of suffixation, e.g. plural suffixes *–sōr* and *–phōr*. Figures 4.27 and 4.29 show this type of affixation.

$^{+H}$**nōng** *'you (singular, honorific)'* ^{M}**nōng**$^{+H}$**sōr** *'you (plural, honorific)'*

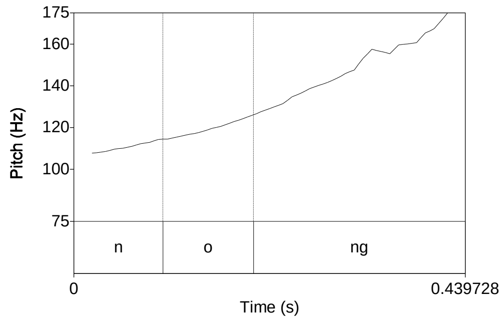


Fig. 4.15

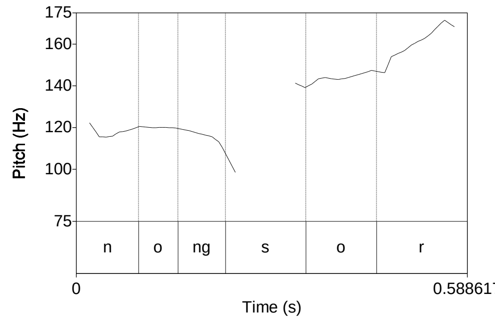


Fig. 4.16

$^{+H}$**no** *'house'*

^{M}**no**$^{+H}$**phōr** *'houses'*

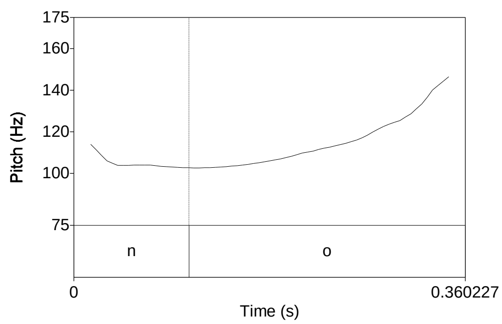


Fig. 4.17

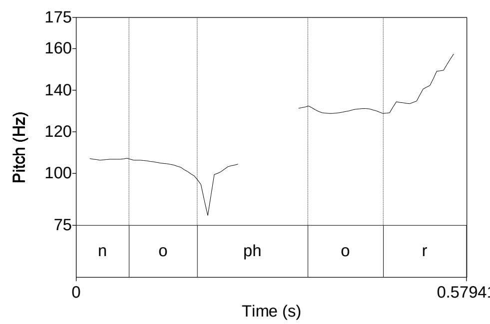


Fig. 4.18

^{L}**raw** *'voice'*

^{M}**raw**^{L}**phōr** *'voices'*

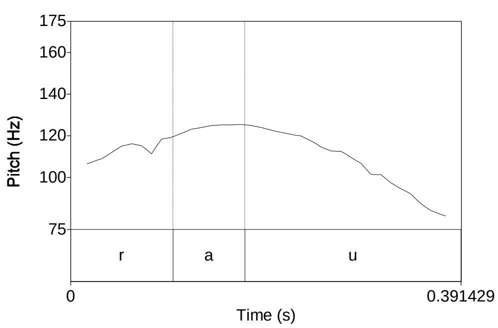


Fig. 4.19

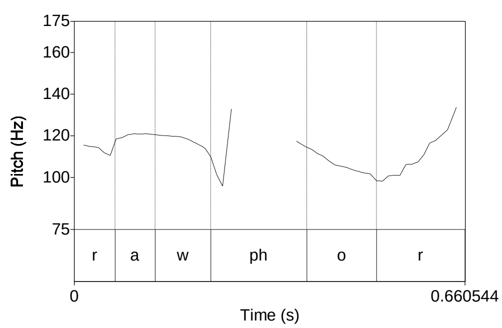


Fig. 4.20

Figure 4.15 and 4.17 illustrate *nōng* and *no* which are specified for a high tone. Figure 4.19 shows *raw* being specified for a low tone. When the plural suffixes *–sōr* and *–phōr* are affixed to these words, it is observed that the inherent tones of the stems are transferred to the plural suffixes *–sōr* and *–phōr*. Figures 4.16, 4.18 and 4.20 show that the suffixes are specified with a tone whereas the stems get the default mid tone. In figures 4.16 and 4.18 the suffixes are specified with a high tone as the non-derived stems were specified with a high tone. Whereas the suffix is specified with a low tone in figure 4.20 as the non-derived form of *raw* was specified with a low tone.[3]

In these cases we see that our working hypothesis b) ii) is vindicated. The suffix has no inherent specification and the specification on the stem gets transferred to the suffix-obeying right alignment. Subsequently, the stem gets a default, mid tone.

The three cases we examined so far are instances of type I derivation in Bodo. Their morphology can be represented as below:

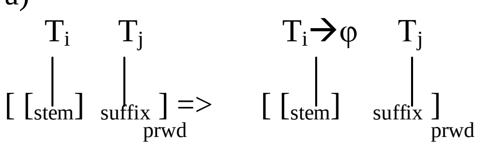
Type I

a.[[stem] *suffix*]$_{\mathbf{prwd}}$

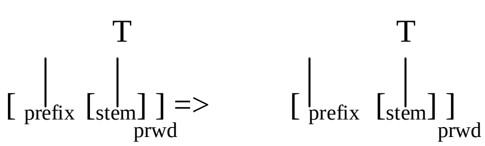
b. [prefix[stem]]$_{\mathbf{prwd}}$

Tone assignment in this type can be represented as:

a)



b)



[3] WE ignore the high tone with segment /r/ in all these cases. (see Chapter II for details)

All these are consistent with our working hypothesis that assumes that derived words are similar to non-derived words in admitting of a single tonal specification on the rightmost syllable.

4.4 The Exceptions

However there two are cases where our hypothesis about the right aligned tone assignment does not hold true. We attempt to describe these cases in the sections 4.4.1 and 4.4.2.

4.4.1 Tthe causative suffix–ho

In this type of suffixation we observe that the suffix is specified for a distinct tonal identity. At the same time the inherent tonal specification of the stem is also preserved. This type of affixation does not result in any tonal alteration of the stem as it is shown in figures below:

^{L}**kham** *'burn'* ^{L}**kham**^{L}**ho** *'to make something burn'*

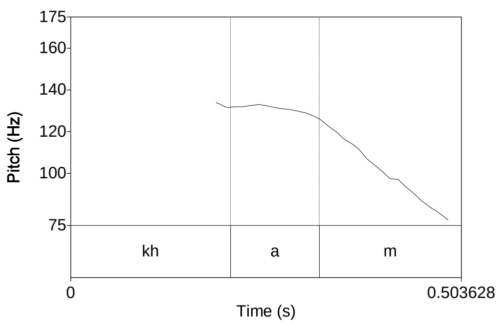


Fig 4.21

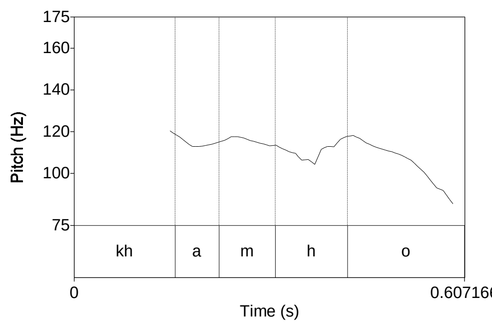


Fig 4.22

^{M}**pho**$^{+H}$**thai** *'believe'* ^{M}**pho**$^{+H}$**thai**^{L}**ho** *'to make believe'*

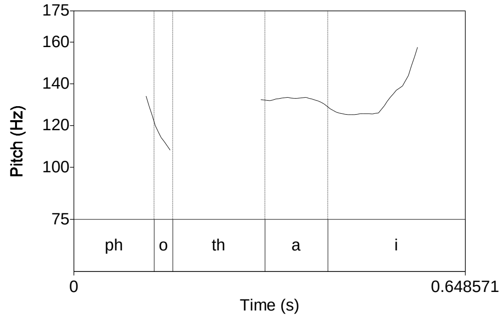


Fig 4.23

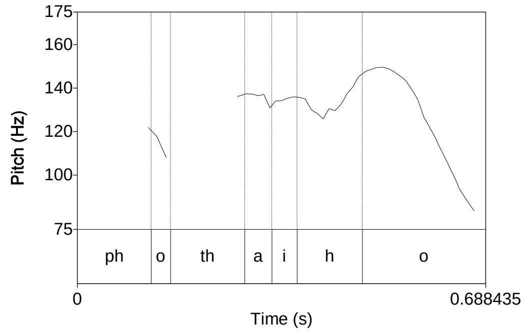


Fig 4.24

$^{+H}$**gi** *'to be afraid'*

$^{+H}$**gi**^{L}**ho** *'frighten'*

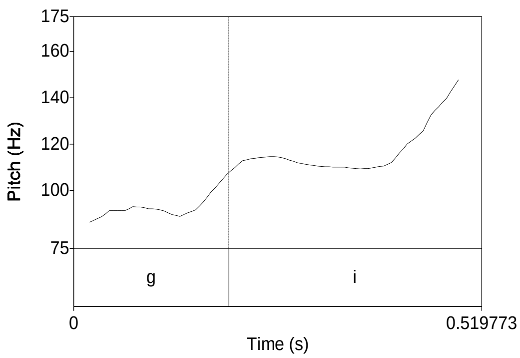


Fig 4.25

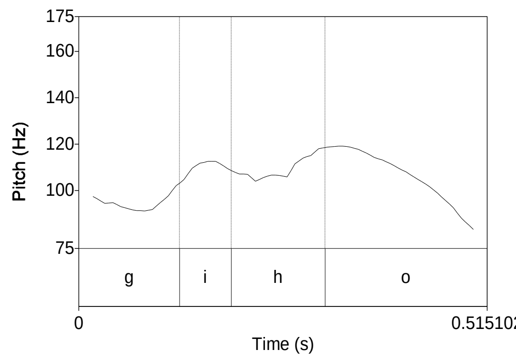


Fig 4.26

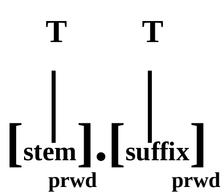
In figure 4.21 it is observed that the lexical item is specified for a low tone. Though it is affixed with a causative suffix, as shown in figure 4.22, the tonal specification of the stem does not change. In figure 4.23 and 4.25 the words *phothai* and *gi* are specified with high tones. Though the causative suffix –*ho* is affixed, the tonal specification of the words does not change as the high pitch contours of the words in figures 4.22 and 4.23 indicate.

A comparison of the figures 4.22, 4.24 and 4.26 indicates that the suffix *-ho* shows a distinct tonal specification. Causative suffix *–ho* is seen as being specified for a low tone in all the cases which results in a pitch picture as shown in figure 4.27.

Fig 4.27

Tonologically speaking, the **[stem].[ho]** seems to be made up of the lexical words with distinct tonal specification. It may be the case that the **[stem].[ho]** form are not really single prosodic words but two distinct prosodic words syntactically embedded within the other. This possibility remains to be examined from the morpho-syntactic point of view contrasting the prefixial causative that may function like 'direct causative' and the –ho form that may function like periphrastic causative. This case can be considered as a Type II derivation and its morphology is represented as below:

Type II



If this suggestion turns out to be true, our working hypothesis is still validated.

4.4.2 –mōn *type alteration*

Another alteration is observed in the plural suffix –mōn. The pictures below show this type of alteration.

^{M}**nōng**$^{+H}$**thang***'you (hon., singular)'*

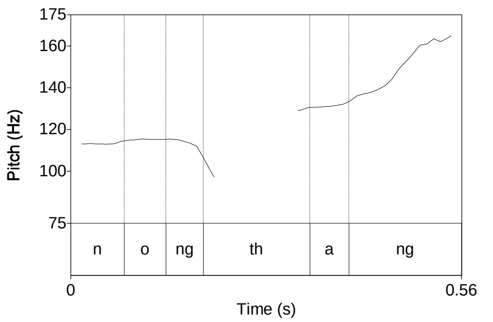


Fig.4.28

^{M}**nōng**$^{+H}$**thang**$^{+H}$**mōn** '*you (hon., plural)'*

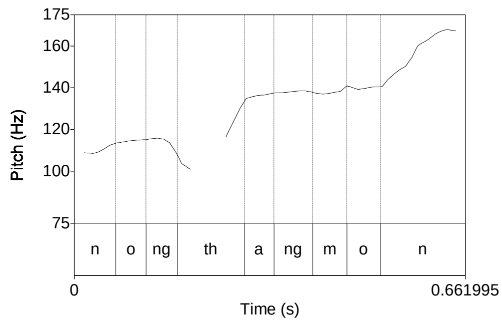


Fig.4.29

^{M}**lay**$^{+H}$**sri** (A proper name)

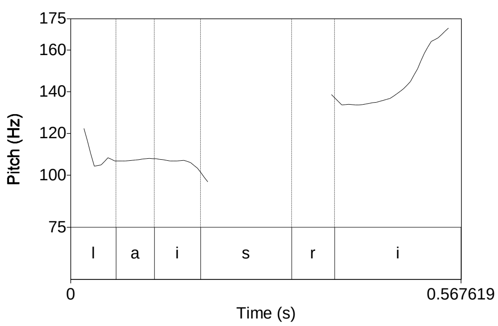


Fig. 4.30

^{M}**lay**$^{+H}$**sri**$^{+H}$**mōn** *'Laysri and others'*

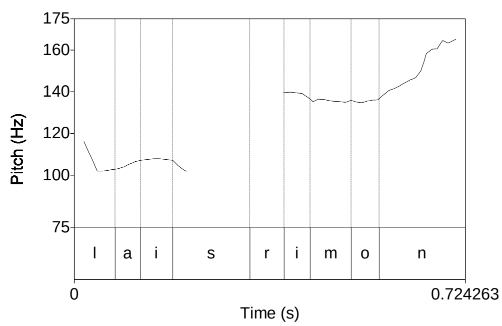
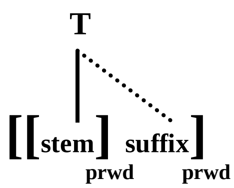


Fig. 4.31

In pictures 4.28 and 4.30 we observe that the lexical items are specified with a high tone. When the –mōn suffix is added to them, the high one is spread to the suffix. Figure 4.29 and 4.31 clearly shows that the suffix mōn carries the same pitch as of the syllable preceding it. As observed in case of monosyllables and disyllables, the nasal consonant /n/ carries a rising tone.

We assume that the –mōn suffix is not specified with an inherent tone. It carries the tonal specification of the preceding syllable. We observe that this kind of alteration is restricted to the stems with a high tone. This case can be considered as a Type III derivation and its morphology is represented as below:

Type III



For the first time we find that there is an instance of tone copying in Bodo. We are not ready to advance any hypothesis regarding tone copying in Bodo till a large number of suffixes of different types namely, derivational and inflectional have been examined in detail.

4.5 Conclusion

We conclude that in Bodo derived words we observe a tonal pattern that is similar to the tone assignment pattern in disyllables derived words too, like the disyllabic lexical entries the tone assignment tends to be right aligned.

A wild hunch that we have is the following. Following the assumption in Lexical Phonology (Kiparsky, 1985), if we assume that these are two distinct levels of word formation in Bodo, namely level I and the word level, we may find that Level I usually behaves like non-derived words (as in English) where every ‘word’ has a single tonal specification but word level affixation may relax the strict phonotactics of the earlier level (again as in English-contrast non-geminate ‘innumerable’ with double ‘unnecessary’) allowing tone copy.

We saw that prefixal causative and ‘*gōbang*’ (see section 4.3.1) pluralization mimic non-derived words in permitting only a single tone specification on the rightmost syllable. Further, *-phōr,* -

sōr pluralization results in transferring tonal specification on the stem to the suffixes, neutralizing the tone on the stem, once again resulting in output form obeying the phonotactics of non-derived words. We feel that these processes may be assigned to Level I of Bodo lexical phonology.

The lone case of *–mōn* pluralization illustrates the process of tone copying in Bodo. If it can be shown that *–mōn* pluralization is distinct from other types of pluralization, not only in admitting multiple tones within a word but also other morphological features like attachment to compound noun etc. A slender piece of evidence with us is data like:

$$[[\text{lai}]\ [\text{siri}]_{\text{feminine}}]\ \text{mōn}.$$

If this suggestion is correct, then we could assign *–mōn* affixation to the word and allow tone copying at this level. However, we need to examine a lot more cases of suffixation before we can come to a conclusion.

Finally looking at the multiple tone specification in [*ho*] causativization, it would fit in nicely with our model of Bodo morpho-phonemics if it could be shown that the [ho] system is really an instance of syntactic, periphrastic causativization.

The morpho-syntactic representations of the three types we have examined are the following:

Type I

a. $[[\overset{T_i}{\text{stem}}]\ \overset{T_j}{\text{suffix}}]_{prwd} \rightarrow [[\overset{T_i \rightarrow \varphi}{\text{stem}}]\ \overset{T_j}{\text{suffix}}]_{prwd}$

b. $[[\overset{T}{\text{stem}}]\ \text{suffix}]_{prwd} \rightarrow [[\overset{T}{\text{stem}}]\ \text{suffix}]_{prwd}$

c. $[\text{prefix}[\overset{T}{\text{stem}}]]_{prwd} \rightarrow [\text{prefix}[\overset{T}{\text{stem}}]]_{prwd}$

Word level

Type II

T

$[[\text{stem}]_{prwd}\ \text{suffix}]_{prwd}$

Type III

T T

$[\text{stem}]_{prwd}\ .\ [\text{suffix}]_{prwd}$

Chapter V

An OT Analysis of Bodo Tones

5.1 Introduction to Optimality Theory

OPTIMALITY THEORY (Prince and Smolensky 1993, McCarthy and Prince 1993a,b) is a model of Generative Grammar, which is non-derivative. In OT the output is the simultaneous application of EVAL to the input. The relation between inputs and outputs is mediated by two formal mechanisms GEN and EVAL. GEN assigns possible structure to the input and EVAL applies the constraint hierarchy to select the best candidate among those created by GEN. The only function of the grammar of a language is to rank and order the constraints, which belong to the UG. To treat the variations across languages in the world, OT assumes that the universal constraints are re-ranked by the grammar of different languages. Earlier theories assumed that variations across languages were the result of parametric selection. OT, unlike parametric theories, asserts that all constraints are present in all languages, the only difference being in the ranking of the constraints.

OT has a set of constraints called the **Faithfulness Constraints,** which tries to preserve the input forms. To preserve different aspects of the input form, OT has different types of **Faithfulness Constraints.** However the desire to preserve the input form varies from language to language. That variation can be taken care of by the ranking of the **Faithfulness Constraints**. On the other hand **Markedness Constraints** use cross-linguistic evidence to avoid specific features or structures. These constraints account for the segmental inventory, syllable structure and phonological alternation, in short, any aspect of linguistic phenomena, be it phonological, morphological or syntactic. The **Faithfulness Constraints** see to it that the specification of the input is preserved in the output, whereas **Markedness Constraints** try to select candidate representation that decrease the markedness of the representation. With the help of constraint ranking, among many outputs the best one is selected as the most plausible output. OT assumes that selected output is optimal. OT evaluates an infinite set of candidate output forms generated by GEN on an input. The winning candidate is the optimal one as it incurs least serious violations among a set of constraints.

Constraint ranking and the selection of the most suitable output are displayed in Table 1. A key to the table is given below.

- * = violation
- ! = fatal violation
- ☞= the most suitable candidate
- Shaded cells no longer matter because a higher ranked constraint has made the decision.

C_1>>C_2

C_1 is a higher-ranked constraint than C_2

	C_1	C_2
a. ☞*candidate a*		*
b. *candidate b*	*!	

Table 1

As shown in Table 1, a tableau lists the outputs vertically in any order. The constraints are listed horizontally. As shown in Table 1, candidate a and candidate b are two possibilities (among the infinite set) generated by GEN. A solid line separates the constraints C1 and C2 indicating strict domination. *Candidate a* satisfies constraint C_1 but violates constraint C_2 (indicated by a '*'). However *Candidate b* violates constraint C_1 and may or may not satisfy constraint C_2. The violation or satisfaction of constraint C_2

does not matter anymore, as C_2 is a lower ranked constraint; moreover the higher ranked constraint C_1 has already made the choice clear. The constraint hierarchy assumes that the violation of C_1 is much more serious (indicated as '*!') than the violation of C_2. The violation of C_2 is irrelevant if C_1 is violated. Hence *Candidate B* cannot emerge as a suitable output (as it violates constraint C_1). Therefore *Candidate A* emerges as the optimal output as indicated by a '☞' (even though it may violate C_2).

5.2 OT Treatment of Tones

Yip (2002) is an attempt at an OT analysis of tonal phonology. She proposes a few constraints pertaining to tone. She lists a few modifications of the well-formedness conditions about tone proposed by Goldsmith (1976):

- Tones are usually associated with syllables, but not always
- Syllables are usually associated with tones, but not always
- Association is preferably one-to-one, but not always
- Tone (especially H tone) is attracted to prominent positions (beginnings of things, edges, accented or stressed syllables) but not always.

All these can be true in some but not all languages. Each of these can be stated as markedness constraints. They are expressed by Yip (2002) as follows:

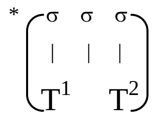
- ***Float**: A tone must be associated with a Tone Bearing Unit (TBU).

  This constraint makes sure that an output like the following is not generated where tone T^3 is not associated with a TBU:

$$^{*}\begin{pmatrix} \sigma & \sigma & \\ | & | & \\ T^1 & T^2 & T^3 \end{pmatrix}$$

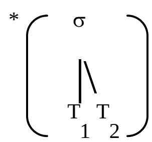
- **SPECIFY T**: A TBU must be associated with a tone.

This constraint rejects an output like the following, as the second syllable is not specified with a tone:



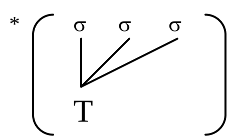
- **NOCONTOUR**: A TBU may be associated with at most one tone.

This constraint rejects an output where a TBU is associated with more than one tone:



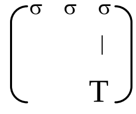
- **NOLONG T**: A tone may be associated with at most one TBU.

Hence an output like the one shown below is to be strictly avoided:

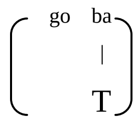


- **ALIGN-TONE**: Align the specified edge (L/R) of a tone span with the head or edge (L/R) of a prosodic or morphological unit.

For example, when this constraint prefers the rightmost syllable of a language to be specified with a tone it would prefer only the following structure:



In non-derived lexical items Bodo prefers this structure as the tone is linked to the rightmost syllable:



Apart from these markedness constraints there are some general faithfulness constraints that preserve underlying contrasts of tone quality and placement:

Tonal faithfulness constraints

- **Dep-T**: No insertion of tones.

This constraint restricts the insertion of a new tone in the output form. If a new tone is inserted then the output is considered to be violating this constraint.

- **Max-T**: No deletion of tones.

This constraint prevents the deletion of a tone present in input in its output form.

- ***Associate**: No new association lines.

This constraint restricts a tone from specifying a new TBU in the output. It makes tones to stay in their original position.

- ***Disassociation**: No removal of association lines.

This constraint makes it sure that a tone association stays in its original position. It prevents a tone from disassociating with the TBU it specifies.

- **NoFusion**: Separate underlying tones must stay separate.

Hence, two or more tones cannot come together and specify a single TBU.

- **Ident-T**: Correspondent tones are the same.

The correspondence of tones in the output is as it is in the input.

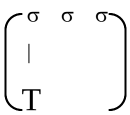
- **Linearity**: Preserve underlying linear order.

The order in which tones occur in the output is the same as it is in the input.

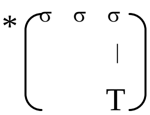
Yip attempts at capturing Goldsmith's observations about the preference for contours and plateaux at the right edge of the word. Goldsmith calls it left-to-right association. In OT Yip captures Goldsmith's observation with the help of alignment constraints like the ones shown below:

- **ALIGN-L**: Each T should align with the left edge of the domain (gradiently assessed)

  This constraint prevents a tone from occurring anywhere except the left edge of the word so that an output like

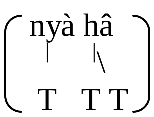


is obtained, but not like

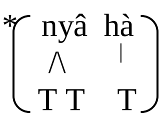
*

- **ALIGN-R CONTOUR:** Contour tones should align with the right edge of the domain.

  Therefore in Mende



is possible, but

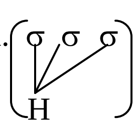
*

is not possible.

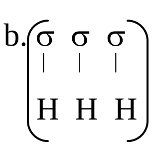
According to Yip, tone is also subject to more general phonological conditions such as the Obligatory Contour Principle (OCP), locality, and markedness constraints:

- **OCP**: Adjacent identical elements are prohibited.

  Leben (1973) proposed the Obligatory Contour Principle (OCP), which says that words with sequences of high toned syllables must be represented as in (a), not as in (b):

a. 

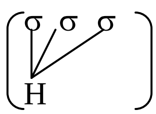
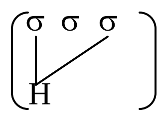
NOT

* b. 

Later it was found that this principle covers not only high tone but also other tones. Its plausibility as a constraint on outputs made its way to OT.

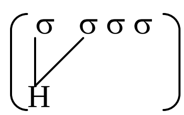
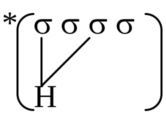
- **NOGAP**: Multiply linked tones cannot skip TBUs.

A set of TBUs, which are linked by only one tone cannot leave a TBU in the middle unspecified with a tone. Hence,

 is possible, but not 

- **LOCAL**: Spread only to the adjacent items.

When an association changes the new association line is formed associating the adjacent item. Hence, for the input

 the output can be  and not * 

- **General markedness**: *H>>*L

This constraint shows the universal preference for a low tone in comparison to a high tone. High tone is more marked than low tone.

It is worth mentioning that in OT all the constraints are universal and present in the grammars of all languages. If a constraint is very low ranked it is assumed that its effects are not visible and hence will not be discussed. Nevertheless it is to be assumed that the constraints exist in all languages.

5.3 OT Treatment of Bodo Tones

5.3.1 Introduction

In this section we use OT to account for the tonal phenomenon in Bodo. Assuming the facts from Chapter II, III and IV, we identify some constraints from the ones suggested by Yip (2002), necessary for OT treatment of tones in Bodo:

Tonal faithfulness constraints

- **Dep-T**: No insertion of tones.
- **Max-T**: No deletion of tones.
- ***Associate**: No new association lines.
- ***Disassociation**: No removal of association lines.
- **NoFusion**: Separate underlying tones must stay separate.
- **Ident-T**: Correspondent tones are the same.
- **Linearity**: Preserve underlying linear order.

Tones also take into account more general phonological conditions like the Obligatory Contour Principle (OCP), locality, and markedness constraints. These conditions are involved in the tonological analysis of Bodo. The conditions that we take into account for Bodo are as follows:

Tonal markedness constraints

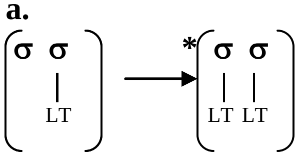
- **OCP**: Adjacent identical elements are prohibited.
- **NoGap**: Multiply linked tones cannot skip TBUs.
- **Local**: Spread only to the adjacent items.
- ***Float**: A tone must be associated with a TBU.
- **Specify T**: A TBU must be associated with a tone.
- **NoLong T**: A tone may be associated with at most one TBU.
- **Align-Tone R**: Each T should align with the right edge of the domain.

5.3.2 A non-derived lexical item must be specified with a tone

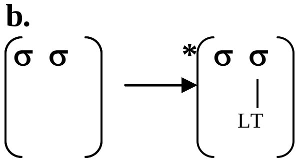
In Chapter II and III we saw that all Bodo non-derived lexical items underlyingly carry a single lexical tone. They are specified with either an H (high) or an L (low) tone. Broadly, it can be assumed that in case of Bodo non-derived lexical items the TBU must retain the lexical tone in the output. It is not possible to have a non-derived lexical entry without being specified for a lexical tone. Hence we propose the constraint **SPECIFY (LT, PRWD)** which says that a prosodic word must be specified for lexical tone.

We assume that Bodo non-derived lexical items are underlyingly specified with a tone. Therefore to rule out the possibility of a high or low tone being inserted, we propose the constraint **DEP-LT (H, L)**. This constraint restricts new High or Low lexical tone insertion into a non-derived lexical item. Hence the following situations are not possible:

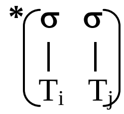
a.

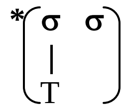


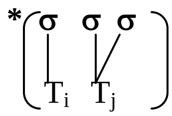
b.



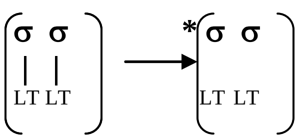
In Chapter III we observed that the underlying high or low tone, with which Bodo disyllables are specified, is right aligned. Further in Chapter IV we observed that the right edge of a derived polysyllabic lexical entry is specified by a lexical tone. Hence we propose the constraint **ALIGN-R (PRWD, LT)** that makes sure that the right edge of the domain in a prosodic word is aligned with the underlying tone. It prohibits the following situations:

a. 

b. 

c. 

The OT analysis therefore rules out any possibility of a lexical item being specified with a lexical tone, anywhere except the right edge of the domain. Hence an input, which, for example, has its left edge specified with an underlying tone, loses its left edged tonal specification in the output in Bodo. This results in the violation of the tonal faithfulness constraint ***DISASSOCIATE**, which restricts the removal of association lines. As Bodo allows this violation, ***DISASSOCIATE** is considered to be a low ranked constraint compared to the other constraints. Following is the violation of this constraint:



- **a) SPECIFY (LT, PRWD):** A prosodic word must be associated with a tone
- **b) ALIGN-R (PRWD, LT):** Each right edge of the domain should align with the T
- **c) DEP-LT (H, L)**: No insertion of High and Low lexical tones

  >>

- **d) *DISASSOCIATE**: No removal of association lines

The ranking logic among individual constraints is of the following nature:

SPECIFY (LT, PRWD) >> *DISASSOCIATE ; the input has to lose certain association lines in the output, if all the TBUs are specified with a tone each. In that case the output would violate ***Disassociate** , yet the output would be plausible. Hence the constraint **Specify (LT, Prwd)** dominates the constraint ***Disassociate**.

Align-R (LT, PRWD)>> ***Disassociate** ; if any other TBU than the right aligned one is specified with a tone in the input, the association lined of those TBUs have to be removed. Hence **Align-R (PRWD, LT)** dominates the constraint ***Disassociate.**

We assume the following ranking for the constraints a), b), c) and d):

Specify (LT, Prwd), Align-R (PRWD, LT), Dep-LT (H, L) >> *Disassociate

Specify (LT, Prwd), Align-R (PRWD, LT), Dep-LT (H, L) >> *Disassociate

INPUT σ σ (| |) LT LT	SPECIFY(LT, PRWD)	ALIGN-R (PRWD, LT)	DEP-T (H, L)	*DISASSOCIATE
a. σ σ (|) LT		*!		*
b. σ σ (| |) LT LT		*!		
c. σ σ	*!	*!		**
d. ☞ σ σ (|) T				*

Table 2

The analysis above shows that each syllable of the input is specified with a tone. The input has at least four possible candidates among others. *Candidate a)* is specified with a tone only on the left edge. Hence, it violates the constraint **Align-R (PRWD, LT).** As this constraint is a higher-ranked constraint, its violation is considered to be a serious one. Hence *Candidate a)* fails to be the optimal candidate in the analysis. Nevertheless it fulfills the constraints **Specify (T, Prwd)** and **Dep-LT (H, L)**. It violates the constraint ***Disassociate,** but as a higher-ranked constraint (**Align-R (PRWD, LT)**) has already decided the choice, its violation is no more significant for the analysis.

Candidate b) violates **ALIGN-R (PRWD, LT)** as one of the tones is not right aligned. However it fulfills the other two constraints- **DEP-LT (H, L)** and ***DISASSOCIATE**.

Candidate c) is not specified with a lexical tone. Hence it violates the constraints **SPECIFY (T, PRWD)** and **ALIGN-R (PRWD, LT)**. There is a double violation of the constraint ***DISASSOCIATE**, as the tones of the syllables are removed twice in the output. It fulfills the constraint **DEP-LT (H, L)**.

Candidate d) satisfies the high-ranking constraints. However it does not satisfy the constraint ***DISASSOCIATE**. As the high ranked constraint has already made the choice, the violation of the dominated constraint ***DISASSOCIATE** is not significant for the analysis. Hence *Candidate d)* emerges as the winner in this analysis as indicated by a "☞". An example from Bodo makes this analysis clear:

SPECIFY (T, PRWD), ALIGN-R (PRWD, LT), DEP-LT (H, L) >> *DISASSOCIATE

INPUT ga hay | | T T	SPECIFY (T, PRWD)	ALIGN-R (PRWD, LT)	DEP-T (H, L)	*DISASSOCIATE
a. ga hay | T		*!		*
b. ga hay | | T T		*!		
c. ga hay	*!	*!		**
d. ga hay ☞ | T				*

Table 3

The explanation given for table 2 applies to table 3 as well.

5.3.3 A TBU without a lexical tone is specified with a default mid tone

In the previous chapters we found some spectrographic evidence to say that Bodo has an underlying default mid tone. We noticed in non-derived monosyllables that the pitch track for a tone always begins at a particular frequency. We identify this frequency as the frequency for mid tone. In the picture below we see that the pitch track begins at 120-125

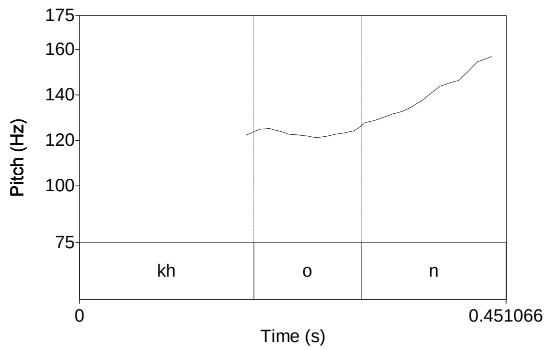


Fig 5.1

Hz. Hence this frequency can be identified as the frequency for a default mid tone.

Again in disyllables we noticed that only the rightmost TBU, i.e. the syllable is specified with a lexical tone (L or H). The other TBUs are specified with the default mid tone. In figure 5.2 we see that the disyllabic non-derived lexical item /erso/ is specified with a

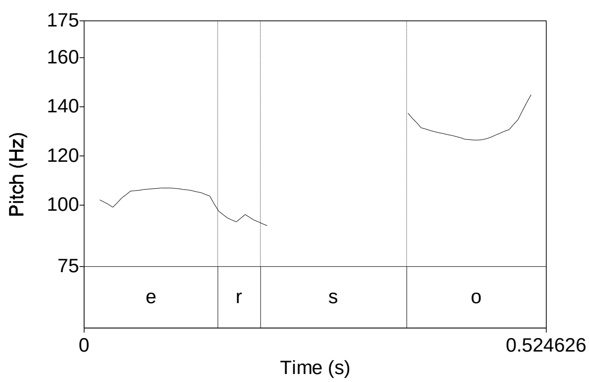
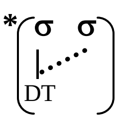


Fig 5.2

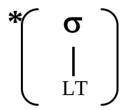
lexical tone (High) on the rightmost syllable. The first or the leftmost syllable is specified with a default mid tone.

It is observed that no TBU in a lexical item in Bodo can be left without being specified with a tone. The TBUs either have to be specified with a lexical or a default tone. These facts prompt us to suggest a few new constraints (suitably modified) that can account for the occurrence of default, mid tones in Bodo, apart from the constraints proposed in the previous section.

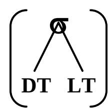
The fact that every TBU in Bodo has to be associated with a tone, prompts us to introduce the tonal markedness constraint **Specify T.** This constraint states that a TBU must be associated with a tone. In Bodo this constraint is ranked as an undominated constraint. We propose a new constraint **Align-L (DT, PrWd)**, which makes sure that the leftmost TBU in a prosodic word is specified with a default tone (DT). Considering the consistency noticed in its occurrence in Bodo, this constraint is considered to be a high-ranked one. It however does not rule out the following possibility in Bodo:

a. *


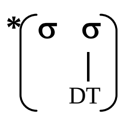
This possibility is ruled out by the high-ranking constraint **Align-R (PrWd, LT)**. Here **a.** is not possible as the default mid tone spreads to the rightmost syllable too. Ideally every lexical item must be specified with a lexical tone on the right and the default mid tone must be specified only on the left of the prosodic word. In **a.** the lexical item is not specified with any lexical tone. Hence it violates the high-ranked constraint **Specify (LT, PrWd). Specify (LT, PrWd)** makes sure that a prosodic word is specified with a lexical tone. As it does not happen in **a.,** it leads to the violation of the constraint **Specify (LT, PrWd)**. But consider **b.** below:

b. *


b. is not possible, as we have seen in figure 5.1 that even in monosyllables, the initial part of the TBU is specified with a default mid tone. This prompts us to present a possible case of tone assignment in monosyllables as below:

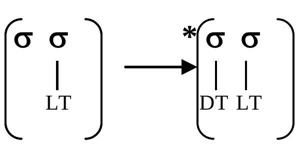
c.


The markedness constraint **NoContour** is dominated in Bodo by **Align-R (PrWd, LT)**. This constraint generally restricts a TBU from being specified with more than one tone. But **c.** is possible in Bodo monosyllables, as **Align-R (PrWd, LT)** is higher-ranked than **NoContour**.

d. *


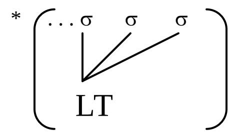
In **d.** the leftmost syllable of the prosodic word is not specified with a tone. Hence it violates the high-ranked constraint **Specify T.** Moreover the default mid tone is specified on the rightmost syllable of the prosodic word. Hence d**.** also violates the constraint **Align-L (DT, PrWd).**

We also propose a new constraint **Dep- DT**, which prohibits the insertion of a default tone in the output. Ideally this constraint should restrict the following derivation:

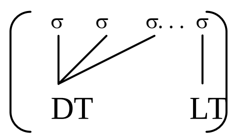


Nevertheless in Bodo, default tone is inserted wherever necessary. Hence, this constraint is considered to be a dominated or a low ranked constraint.

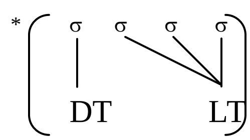
The constraint **No Long LT** restricts a lexical tone from being associated with more than one TBU. It is considered to be a high-ranked constraint in the present analysis. Hence the following output is not possible:



Another constraint **No Long DT** is proposed, which restricts a default tone from being associated with more than one TBU. However this is regarded as a dominated constraint as in case of trisyllables and derived lexical items a default tone is observed to have spread to the nearby TBUs. Hence the following output can be optimal in Bodo:



Again a possibility like the following is ruled out in Bodo:



The high-ranking constraint **No Long LT** prevents the spreading of the lexical tone. Moreover another high-ranking constraint **Align-R (Prwd, Lt)** prevents anything but the right of the prosodic word from being associated with the lexical tone.

The new constraints proposed in this section can be listed as below:

a) **Specify T**: A TBU must be associated with a tone.

b) **Align-L (DT, PRWD):** Each default tone should align with the left edge of the domain,

c) **Dep- DT**: No insertion of default tones,

d) No Long LT: A lexical tone must be associated with at most one TBU,

e) No Long DT: A default tone must be associated with at most one TBU.

f) NoContour: A TBU may be associated with at most one tone.

Hence the constraint ranking for Bodo monosyllables is as following:

Specify T, Specify (LT, Prwd), Align-R (prwd, lt), Align-L (dt, prwd), Dep-lt (H, L)
>>
***Disassociate, NoContour, Dep- dt**

INPUT σ | LT	SPECIFY T	SPECIFY (LT, PRWD)	ALIGN-R (PRWD, LT)	ALIGN-L (DT, PRWD)	DEP-LT (H, L)	*DISASSOCIATE,	NOCONTOUR	DEP- DT
a. σ | LT				*!				
b. σ | DT		*!	*!			*		
c. σ |	*!	*!	*!	*!		*		
☞d. σ /\ DT LT							*	*

Table 4

In the table above, *candidate* **a.** cannot be the optimal candidate as it violates the high-ranking constraint **Align-R (prwd, lt)**. *Candidate **b.*** violates the high-ranking constraint **Specify (LT, Prwd)** as the candidate does not have any TBU specified with a lexical tone. *Candidate **c.*** is not specified with any tone. Hence it violates the constraints **Specify T, Specify (LT, Prwd), Align-R (prwd, lt)** and **Align-L (dt, prwd)**. *Candidate **d.*** satisfies all the high-ranking candidates. However as **d.** is specified with two tones, it violates the constraint **NoContour**. As **NoContour** is a dominated constraint, its violation does not affect in the emergence of **d.** as the optimal candidate.

Tone assignment in the Bodo monosyllable /khon^{H}/ can be shown with the help of the following optimality analysis:

SPECIFY T, SPECIFY (LT, PRWD), ALIGN-R (PRWD, LT), ALIGN-L (DT, PRWD), DEP-LT (H, L) >>*DISASSOCIATE, NOCONTOUR, DEP- DT

INPUT **khon** | H	SPECIFY T	SPECIFY (LT, PRWD)	ALIGN-R (PRWD ,LT)	ALIGN-L (DT, PRWD)	DEP-LT (H, L)	*DISASSOCIATE,	NOCONTOUR	DEP- DT
a. **khon** | H				*!				
b. **khon** | **M**		*!	*!			*		
c. **khon** |	*!	*!	*!	*!		*		
☞d.**khon** /\\ M H							*	*

Table 5

The analysis presented in table 4 is applicable to table 5.

The constraints suggested in this section, for optimality analysis of Bodo, can be ranked as below to find out the optimal candidate in Bodo polysyllables:

SPECIFY T, SPECIFY (LT, PRWD), ALIGN-R (PRWD, LT), DEP-LT (H, L), ALIGN-L (DT, PRWD), NO LONG LT>>*DISASSOCIATE, DEP- DT, NO LONG DT

INPUT σ σ σ | | | LT	SPECIFY T,	SPECIFY (LT, PRWD)	ALIGN-R (LT, PRWD)	ALIGN-L (DT, PRWD)	DEP-LT (H, L)	NO LONG LT	*DISASSOCIATE	DEP- DT	NO LONG DT
a.σ σ σ | | | LT	**!			*!					
b.σ σ σ | | | DT LT	*!			*!				*	
c.σ σ σ | | | DT LT	*!							*	
d.σ σ σ | \\\| DT LT						*!			
e. σ σ σ ☞ |/ | DT LT								*	*

Table 6

The analysis in table 6 shows that in the input only the rightmost syllable of the word is specified with a tone, i.e. a lexical tone. The other two syllables are not specified with any tone. This results in the violation of the constraint **SPECIFY T** which says that each TBU must be associated with a tone. As the first two syllables of the word are not specified with tones, it violates **SPECIFY T** twice. As this constraint is a high-ranking constraint, its violation makes *candidate a* implausible.

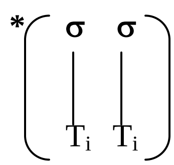
In *Candidate b)* the second syllable of the lexical item is specified with a default tone. However the leftmost syllable is left unspecified for a tone. This results in the fatal violation of the constraint **ALIGN-L (DT, PRWD)**, which says that DT or default tones should be left aligned. As a default tone is inserted in the output, *candidate b)* violates the constraint **DEP- DT** which restricts the insertion of default tones. However, the constraint **DEP- DT** is a low ranking one. Hence its violation does not matter. But the violation of the high-ranked constraint, **ALIGN-L (DT, PRWD)** has already made *candidate b)* non-optimal.

In *Candidate c)* the syllable on the left edge is specified with a default tone. Therefore it satisfies the constraint **ALIGN-L (DT, PRWD).** However the second syllable of the lexical item 4is not specified with any tone, which results in the violation of the constraint **SPECIFY T.** As **SPECIFY T** is a high-ranked constraint, its violation makes *candidate c)* non-optimal. This candidate also violates **DEP- DT**. As the high ranked constraint **ALIGN-L (DT, PRWD)** has already made the choice the violation of the low ranked constraint **DEP- DT is** irrelevant.

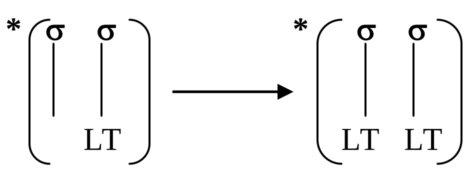
In case of *candidate d)*, one lexical tone is associated with two TBUs. The constraint **NO LONG LT** says that a single lexical tone cannot be associated with more than one TBU. Hence *candidate d)* violates the constraint **NO LONG LT.** As **NO LONG LT** is a higher ranked constraint, its violation results in the rejection of *candidate d)* as a non-optimal candidate.

In *Candidate e)* the default tone is associated with the leftmost syllable of the domain and it spreads to the adjoining syllable, which also is not specified with a lexical tone. This candidate fulfills all the higher ranked constraints but violates the dominated constraints **DEP- DT** and **NO LONG DT**. As in the output, default tone is inserted; the candidate violates the constraint **DEP- DT**. As the tone is spread from the leftmost syllable to the adjoining syllable, it violates the constraint **NO LONG DT.** This constraint restricts default tones being associated with more than one TBU. However as these two constraints are dominated, their violation can still make the candidate plausible. Therefore *candidate e)* emerges as the optimal candidate in the analysis.

Here one might posit the question why not use the tonal faithfulness constraint **OCP** which prevents adjacent identical items, to rule out possibilities like:

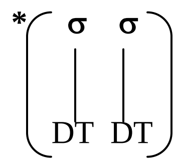


Our answer to this problem would be that with the help of other existing high-ranked constraints, such as the **ALIGN-R (PRWD, LT)**, **ALIGN-L (DT, PRWD)** and **DEP-LT (H, L)**, such possibilities are anyway ruled out. A candidate like the following is ruled out with the existing constraint



ALIGN-R (PRWD, LT). This constraint says that only the right edge of the prosodic word should be specified with a lexical tone. Moreover the constraint **DEP-LT (H, L)** prevents the insertion of lexical tone. As a lexical tone is inserted in this derivation, **DEP-LT (H, L)** is violated which makes this derivation non-optimal.

As the high ranked constraint **ALIGN-L (DT, PRWD)** restricts default tones (DT) only to the left edge of the prosodic word, a possibility like the following is ruled out:



As shown here, the existing constraints very well make the choice of the optimal candidate. Hence, **OCP** does not perform any additional work for us. However, since **OCP** is deemed to be a universal constraint we assume that it is redundantly present in the grammar of Bodo as well. But we choose to ignore it in the present analysis.

An example from Bodo is given in table 7 to show the viability of the constraint ranking for Bodo non-derived polysyllabic entries:

SPECIFY T, SPECIFY (LT, PRWD), ALIGN-R (PRWD, LT), DEP-LT (H, L), ALIGN-L (DT, PRWD), NO LONG LT
>>
***DISASSOCIATE, DEP- DT, NO LONG DT**

INPUT ga hay LT	SPECIFY T,	SPECIFY (LT, PRWD)	ALIGN-R (PRWD, LT)	ALIGN-L (DT, PRWD)	DEP-LT (H, L)	NO LONG LT	*DISASSOCIATE	DEP- DT	NO LONG DT
a.ga hay LT	*!			*!					
b. ga hay LT LT			*!		*!				
c. ga hay ☞ DT LT								*	
d. ga hay DT DT		*!	*!	*!			*	**	

Table 7

In the analysis above the input /gahay/ is specified with a lexical tone on the right edge of the prosodic word. *Candidate a)* in the analysis violates the constraint **SPECIFY T** as the leftmost TBU of the prosodic word is not specified with a tone. As **SPECIFY T** is a higher-ranked constraint, its violation makes *candidate a)* an implausible output.

Candidate b) is specified with a lexical tone each on both the syllables of the prosodic word. It also violates the high-ranked constraint **ALIGN-R (PRWD, LT).** The constraint **ALIGN-R (PRWD, LT)** restricts the lexical tones to the rightmost TBU of a prosodic word. As the leftmost TBU is also specified with a lexical tone, the candidate violates the constraint **ALIGN-R (PRWD, LT)**. The insertion of a lexical tone on the left edge of the prosodic word violates the constraint **DEP-LT (H, L)**. This DEP constraint prevents the insertion of a lexical tone. **SPECIFY (LT, PRWD), ALIGN-R (PRWD, LT)** and **DEP-LT (H, L)** are all undominated, high-ranked constraints. Hence their violation makes *candidate b)* an implausible output.

Candidate c fulfills all the high-ranked constraints. Nevertheless it violates a low ranked constraint **Dep- dt**. As **Dep- dt** is a dominated constraint, its violation can still make *candidate c)* the optimal output in the absence of a more suitable candidate.

Candidate d) is specified with a default tone on both of its TBUs. As there is no lexical tone associated with any of the TBUs, it violates the constraint **Specify (LT, Prwd).** Apart from this, the second instance of DT, which is linked to the right syllable, violates **Align-L (DT, PRWD)**. As the violated constraints **Specify (LT, Prwd)** and **Align-L (DT, PRWD)** are high-ranked, *candidate d)* does not emerge as an optimal output.

5.3.4 Tone assignment in Bodo derived Polysyllables

We now consider derived words and their tone pattern in Bodo. Though Bodo derived polysyllables follow the system of tone assignment as described in section 5.3.2, we observed some cases that do not follow the general rule of tone assignment. The following sections give an optimality account of the default tone assignment patterns in derived polysyllables along with the tone assignment patterns in *–mōn* and *–ho* type of suffixes.

5.3.4.1 The general pattern

In Chapter IV we discussed the general tone assignment pattern of Type I derived polysyllables. We noticed that Type I derivations in Bodo follow the tone assignment pattern of the non-derived polysyllabic lexical entries allowing us to assign the word formation process to level I of Bodo lexical phonology model (Kiparsky, 1985). We saw three possibilities in this type, as following:

T_i T_j $T_i \rightarrow \varphi$ T_j
a. [[stem] suffix]$_{prwd}$ ➔ [[stem] suffix]$_{prwd}$

T T
b. [[stem] suffix]$_{prwd}$ ➔ [[stem] suffix]$_{prwd}$

T T
c. [prefix[stem]]$_{prwd}$ ➔ [prefix[stem]]$_{prwd}$

In all these cases the derived form follows the tone assignment pattern of the non-derived polysyllabic entries, where the lexical tone is right aligned. If there is a lexical tone that is not right aligned, it is either transferred to the right of the prosodic word or deleted if the right of the lexical item is already specified with a tone. In case of (a) type of derivations, we see that the tone of the suffix is preserved whereas the tone of the stem is lost. This prompts us to arrive at the conclusion that **MAX Sf LT>> MAX Stm LT** is underlyingly present in Bodo derivations. An example each for the a, b and c type of derivations can show how in the OT analysis of Type I derivations, the constraint hierarchy suggested for non-derived lexical entries will select the desired representation as optimal.

5.3.4.1.1 Type I (a) derivation

$$^{M}\textbf{man}^{+H}\textbf{si}+^{M}\textbf{go}^{+H}\textbf{bang} \rightarrow {}^{M}\textbf{man}^{M}\textbf{si}^{M}\textbf{go}^{+H}\textbf{bang}$$

Here, the derived word is considered to be a prosodic word and tone assignment is carried out accordingly. The constraint hierarchy for this type of derivation is as following:

MAX Sf LT, SPECIFY T, SPECIFY (LT, PRWD), ALIGN-R (PRWD, LT), DEP-LT (H, L), ALIGN-L (DT, PRWD), NO LONG LT

>>

***DISASSOCIATE, DEP- DT, NO LONG DT, MAX Stm LT**

MAX Sf LT, SPECIFY T, SPECIFY (LT, PRWD), ALIGN-R (PRWD, LT), DEP-LT (H, L), ALIGN-L (DT, PRWD), NO LONG LT>>*DISASSOCIATE, DEP- DT, NO LONG DT, MAX Stm LT

INPUT [[mansi]gōbang]prwd M H M H	MAX SF LT	SPECIFY T,	SPECIFY (LT, PRWD)	ALIGN-R(LT, PRWD)	ALIGN-L(DT, PRWD)	DEP-LT (H,L)	NO LONG LT	*DISASSOCIATE	DEP-DT	NO LONG DT	MAX STM LT
a. [[mansi]gōbang]prwd M H M H				*!	*!						
b. [[mansi]gōbang]prwd M M M H					**!			*	*		
c. ☞ [[mansi]gōbang]prwd M H								**		**	*
d. [[mansi]gōbang]prwd M H M H	*!							**		**	

Table 8

In the analysis above, the input is considered as a single prosodic word. It violates the high ranking constraint **ALIGN-L (DT, PRWD),** as the default M(id) tone shows up in the third syllable of the prosodic word. This candidate also violates the high-ranking constraint **ALIGN-R (PRWD, LT).** This constraint makes sure that the lexical tone is associated with the right of the prosodic word. Hence, this candidate cannot be an optimal output.

Candidate b violates **ALIGN-L (DT, PRWD)** as apart from the leftmost syllable, there are two more TBUs, which are individually specified with a default tone. It violates the high-ranking constraint **ALIGN-L (DT, PRWD)** twice. As in this analysis a default tone is inserted, the low-ranking constraint **DEP- DT** is violated.

Candidate c does not violate any of the high-ranking constraints. Nevertheless, it violates the low-ranking constraints **NO LONG DT.** It violates this constraint as the default tone is spread to the other two syllables. However, its violation is not serious in nature and the candidate emerges as the optimal output.

Candidate d is non optimal, as it violates the high-ranking **MAX Sf LT** by de-linking the lexical tone of the suffix in preference for the lexical tone of the stem.

5.3.4.1.2 Type I (b) derivation

$^{+H}$nōng+sōr→^{M}nōng^{+H}sōr

In this type of derivation, the suffix is not inherently specified with a tone. As the derived word is considered as a prosodic word, the lexical tone of the stem is transferred to the suffix to satisfy **ALIGN-R (PRWD, LT)**. The stem is then specified with a default mid tone. The OT analysis of this type of derivation is shown below:

MAX Sf LT, SPECIFY T, SPECIFY (LT, PRWD), ALIGN-R (PRWD, LT), DEP-LT (H, L), ALIGN-L (DT, PRWD), NO LONG LT

>>

***DISASSOCIATE, DEP- DT, NO LONG DT, MAX Stm LT**

INPUT [[nōng]sōr]$_{prwd}$ H	MAXSF LT	SPECIFY T,	SPECIFY (LT, PRWD)	ALIGN-R(LT, PRWD)	ALIGN-L(DT, PRWD)	DEP-LT (H,L)	NO LONG LT	*DISASSOCIATE	DEP-DT	NO LONG DT	MAX STM LT
a. [[nōng]sōr]$_{prwd}$ H		*!		*!	*!						
b. [[nōng]sōr]$_{prwd}$ H H				*!	*!	*!					
c. [[nōng]sōr]$_{prwd}$ DT Low						*!			*		*
☞d. [[nōng] sōr]$_{prwd}$ DT H									*		

Table 9

In table 9, the input is a prosodic word and it is not specified with any tone on the right of the prosodic word. Moreover the leftmost syllable of the prosodic word is specified with a lexical tone H (igh).

Hence, *candidate a* violates the high-ranking constraint **SPECIFY T** as the rightmost syllable of the prosodic word is not specified with any tone. It also violates the high-ranking constraint **ALIGN-R (PRWD, LT)**. As there is no lexical tone aligned on the right of the prosodic word, this constraint is violated. Moreover, in the derivation there is no lexical tone associated with the left of the prosodic word. Hence the constraint **ALIGN-L (DT, PRWD)** is also violated. Considering the violation of the high-ranking constraints, *candidate a* cannot emerge as an optimal candidate.

Candidate b violates **ALIGN-R (PRWD, LT)**, **ALIGN-L (DT, PRWD)** and **DEP-LT (H, L)**. As *candidate b* has two lexical tones in the same prosodic word, it violates **ALIGN-R (PRWD, LT).** As there is no default mid tone specified on the left of the prosodic word, it also violates the constraint **ALIGN-L (DT, PRWD)**. As a new lexical tone is inserted the high-ranking constraint **DEP-LT (H, L)** is violated. Moreover, we assume that the universal constraint **OCP** is underlyingly dominant in Bodo, which prohibits an output like *candidate b.*

Candidate c has a new lexical tone, L(ow) associated with it. Therefore it violates the high-ranking constraint **DEP-LT (H, L)**, which prohibits the insertion of a new lexical tone. As a default tone is inserted in the analysis the candidate also violates the constraint **DEP-DT.** The violation of the high-ranking constraint makes the candidate non-optimal.

Candidate d satisfies all the constraints in the analysis. It violates the low-ranking constraint **DEP- DT**. It however does not prevent *candidate d* from becoming the optimal candidate.

5.3.4.1.3 Type I (c) derivation

pho+^{L}thang→ ^{M}pho^{L}thang

In this type of derivations, a tonologically unspecified prefix is attached to a stem. However, the derivation is considered to be a prosodic word. Here the prefix is associated with a default, mid tone, whereas the tonal specification of the stem is preserved.

MAX Sf LT, SPECIFY T, SPECIFY (LT, PRWD), ALIGN-R (PRWD, LT), DEP-LT (H, L), ALIGN-L (DT, PRWD), NO LONG LT
>>
***DISASSOCIATE, DEP- DT, NO LONG DT, MAX Stm LT**

INPUT [[pho]thang]$_{prwd}$ (L on thang)	MAXSF LT	SPECIF YT,	SPECIF Y(LT, PRWD)	ALIGN-R(LT, PRWD)	ALIGN-L(DT, PRWD)	DEP-LT (H,L)	NO LONG LT	*DISASS OCIATE	DEP-DT	NO LONG DT	MAX STMLT
a. [[pho]thang]$_{prwd}$ (L(ow) on thang)		*!			*!						
b. [[pho]thang]$_{prwd}$ (LT on pho, L(ow) on thang)				*!	*!	*!					
c. ☞ [[pho]thang]$_{prwd}$ (DT on pho, L(ow) on thang)									*		

Table 10

In the analysis above, *candidate a* is associated with no tone on the leftmost syllable. Hence, it violates the high-ranking constraint **SPECIFY T**. It also violates the high-ranking constraint **ALIGN-L (DT, PRWD)** as there is no default, mid tone specified with the left of the prosodic word. Therefore *candidate a* cannot be optimal.

Candidate b has a lexical tone inserted on the left of the prosodic word. It is a violation of the high-ranking constraint **DEP-LT (H, L)** as this constraint prohibits the insertion of new lexical tones. The lexical tone insertion also violates the high-ranking constraint **ALIGN-R (PRWD, LT)**. As there is no default, mid tone specified with the left of the prosodic word, a serious violation of the high-ranking constraint **ALIGN-L (DT, PRWD)** is prompted. Hence, *candidate b* cannot be the optimal candidate.

Candidate c fulfills all the high-ranking constraints in the analysis. Although it violates the low-ranking constraint **DEP- DT**, it is not important in the analysis. Hence, *candidate c* emerges as the optimal output in the analysis.

Hence, we saw in section 5.2.1 that the OT analysis of the derived polysyllables is possible with the existing constraints used for the OT analysis of non-derived polysyllables with the addition of the high ranking **MAX Sf LT** and the down ranked **MAX Stm LT**.

5.3.4.2 The –mōn suffix[1]

In our previous discussion we assumed that the *–mōn* suffix is not specified with an inherent tone. The lexical tone of the stem is spread to the suffix as seen in figure 5.3 and 5.4. Another interesting observation in this regard is the fact that this kind of alteration is restricted only to the stems with a high tone.

[1] It is observed that that the *–mōn* suffix is attached only to stems specified with high tones. Apparently we do not have any explanation for that. We assume that to be a lexical gap in Bodo grammar. It is possible to explain the gap in terms of constraint hierarchy. We colclude that the constraint **NO LONG LOW T** dominates the constraint **NO LONG HIGH T.** However, if would be interesting to test what native speakers do when the *–mōn* suffix is attached to a stem with a low tone.

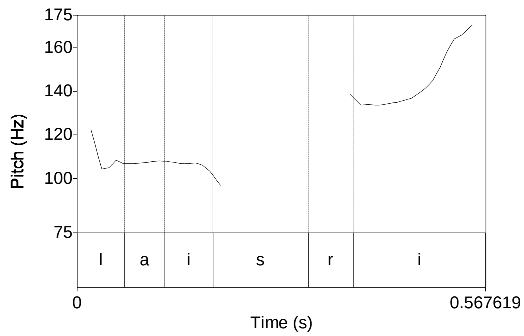


Fig. 5.3

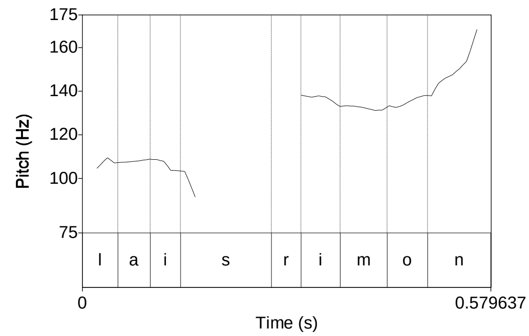


Fig 5.4

In figure 5.3 the non-derived lexical item /laisri/ is seen to be specified with a high tone. In figure 5.4 the –mōn suffix is attached to the non-derived lexical item. It is observed that the high tone of the rightmost syllable of the non-derived lexical item is now spread to the suffix –mōn.

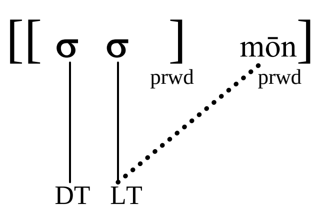
We explain the case of –mōn suffixation with the help of a morphological explanation. We regard the derived lexical item as a single prosodic unit. At the same time the stem of the lexical item also preserves its identity as a distinct prosodic word. The morphological structure of the derived lexical item in case of *–mōn* suffixation is shown below:

1.

[[ ]$_{prwd}$ mōn]$_{prwd}$

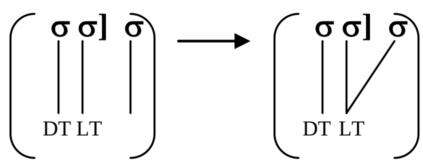
In Bodo **Specify (LT, Prwd)** is a high-ranking constraint. Hence, –mōn, which is regarded as a prosodic word and which is not inherently specified with a lexical tone, needs a lexical tone specification. Hence the following situation arises:

2.



In 2, the lexical tone of the prosodic word (=the stem) spread to the right edge of the derived prosodic word. It satisfies the need of the derived prosodic word to have a lexical tone. In the derived words there are two right prosodic word boundaries, both of which have to be satisfied. Thus we see that no new constraints are needed to explain the tonal pattern of the derived forms.

However the constraint **NO LONG LT** moves lower in the constraint hierarchy. This ranking, therefore, allows lexical tone spread in –mōn type of derivations as shown below:



The illustration shows that initially the suffix –mōn is not specified with any tone. However in the derivation, the lexical tone (High, in –mōn type of suffixation) of the stem spreads to the suffix. Hence, it leaves no TBU unspecified with a tone.

The constraint hierarchy of the constraint necessary for –mōn type of derivation looks as below:

MAX Sf LT, SPECIFY T, SPECIFY (LT, PRWD), DEP-LT (H, L), ALIGN-R (PRWD, LT), ALIGN-L (DT, PRWD)>>*DISASSOCIATE, DEP- DT, NO LONG DT, NO LONG LT, MAX Stm LT

Table 11 shows how these constraints select an optimal candidate:

INPUT σ σ]σ DT LT	MAX SF LT	SPECFY T	SPECFY (LT, PRWD)	ALIGN-R (PRWD, LT),	DEP-LT (H, L)	ALIGN-L (DT, PRWD)	LOCAL	*DISASSOCIATE	DEP-DT	NO LONG DT	NO LONG LT	MAX STM LT
a.σ σ]σ DT LT		*!		!*								
b.σ σ]σ DT LT DT				!*		*!			*			
c.σ σ]σ DT LT LT					*!							
d.σ σ] σ ☞ DT LT											*	

Table 11[2]

In the analysis above, *candidate a*, the suffix is not specified with a tone. Hence, it violates the constraint **SPECIFY T.** As the right edge of the prosodic word is not specified with a tone, *candidate a* also violates the constraint **ALIGN-R (PRWD, LT)**. The constraint **ALIGN-R (PRWD, LT)** is a high-ranking constraint. Hence, its violation is serious and the candidate cannot be an optimal output.

Candidate b has the right edge of the prosodic word specified with a default, mid tone. Hence, it violates the constraint **ALIGN-L (DT, PRWD)**. As **ALIGN-L (DT, PRWD)** is a high-ranked constraint, its violation prevents *candidate b* from becoming the optimal candidate. As the right edge of the prosodic word is not specified with a lexical tone, the candidate also violates the high-ranking constraint **ALIGN-R (PRWD, LT)**.

Candidate c is specified with two non-identical lexical tones on the right edge of the stem and on the suffix. This is a **DEP-LT (H, L)** violation as a lexical tone is inserted in this

[2] There is a possibility of a candidate like **σ σ]σ** DT LT LT

However, this candidate violates the constraint **DEP-LT (H, L),** as a new lexical tone is inserted into the derivation. Moreover it also violates the underlyingly dominant constraint **OCP** as two adjacent identical items are prohibited by **OCP**.

derivation, whereas the high-ranking constraint **DEP-LT (H, L)** prohibits the insertion of any lexical tone.

Candidate d fulfills all the constraints except the dominated constraint **NO LONG LT**. *Candidate d* is specified on the right edge with a spread lexical tone, violating the constraint **NO LONG LT.** However, its violation is not serious as **NO LONG LT** is a dominated constraint in the analysis. As *candidate d* does not violate any of the high-ranked constraints, it emerges as the optimal candidate.

With the help of the constraint ranking suggested above, the following case of tone alteration in Bodo can be taken care of:

^{M}**lay**$^{+H}$**sri + mōn** ⟶ ^{M}**lay**$^{+H}$**sri**$^{+H}$**mōn** *'Laysri and others'.*

Table 12 shows how the optimal candidate ^{M}**lay**$^{+H}$**sri**$^{+H}$**mōn** is chosen from a variety of possible candidates.

MAX Sf LT, SPECIFY T, SPECIFY (LT, PRWD), DEP-LT (H, L), ALIGN-R (PRWD, LT), ALIGN-L (DT, PRWD)>>*DISASSOCIATE, DEP- DT, NO LONG DT, NO LONG LT, MAX Stm LT

INPUT lay sri] mōn | | | DT LT	MAX SF LT	SPECIFY T	SPECIFY (LT, PRWD)	ALIGN-R (PRWD, LT),	DEP-LT (H, L)	ALIGN-L (DT, PRWD)	LOCAL	*DISASSOCIATE	DEP-DT	NO LONG DT	NO LONG LT	MAX STM LT
a.lay sri] mōn | | | DT LT		*!		!*								
b.lay sri] mōn | | | DT LT DT				!*		*!			*			
c.lay sri] mōn | | | DT LT$_i$ LT$_j$					*!							
d.lay sri] mōn | | | DT LT LT					*!							
e.lay sri] mōn ☞| |/ DT LT											*	

Table 12

The analysis of table 11 is also valid for table 12.

5.3.4.3 The *–ho* suffix

-ho is a causative suffix in Bodo. In the discussion on *–ho* suffixation in the previous chapter, we came to the conclusion that the suffix *–ho* is inherently specified with a tone. When the suffix is attached to a stem the inherent specifications of both the stem and the suffix are preserved. Hence a case like the following is noticed in the Bodo causativization:

^{M}**pho**$^{+H}$**thai** *'believe'* + ^{L}**ho** ⟶ ^{M}**pho**$^{+H}$**thai**^{L}**ho** *'to make believe'*

Hence it is clear that in *–ho* type of derivation the inherent tonal specification of the stem is preserved in the output. Even the inherent tonal specification of the suffix is preserved in the output. Unlike the *–mōn* suffix, the *–ho* suffix can be attached to a stem with both high and low tonal specification.

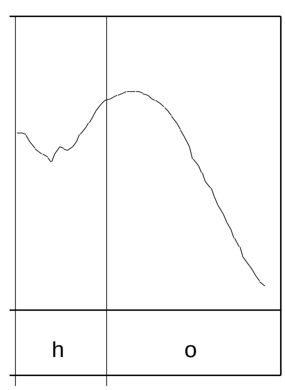


Fig. 5.5

If we look at the picture 5.5 of the suffix *–ho,* we see that it is inherently specified with a low tone.

These facts about the *–ho* suffix prompts us to assume that in this type of suffixation the stem and the suffix behave as two distinct prosodic words. The morphological representation can be shown as following:

3. [ ]$_{prwd}$. [ho]$_{prwd}$
|
L

As the stem and the suffix behave as two distinct prosodic units, they follow the tone assignment system of the prosodic words, discussed in section 3.3.1 of Chapter III of this thesis. Hence, the constraint ranking and analysis proposed for *–mōn* type of affixation is valid for *–ho* type of affixation also.

Hence, the following ranking of constraints is suggested for *–ho* type of suffixations:

MAX Sf LT, SPECIFY T, SPECIFY (LT, PRWD), DEP-LT (H, L), ALIGN-R (PRWD, LT), ALIGN-L (DT, PRWD)>>*DISASSOCIATE, DEP- DT, NO LONG DT, NO LONG LT, MAX Stm LT

INPUT [[pho thai] ho] DT LT LT	MAX SF LT	SPECIFY T	SPECIFY (LT, PRWD)	ALIGN-R (LT, PRWD)	ALIGN-L (DT, PRWD)	DEP-LT (H, L)	*DISASSOCIATE	DEP-DT	NO LONG LT	NO LONG DT	MAX STM LT
a.[[pho thai] ho] DT LT	*!						*		*		
b.[[pho thai] ho] DT LT			*!	*!			*			*	*
c.[[pho thai] ho] ☞ DT LT LT											

Table 13

In Table 13 the OT analysis of a *–ho* type of suffixation is shown. In the input the stem /phothai/ is a prosodic word. Hence, it has a default mid tone associated with its left edge and a lexical tone on its right edge. Similarly, as *–ho* also behaves as a prosodic word, it has a lexical tone associated with it.

In the analysis, in *candidate a* the inherent lexical tone of the suffix is lost and the lexical tone of the stem spreads to the suffix. It violates the high-ranking **MAX Sf LT** and also the low-ranking constraint **NO LONG LT.** This constraint prevents a lexical tone from being associated with more than one syllable. As the lexical tone in *a* is associated with two TBUs, it is a violation of the constraint **NO LONG LT**. As the inherent tone of the suffix -*ho* is disassociated, the constraint ***DISASSOCIATE** is violated. However, as ***DISASSOCIATE** is a dominated constraint, its violation does not matter to the analysis.

In *candidate b* the lexical tone of the stem is deleted and the default tone is spread to the rightmost syllable of the stem. As the stem is considered to be a prosodic word, the deletion of the lexical tone is a serious violation of the constraint **SPECIFY (LT, PRWD)** **SPECIFY (LT, PRWD)** which says that every prosodic word should be associated with a lexical tone. This candidate also violates the high-ranking constraint **ALIGN-R (PRWD, LT)** and the low ranking constraint **MAX Stm LT**. As the inherent lexical tone of the stem is deleted, it also prompts the violation of the low ranking constraint ***DISASSOCIATE**. Considering the serious constraint violations *candidate b* cannot be the optimal output.

Candidate c fulfills all the high-ranking constraints in the analysis. Hence, it emerges as the optimal output.

The *–ho* affixes we have examined permit us to come to the conclusion that derived forms in Bodo do not require any major re-ranking or introduction of new constraints (only three) in the constraint hierarchy suggested for non-derived words. However, a word of caution: as we said earlier (Chapter IV), more work needs to be done in the field of morphological derivations in Bodo before we can arrive at a definitive statement regarding tone and morphological derivations in the language.

5.4 Conclusion

In this chapter, for the OT analysis of the morphophonemics of Bodo we have used two different types of alignment constraints. They are **ALIGN-R (PRWD, LT)** and **ALIGN-L (DT, PRWD)**. **ALIGN-L (DT, PRWD)** says that each default tone should align with the left edge of the domain. Whereas **ALIGN-R (PRWD, LT)** says that the left edge of the domain should be specified with a lexical tone. Earlier we tried using the **ALIGN-R (LT, PRWD)** constraint for lexical tones. But later we found out that in case of derived polysyllables the lexical tone may be assigned to two syllables on the right of the prosodic word. Hence we had to modify the constraint to **ALIGN-R (PRWD, LT)** for the benefit of the analysis of the derived polysyllables.

Given morphological assumptions, the same constraint hierarchy that was argued for non-derived words can be extended to morphologically derived forms. But more extensive work needs to be done before broad generalization regarding tone and morphology in Bodo.

Appendix I

List of derived and non-derived lexical items used in this work

A

a^{L}dōy paternal uncle
a^{H}dōy the calf of the leg
a^{H}khay hand
a^{L}khay fried paddy
a^{H}may may maternal uncle
a^{L}may be vexed
a^{L}pha my father
a^{H}pha palm of the feet

B

^{H}bar *v*. jump
^{L}bar *n*. day
^{L}bar *n*. wind
^{L}bar *v*.bloom
^{H}bar^{L}ho to make one jump
^{H}baw *v*. dedicated to god
^{L}baw *v*. to forget
^{H}bay *v*. break
^{L}bay *v*. buy
be^{L}kheng make open
be^{L}khew make loose, make open
^{H}beng *v*. watch
^{L}beng *v*. agree
^{H}bi *v*.beg ask pray
^{L}bi pro*n*. he or she
bi^{L}phōr these
bi^{H}sōr they
bi^{L}si wife
bisi^{H}ni their
bisi^{L}ni tear off
bi^{H}thang he (honorific)
bi^{H}thang^{H}mon they (honorific)
be^{H}ma spider
be^{L}ma thick, bulky
bi^{L}dōy egg of birds
bi^{H}dōy his uncle
bo^{H}kha make separate
^{H}bu *v*.strike, beat
^{L}bu *v*. swell
bu^{H}khu make fall down, make uproot
^{H}bung *v*. speak
^{L}bung *v*. fulfil

D

da^{H}bōr moment
da^{L}bōr tub
da^{L}lang bridge
da^{H}lang do not take
^{H}dang *v*. touch
^{L}dang *v*. clean or clear
^{H}daw bird
daw^{H}phōr birds
^{H}ded big
^{H}dō *n*. cooking pot
^{L}dō *v*. erect a post
^{H}dōy *v*. lay eggs, place; on a head
^{L}dōy *n*. water
^{L}dōy *v*. sweeten, feel sweet
dōy^{H}khar run by holding ones hand
dōy^{H}khar run by holding on hands
^{H}dung deep

E

e^{H}lo bring liquid with fingers
e^{L}lo this only
endiphi^{H}phang castor oil plant
^{L}er *v*. grow , increase
^{H}er *v*. move by a finger or handle
er^{H}so more with a speed
er^{H}so hide
^{L}ew *v*. plough
^{H}ew *v*. cut the jungle to make it clear
^{H}ew *v*. fry
ew^{L}a *n*. one does not plough
ew^{H}a *v*. one does not fry

G

^{H}ga be separate
^{H}gab *n.* color
^{L}gab *v.*weep
ga^{H}hay short, low
ga^{L}hay main, principal, head
gahe^{H}nai get a knock on a leg
galang^{H}o goes on treading
^{L}gan *v.* wear
^{L}gan *n.* music
^{H}gaw *v.* tear or split
^{L}gaw *v.* shoot by arrow or gun shell
ge^{H}ble become powder
ge^{H}ble melt into
ge^{L}beng straight
ge^{H}beng thin
ge^{H}bla *adj.* Turn into powder
ge^{H}bla whenever
^{L}geng open automatically
^{L}gew open
^{H}gi be afraid of
^{H}gi^{L}ho make afraid
^{H}glob *v.* devour
^{L}glob *v.* fully completely
go^{H}ba thin
go^{L}ba embrace
go^{L}ba vomit
go^{L}mo yellow
go^{H}mo be surprised
^{L}gong *adj.* bent
^{L}gong *v.* bend
^{H}gong *n.* horn
go^{H}song stand up
go^{H}ong^{H}ho make one stand up
go^{H}thang green
go^{L}thang living, alive
go^{L}tho child
gotho^{L}phōr children
go^{H}za red
go^{L}za empty
^{H}gu put off, up root
gu^{H}bung other, thick
gu^{L}bung be muddy
gu^{L}bung with good sounds
gu^{L}dung hot
gu^{H}dung hole
gunthu^{H}thri the forepart of the nose above the chin

H

^{H}ha land
^{L}ha be able
^{L}ha cut by pressing
hab^{L}a does not enter
ha^{L}ba marriage task, work
hadong^{H}mon cut by pressing
^{H}ham *v.* be lean and thin
^{L}ham *v.* come around, be recovered
ha^{H}su measure land
ha^{L}su pass urine
^{L}hay be lower
hinzawsi^{H}khla matured girl
^{H}hor send
^{L}hor night
^{L}hor bend, hang
ho^{H}so drive
ho^{L}so pour
^{H}hu land
^{L}hu rub

K

^{L}kha bind, tie
^{H}kha pluck
kha^{L}lay do perform
kha^{H}lay refused things, surplus
^{H}kham boiled rice
^{L}kham drum, burn
^{L}kham^{L}ho to make burn
khamgli^{H}dong has been burnt
khamho^{H}bay has smelt after burning
kha^{H}nay hair
kha^{L}nay to bind
^{H}khar run
^{L}khar smell like a fish
^{H}kheb pinch
^{L}kheb trip
khe^{L}ray national festival of the Bodos
khe^{H}ray mustard seed cake
kherkha^{H}ni elbow

khigra^{H}no latrine
^{H}khon arrange clothes
^{L}khon sing occasion
^{L}khon pick up one by one
^{H}khu make naked, remove skin
^{L}khu throw
^{H}khur dig soil by nail
^{L}khur cause to itch
khu^{H}ser sugar cane
khu^{L}ser prick with nails
khuseng^{H}gra cicada (an insect)
khuser^{H}aw in the sugarcane

L

^{H}law be long
^{L}law gourd
lay^{H}sri a proper name
lay^{H}sri^{H}mon laysri and others
^{H}lir write, plaster wall
^{L}lir be heavy
^{H}lom be merged in water
^{L}lom be ill
lu^{H}khang finish work
lu^{H}khang finish pouring

M

man^{H}si man
man^{H}si^{H}phōr men
^{L}maw move
^{L}me^{H}thay song , music
^{L}me^{L}thay molasses
mi^{H}thi know, understand
mi^{H}thi^{L}ho to make know
^{L}mō^{L}dōm body
^{L}mō^{L}dōm sweet melling
^{H}mōn get
^{L}mōn ripen, boil
mōnsada^{H}za be not sorry
^{L}mo^{H}sow cow

N

naphithi^{H}khri a kind of small fish
(Assamese: Puthi)
^{H}no house
^{L}no offer
^{H}nōng you (singular)
nōng^{H}sōr you (plural)
nōng^{H}thang you (singular, honorific)
nōng^{H}thang^{H}mon (plural, honorific)
no^{H}phōr houses

O

^{H}on love
^{L}on rice powder
^{L}on spread a loom

P

pha^{L}ham make cured
pha^{L}hay make lower
^{H}phan *v.* twist
^{L}phan *v.* sell
^{H}phe *v.* be intoxicated
^{L}phe *v.* be mild
phe^{H}ded to make big
phe^{H}reb make weak
phe^{L}sem make less
phiding^{H}nay to turn around
phi^{L}lir make heavy
phi^{H}sa small ones
^{L}phi^{H}sa son
phisi^{L}ri make fall down
phō^{L}thaw make tasteful
phō^{L}thang give life, save
phō^{H}thay believe
pho^{H}thai^{L}ho make believe
^{H}phōy n. plant seeds
^{L}phōy v. come
phu^{H}dung make deep
^{H}phung *n.* morning
^{L}phung *v.* be fast and fleshy
phu^{L}rung make soft

R

^{H}**ran** become dry
^{L}**ran** divide
^{L}**raw** voice
raw^{L}**phōr** voices
^{H}**ray** *v.* harm by magical power
^{L}**ray** *v.* abuse
^{L}**ray** *v.* speak
^{H}**reb** be mild
^{H}**ro** *v.* leak out
^{L}**ro** *v.* stop going
rongza^{H}**dong** has become happy
^{L}**rung** become mild

S

^{L}**sa** *v.* place a fishing instrument net etc.
^{H}**sa** *n.* north *v.* make rope
^{L}**sa** *v.* ache
^{H}**san** *v.* count , think
^{L}**san** *n.* sun
^{L}**sem** decrease
^{H}**ser** *v.* examine by pressing
^{L}**ser** *v.* leak water
^{L}**ser** *n.* a see
^{L}**sew** *n.* musical tune
^{H}**sew** *v.* be rotten
^{L}**sew** *n.* motion
^{H}**si** cloth
^{L}**si** wet
si^{H}**gi** make afraid
si^{H}**ling** be separate
si^{L}**ling** make pieces
si^{L}**ri** fall down
sō^{L}**gab** make weep
sō^{L}**maw** make moving
so^{L}**may** be fit, decorate
so^{H}**may** oath
^{H}**song** cook
^{L}**song** seek opportunity, find out.
^{H}**sōr** all around
^{L}**sōr** who
^{L}**sōr** iron
^{H}**su** wash, saw, thorn
^{L}**su** weigh, measure
su^{L}**bung** make speak
su^{H}**gu** nine
sugu^{L}**bung** make muddy

T

^{H}**thab** *v.* paste
^{L}**thab** *adv.* At once
thabay^{L}**bay** wander
thabay^{H}**dong** has walked
^{H}**thang** *v.* go
^{L}**thang** *v.* live
thangphla^{H}**dong** has pretended to go
^{L}**thaw** *n.* oil
^{L}**thaw** *v.* strike with force
thi^{L}**a** steep
thi^{L}**a** a parrot like bird
thi^{H}**a** does not keep for one
^{L}**thōn** *v.* urge on, incite
^{L}**thōn** *v.* tell

U

^{H}**un** sharpen
^{L}**un** behind

Z

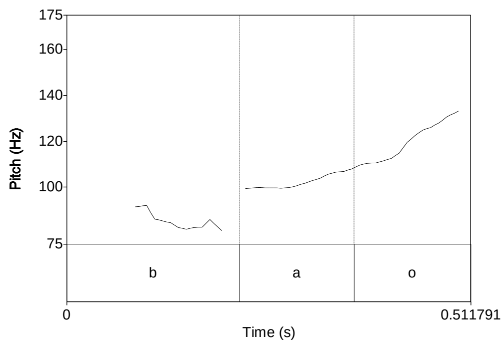
^{H}**za** eat
^{L}**za** be, become
za^{H}**dong**^{H}**mon** ate
zapha^{H}**bay** has already eaten together
za^{H}**slay** eat or take by barter system
za^{L}**slay** be or exist by barter system
zay^{H}**ō** eats
zay^{L}**ō** is, exists
zen^{L}**nay** to begin
zen^{H}**nay** to be defeated
^{L}**zi** v.tear
^{H}**zi** cloth
zi^{L}**bow** serpent
zibow^{L}**phōr** serpents

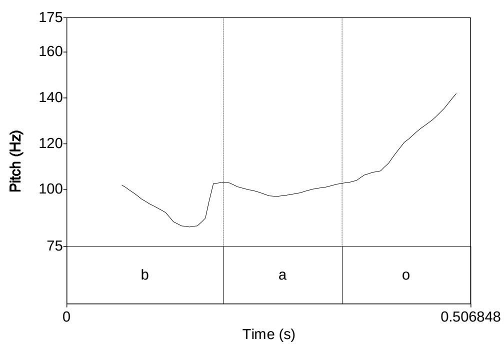
Appendix II

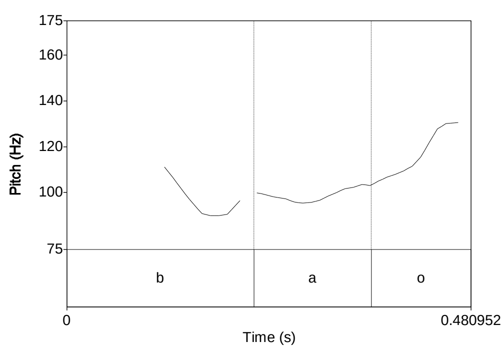
Selected Pitch Pictures of the Analysed Bodo Words

*Monosyllables**

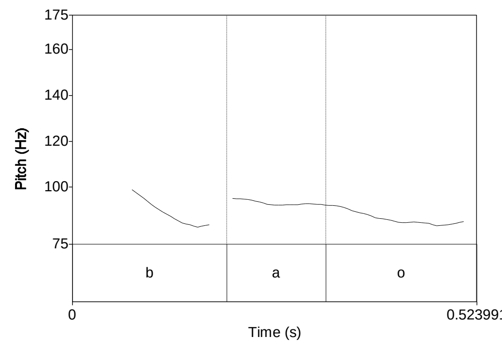
^{H}**baw**

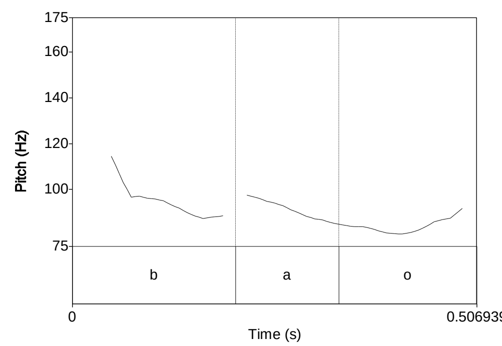


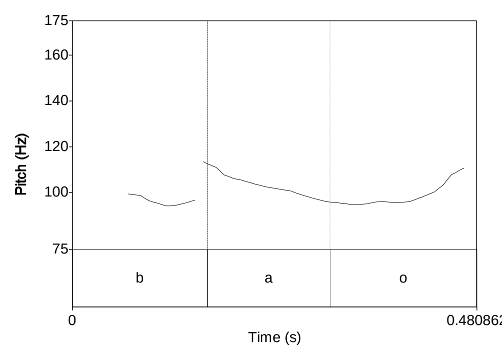




^{L}**baw**

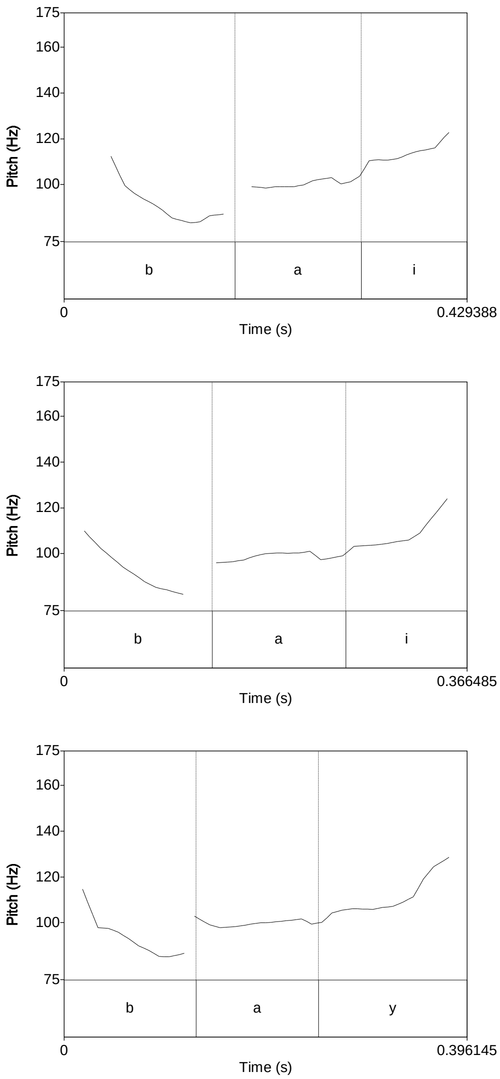




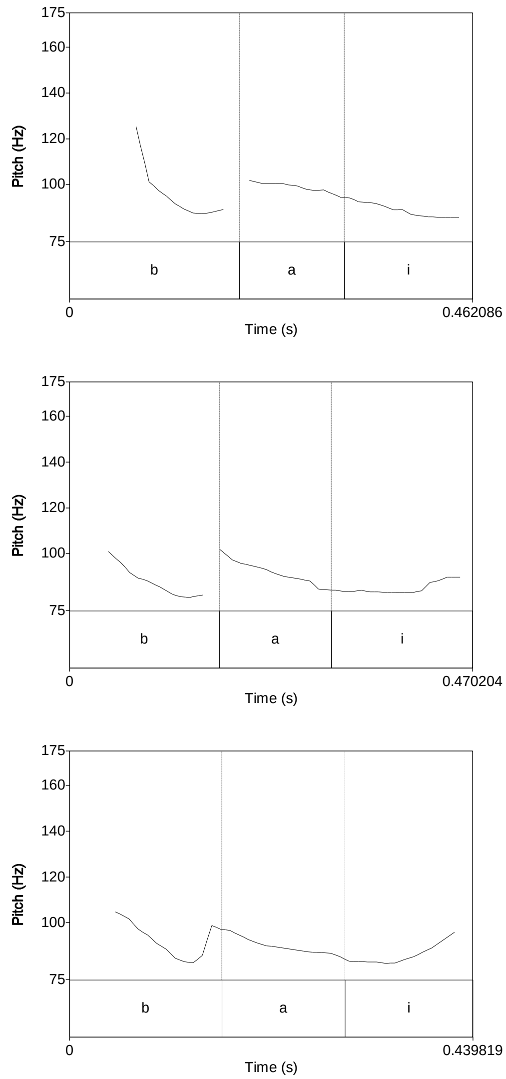


*For gloss, refer to Appendix I

^{H}bay


175
160
140
120
100
75
Pitch (Hz)
b
a
i
0
0.429388
Time (s)
b
a
i
0.366485
b
a
y
0.396145

^{L}bay


175
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140
120
100
75
Pitch (Hz)
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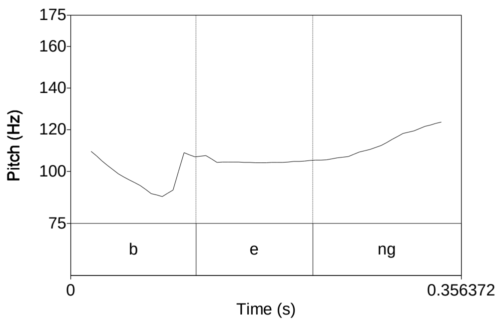
a
i
0
0.462086
Time (s)
b
a
i
0.470204
b
a
i
0.439819

^{H}beng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140
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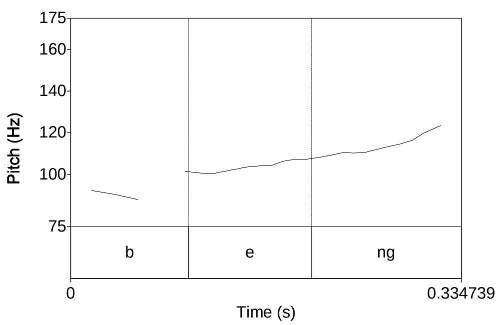
100
75
Pitch (Hz)
b
e
ng
0
0.356372
Time (s)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100
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b
e
ng
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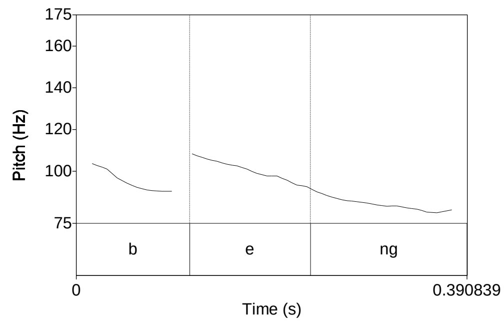
Time (s)

^{L}beng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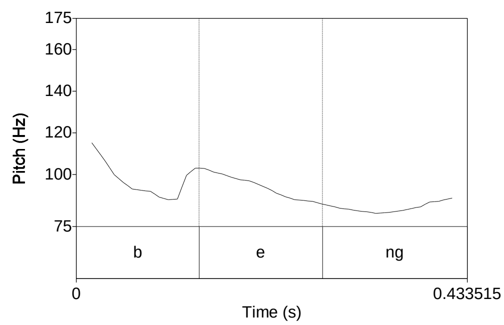
Time (s)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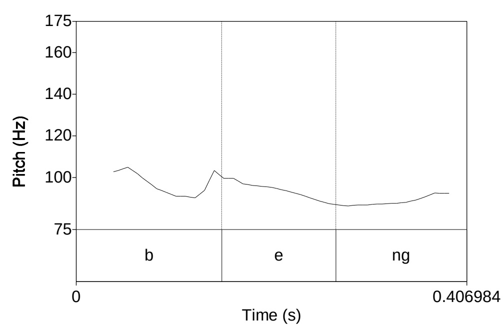
140
120
100
75
Pitch (Hz)
b
e
ng
0
0.433515
Time (s)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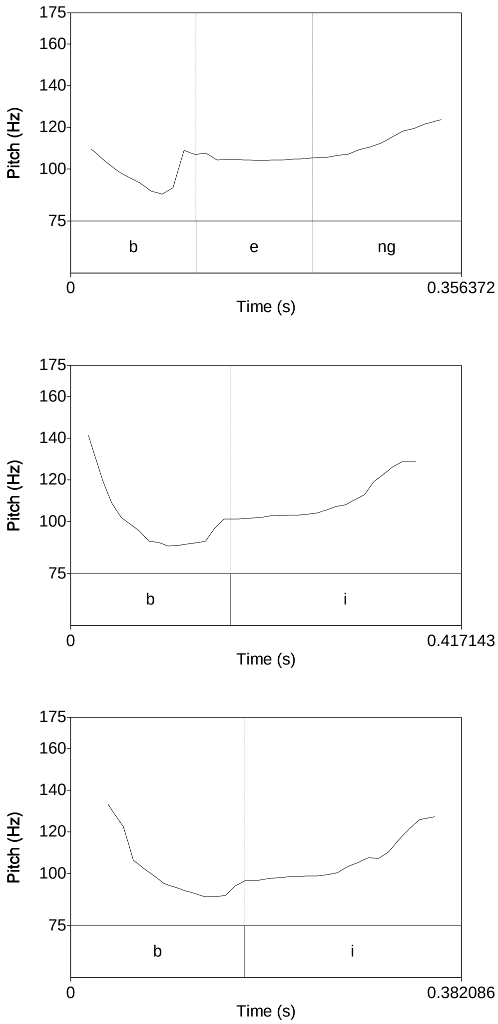
140
120
100
75
Pitch (Hz)
b
e
ng
0
0.406984
Time (s)

^{H}bi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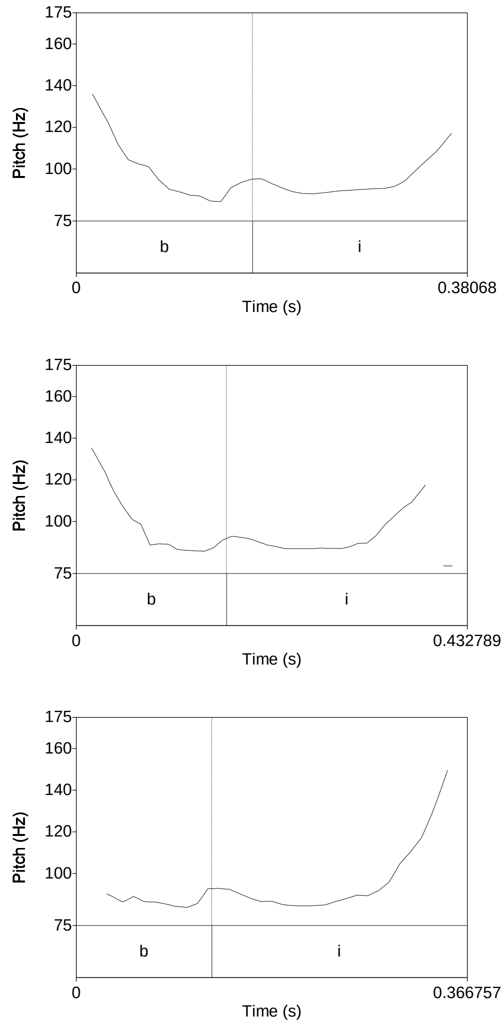
100
75
Pitch (Hz)
b
e
ng
0
0.356372
Time (s)
b
i
0
0.417143
Time (s)
b
i
0
0.382086
Time (s)

^{L}bi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100
75
Pitch (Hz)
b
i
0
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Time (s)
b
i
0
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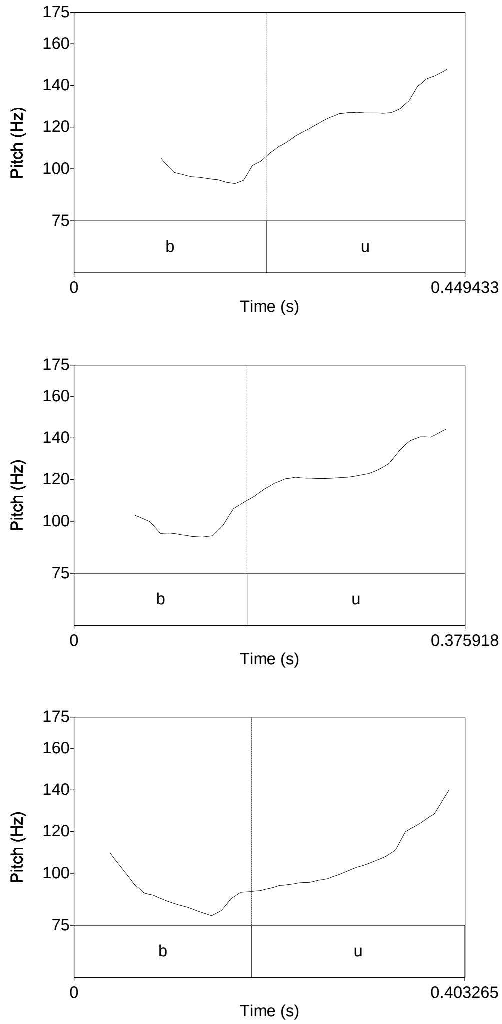
Time (s)
b
i
0
0.366757
Time (s)

^{H}bu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100
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Pitch (Hz)
b
u
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Time (s)
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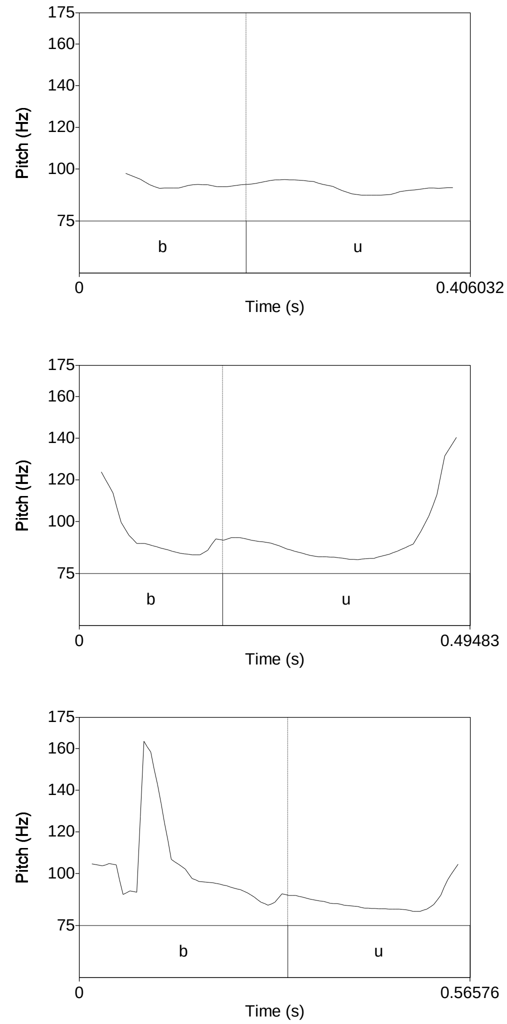
Time (s)
0
0.403265
Time (s)

^{L}bu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100
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Time (s)
0
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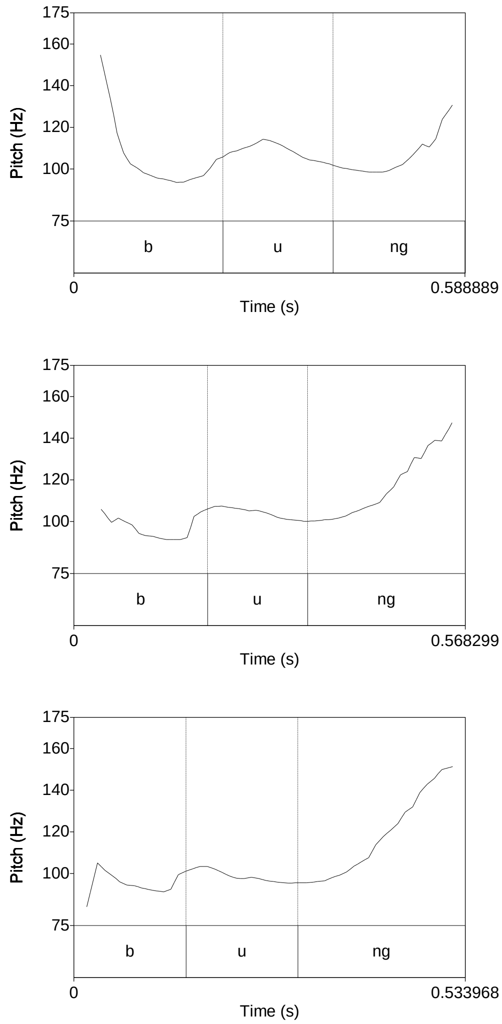
Time (s)

^{H}bung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Pitch (Hz)
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Time (s)
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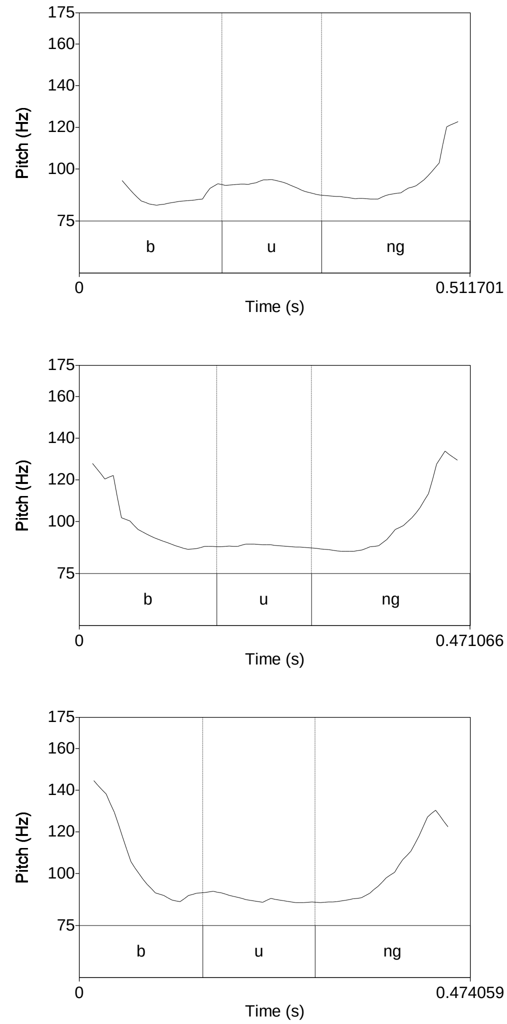
Time (s)
0
0.533968
Time (s)

^{L}bung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Pitch (Hz)
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Time (s)
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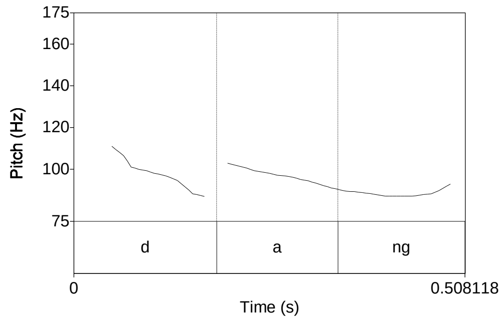
Time (s)
0
0.474059
Time (s)

^{H}dang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Pitch (Hz)
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a
ng
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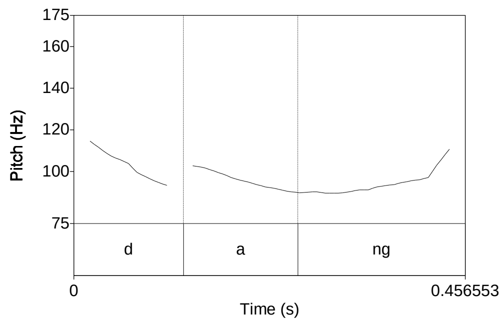
Time (s)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Pitch (Hz)
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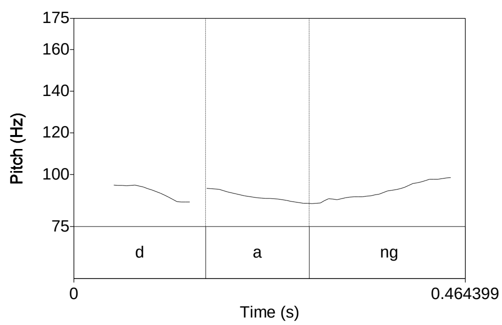
Time (s)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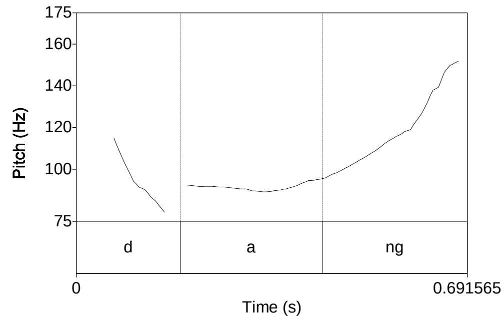
Time (s)

^{L}dang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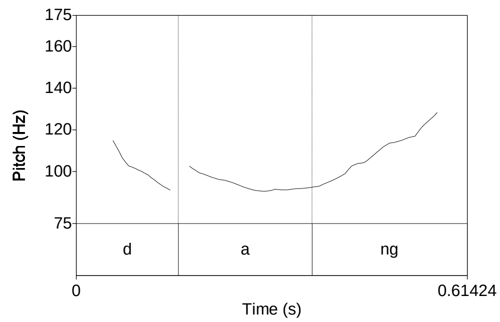
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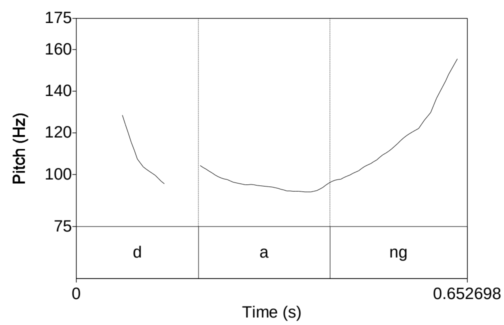
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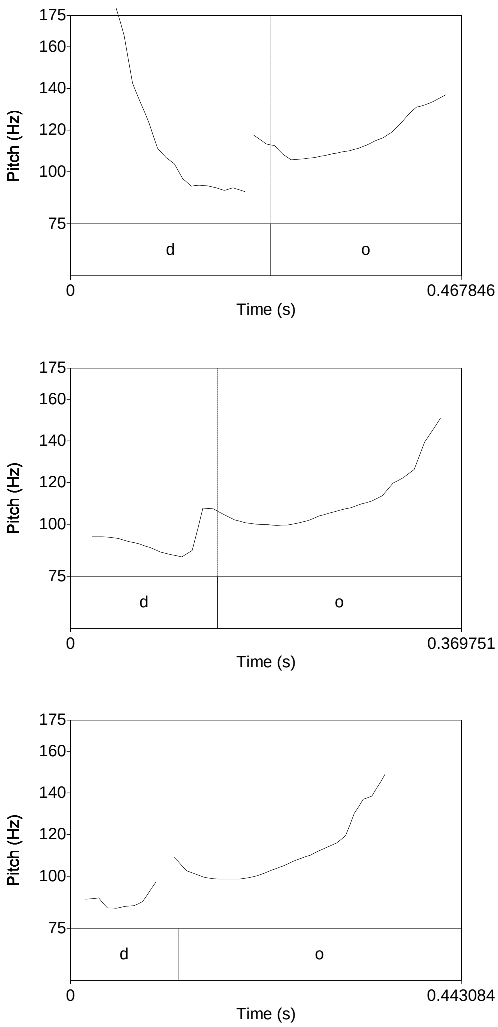
^{H}do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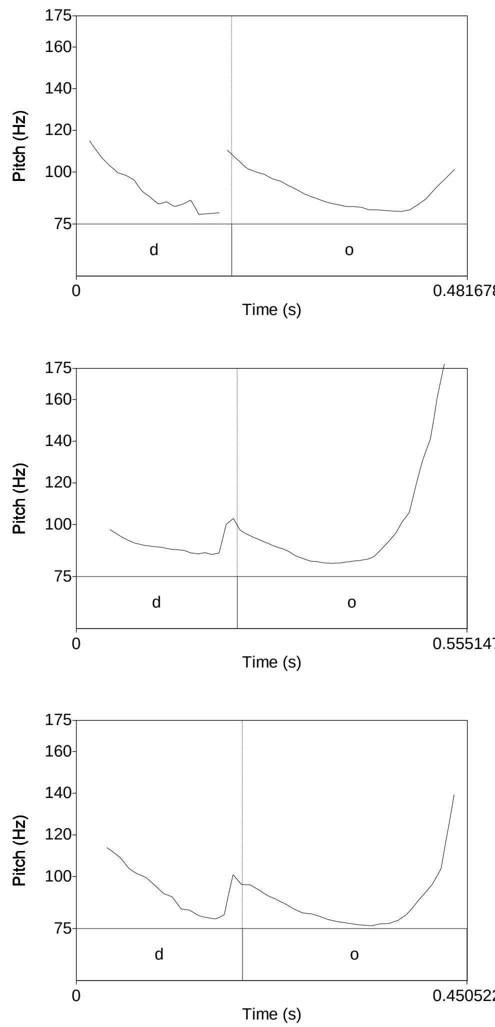
^{L}do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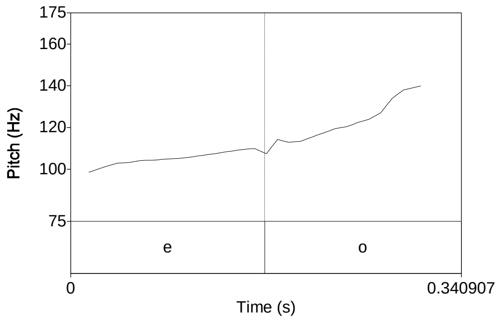
^{H}eo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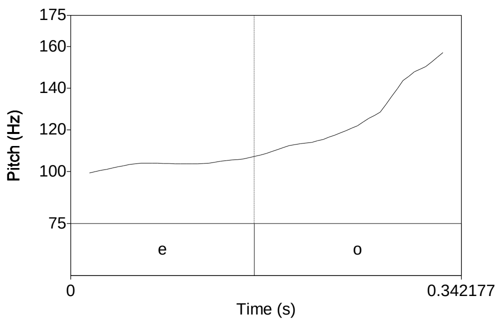
Time (s)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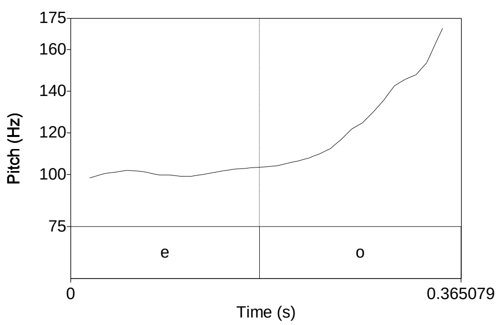
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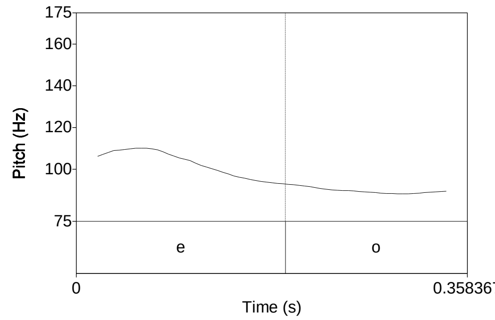
Time (s)

^{L}eo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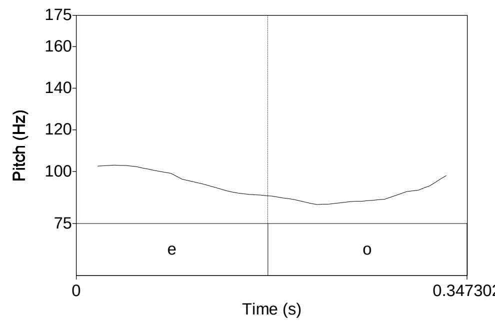
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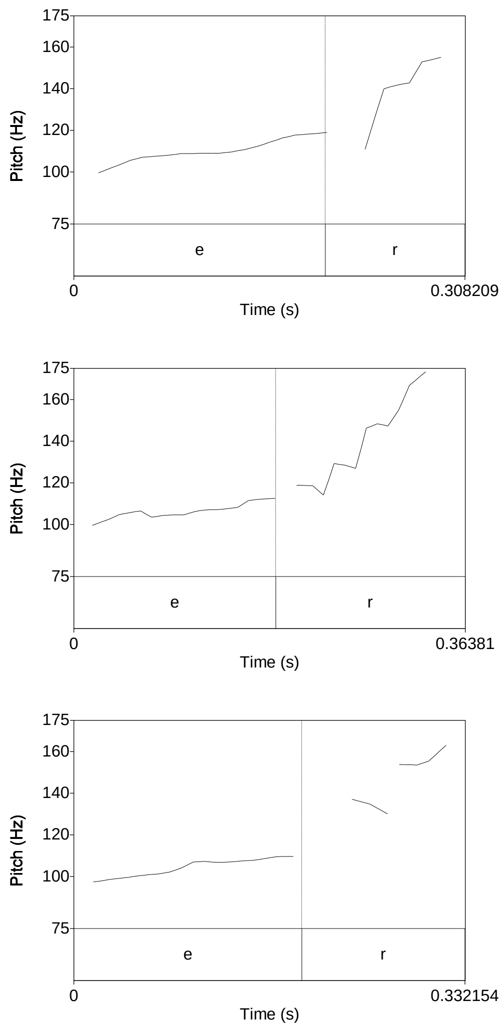
Time (s)

^{H}er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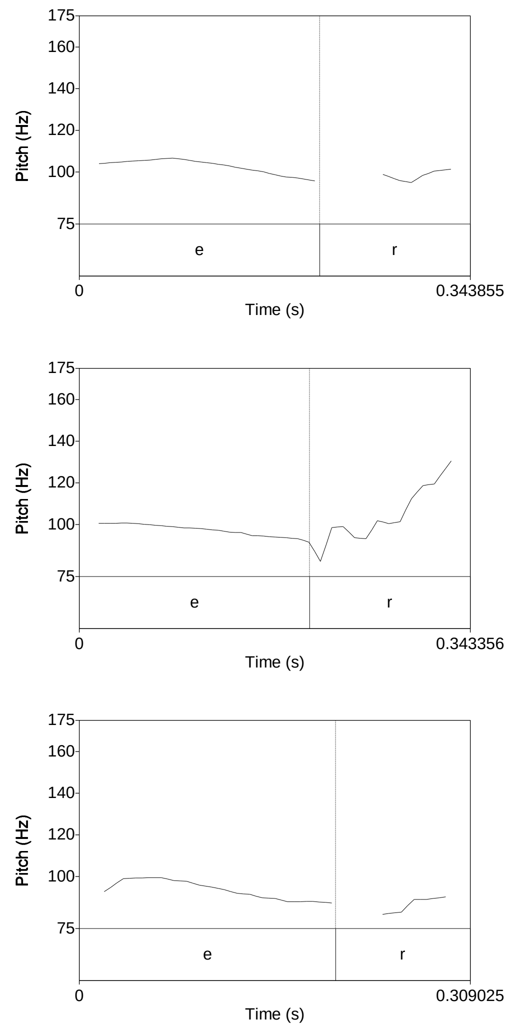
^{L}er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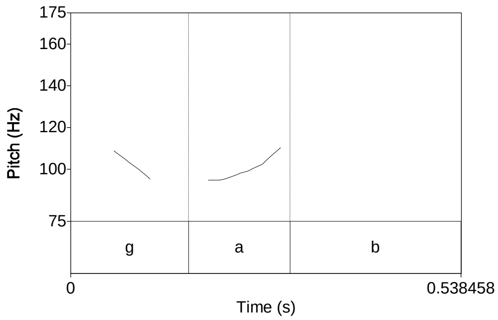
^{H}gab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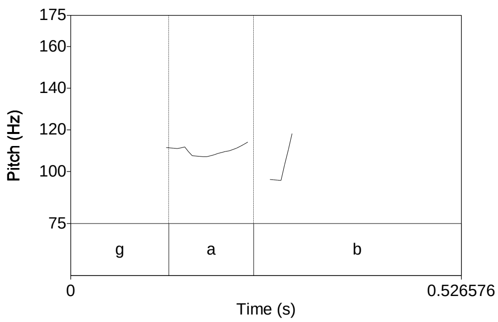
Time (s)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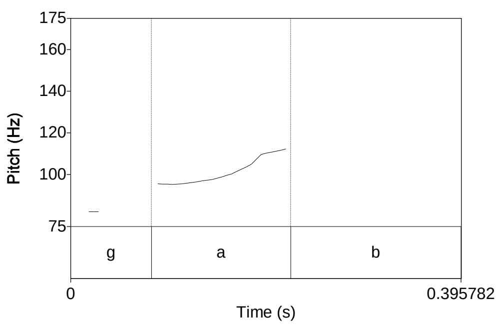
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Pitch (Hz)
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b
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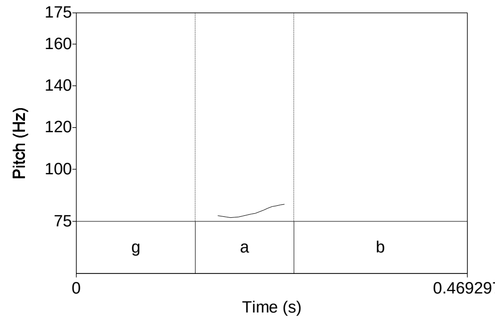
Time (s)

^{L}gab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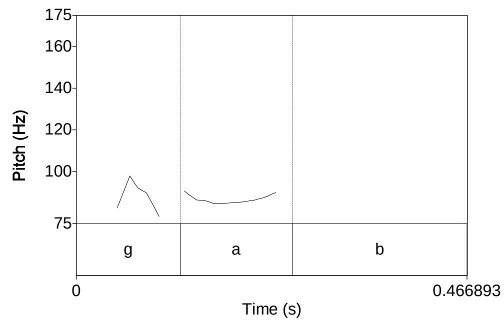
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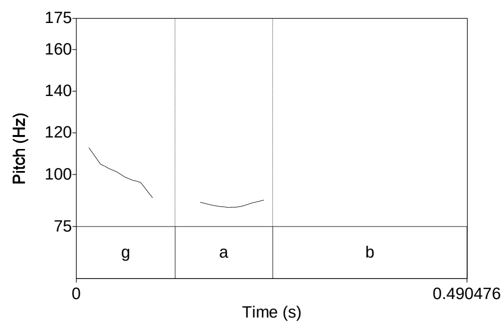
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Pitch (Hz)
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b
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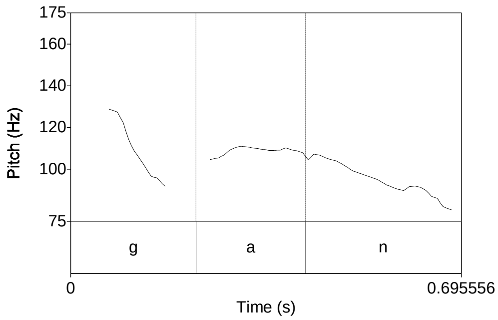
Time (s)

^{L}**gan**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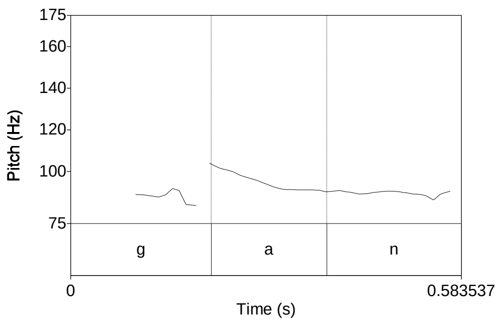
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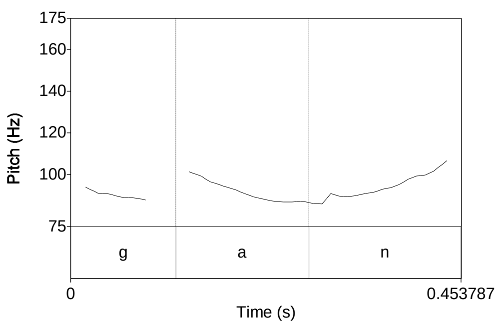
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Pitch (Hz)
g
a
n
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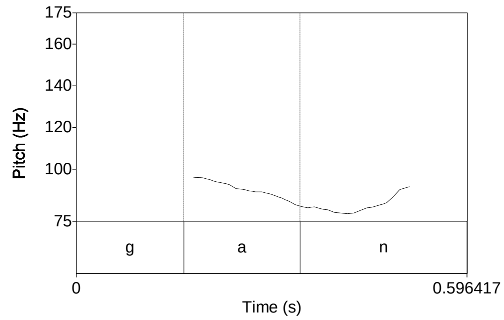
Time (s)

^{L}**gan**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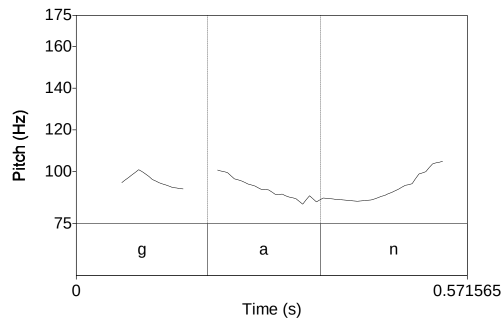
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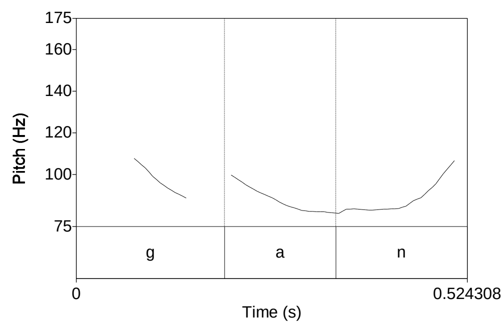
Time (s)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Pitch (Hz)
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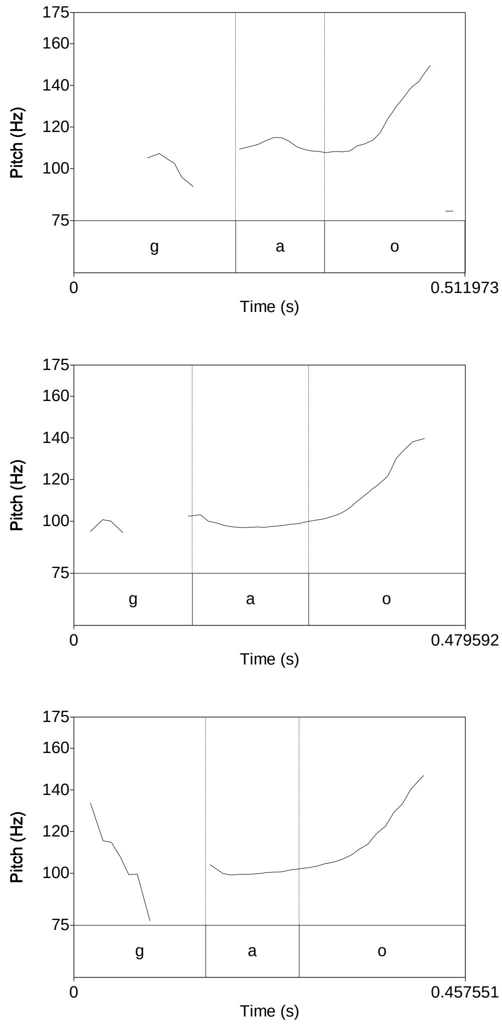
Time (s)

^{H}gao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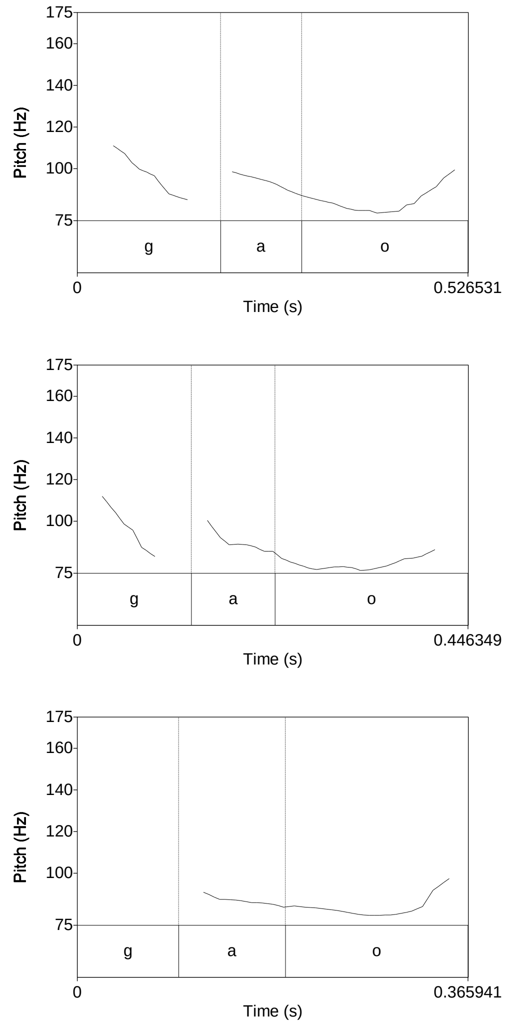
^{L}gao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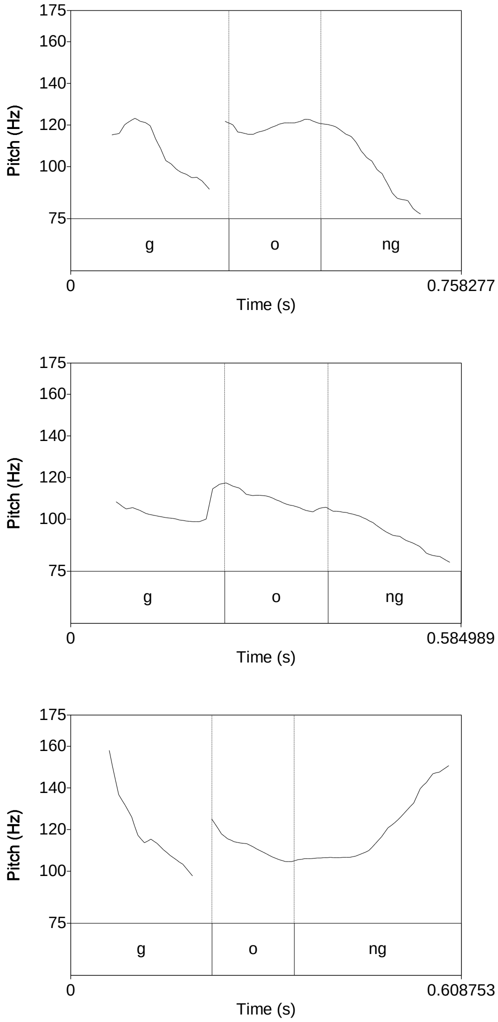
^{H}gong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Time (s)
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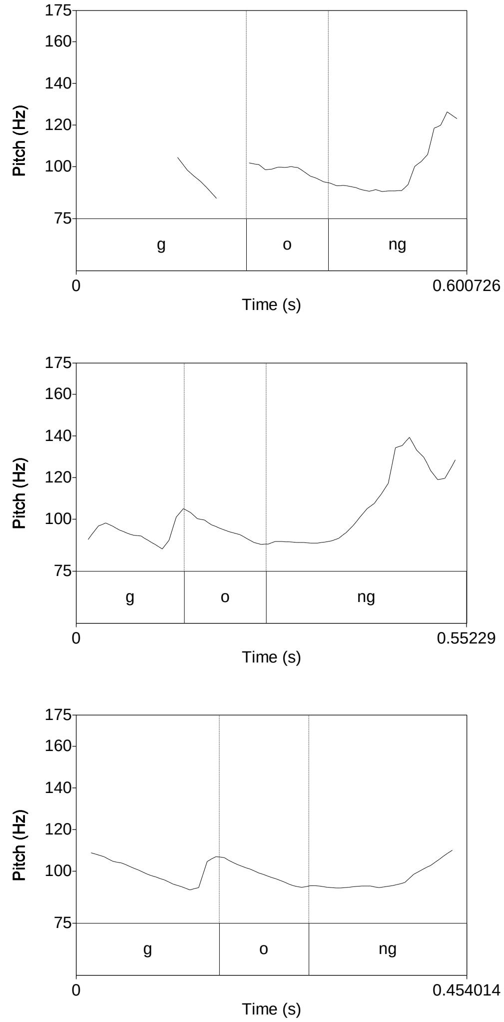
^{L}gong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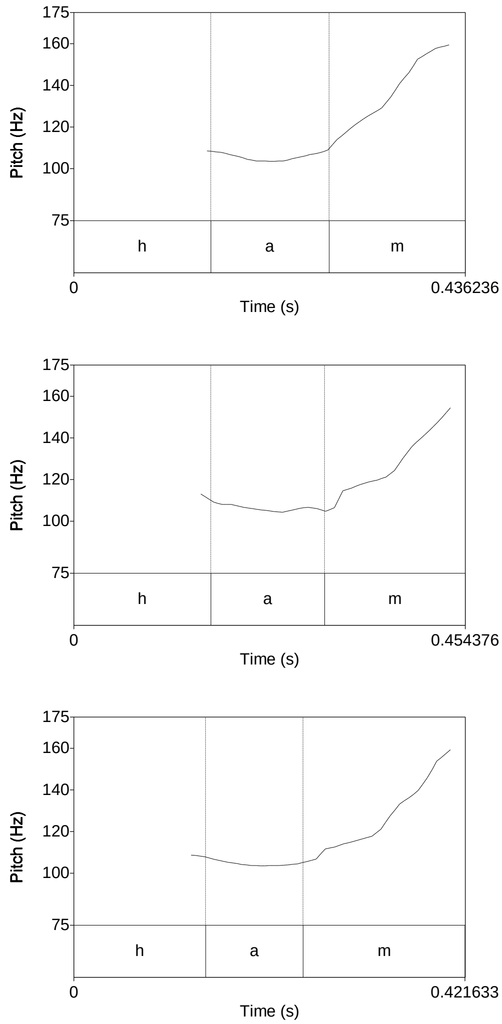
^{H}ham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Time (s)
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Time (s)
0
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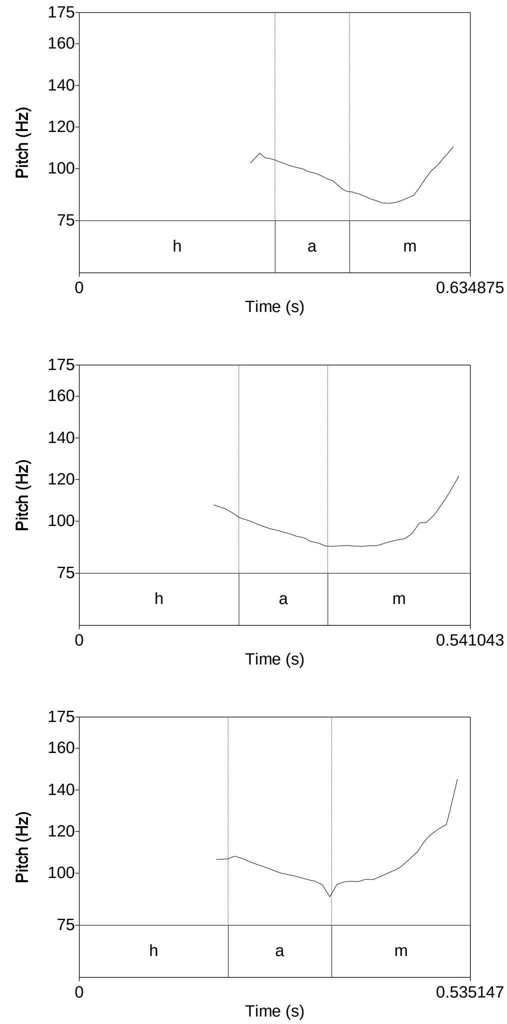
Time (s)

^{L}ham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m
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Time (s)
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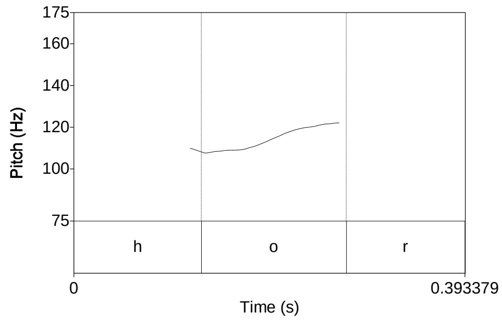
Time (s)

^{H}hor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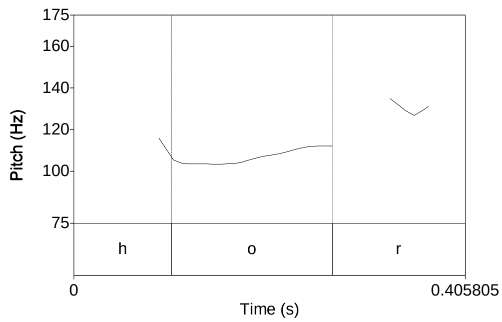
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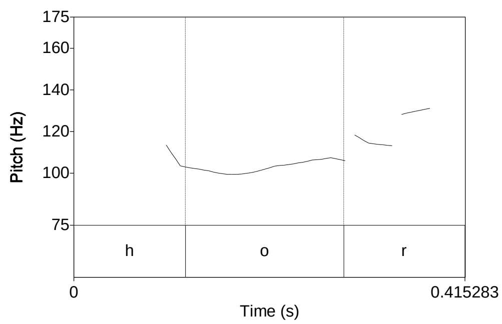
Time (s)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Pitch (Hz)
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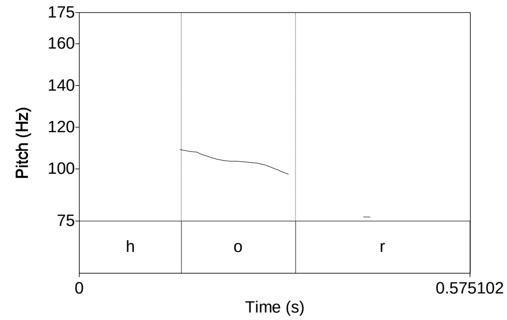
Time (s)

^{L}hor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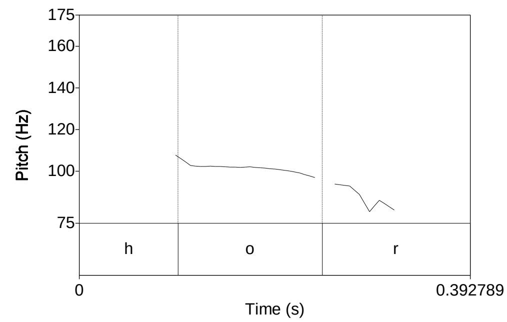
Time (s)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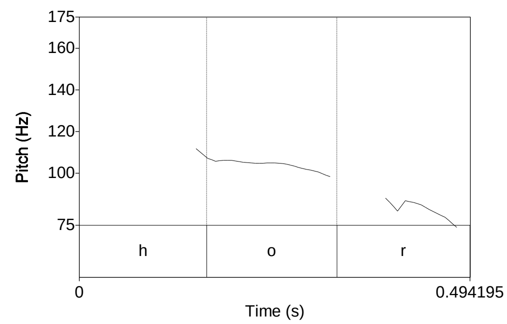
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Pitch (Hz)
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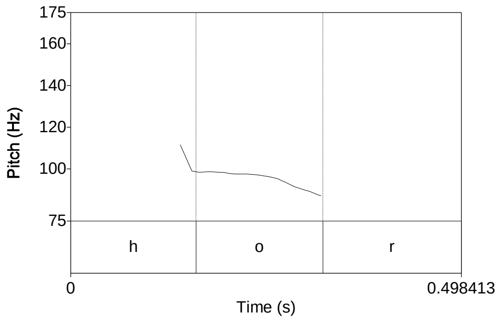
Time (s)

^{L}hor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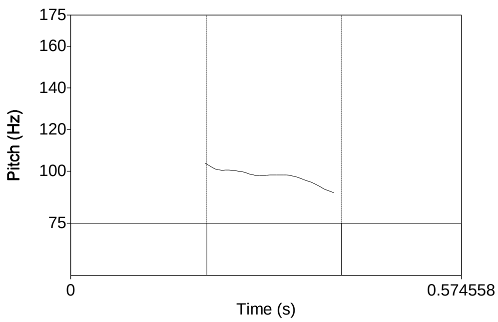
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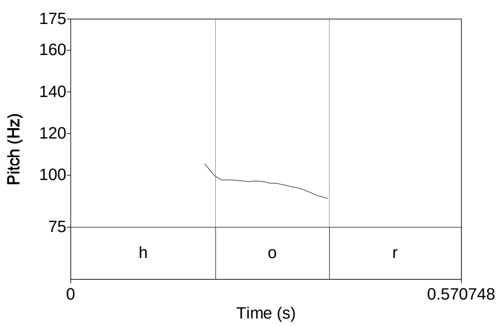
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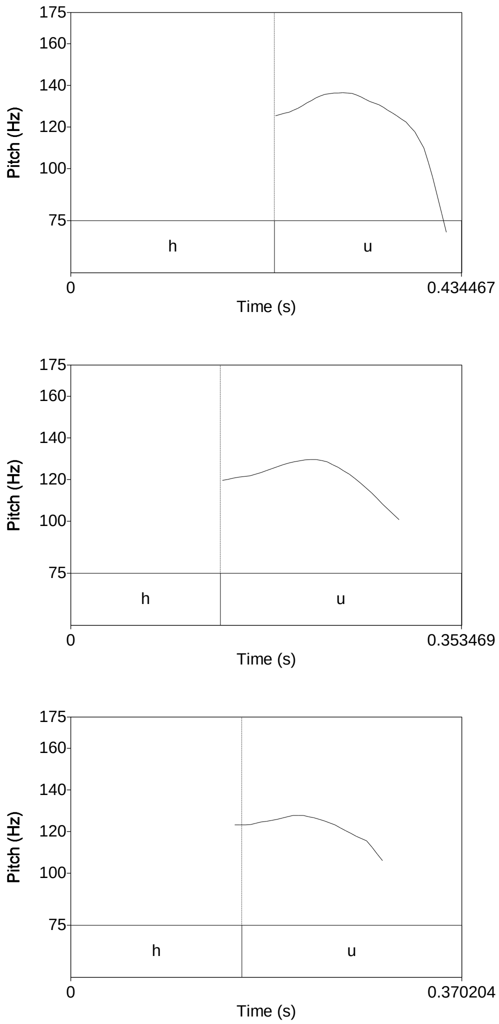
Time (s)

^{H}hu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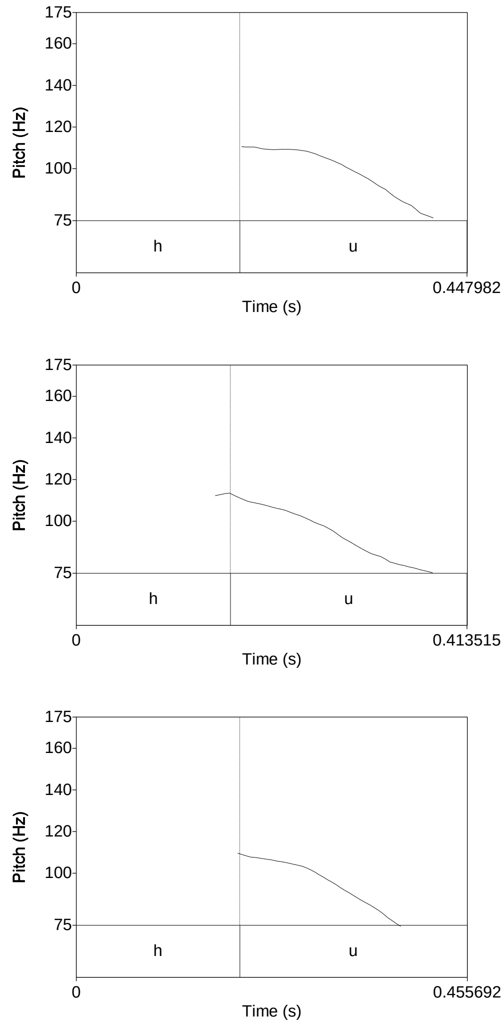
Time (s)

^{L}hu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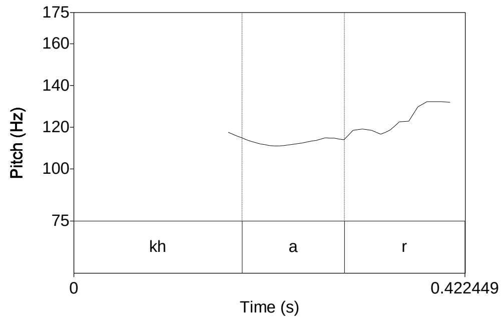
Time (s)

^{H}khar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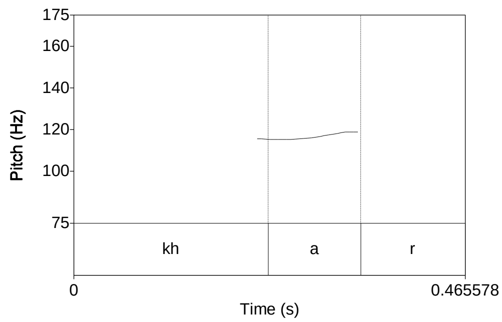
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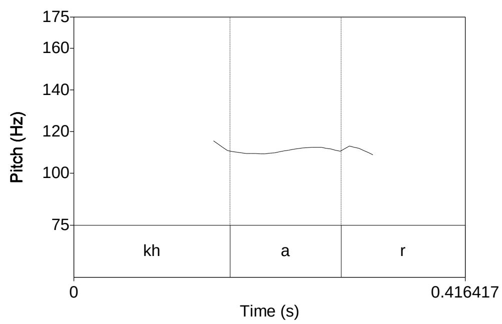
Time (s)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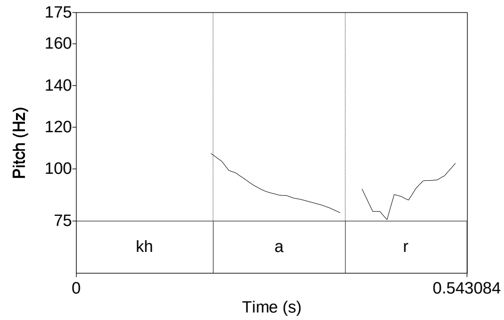
Time (s)

^{L}khar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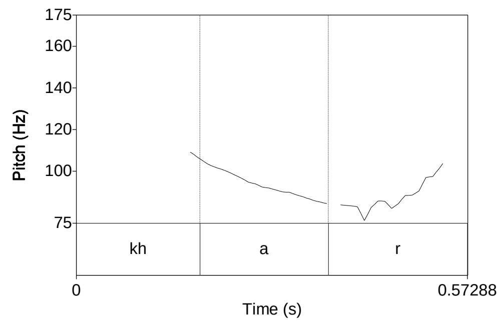
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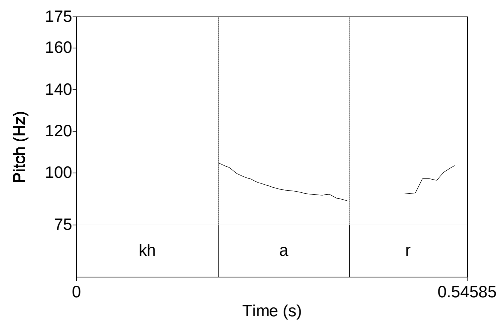
Time (s)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a
r
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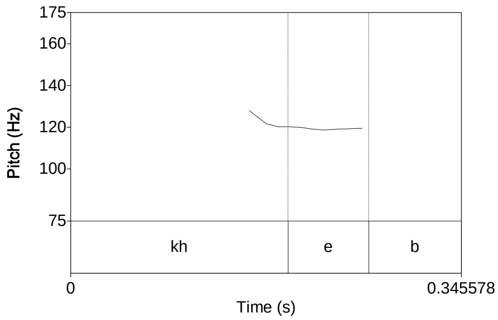
Time (s)

^{H}kheb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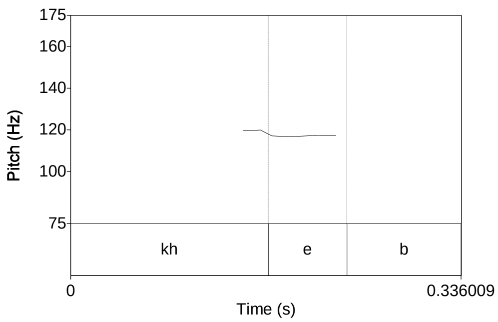
Time (s)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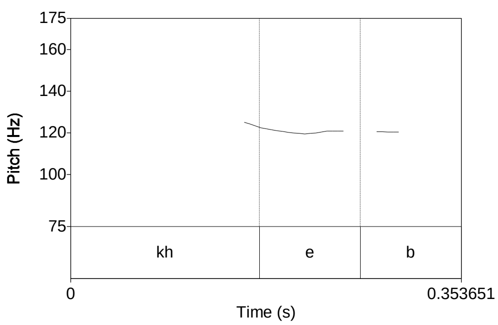
Time (s)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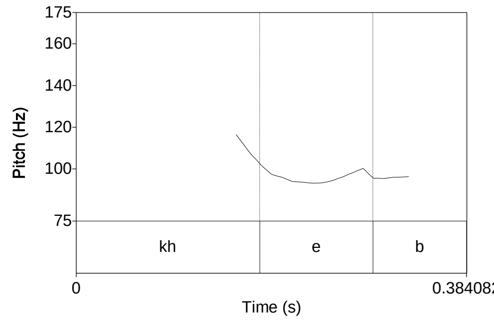
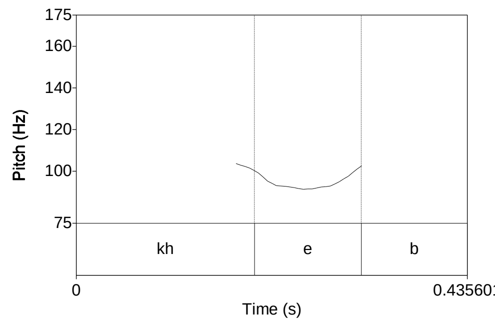
0
0.353651
Time (s)

^{L}kheb


175
160
140
120
100
75
Pitch (Hz)
kh
e
b
0
0.384082
Time (s)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140
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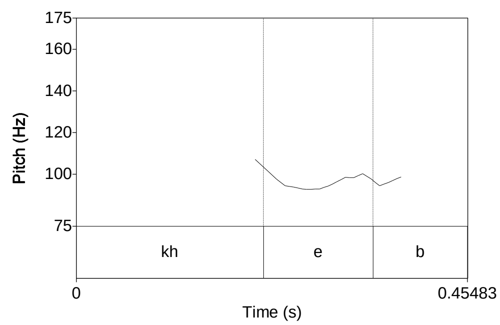
100
75
Pitch (Hz)
kh
e
b
0
0.435601
Time (s)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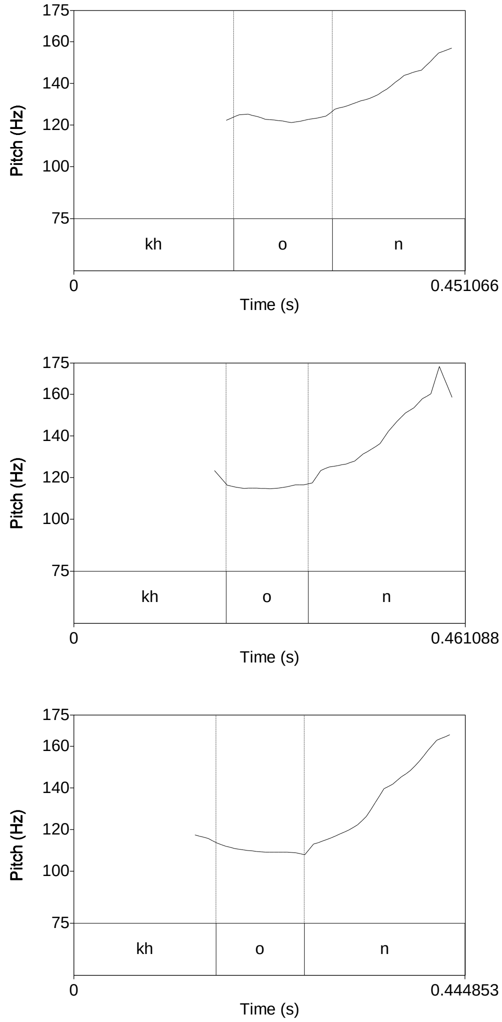
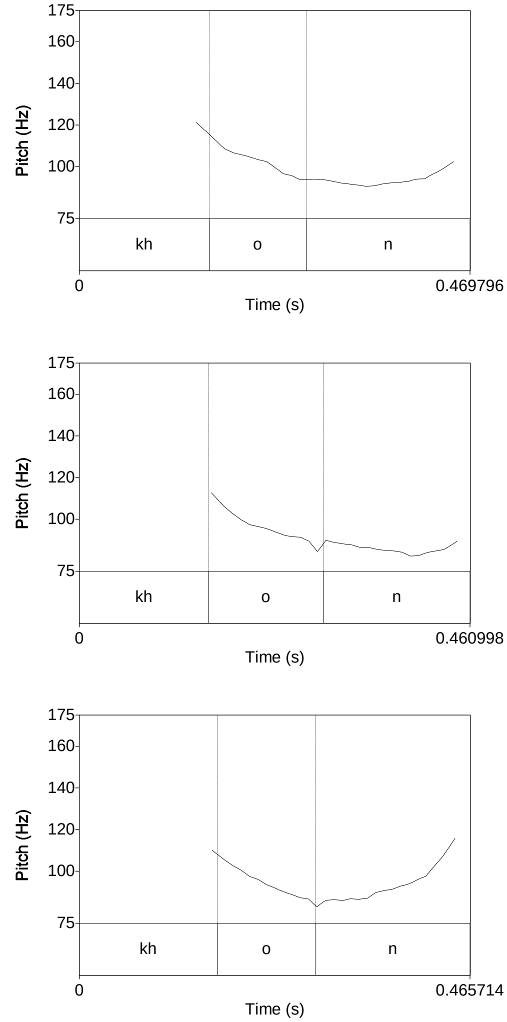
140
120
100
75
Pitch (Hz)
kh
e
b
0
0.45483
Time (s)

^{H}khon



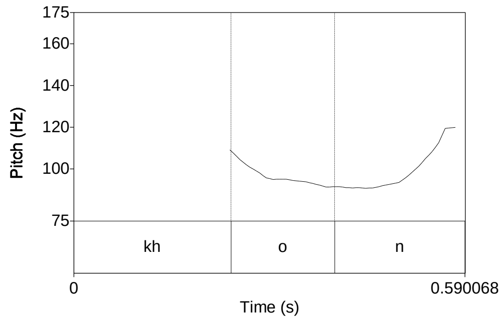
175
160
140
120
100
75
Pitch (Hz)
kh
o
n
0
0.451066
0.461088
0.444853
Time (s)

^{L}khon



175
160
140
120
100
75
Pitch (Hz)
kh
o
n
0
0.469796
0.460998
0.465714
Time (s)

^{L}khon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160
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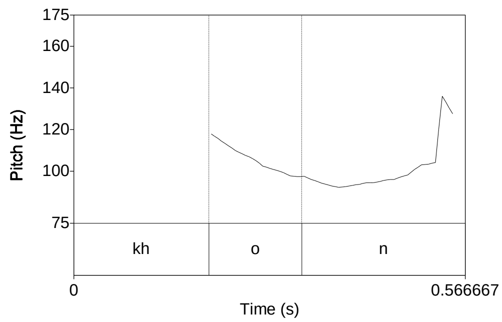
100
75
Pitch (Hz)
kh
o
n
0
0.590068
Time (s)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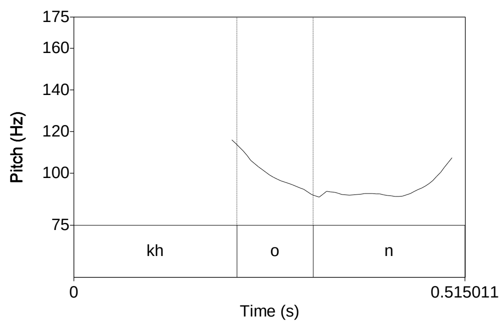
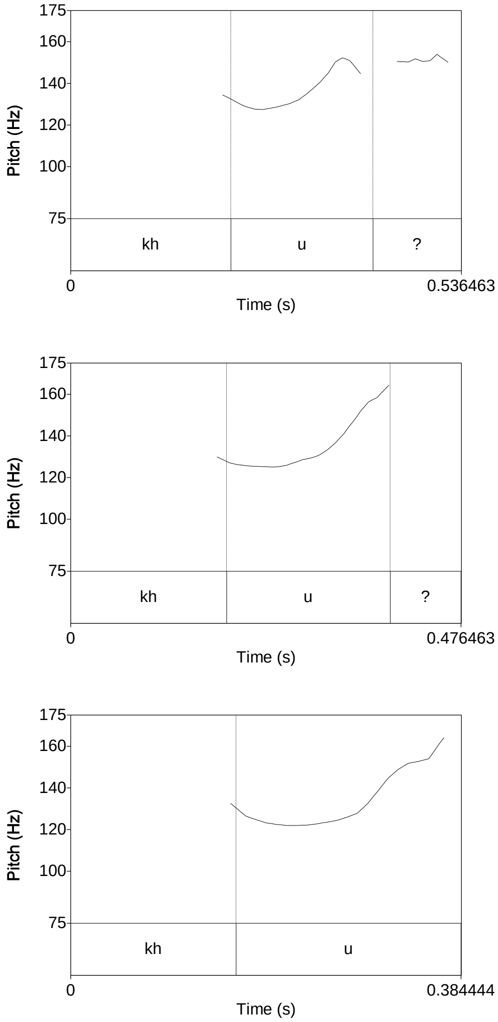
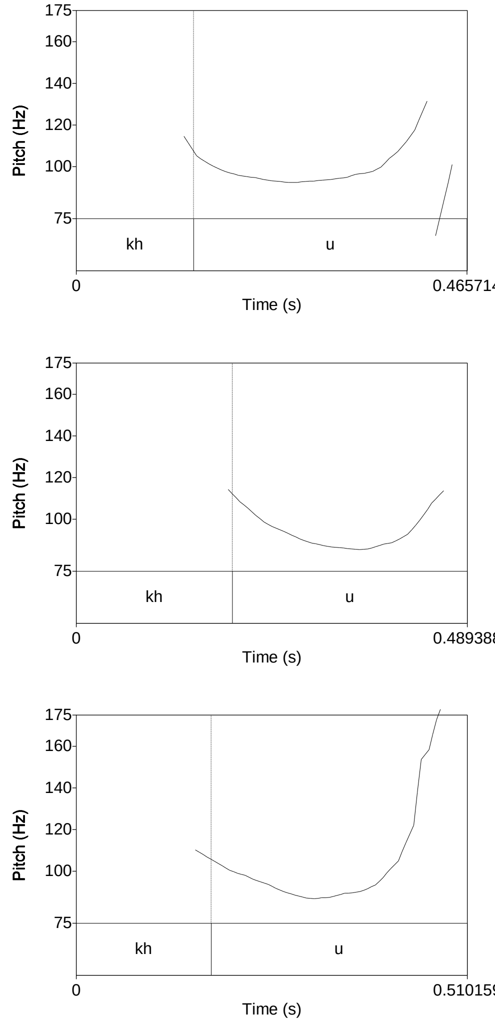
160
140
120
100
75
Pitch (Hz)
kh
o
n
0
0.566667
Time (s)


175
160
140
120
100
75
Pitch (Hz)
kh
o
n
0
0.515011
Time (s)

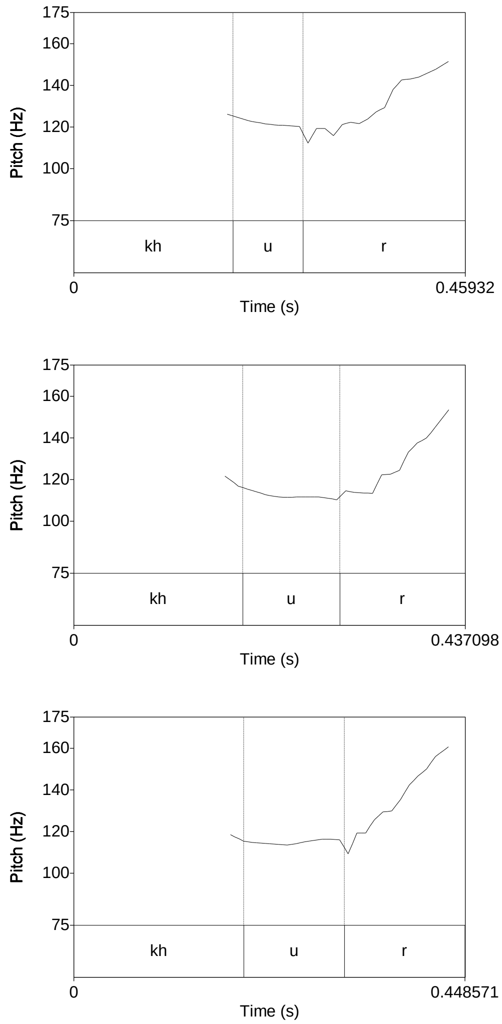
^{H}khu


175
160
140
120
100
75
Pitch (Hz)
kh
u
?
0
0.536463
Time (s)
175
160
140
120
100
75
Pitch (Hz)
kh
u
?
0
0.476463
Time (s)
175
160
140
120
100
75
Pitch (Hz)
kh
u
0
0.384444
Time (s)

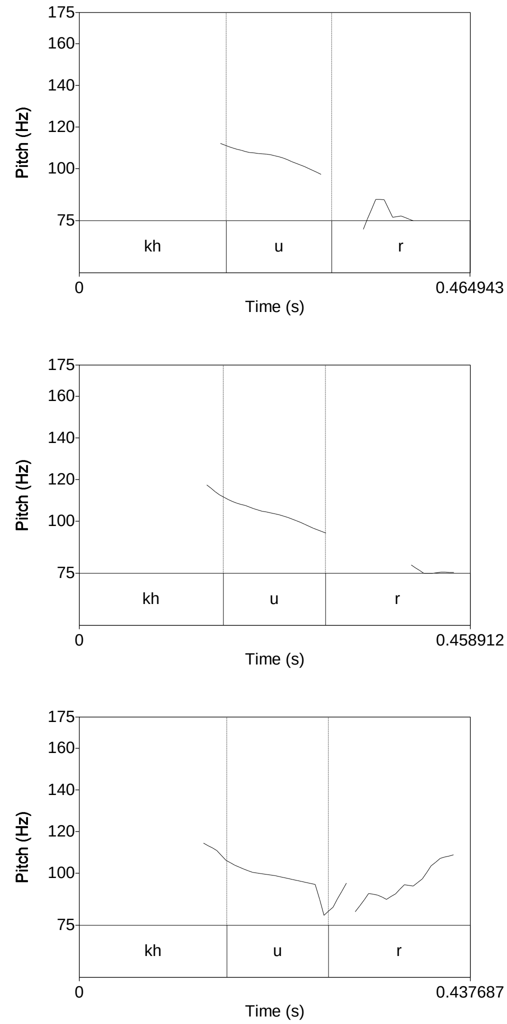
^{L}khu


175
160
140
120
100
75
Pitch (Hz)
kh
u
0
0.465714
Time (s)
175
160
140
120
100
75
Pitch (Hz)
kh
u
0
0.489388
Time (s)
175
160
140
120
100
75
Pitch (Hz)
kh
u
0
0.510159
Time (s)

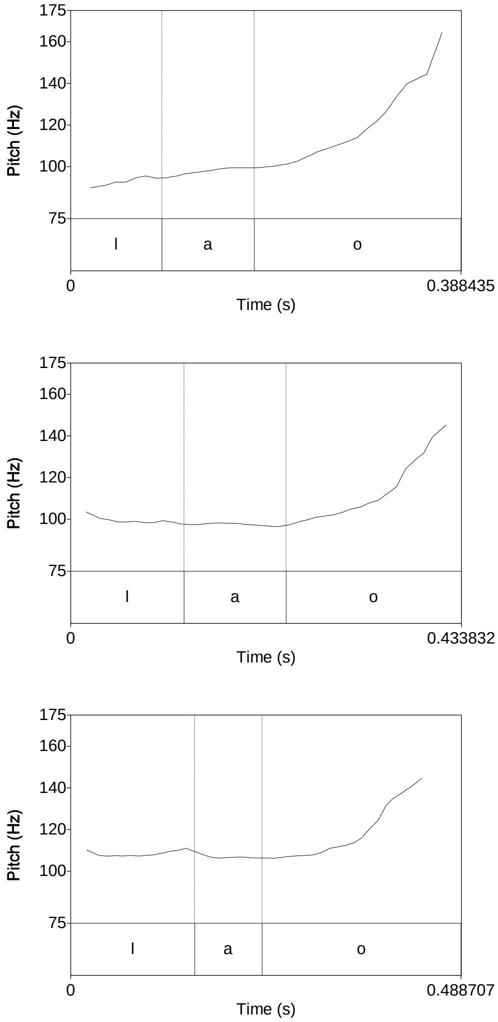
^{H}khur


175
160
140
120
100
75
Pitch (Hz)
kh
u
r
0
0.45932
Time (s)
0.437098
0.448571

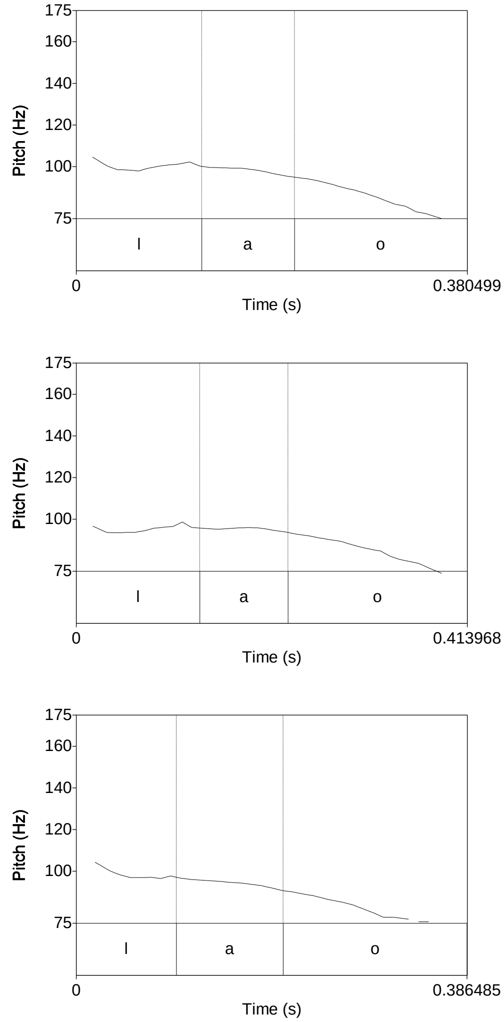
^{L}khur


175
160
140
120
100
75
Pitch (Hz)
kh
u
r
0
0.464943
Time (s)
0.458912
0.437687

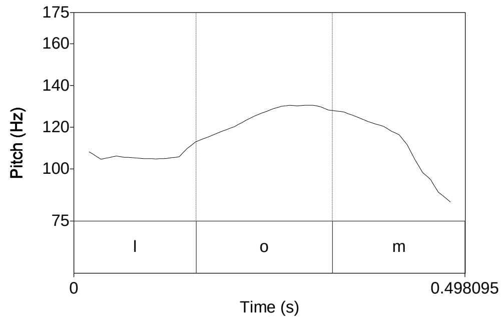
^{H}law

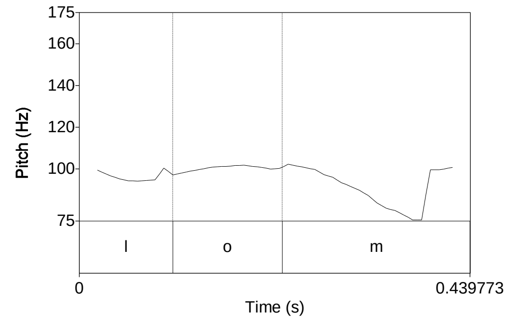

Pitch (Hz)
175
160
140
120
100
75
l
a
o
0
0.388435
Time (s)
0.433832
0.488707

^{L}law


Pitch (Hz)
175
160
140
120
100
75
l
a
o
0
0.380499
Time (s)
0.413968
0.386485

^{H}lom | **^{L}lom**


175
160
140
120
100
75
Pitch (Hz)
l
o
m
0
0.498095
Time (s)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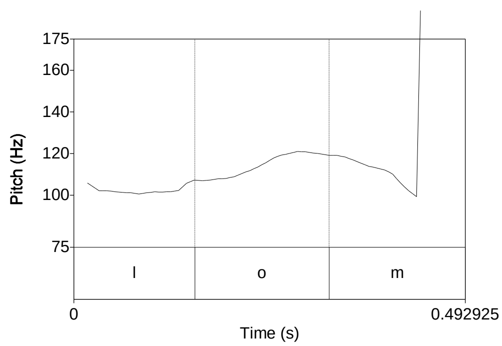
160
140
120
100
75
Pitch (Hz)
l
o
m
0
0.439773
Time (s)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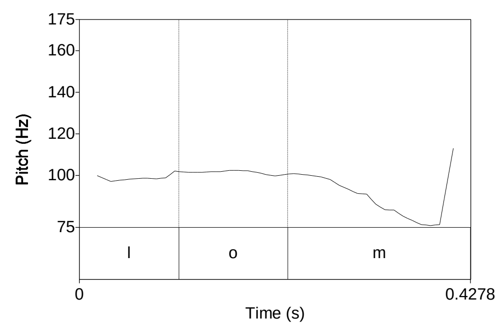
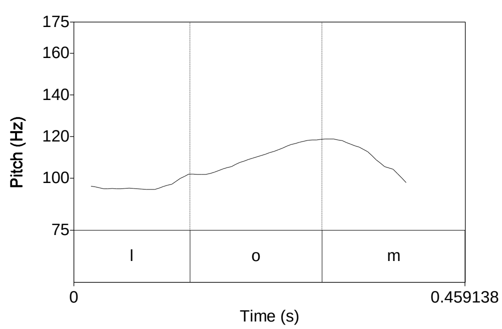
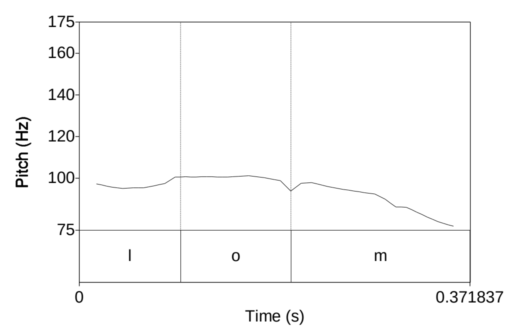
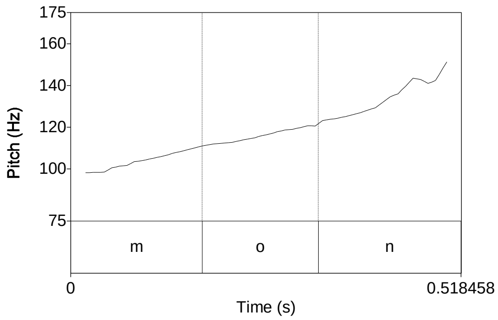
160
140
120
100
75
Pitch (Hz)
l
o
m
0
0.492925
Time (s)


175
160
140
120
100
75
Pitch (Hz)
l
o
m
0
0.4278
Time (s)


175
160
140
120
100
75
Pitch (Hz)
l
o
m
0
0.459138
Time (s)


175
160
140
120
100
75
Pitch (Hz)
l
o
m
0
0.371837
Time (s)

^{H}mon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160
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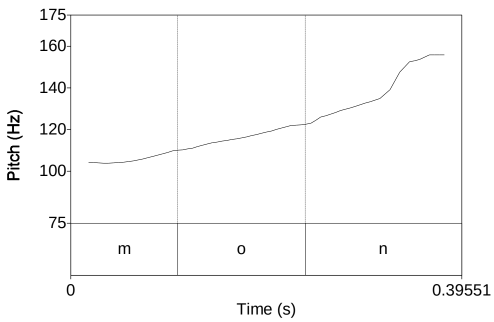
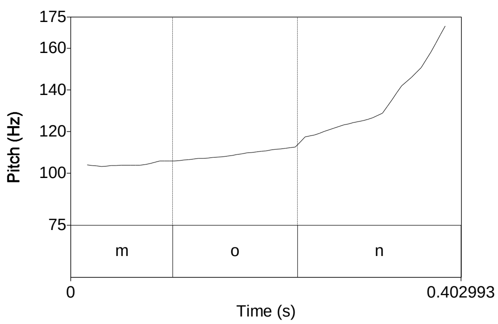
120
100
75
Pitch (Hz)
m
o
n
0
0.518458
Time (s)


175
160
140
120
100
75
Pitch (Hz)
m
o
n
0
0.39551
Time (s)


175
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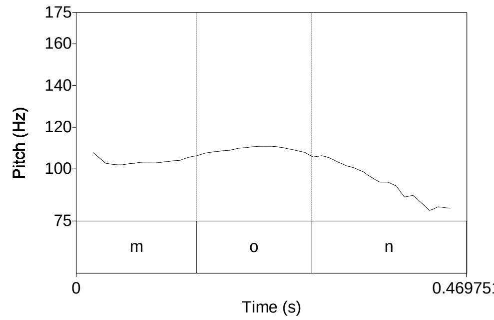
120
100
75
Pitch (Hz)
m
o
n
0
0.402993
Time (s)

^{L}mon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100
75
Pitch (Hz)
m
o
n
0
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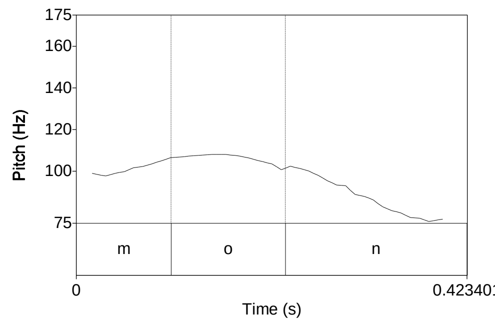
Time (s)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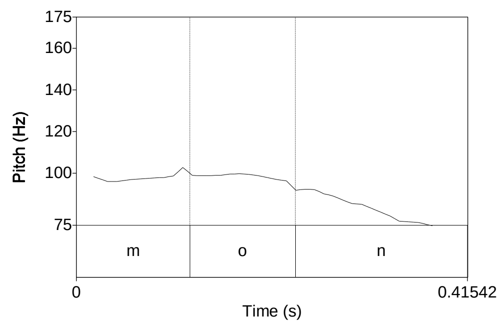
120
100
75
Pitch (Hz)
m
o
n
0
0.423401
Time (s)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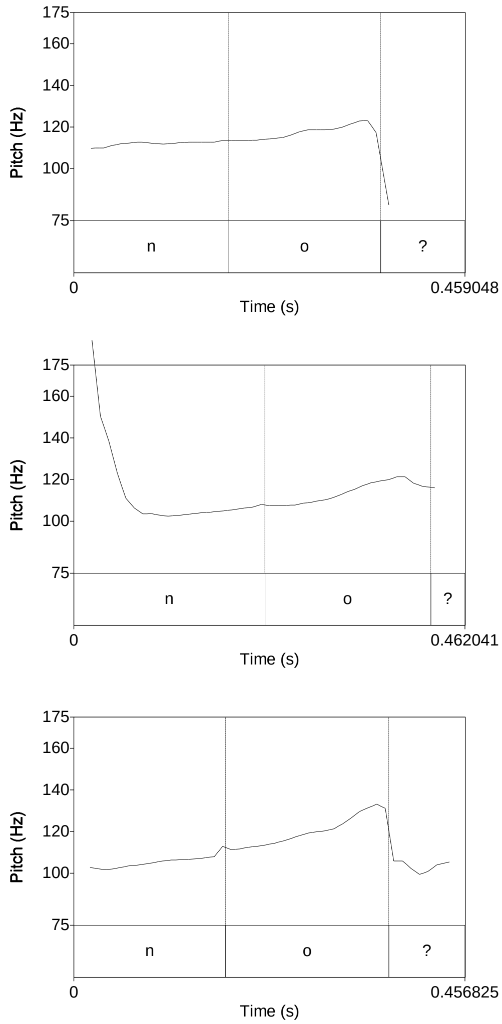
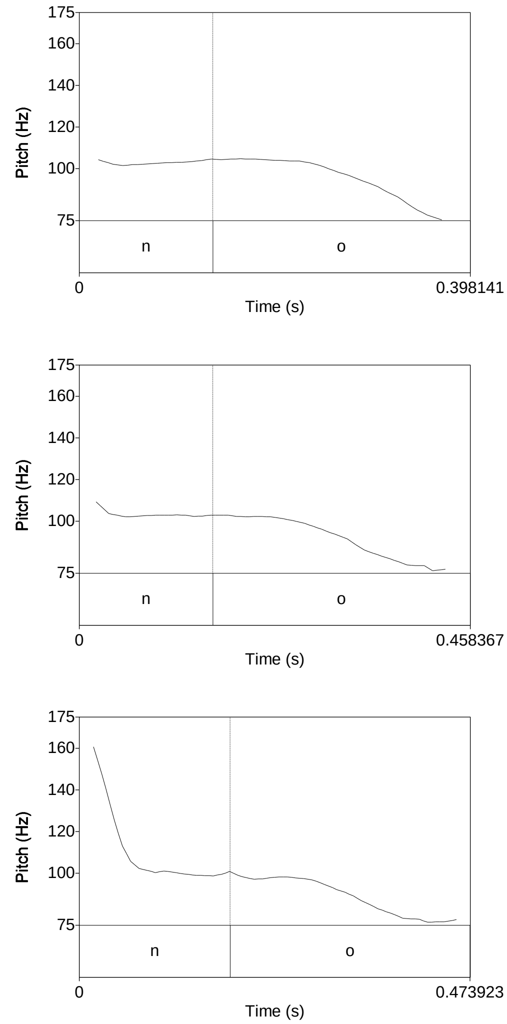
120
100
75
Pitch (Hz)
m
o
n
0
0.41542
Time (s)

[H]no



175
160
140
120
100
75
Pitch (Hz)
n
o
?
0
0.459048
0.462041
0.456825
Time (s)

[L]no



175
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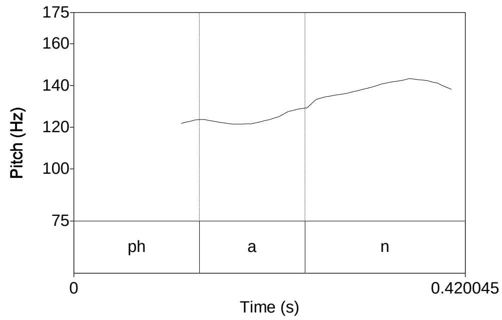
120
100
75
Pitch (Hz)
n
o
0
0.398141
0.458367
0.473923
Time (s)

^{H}phan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100
75
Pitch (Hz)
ph
a
n
0
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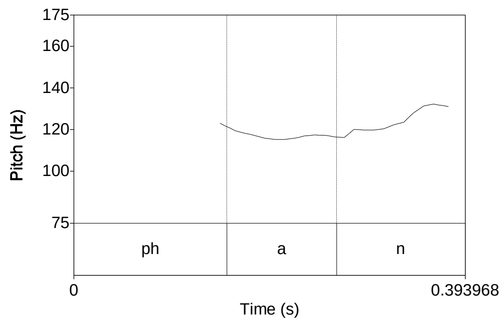
Time (s)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100
75
Pitch (Hz)
ph
a
n
0
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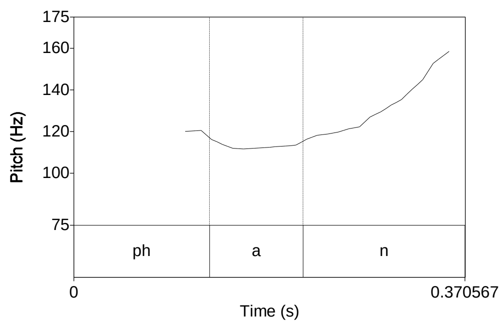
Time (s)


175
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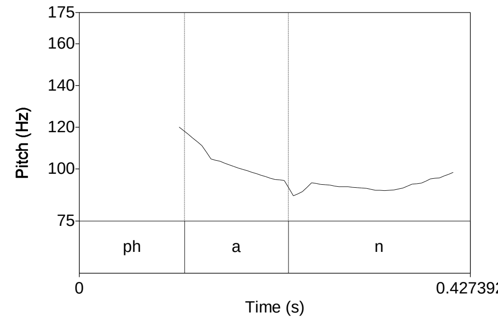
120
100
75
Pitch (Hz)
ph
a
n
0
0.370567
Time (s)

^{L}phan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120
100
75
Pitch (Hz)
ph
a
n
0
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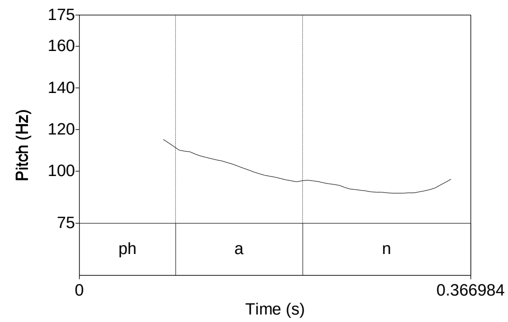
Time (s)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120
100
75
Pitch (Hz)
ph
a
n
0
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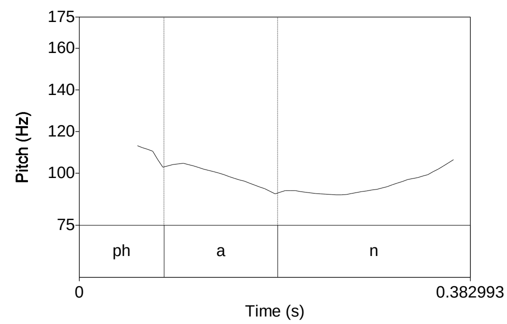
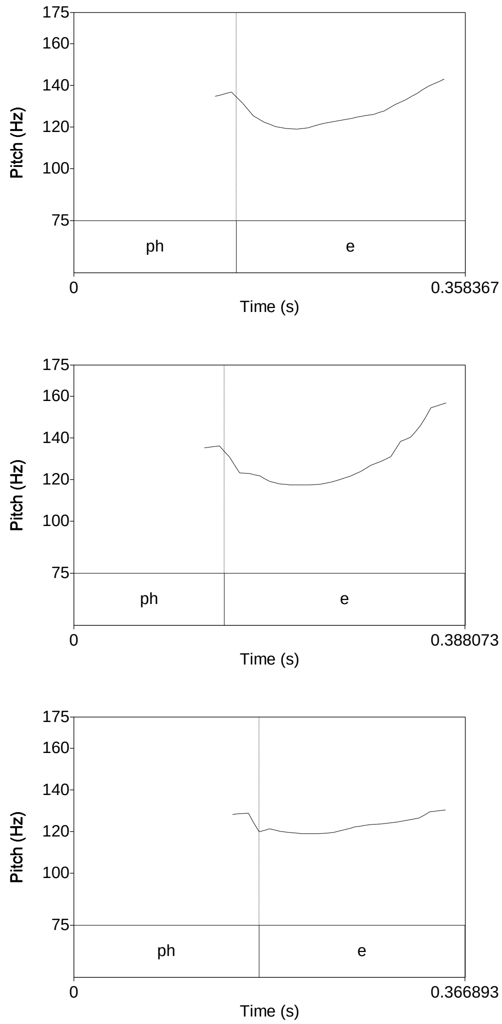
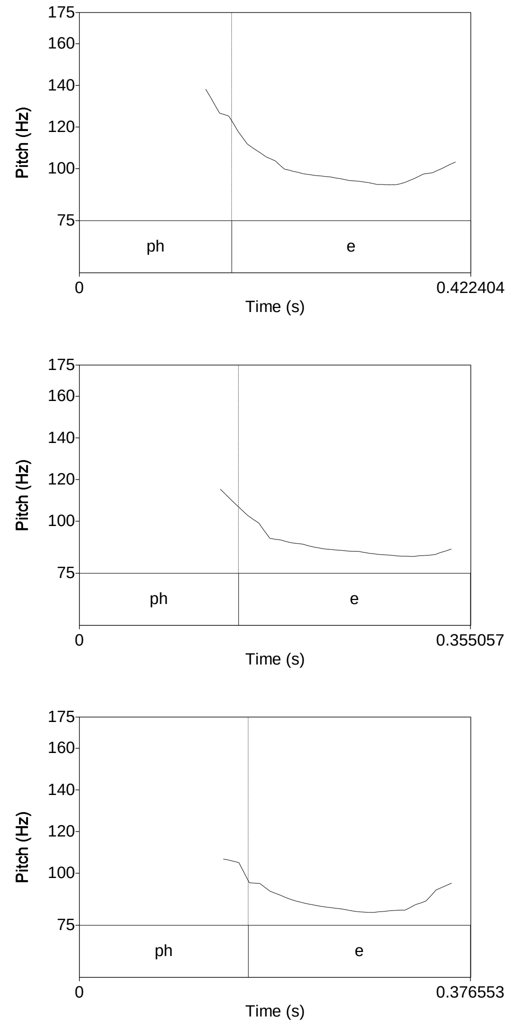
Time (s)


175
160
140
120
100
75
Pitch (Hz)
ph
a
n
0
0.382993
Time (s)

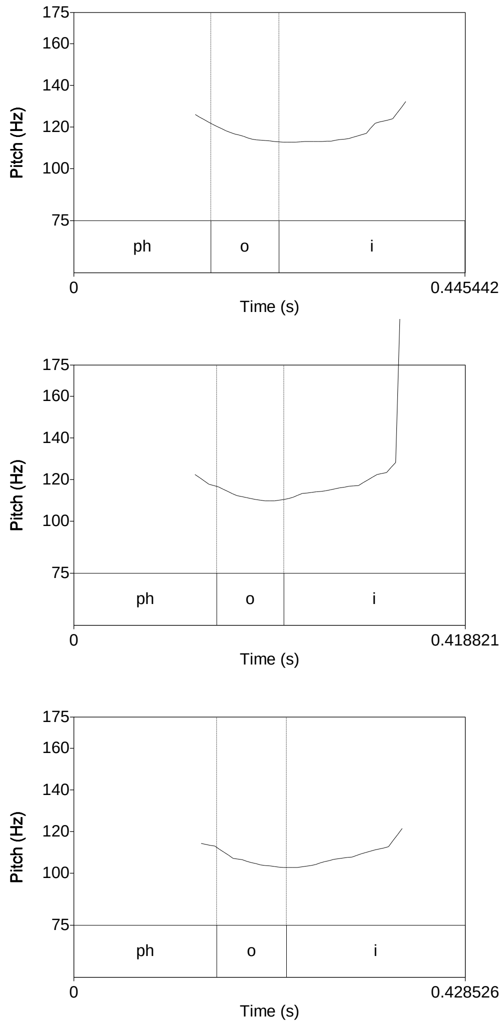
$^{\mathrm{H}}$phe



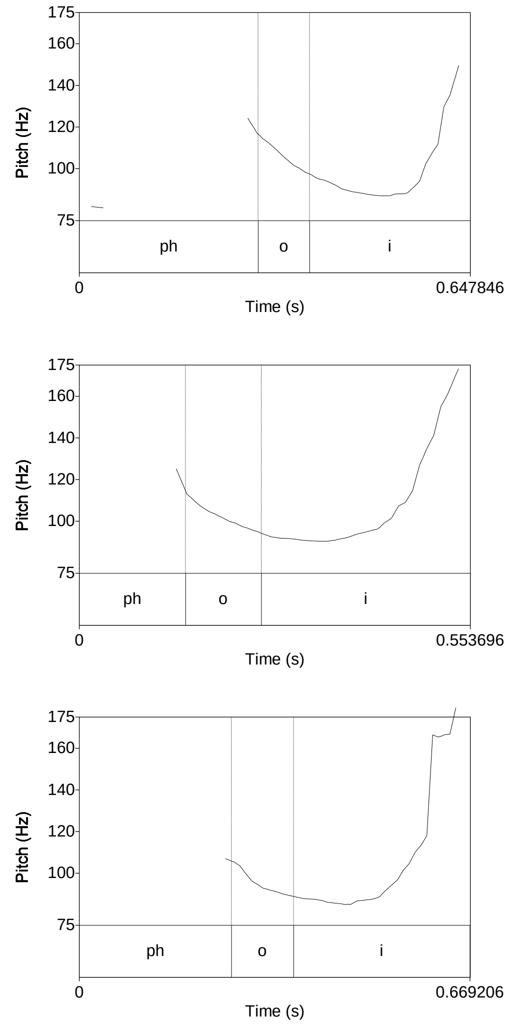
$^{\mathrm{L}}$phe



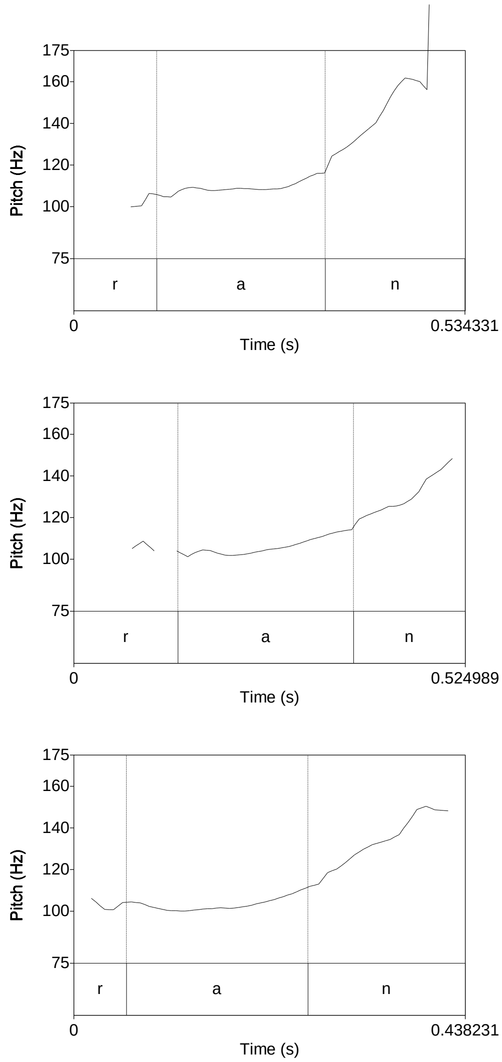
^{H}phoy


175
160
140
120
100
75
Pitch (Hz)
ph
o
i
0
0.445442
Time (s)
175
160
140
120
100
75
Pitch (Hz)
ph
o
i
0
0.418821
Time (s)
175
160
140
120
100
75
Pitch (Hz)
ph
o
i
0
0.428526
Time (s)

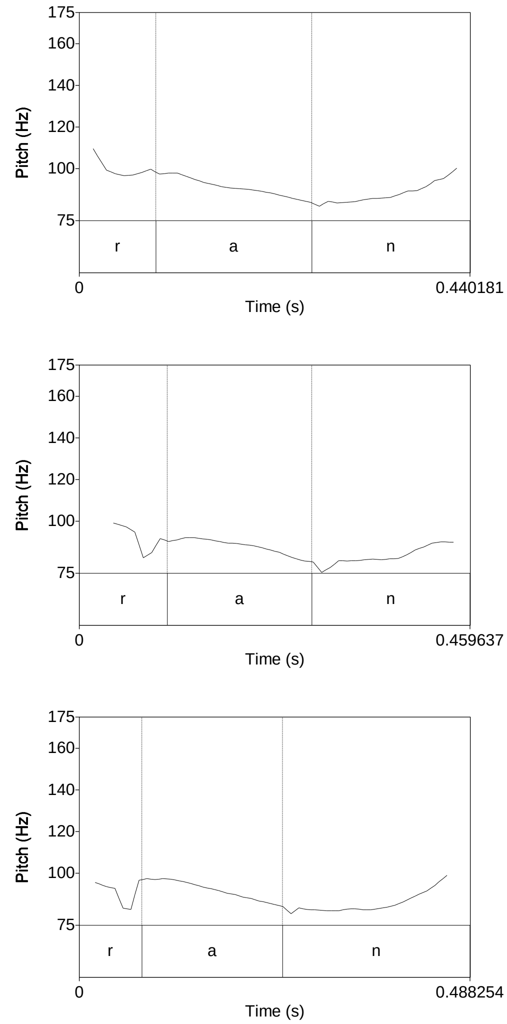
^{L}phoy


175
160
140
120
100
75
Pitch (Hz)
ph
o
i
0
0.647846
Time (s)
175
160
140
120
100
75
Pitch (Hz)
ph
o
i
0
0.553696
Time (s)
175
160
140
120
100
75
Pitch (Hz)
ph
o
i
0
0.669206
Time (s)

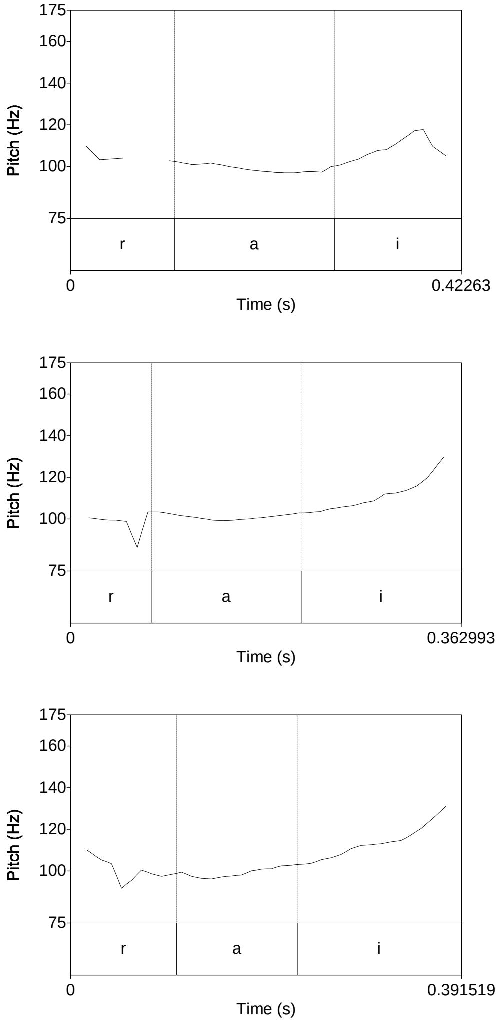
^{H}ran


175
160
140
120
100
75
Pitch (Hz)
r
a
n
0
0.534331
0.524989
0.438231
Time (s)

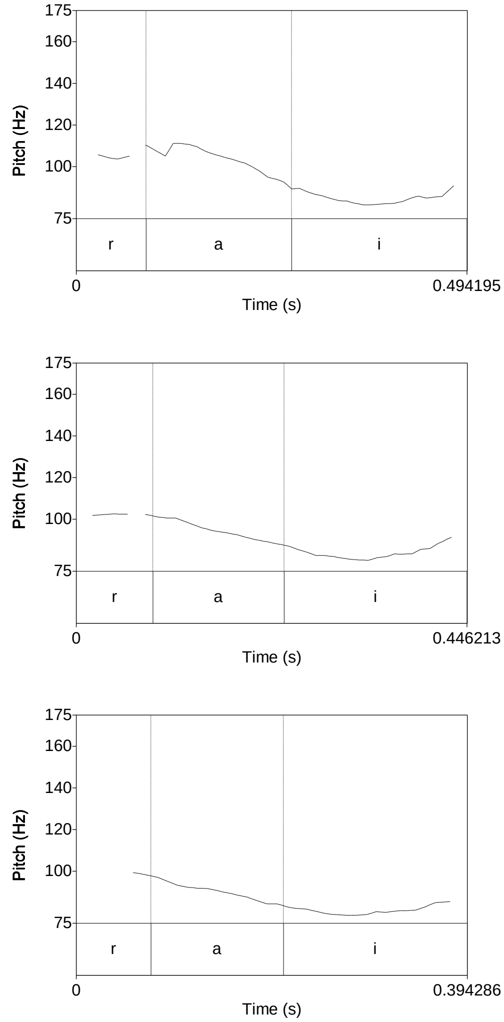
^{L}ran


175
160
140
120
100
75
Pitch (Hz)
r
a
n
0
0.440181
0.459637
0.488254
Time (s)

^{H}ray


175
160
140
120
100
75
Pitch (Hz)
r
a
i
0
0.42263
Time (s)
0.362993
0.391519

^{L}ray


175
160
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120
100
75
Pitch (Hz)
r
a
i
0
0.494195
Time (s)
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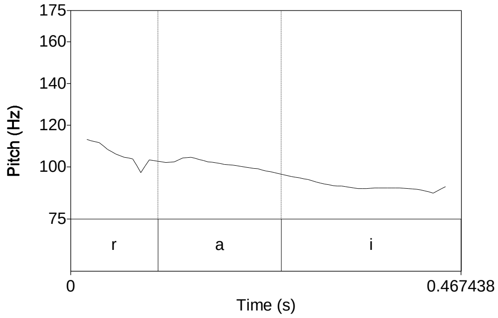
0.394286

^{L}ray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120
100
75
Pitch (Hz)
r
a
i
0
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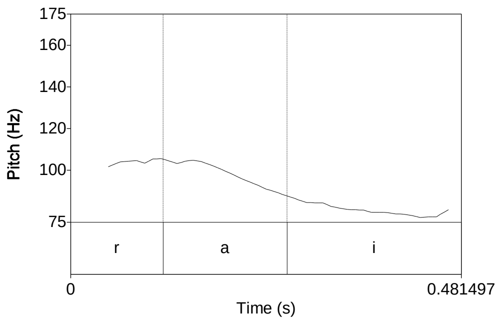
Time (s)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140
120
100
75
Pitch (Hz)
r
a
i
0
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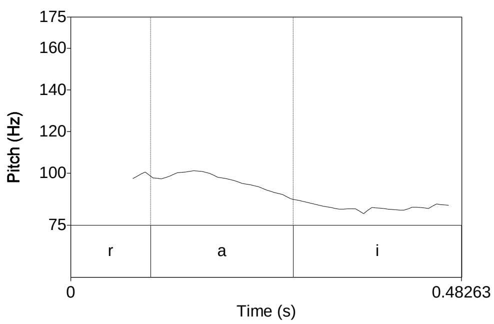
Time (s)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120
100
75
Pitch (Hz)
r
a
i
0
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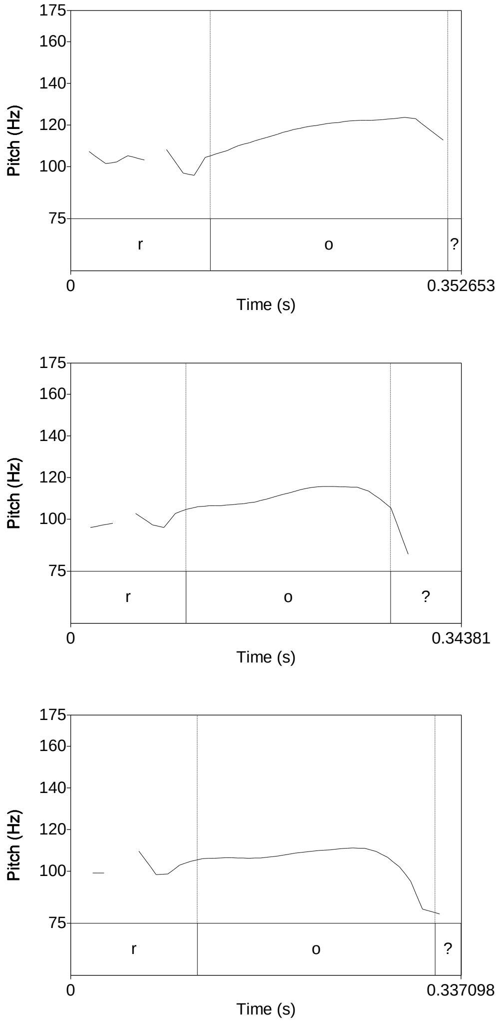
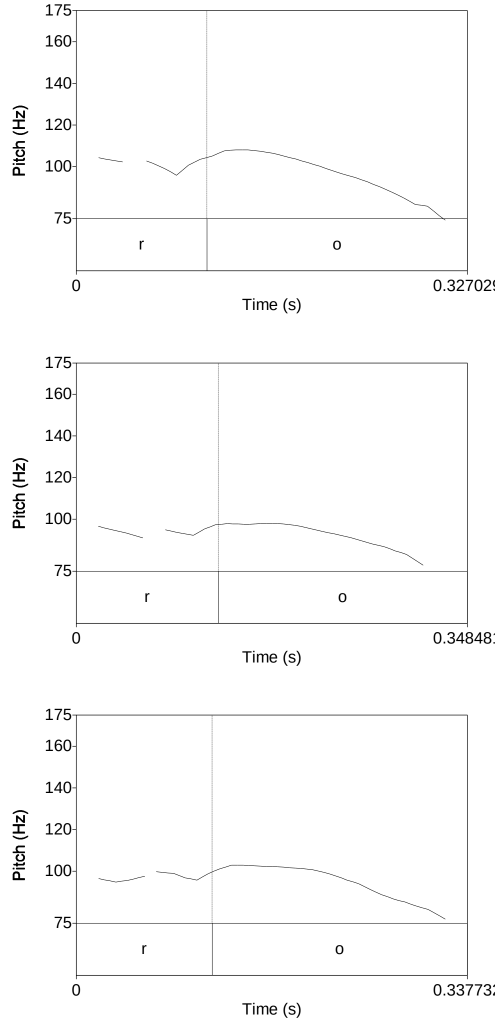
Time (s)

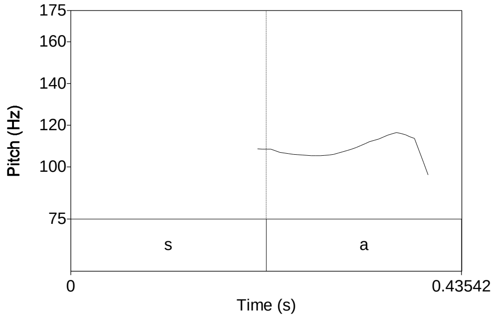
^{H}ro


175
160
140
120
100
75
Pitch (Hz)
r
o
?
0
0.352653
Time (s)
175
160
140
120
100
75
Pitch (Hz)
r
o
?
0
0.34381
Time (s)
175
160
140
120
100
75
Pitch (Hz)
r
o
?
0
0.337098
Time (s)

^{L}ro


175
160
140
120
100
75
Pitch (Hz)
r
o
0
0.327029
Time (s)
175
160
140
120
100
75
Pitch (Hz)
r
o
0
0.348481
Time (s)
175
160
140
120
100
75
Pitch (Hz)
r
o
0
0.337732
Time (s)

^{H}sa


175
160
140
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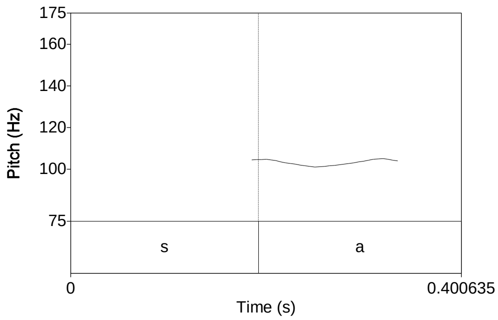
100
75
Pitch (Hz)
s
a
0
0.43542
Time (s)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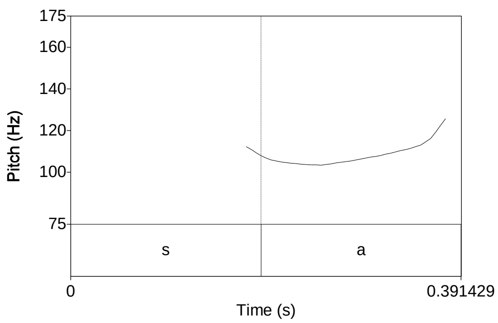
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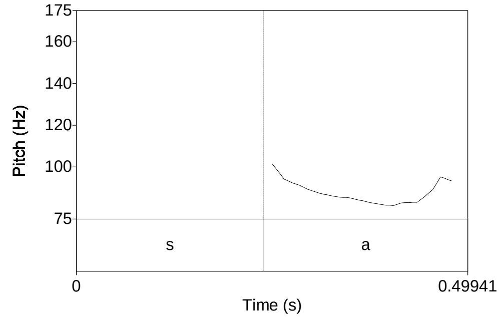
Time (s)

^{L}sa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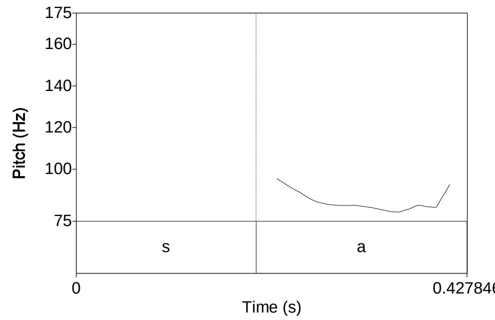
Time (s)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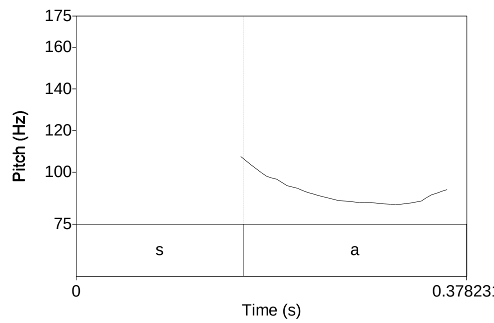
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Pitch (Hz)
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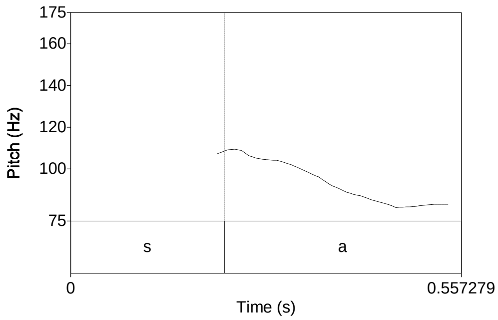
Time (s)

^{L}sa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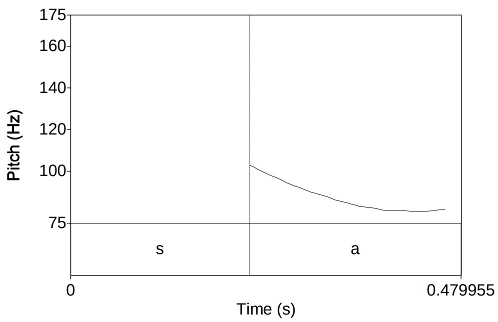
Time (s)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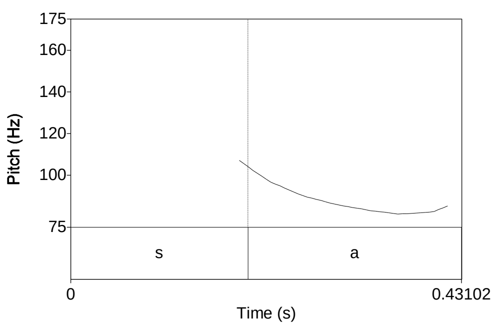
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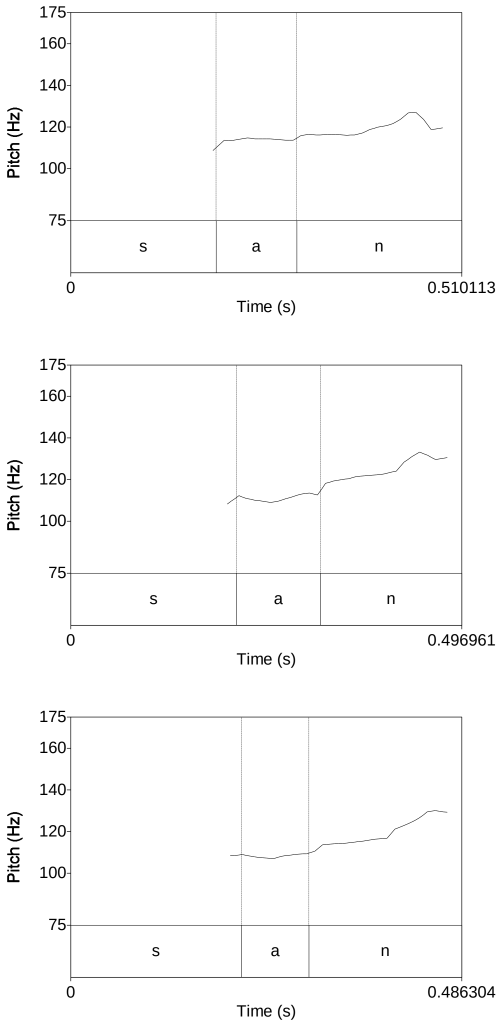
Time (s)

^{H}san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Pitch (Hz)
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Time (s)
0
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Time (s)
0
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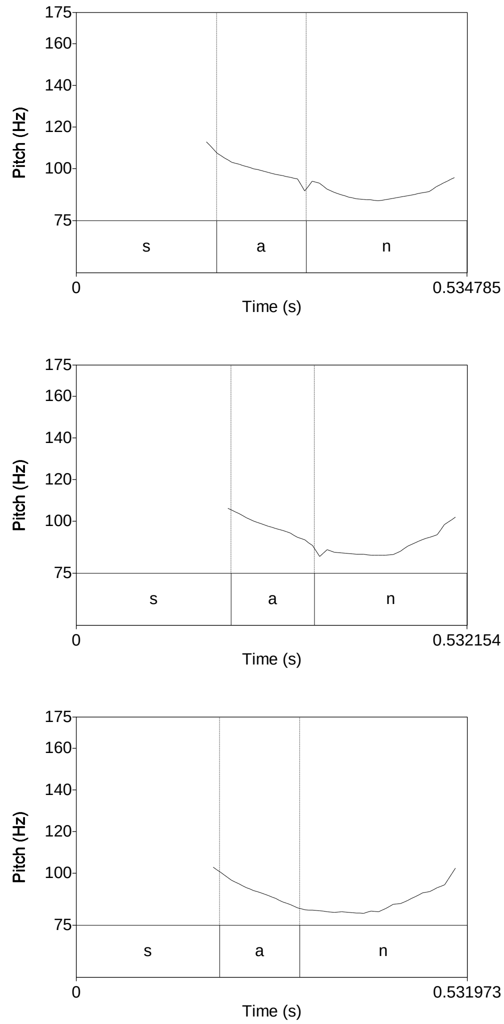
Time (s)

^{L}san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Time (s)
0
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Time (s)
0
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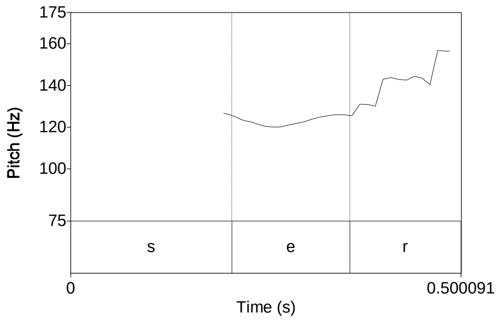
Time (s)

^{H}ser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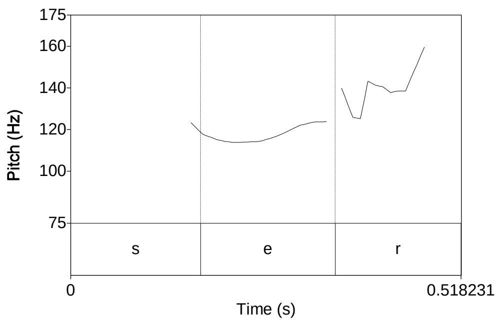
Time (s)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Pitch (Hz)
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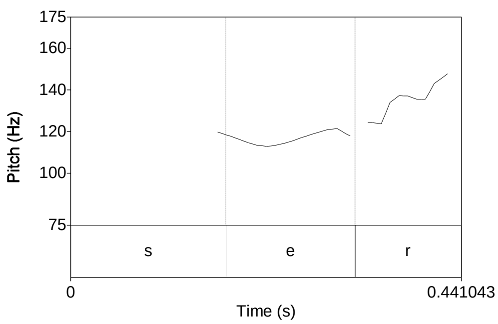
Time (s)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Pitch (Hz)
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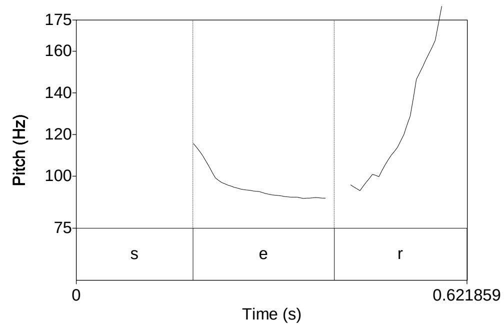
Time (s)

^{L}ser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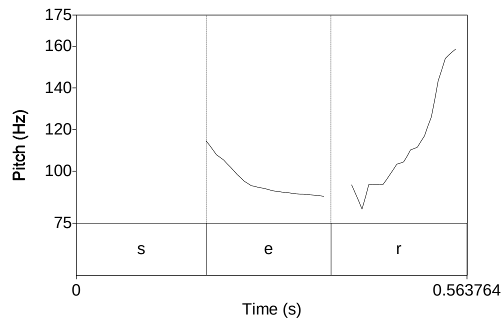
Time (s)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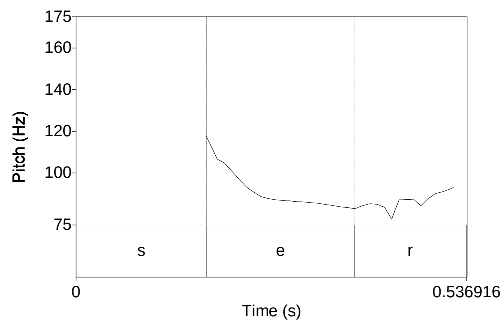
Time (s)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100
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Pitch (Hz)
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0
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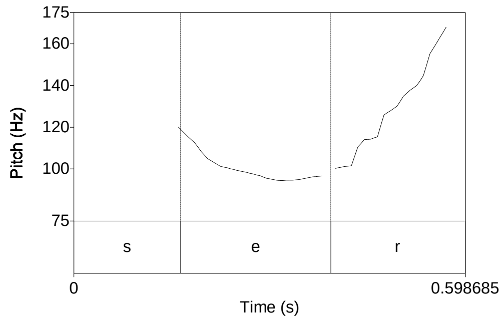
Time (s)

^{L}ser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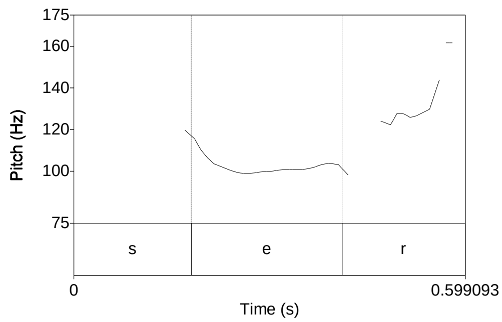
Time (s)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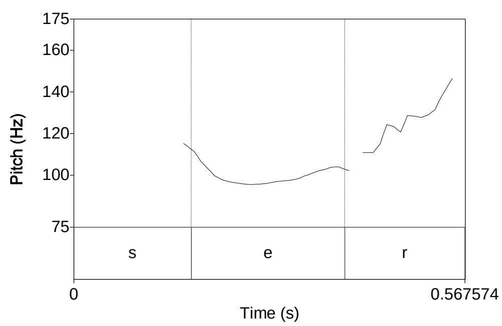
Time (s)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Pitch (Hz)
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0
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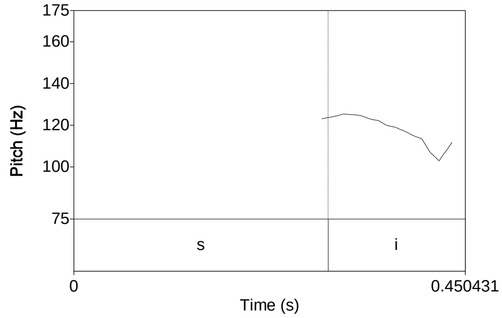
Time (s)

^{H}**si**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100
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Pitch (Hz)
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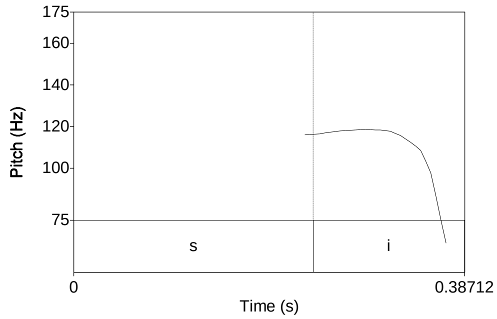
Time (s)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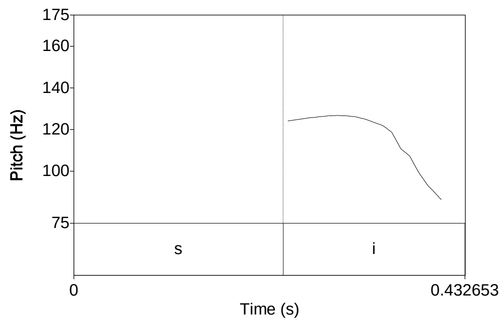
Time (s)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100
75
Pitch (Hz)
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i
0
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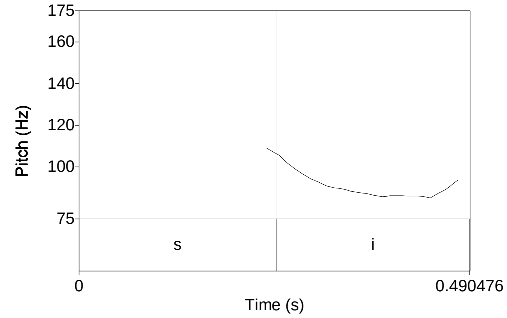
Time (s)

^{L}**si**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100
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Pitch (Hz)
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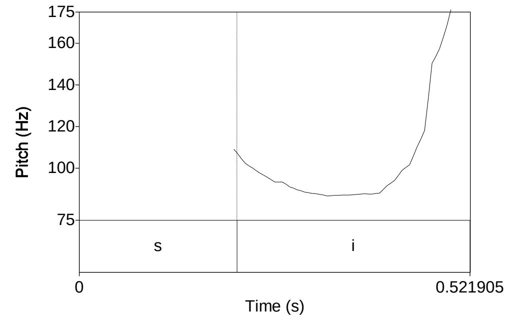
Time (s)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100
75
Pitch (Hz)
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0
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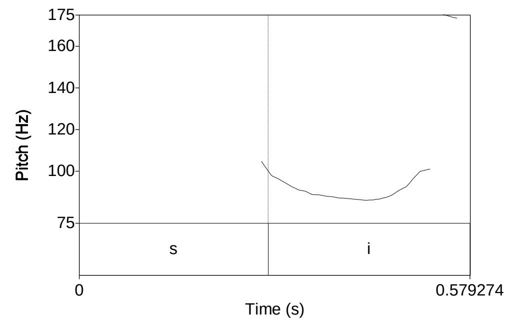
Time (s)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100
75
Pitch (Hz)
s
i
0
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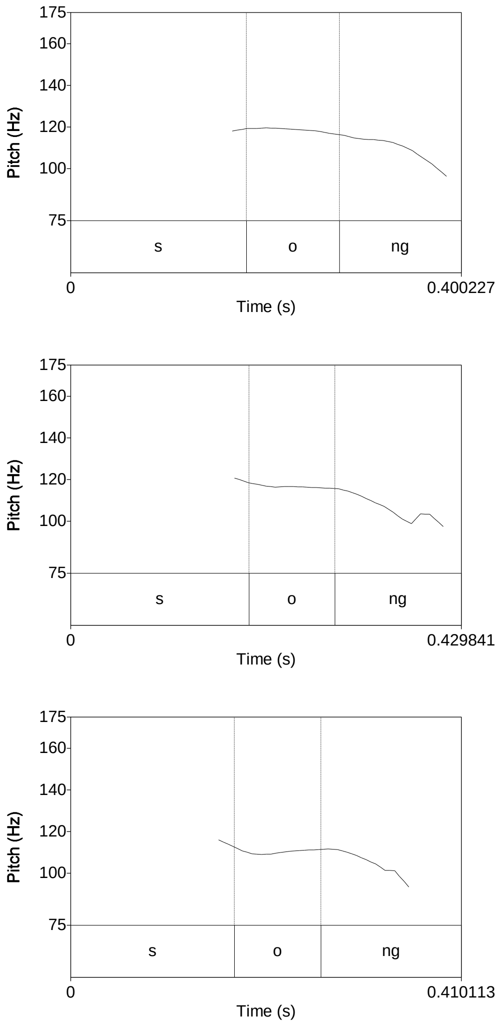
Time (s)

^{H}song



175
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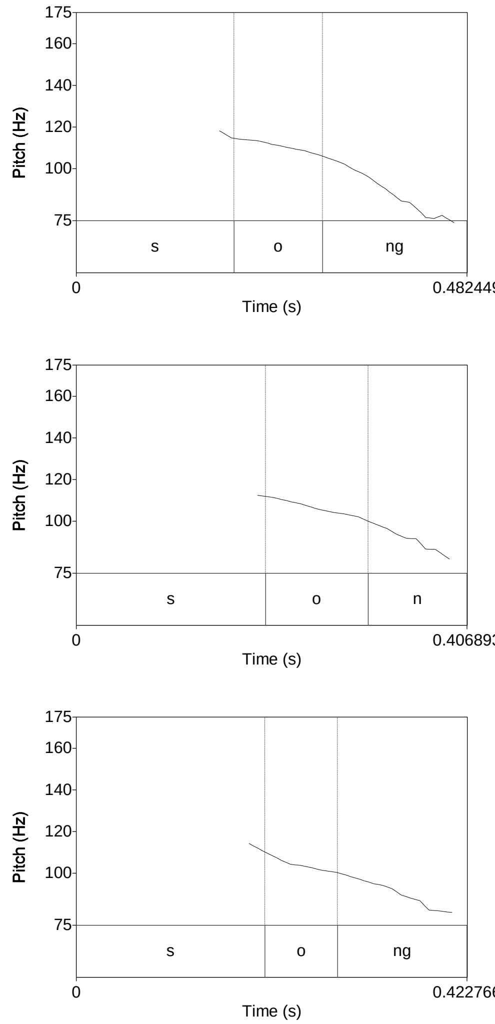
100
75
Pitch (Hz)
s
o
ng
0
0.400227
Time (s)
s
o
ng
0
0.429841
Time (s)
s
o
ng
0
0.410113
Time (s)

^{L}song



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100
75
Pitch (Hz)
s
o
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0
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Time (s)
s
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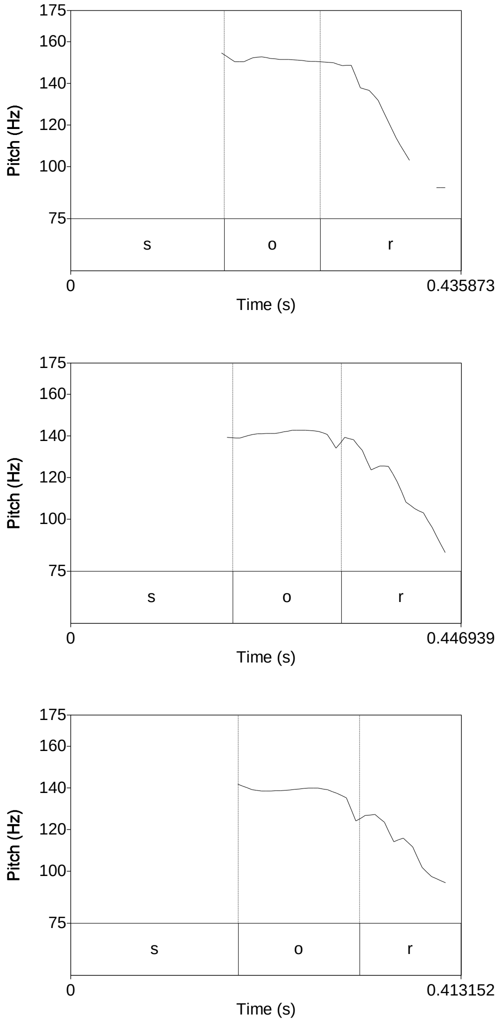
0
0.406893
Time (s)
s
o
ng
0
0.422766
Time (s)

^{H}sor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Pitch (Hz)
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0.435873
Time (s)
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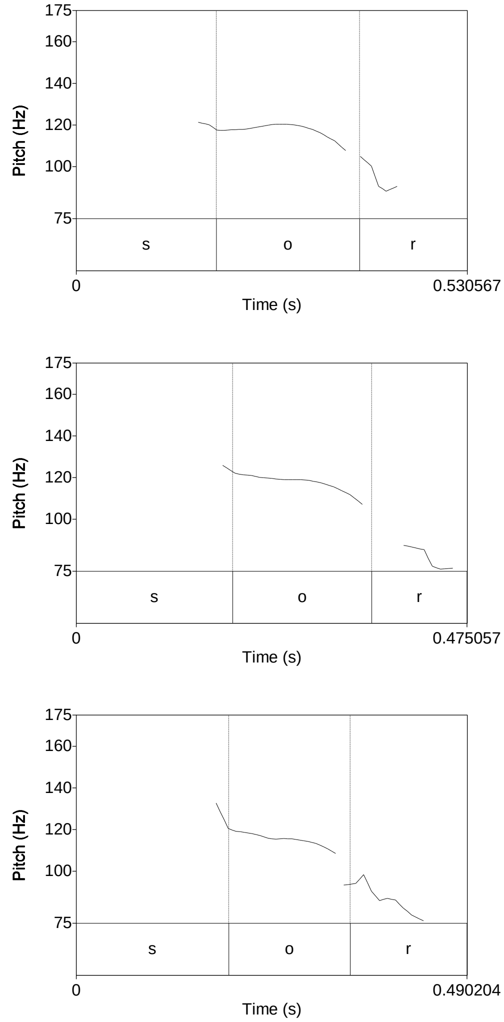
0.413152

^{L}sor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Pitch (Hz)
s
o
r
0
0.530567
Time (s)
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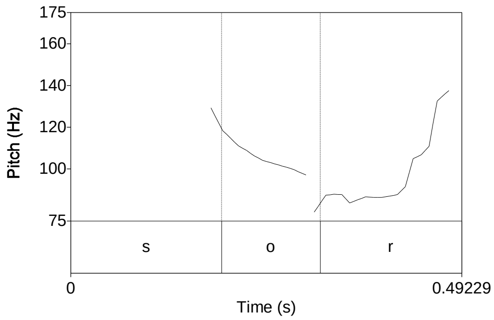
0.490204

^{L}sor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Pitch (Hz)
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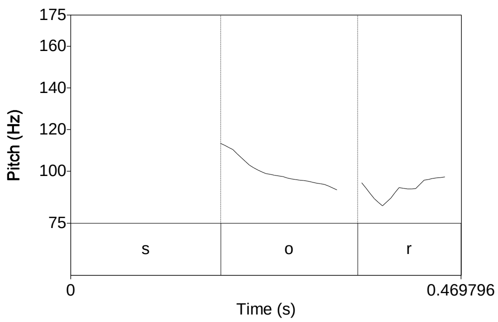
Time (s)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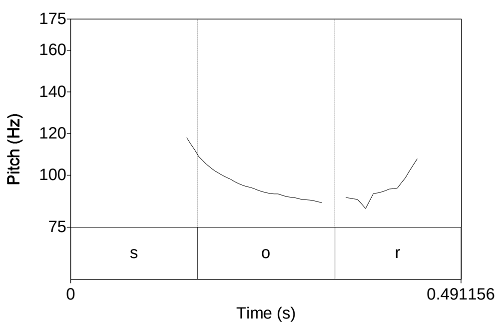
Time (s)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Pitch (Hz)
s
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r
0
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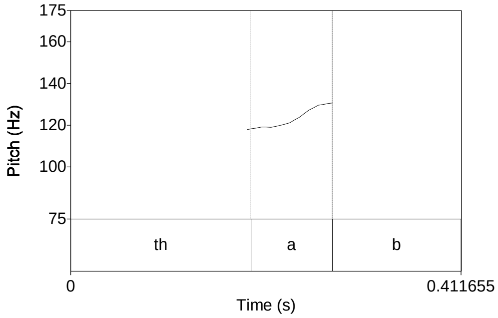
Time (s)

^{H}thab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Pitch (Hz)
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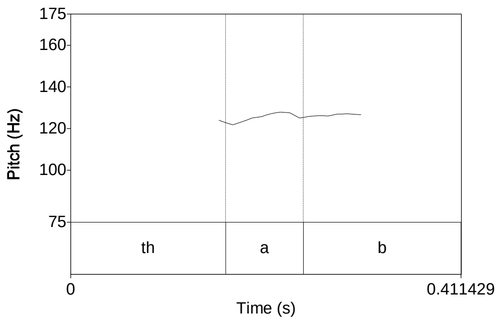
Time (s)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Pitch (Hz)
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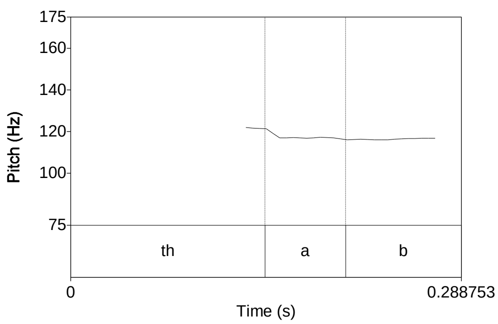
Time (s)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Pitch (Hz)
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b
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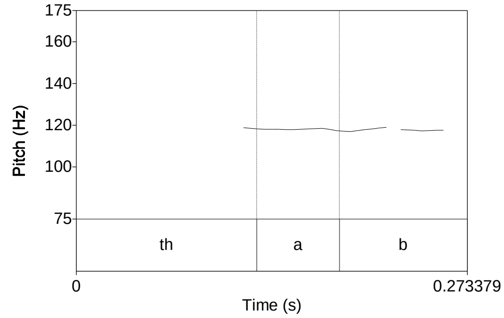
Time (s)

^{L}thab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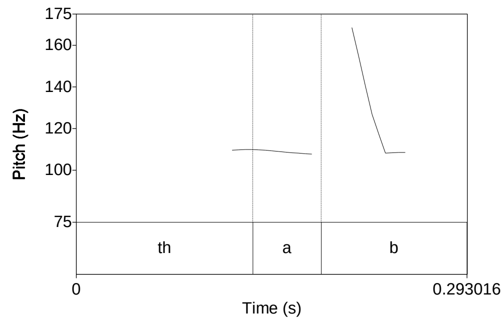
Time (s)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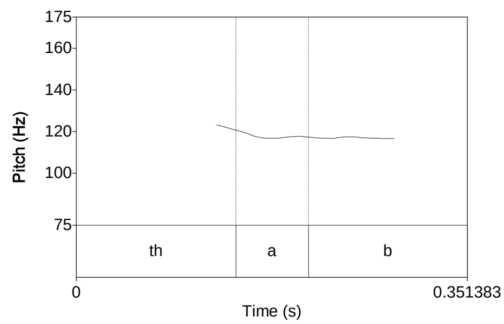
Time (s)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Pitch (Hz)
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b
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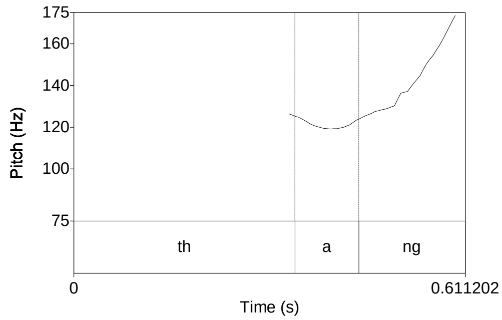
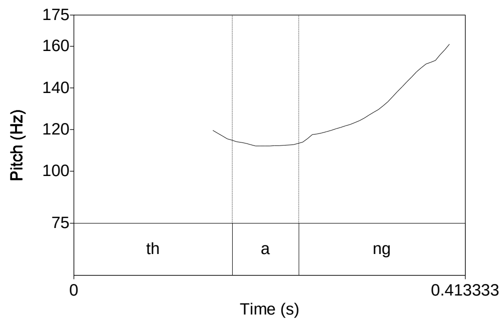
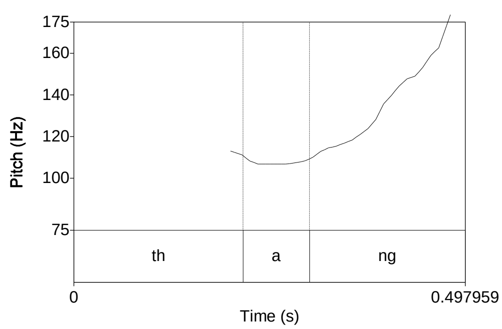
Time (s)

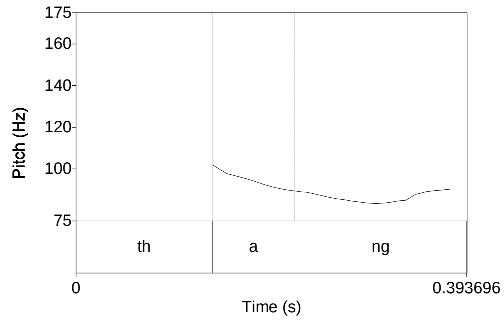
^{H}thang

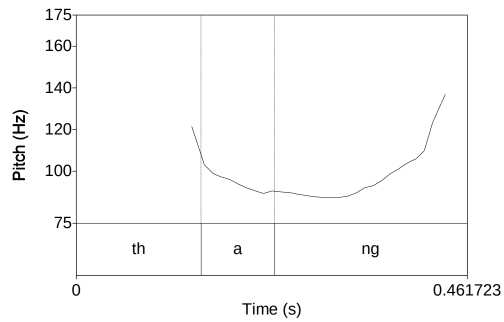


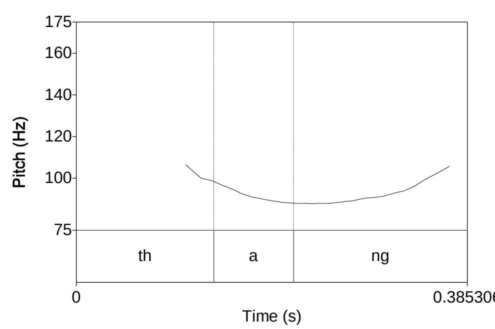




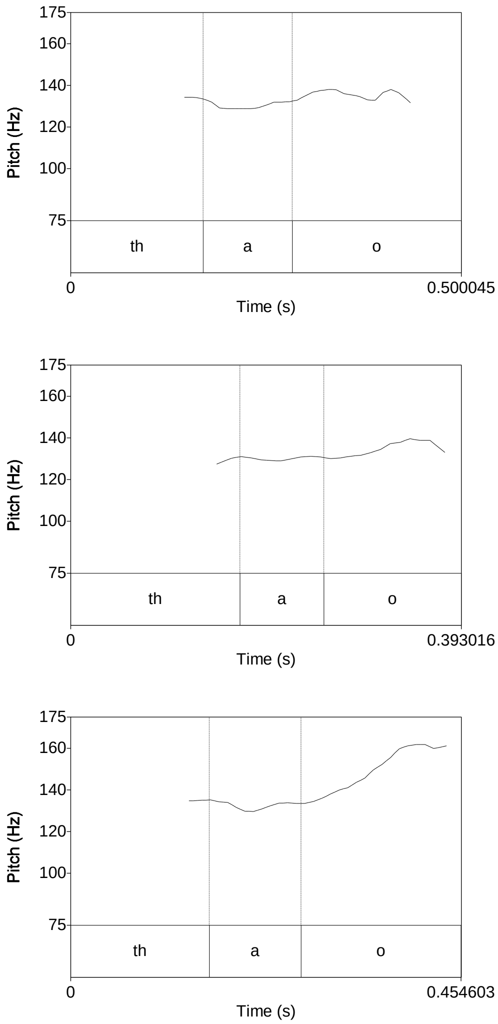
^{L}thang







^{H}thaw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Pitch (Hz)
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a
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0
0.500045
Time (s)
175
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140
120
100
75
Pitch (Hz)
th
a
o
0
0.393016
Time (s)
175
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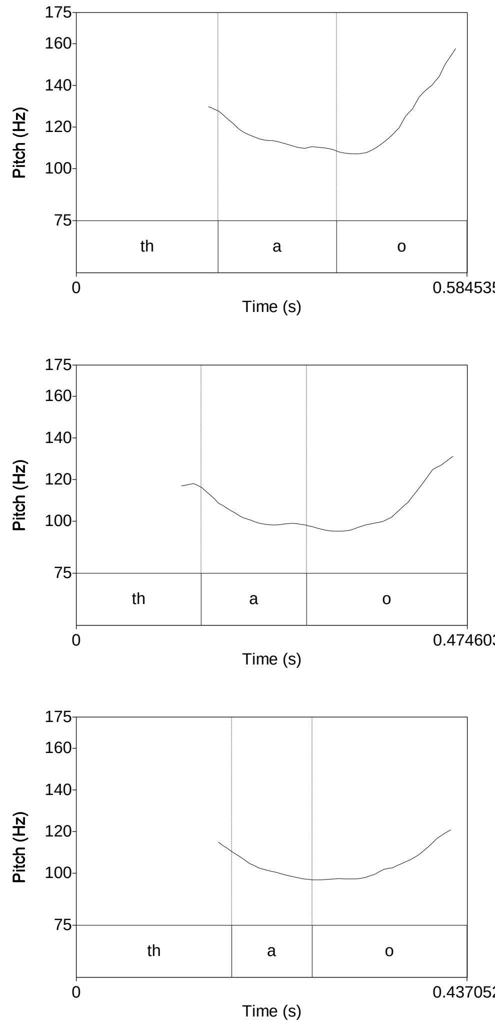
140
120
100
75
Pitch (Hz)
th
a
o
0
0.454603
Time (s)

^{L}thaw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75
Pitch (Hz)
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a
o
0
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Time (s)
175
160
140
120
100
75
Pitch (Hz)
th
a
o
0
0.474603
Time (s)
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140
120
100
75
Pitch (Hz)
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a
o
0
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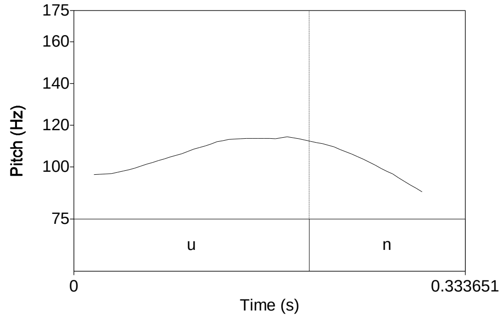
Time (s)

^{H}un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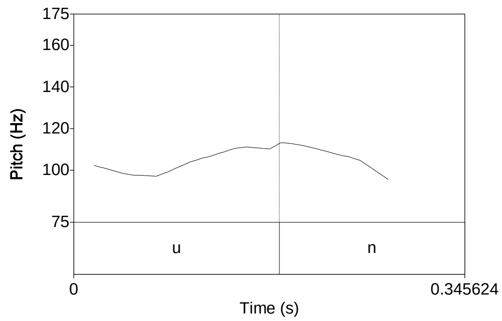
Time (s)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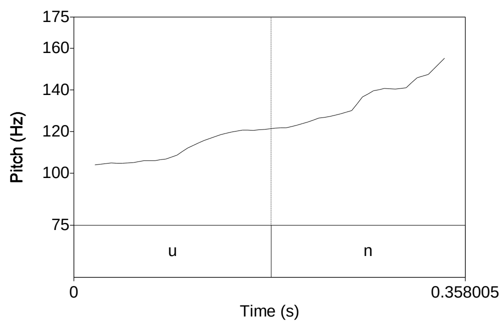
Time (s)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Pitch (Hz)
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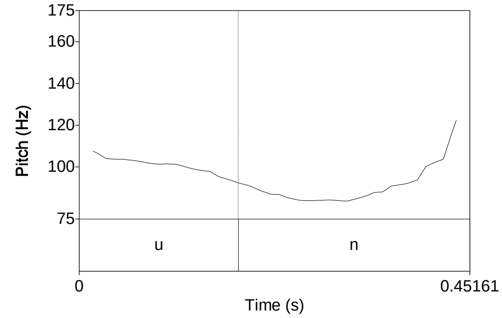
Time (s)

^{L}un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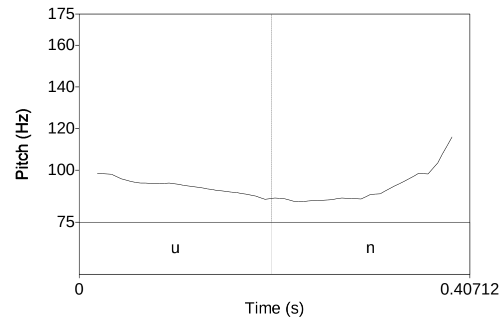
Time (s)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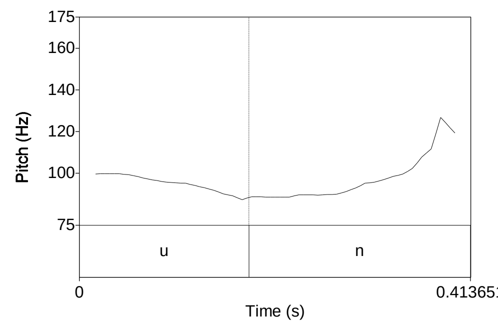
Time (s)


175
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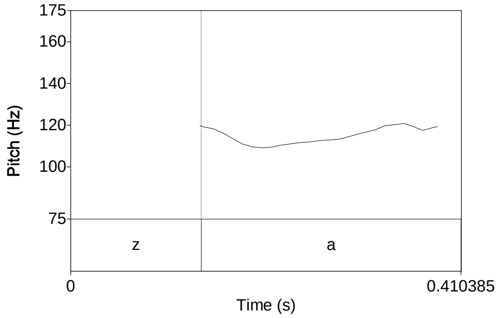
100
75
Pitch (Hz)
u
n
0
0.413651
Time (s)

^{H}za


175
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140
120
100
75
Pitch (Hz)
z
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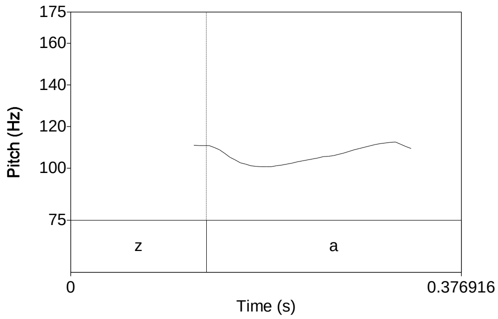
Time (s)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Pitch (Hz)
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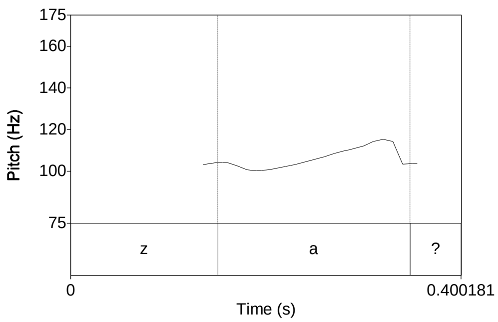
Time (s)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Pitch (Hz)
z
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?
0
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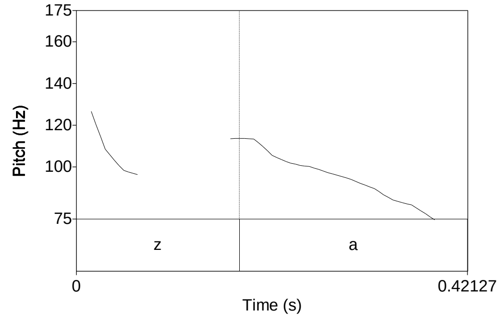
Time (s)

^{L}za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Pitch (Hz)
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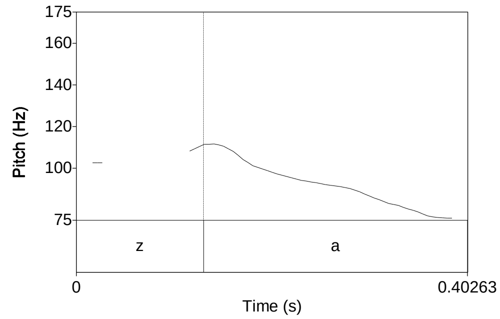
Time (s)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Pitch (Hz)
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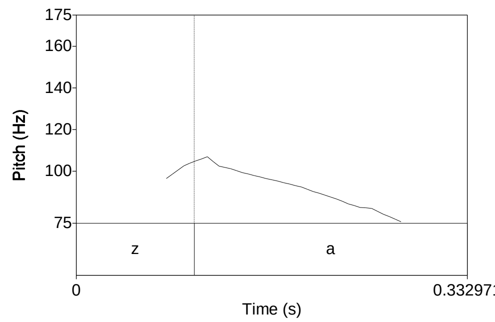
Time (s)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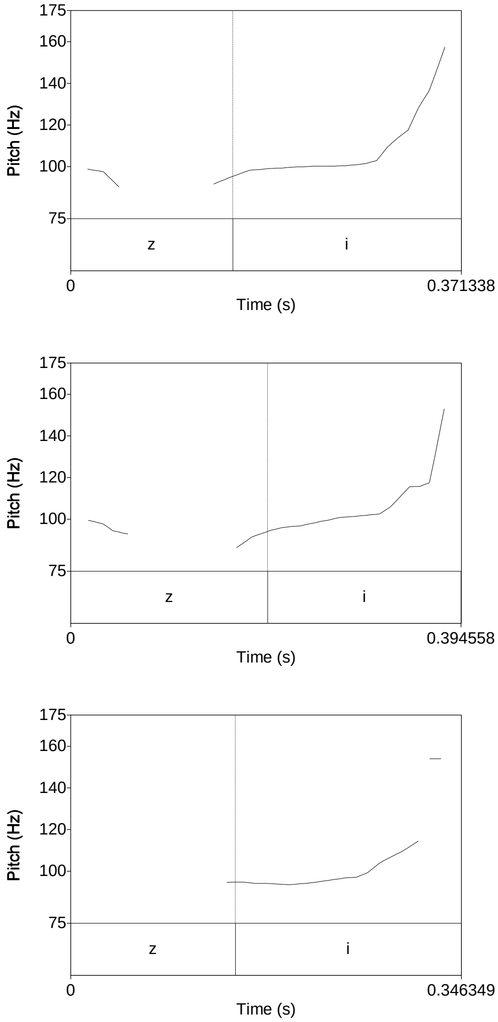
100
75
Pitch (Hz)
z
a
0
0.332971
Time (s)

^{H}zi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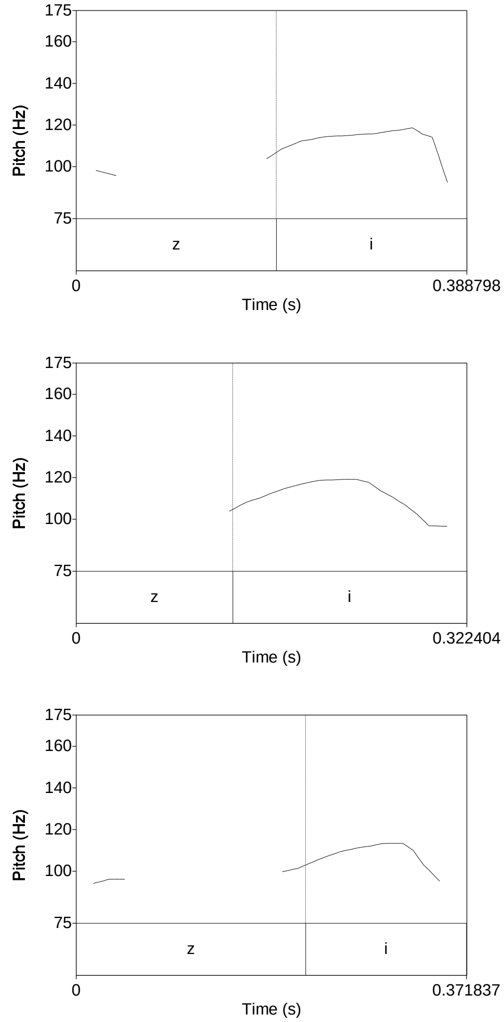
Pitch (Hz)
z
i
0
0.371338
Time (s)
175
160
140
120
100
75
Pitch (Hz)
z
i
0
0.394558
Time (s)
175
160
140
120
100
75
Pitch (Hz)
z
i
0
0.346349
Time (s)

^{L}zi


175
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140
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100
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Pitch (Hz)
z
i
0
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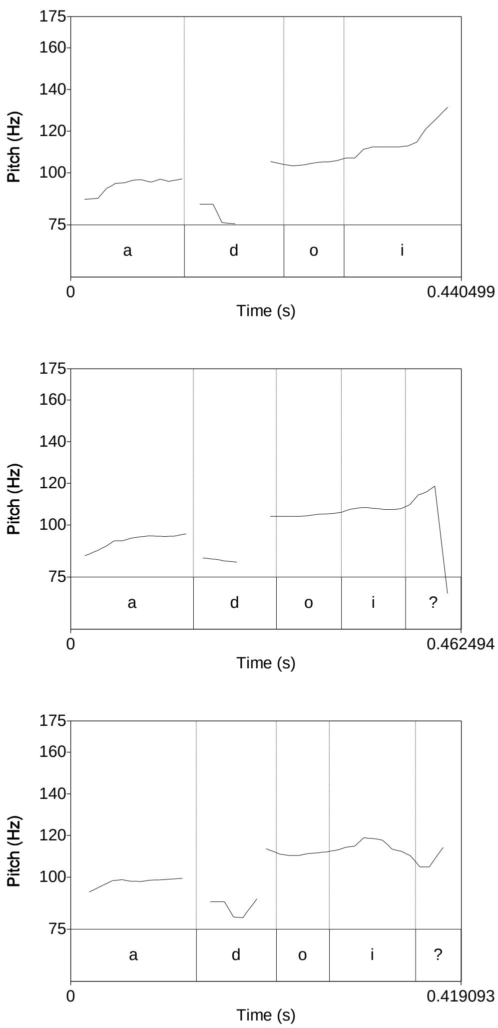
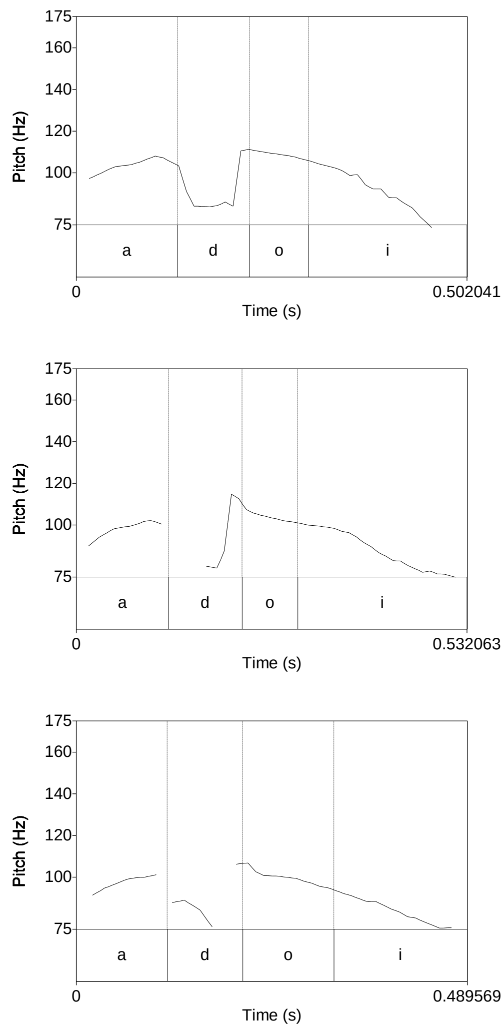
Time (s)
175
160
140
120
100
75
Pitch (Hz)
z
i
0
0.322404
Time (s)
175
160
140
120
100
75
Pitch (Hz)
z
i
0
0.371837
Time (s)

Disyllables

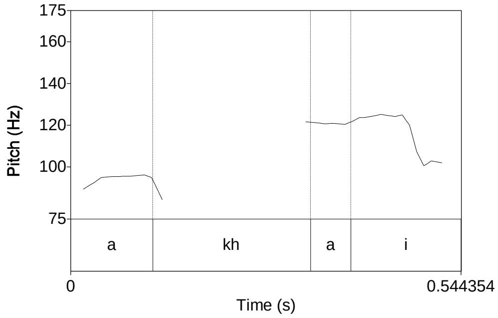
a^{H}doy

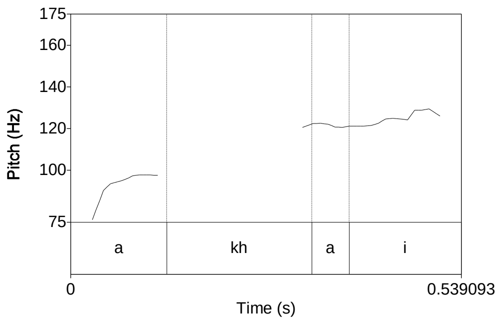


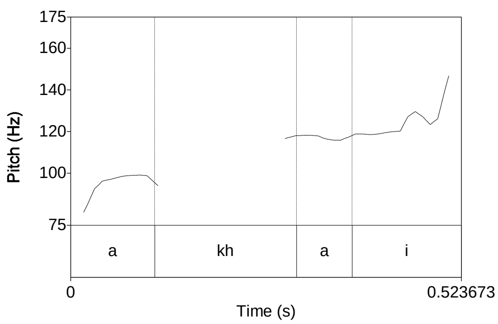
a^{L}doy



a^{H}khay







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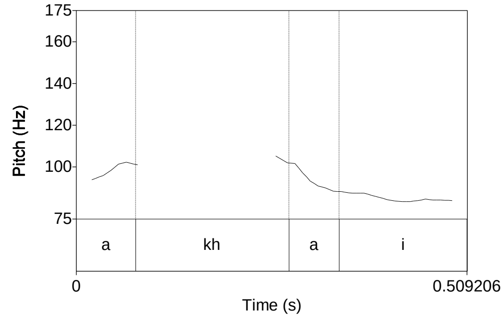
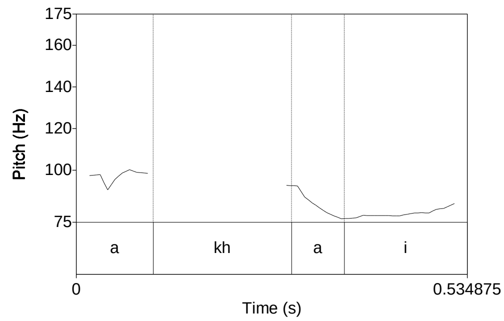
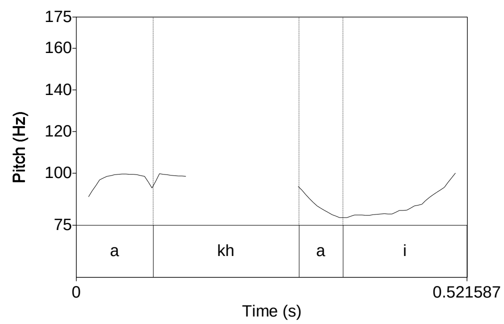
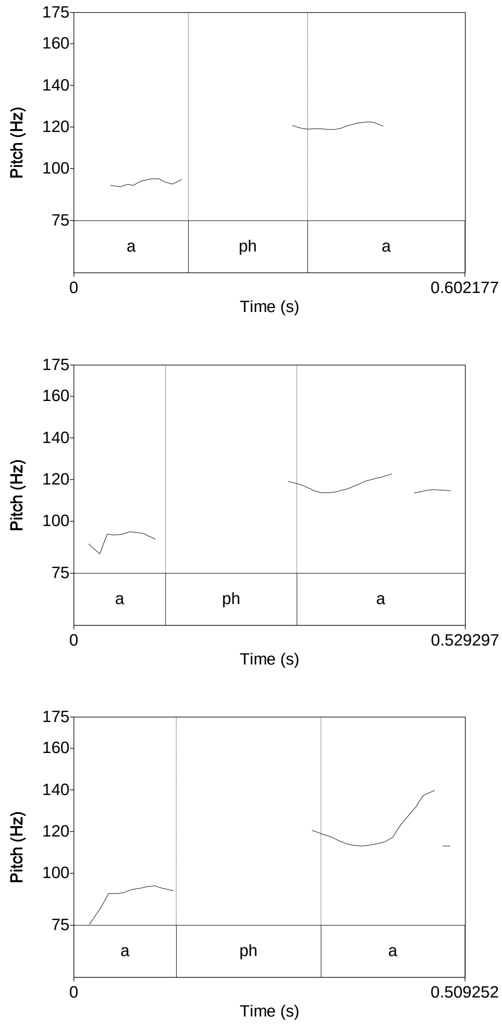


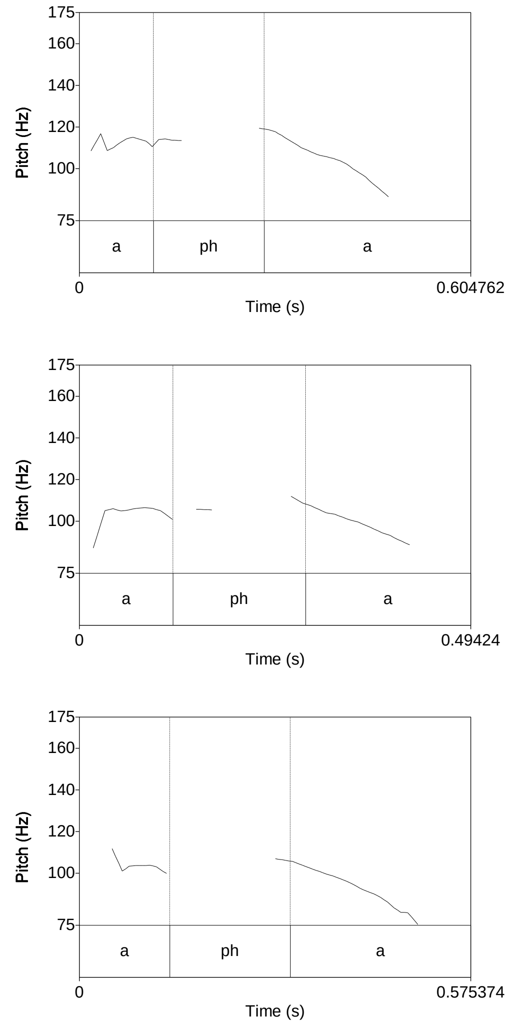




a^{H}pha


175
160
140
120
100
75
Pitch (Hz)
a
ph
a
0
0.602177
0.529297
0.509252
Time (s)

a^{L}pha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Pitch (Hz)
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ph
a
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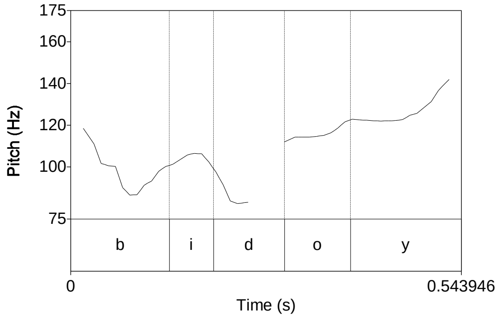
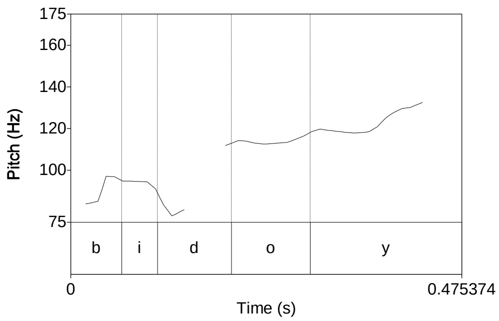
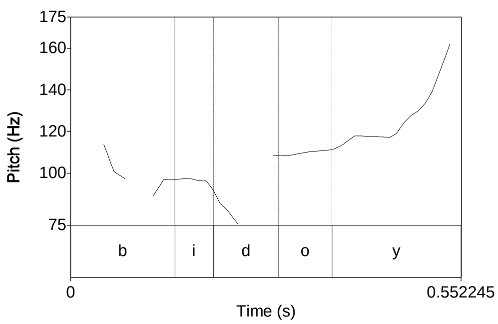
0.49424
0.575374
Time (s)

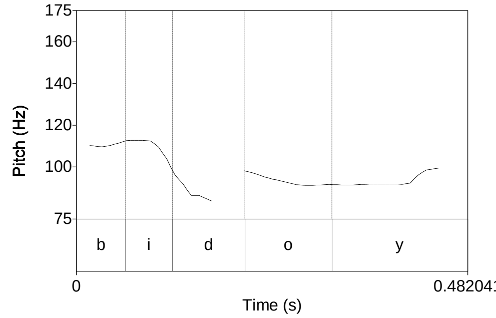
bi^{H}doy

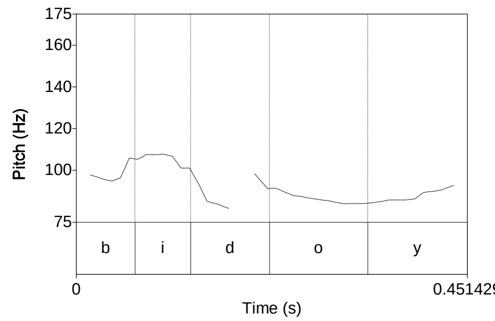




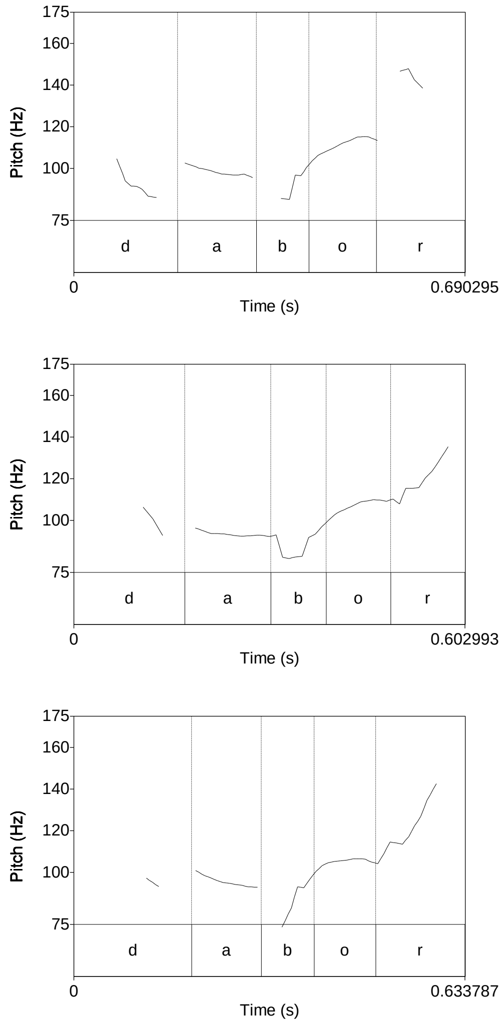


bi^{L}doy

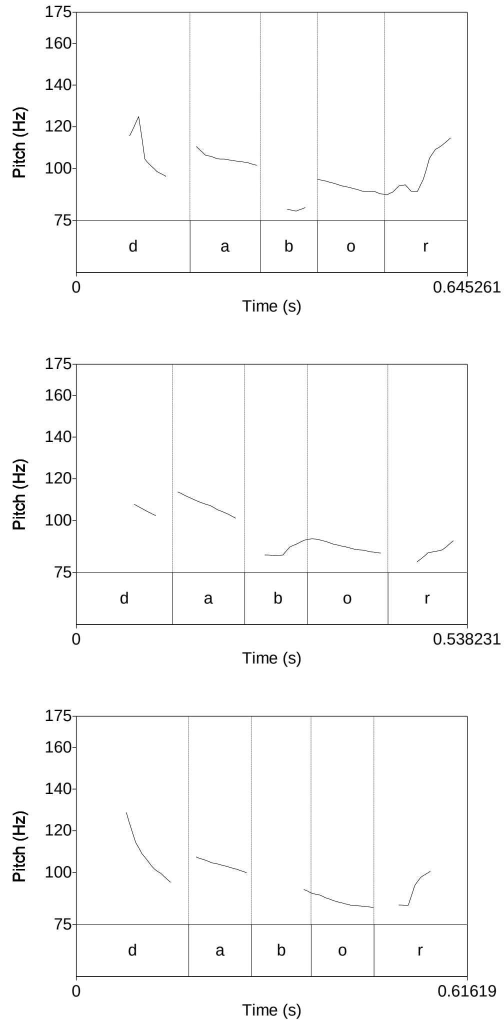




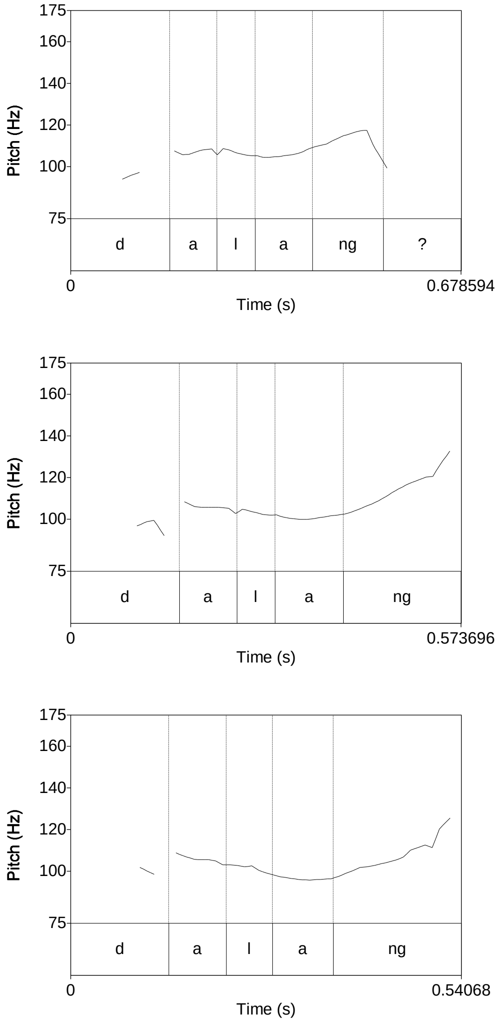
da^{H}bor



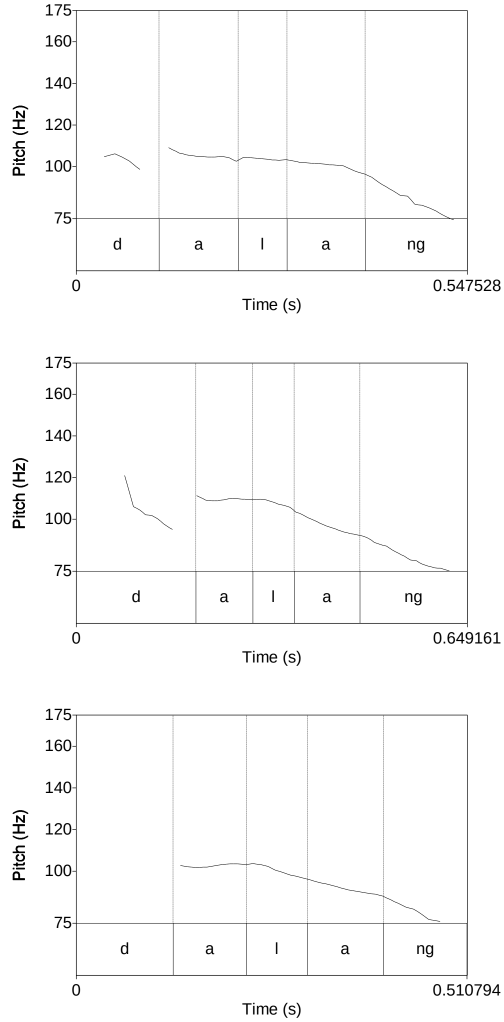
da^{L}bor



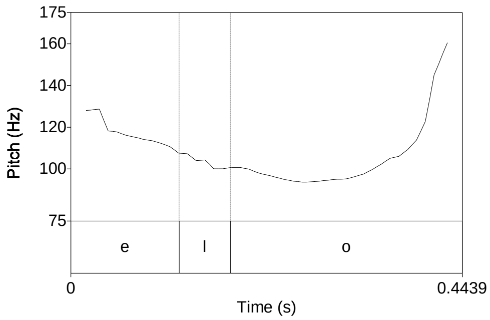
da^{HL}ang



da^{L}lang



e^L^lo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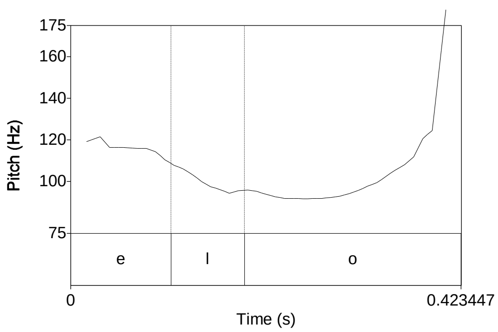
100
75
Pitch (Hz)
e
l
o
0
0.4439
Time (s)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100
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Pitch (Hz)
e
l
o
0
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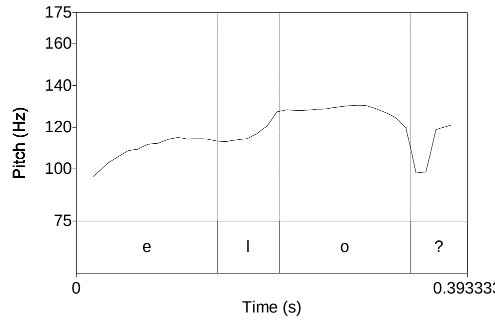
Time (s)

e^H^lo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75
Pitch (Hz)
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l
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?
0
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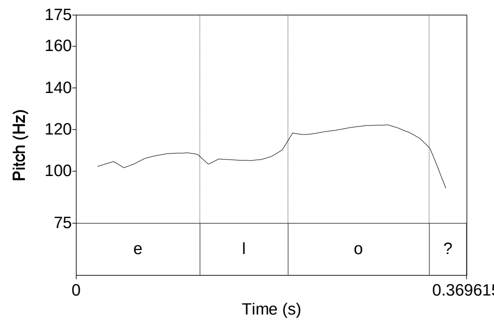
Time (s)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Pitch (Hz)
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?
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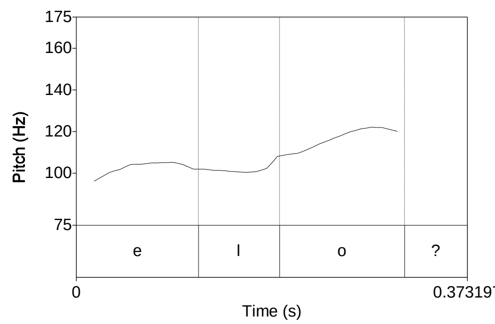
Time (s)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100
75
Pitch (Hz)
e
l
o
?
0
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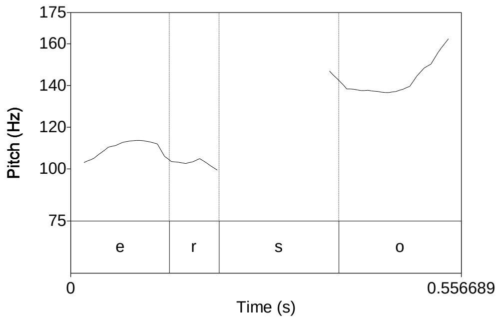
Time (s)

er^{H}so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75
Pitch (Hz)
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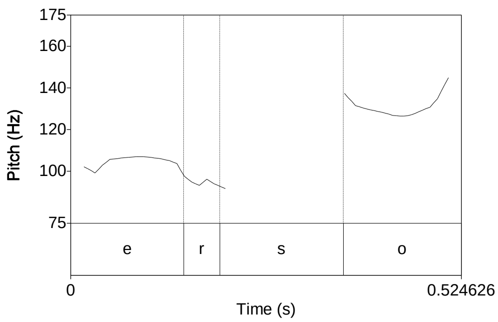
r
s
o
0
0.556689
Time (s)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Pitch (Hz)
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r
s
o
0
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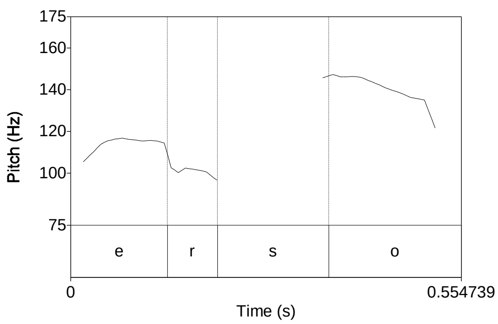
Time (s)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100
75
Pitch (Hz)
e
r
s
o
0
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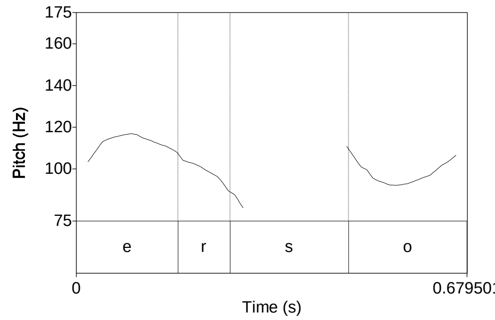
Time (s)

er^{L}so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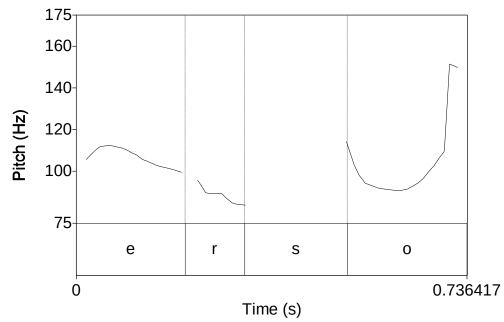
Time (s)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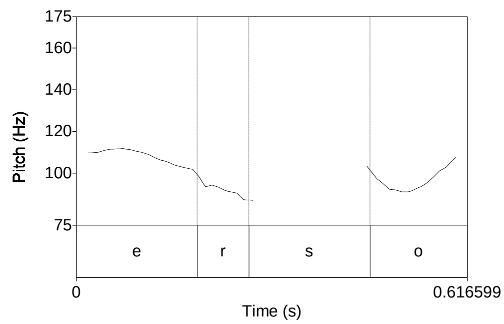
Time (s)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s
o
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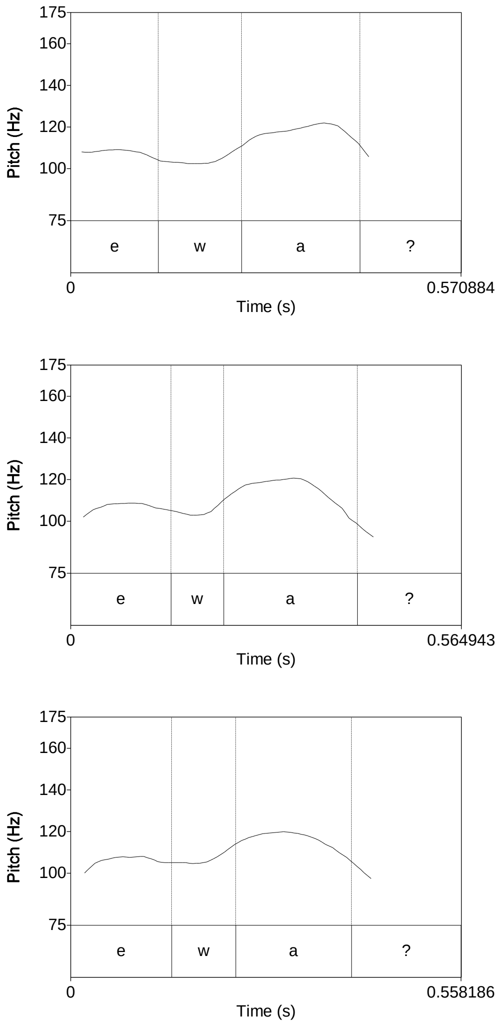
Time (s)

e^{H}wa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w
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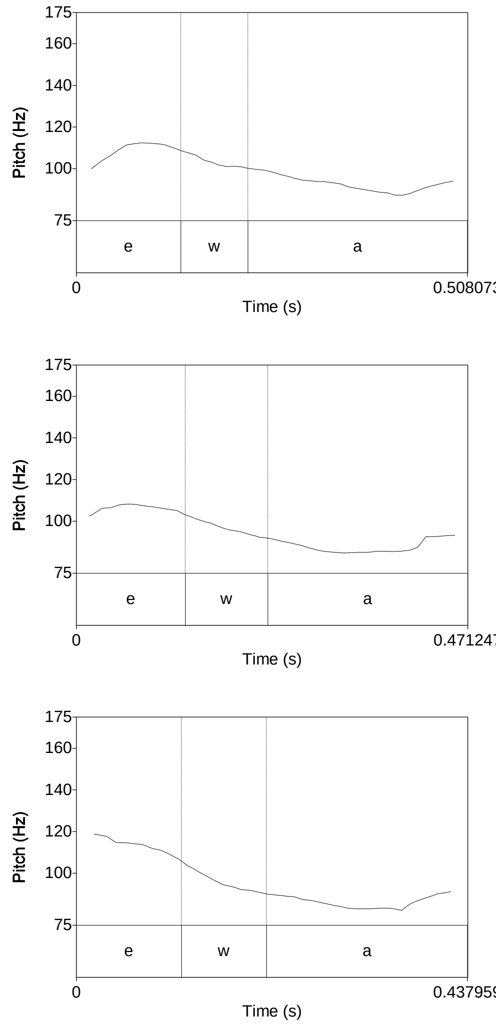
Time (s)

e^{L}wa


Pitch (Hz)
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100
75
e
w
a
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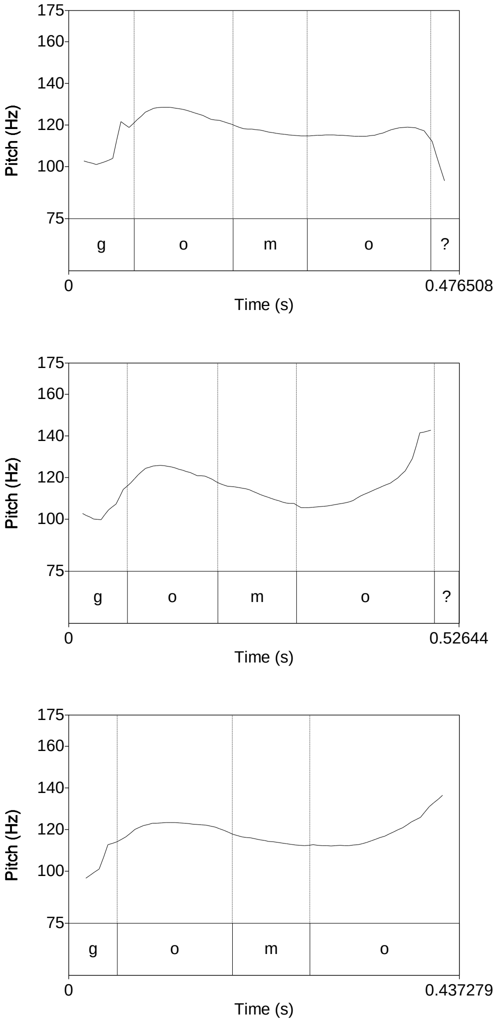
Time (s)

go^{H}mo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100
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Pitch (Hz)
g
o
m
o
?
0
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Time (s)
175
160
140
120
100
75
Pitch (Hz)
g
o
m
o
?
0
0.52644
Time (s)
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120
100
75
Pitch (Hz)
g
o
m
o
0
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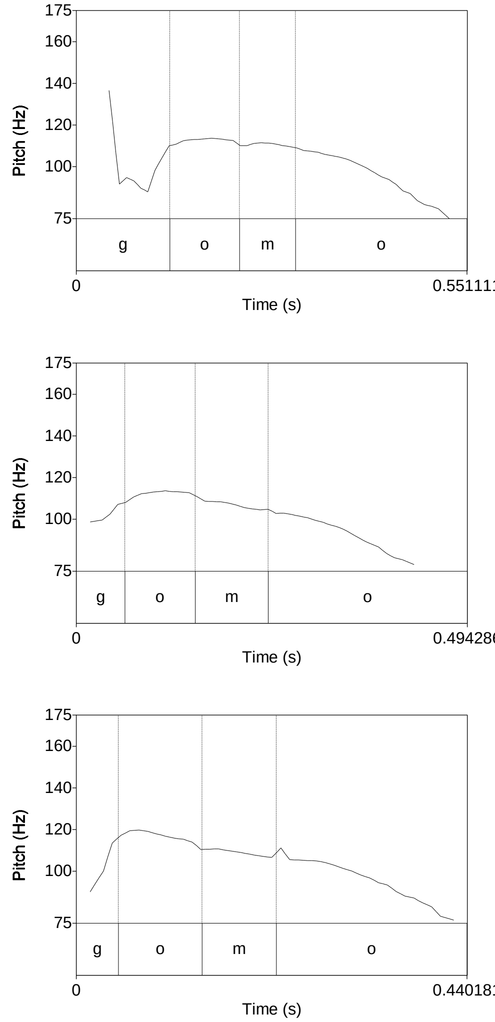
Time (s)

go^{L}mo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100
75
Pitch (Hz)
g
o
m
o
0
0.551111
Time (s)
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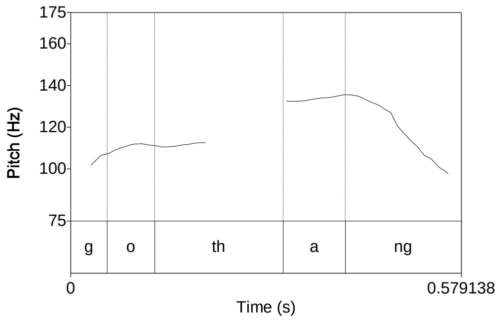
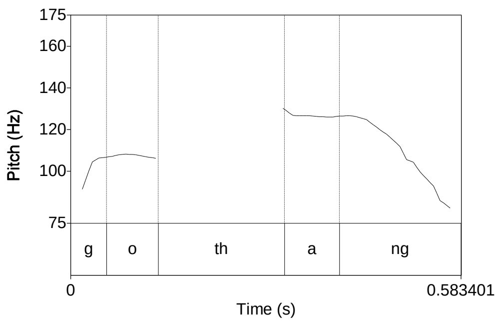
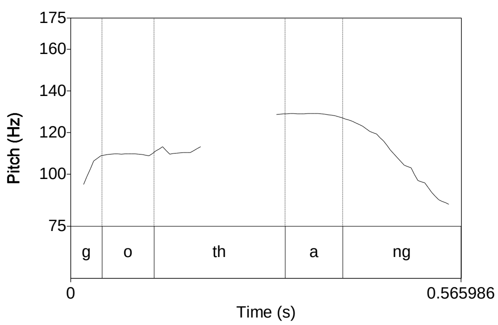
140
120
100
75
Pitch (Hz)
g
o
m
o
0
0.494286
Time (s)
175
160
140
120
100
75
Pitch (Hz)
g
o
m
o
0
0.440181
Time (s)

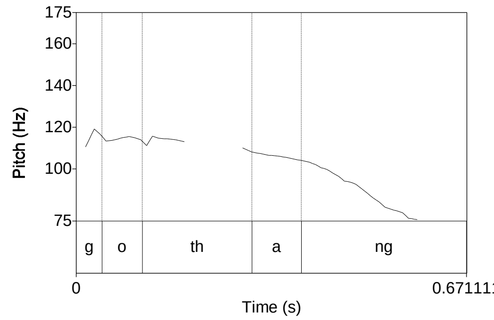
go^{H}thang

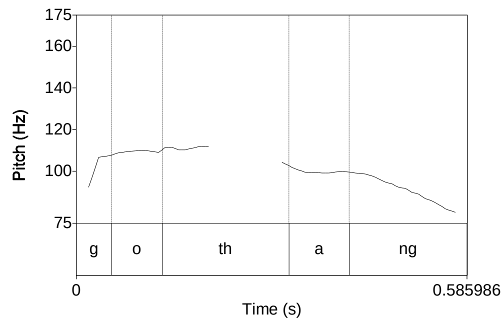


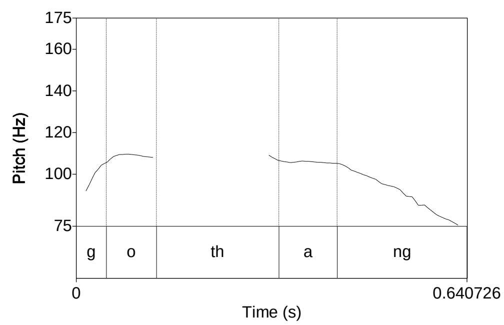




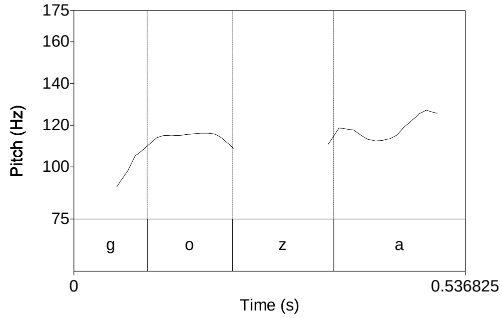
go^{L}thang







go^{H}za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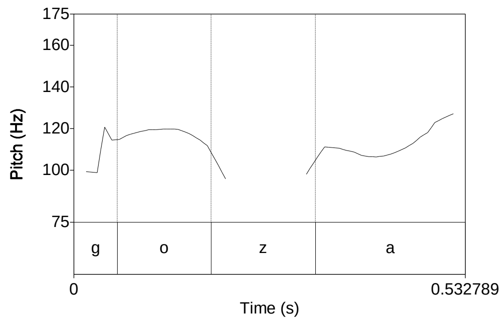
120
100
75
Pitch (Hz)
g
o
z
a
0
0.536825
Time (s)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120
100
75
Pitch (Hz)
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o
z
a
0
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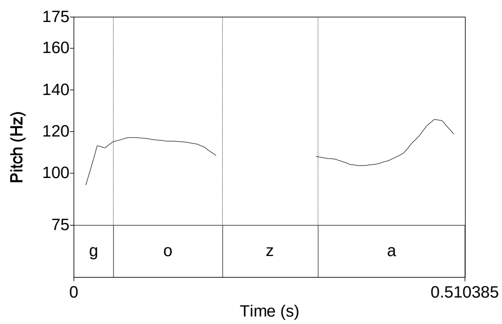
Time (s)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120
100
75
Pitch (Hz)
g
o
z
a
0
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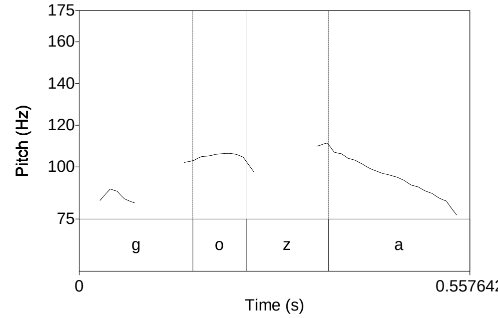
Time (s)

go^{L}za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o
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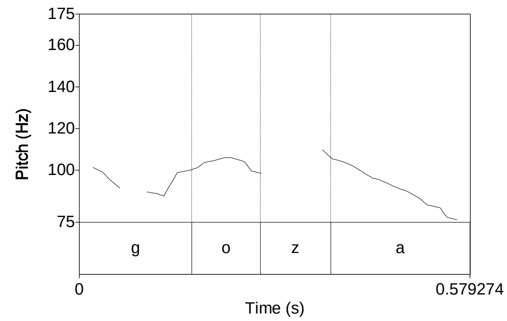
Time (s)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o
z
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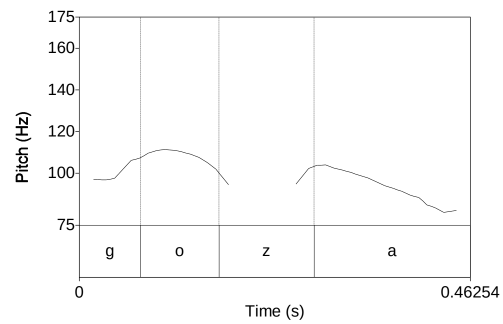
Time (s)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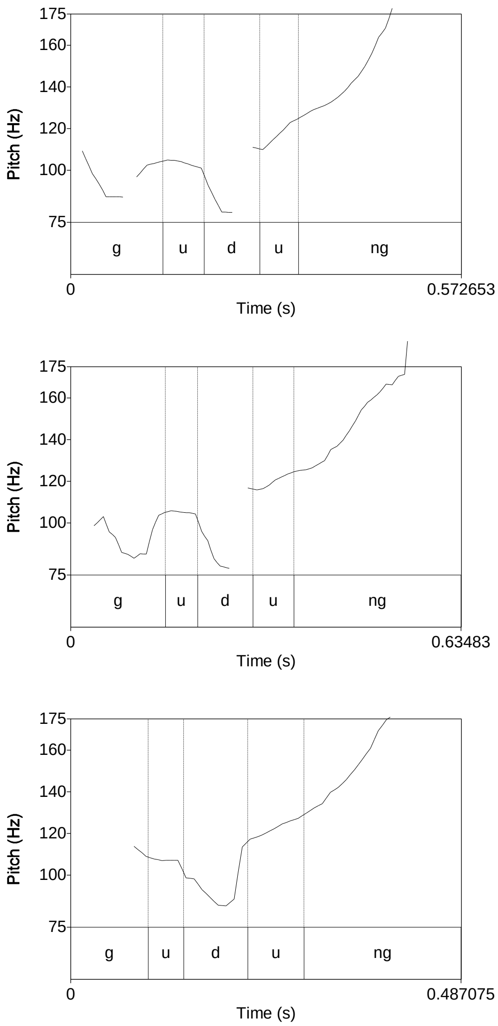
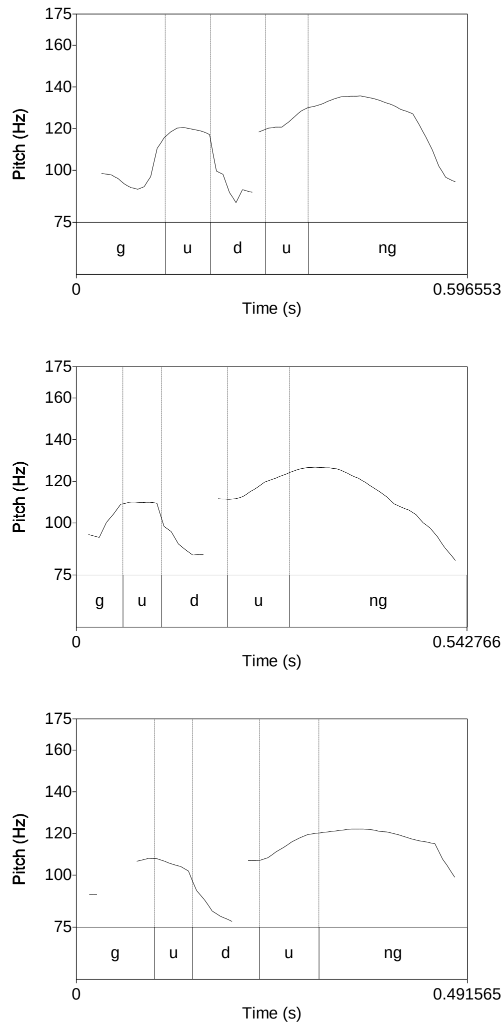
100
75
Pitch (Hz)
g
o
z
a
0
0.46254
Time (s)

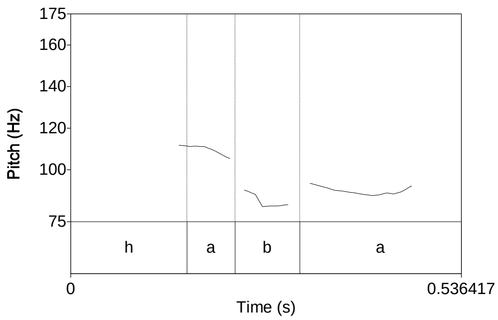
gu^{H}dung



gu^{L}dung



ha^{L}ba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Pitch (Hz)
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b
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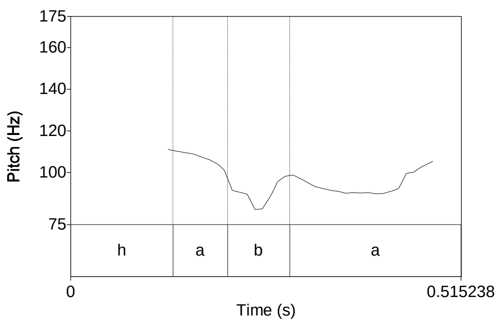
Time (s)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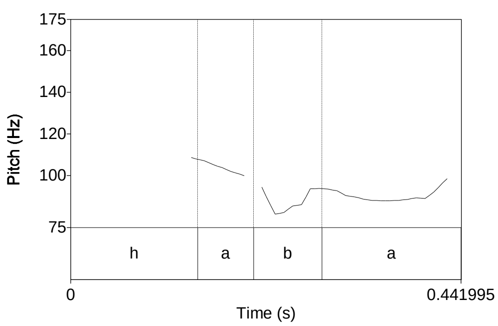
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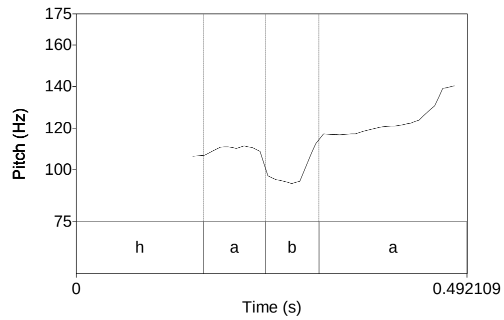
Time (s)

ha^{H}ba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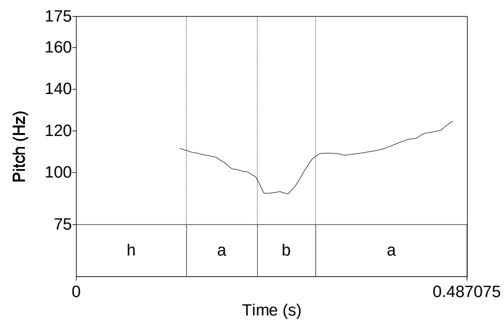
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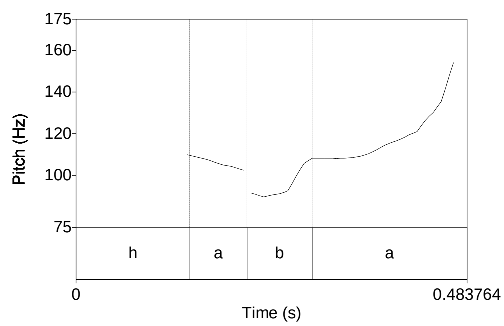
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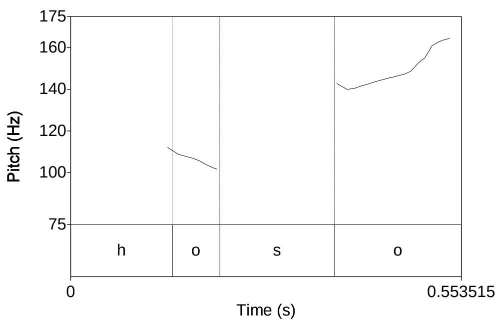
Time (s)

ho^{H}so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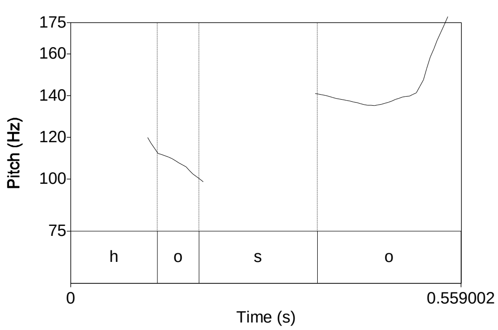
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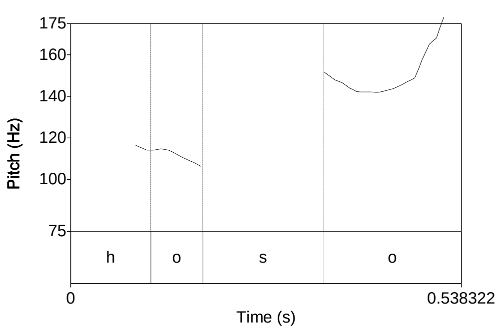
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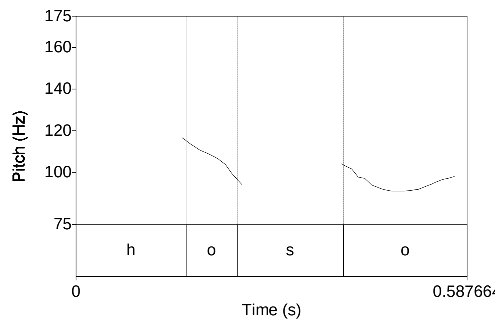
Time (s)

ho^{L}so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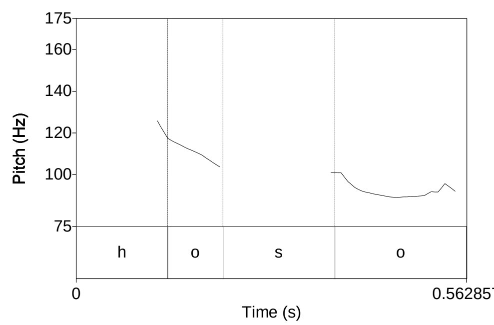
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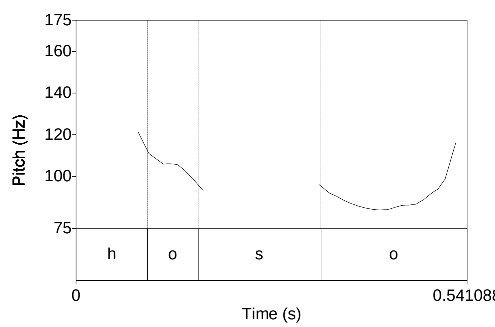
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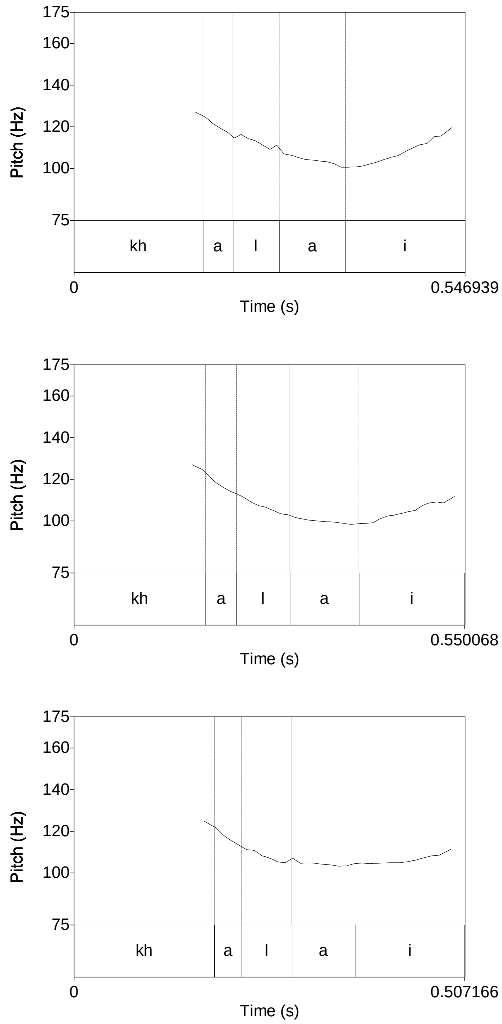
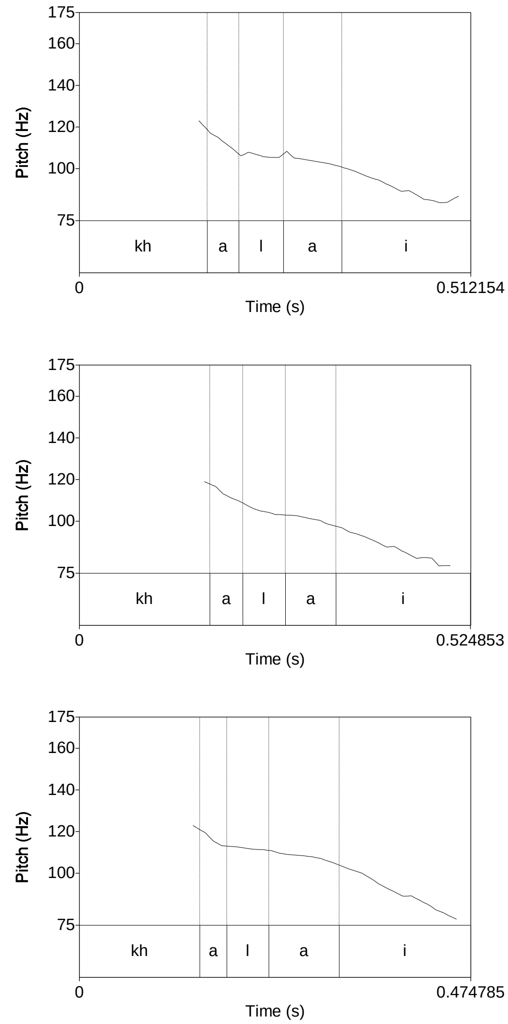
Time (s)

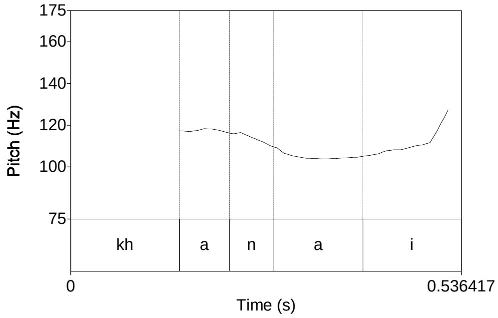
kha^{H}lay

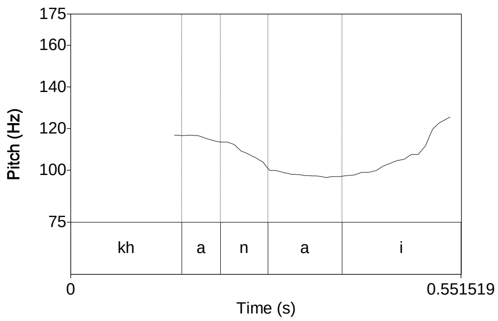


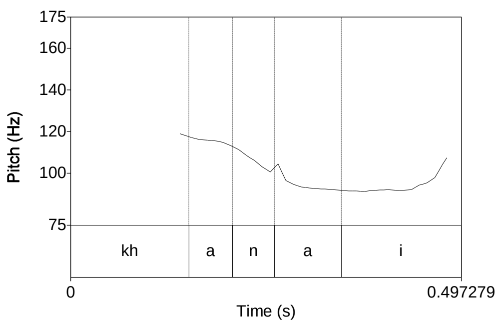
kha^{L}lay



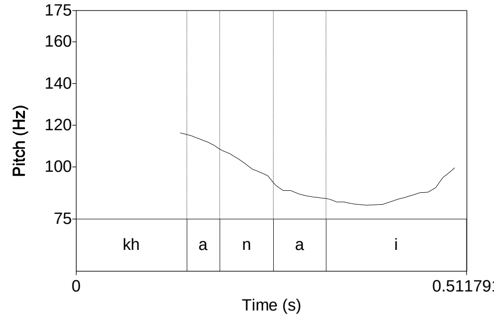
kha^{H}nay

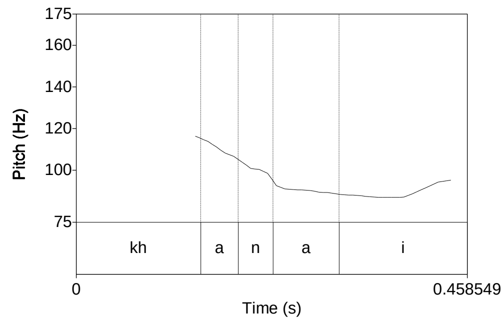


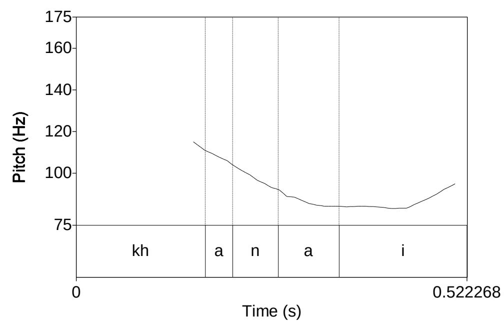




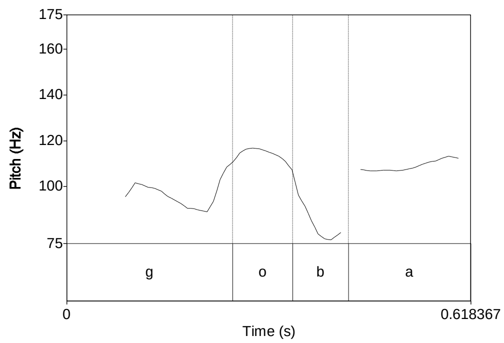
kha^{L}nay







go^{H}ba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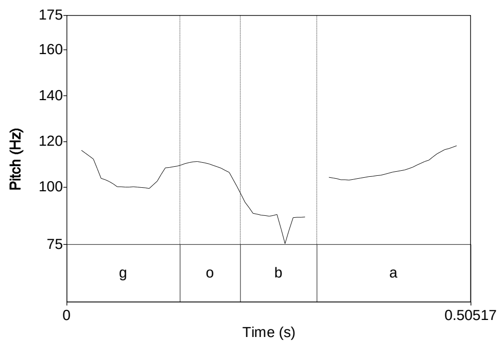
Time (s)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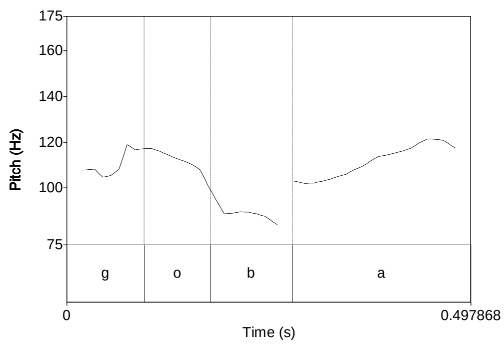
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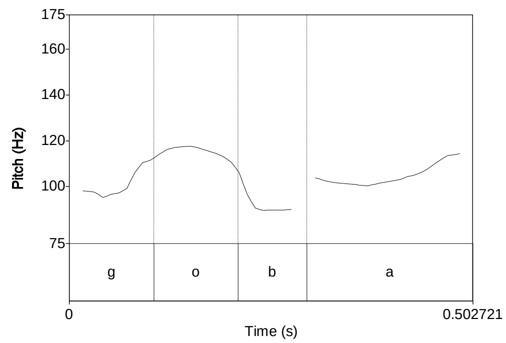
go^{H}ba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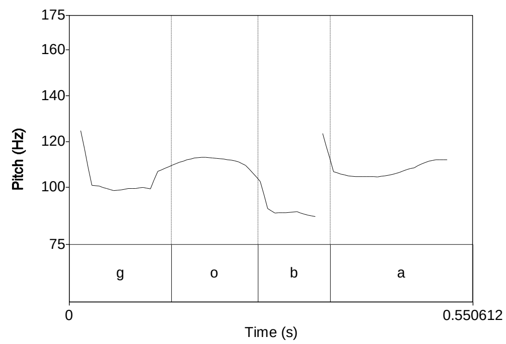
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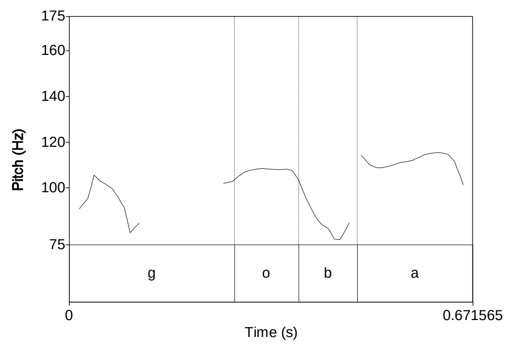
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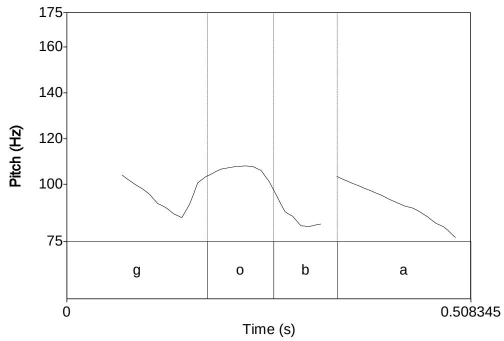
go^{L}ba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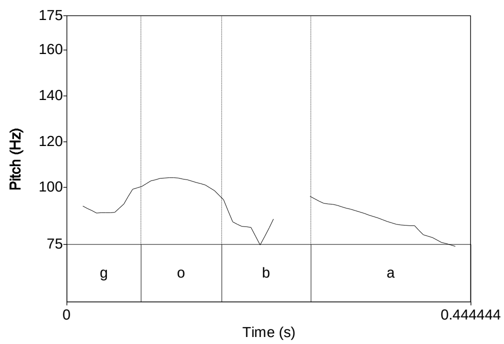
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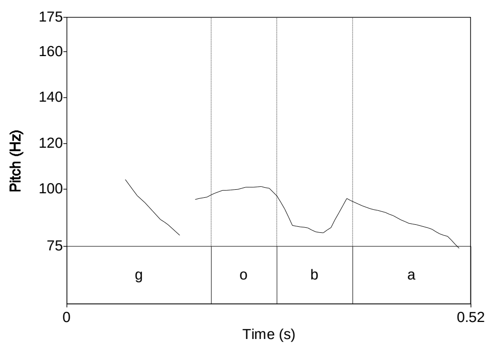
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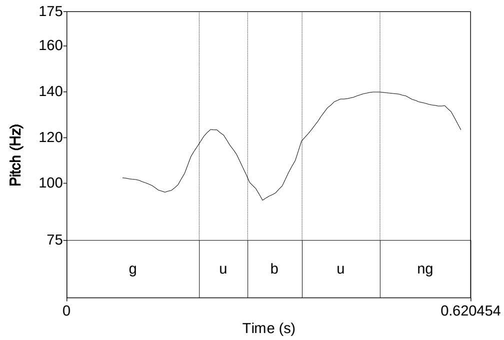
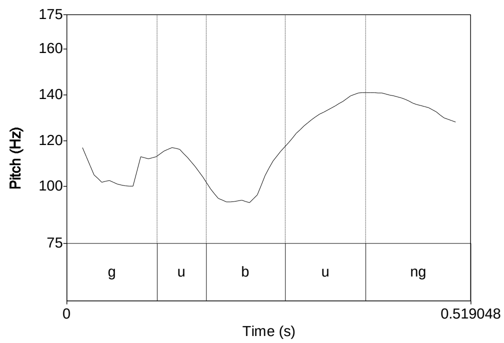
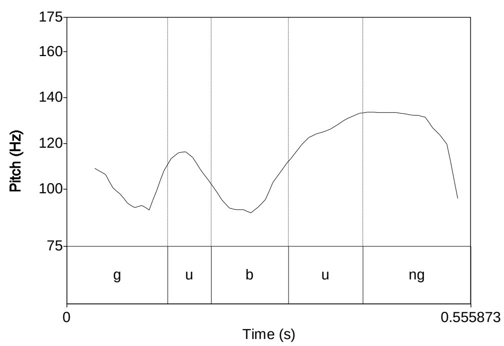
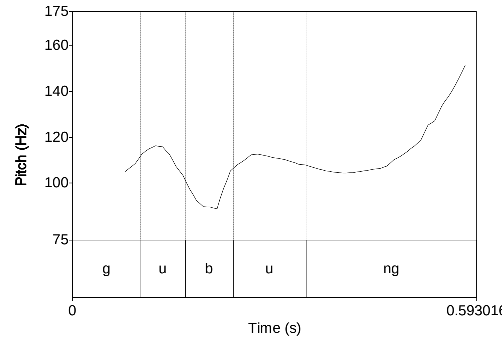
gu^{H}bung

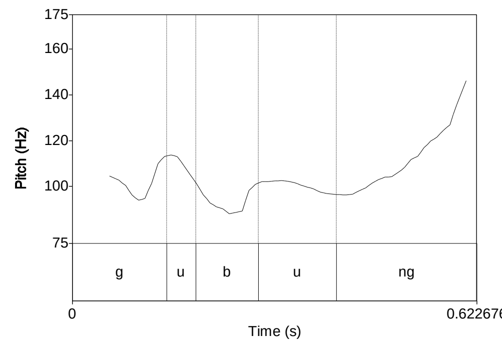


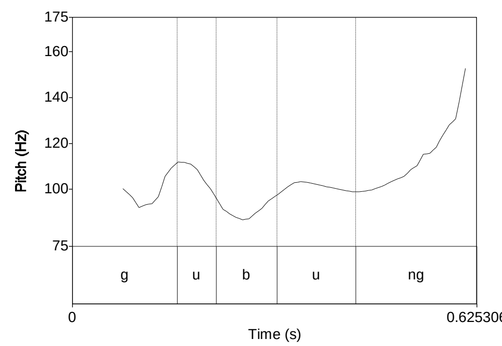




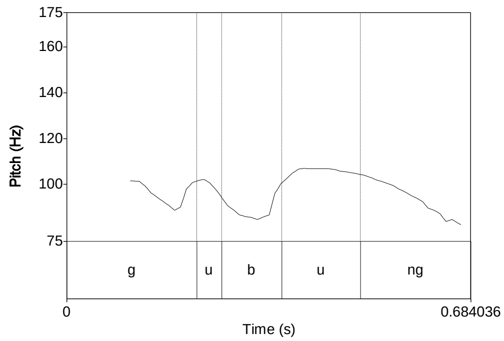
gu^{L}bung







gu^{L}bung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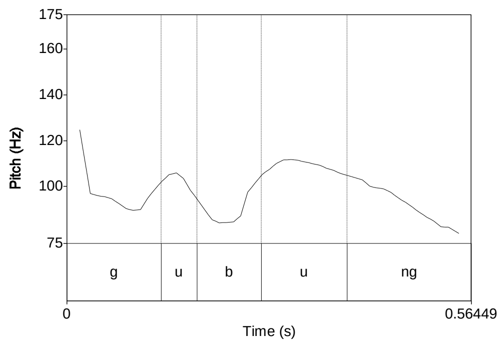
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ng
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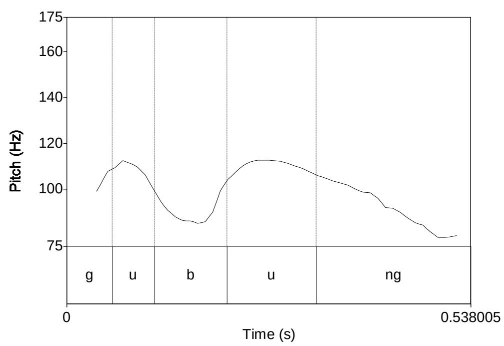
Time (s)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b
u
ng
0
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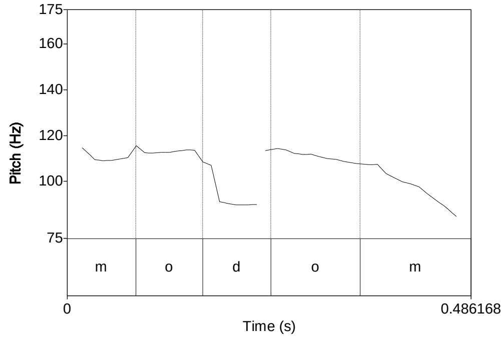
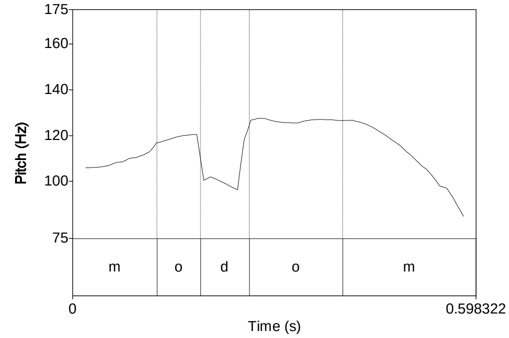
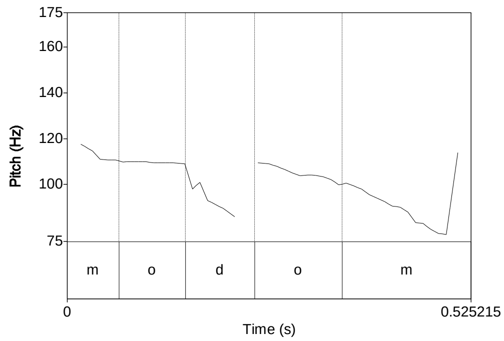
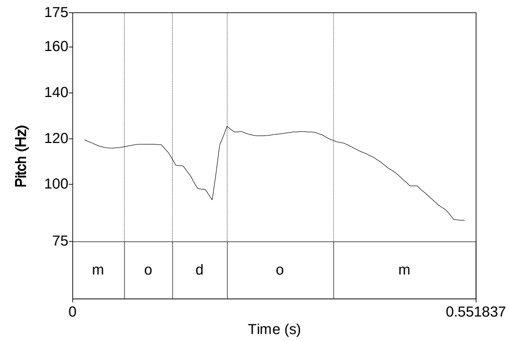
Time (s)

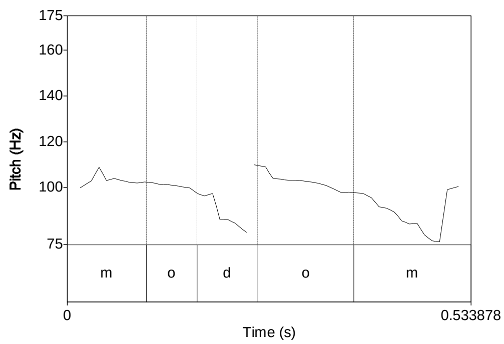
mo^{L}dom **mo^{L}dom**

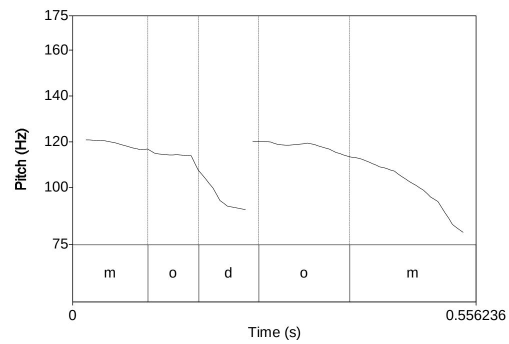




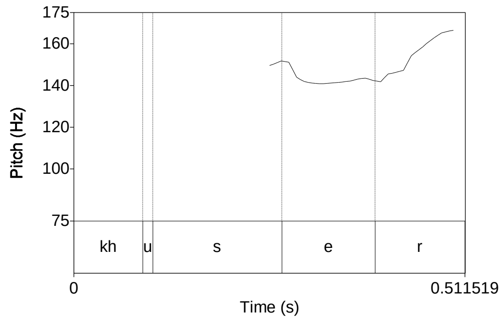


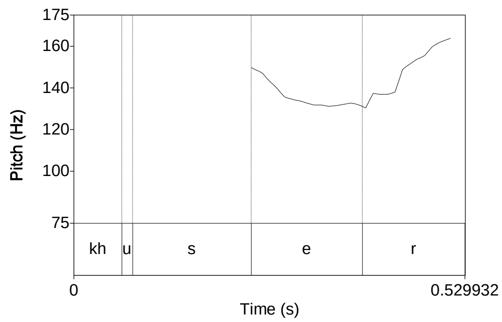


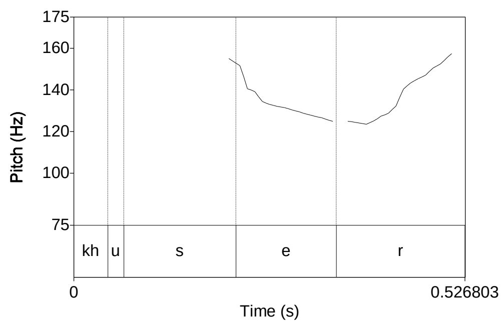




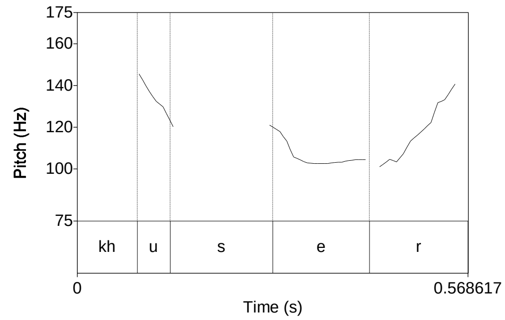
khu^{H}ser

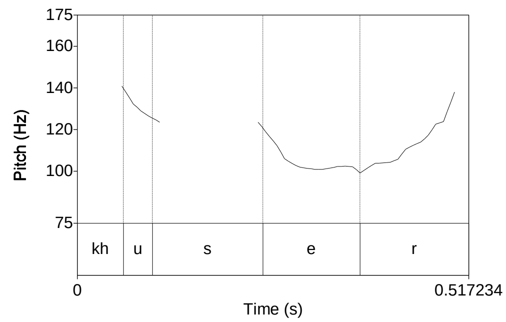


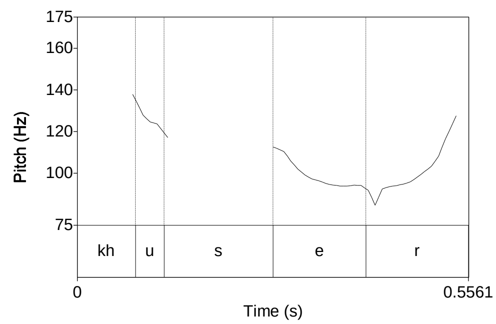




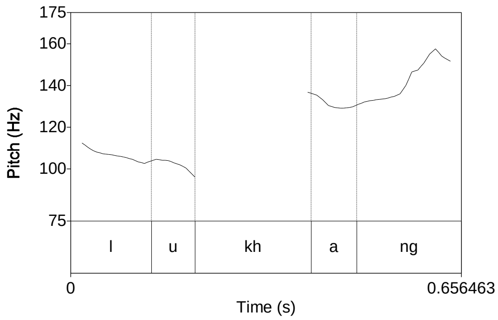
khu^{L}ser

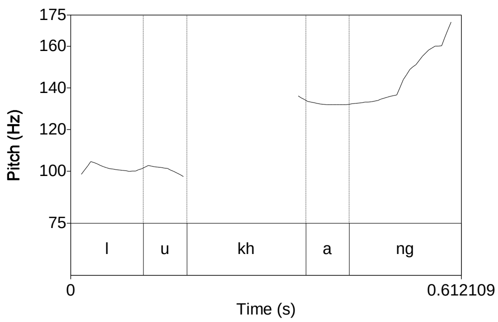


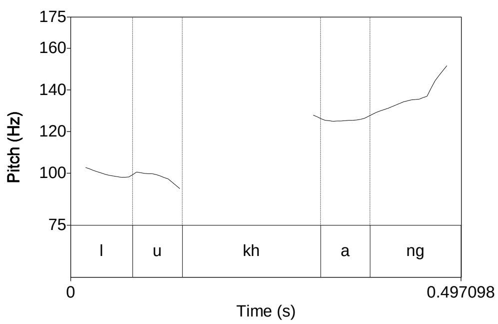




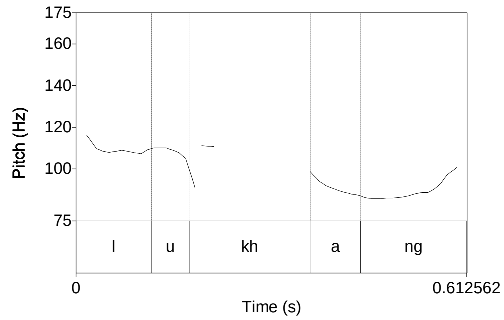
lu^{H}khang

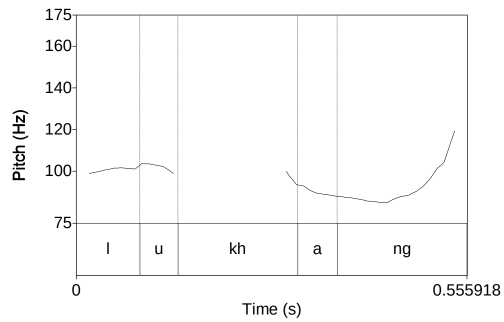


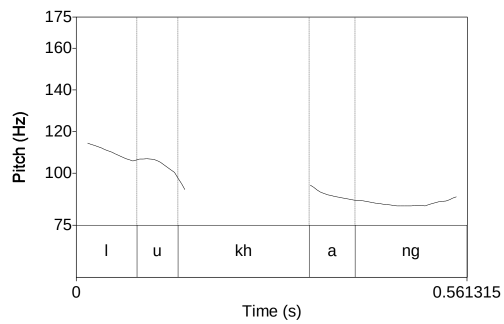




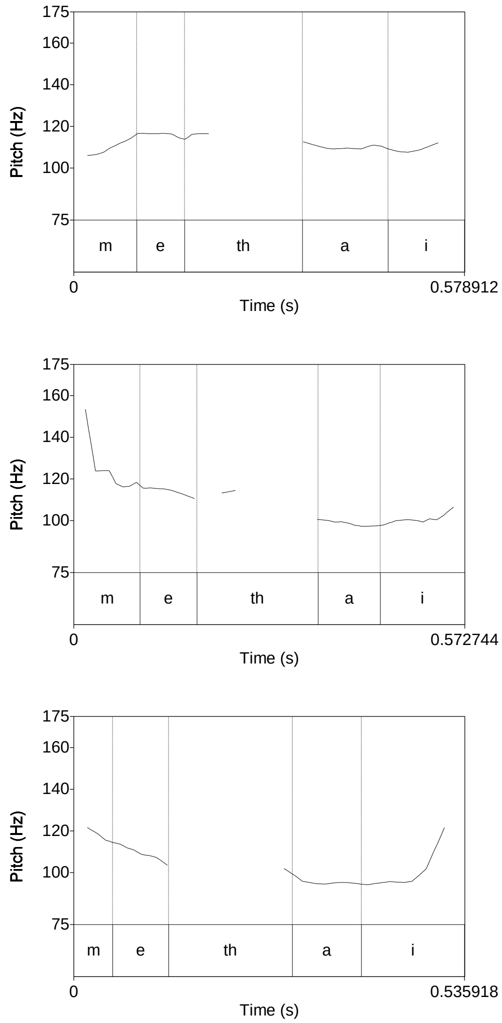
lu^{L}khang



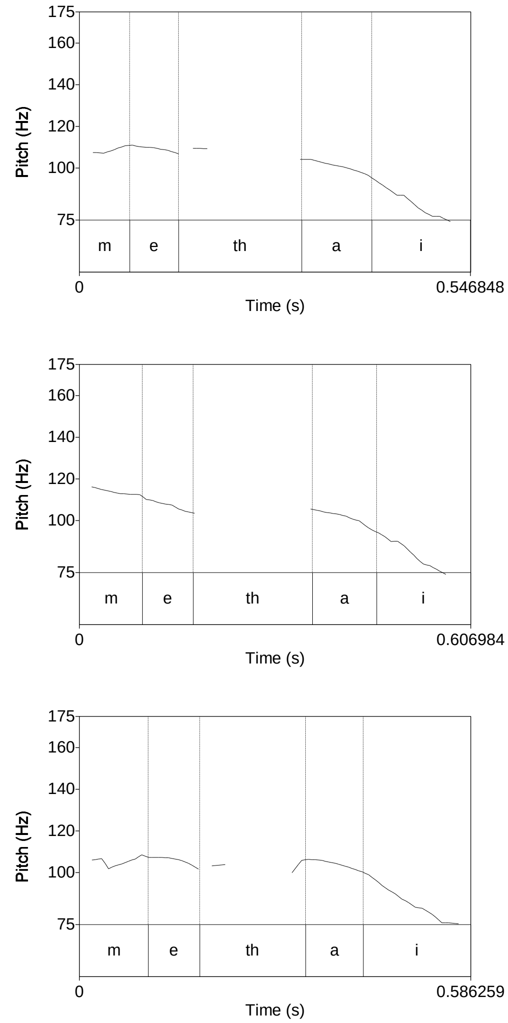




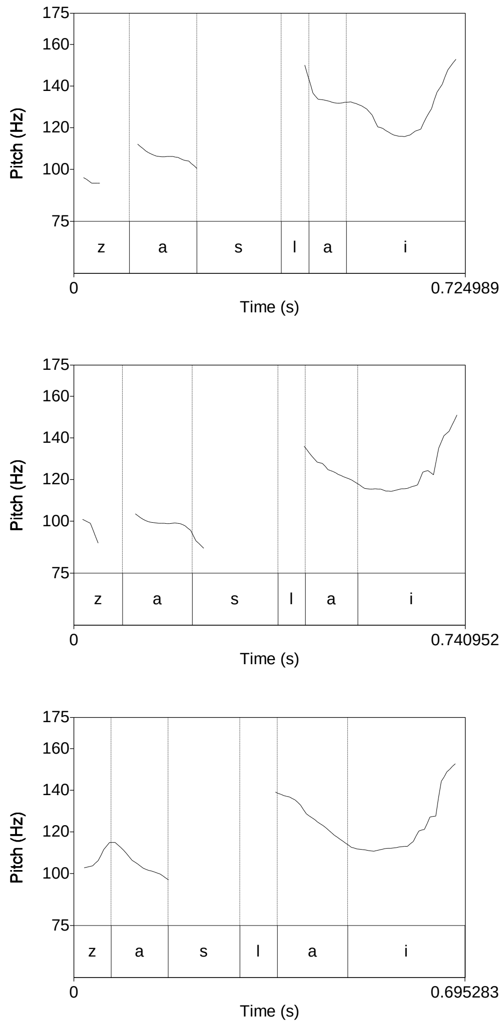
me^{H}thay



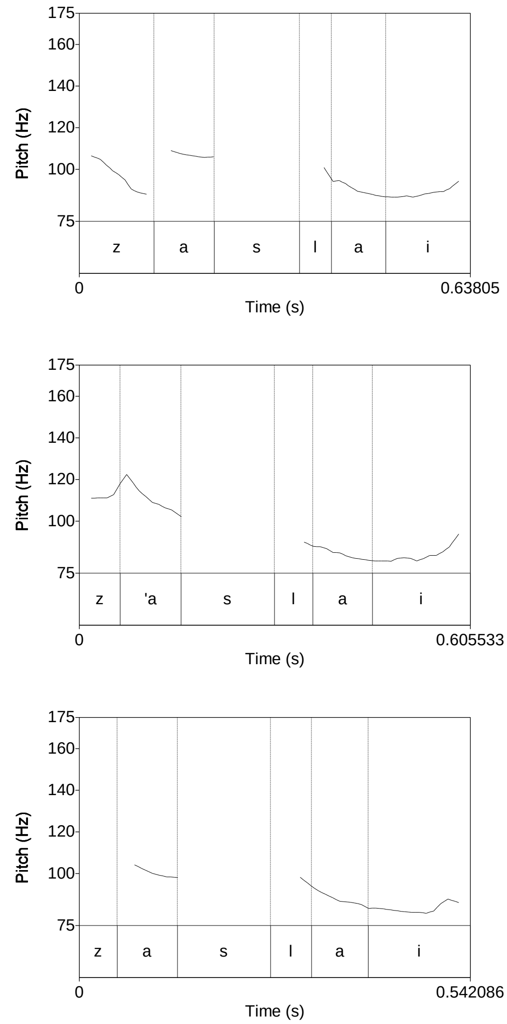
me^{L}thay



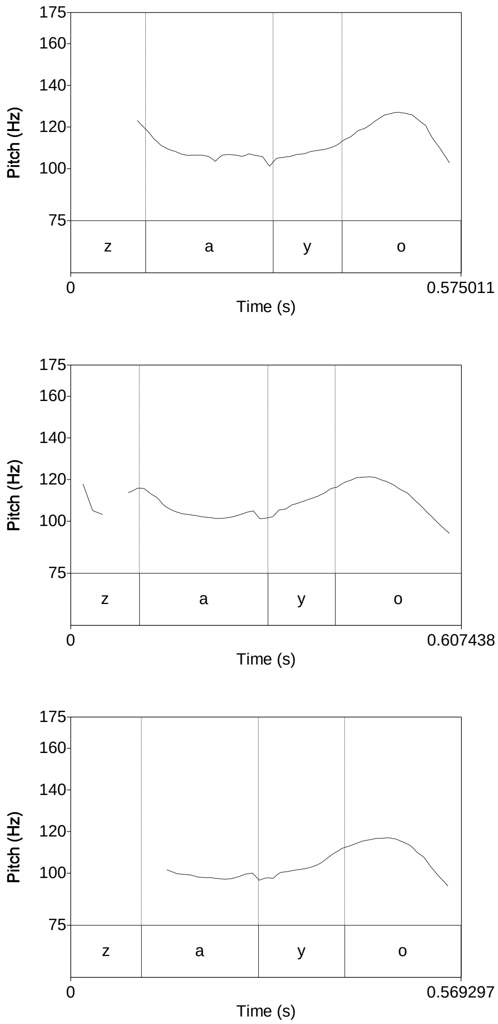
za^{H}lay



za^{L}lay



zay^{H}o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100
75
Pitch (Hz)
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y
o
0
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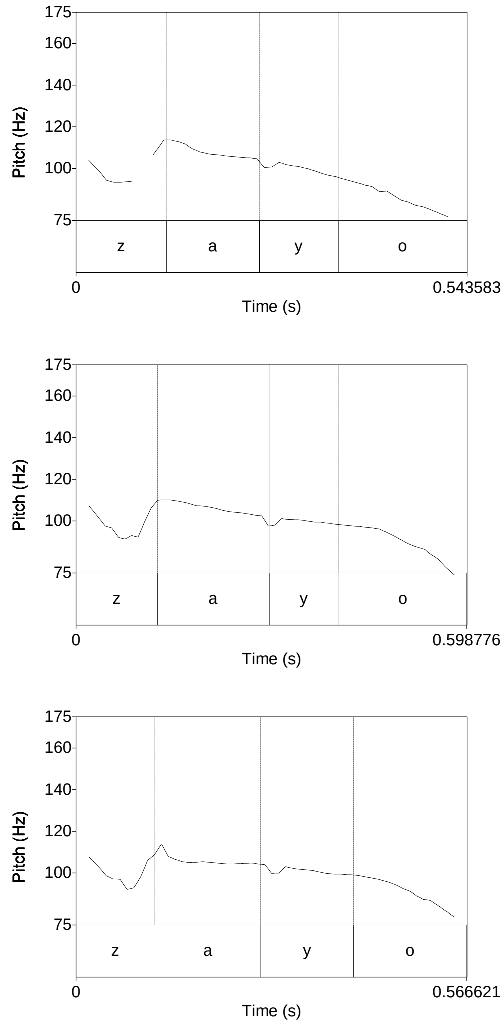
0.569297
Time (s)

zay^{L}o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120
100
75
Pitch (Hz)
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y
o
0
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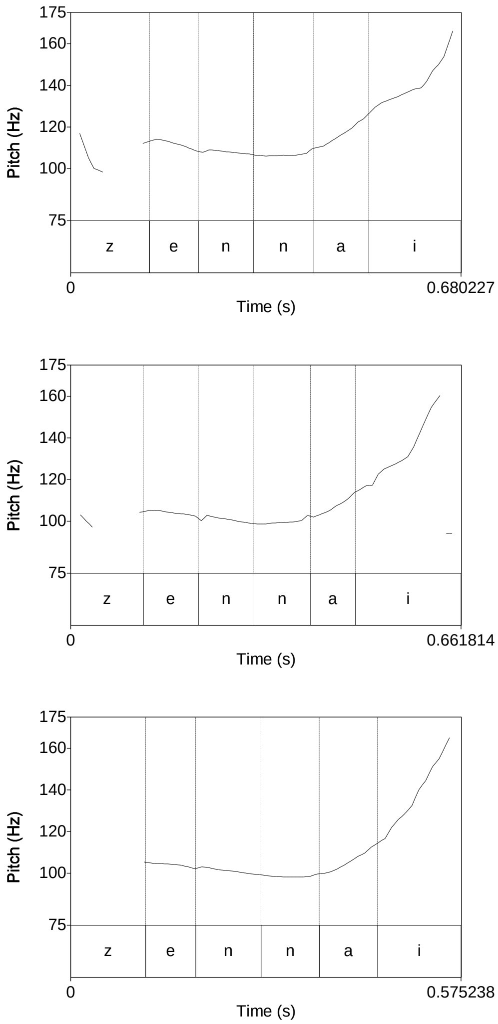
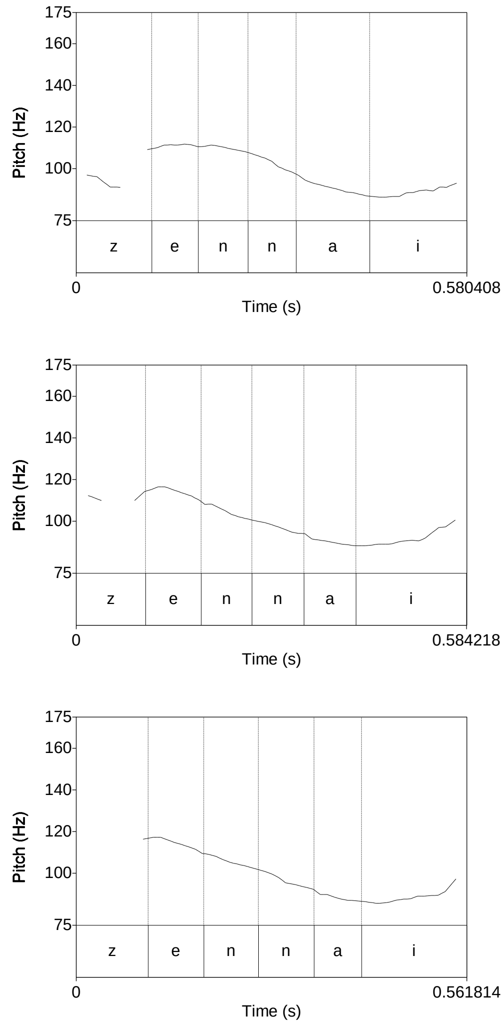
0.598776
0.566621
Time (s)

zen^{H}nay



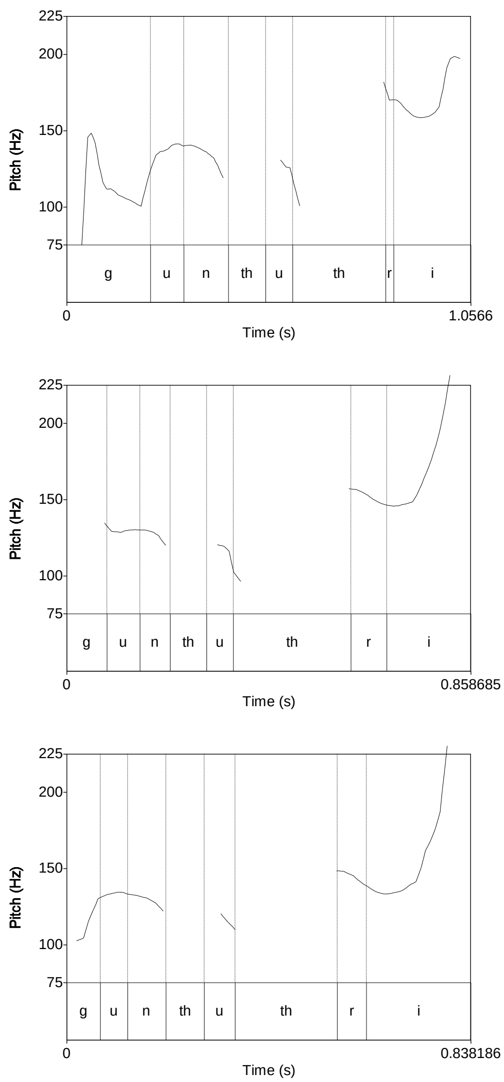
zen^{L}nay



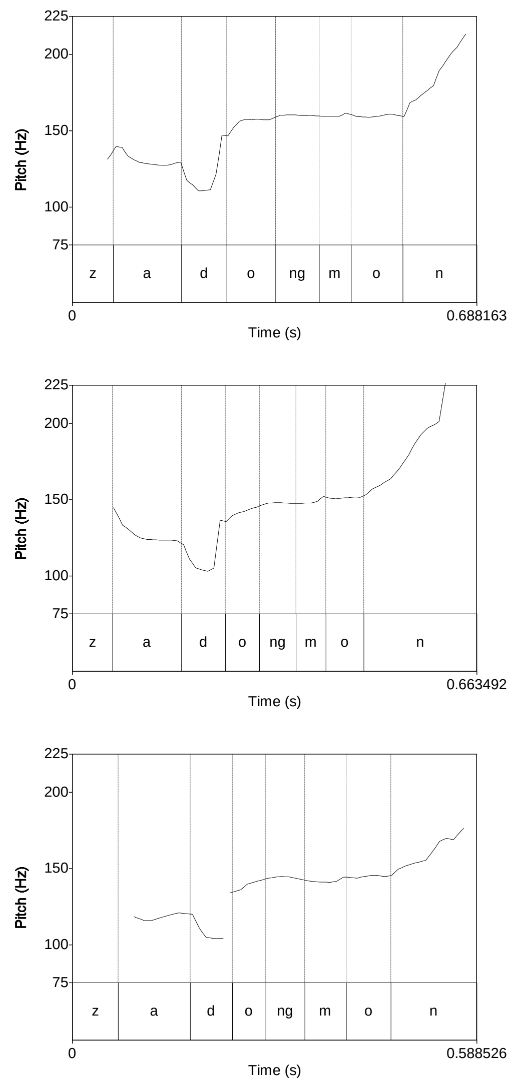
*Pictures of the 0 tone claimed by Bhattacharya (1977)**

In this set of pictures, in the gloss, the tone is marked as in Bhattacharya (1977). For our version of tone assignment for these words, please refer to Appendix I.

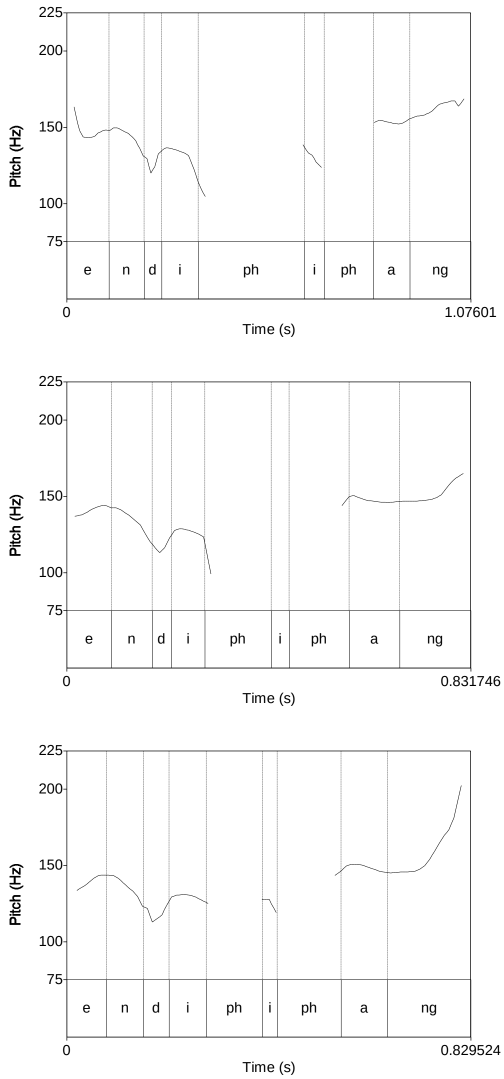
^{2}gun^{0}thu^{1}thri



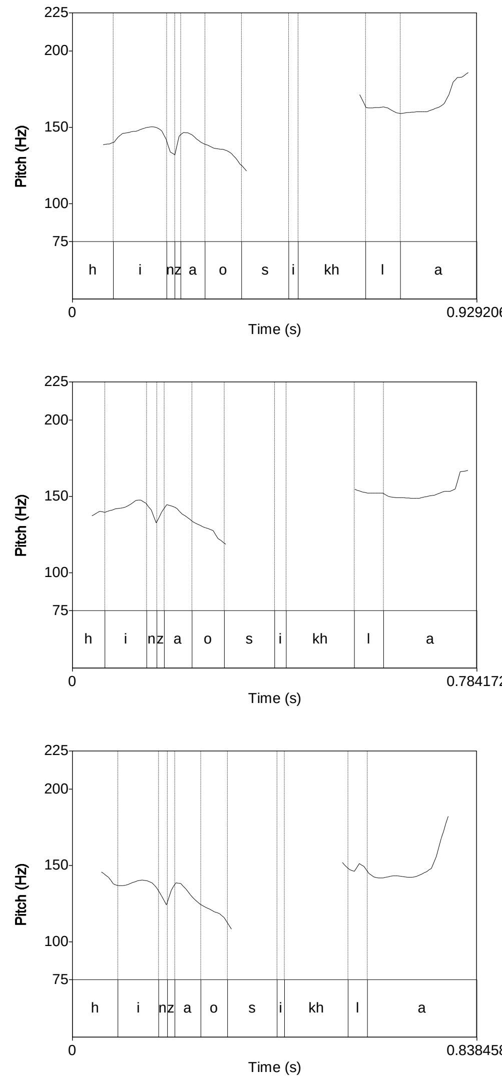
^{1}za^{0}dong^{0}mon



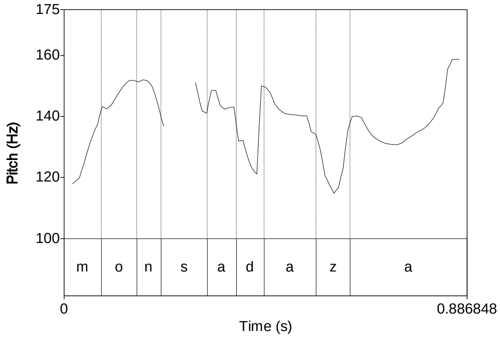
^{2}en^{1}di^{0}phi^{1}phang

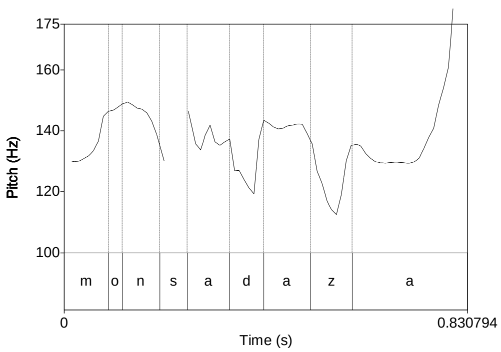


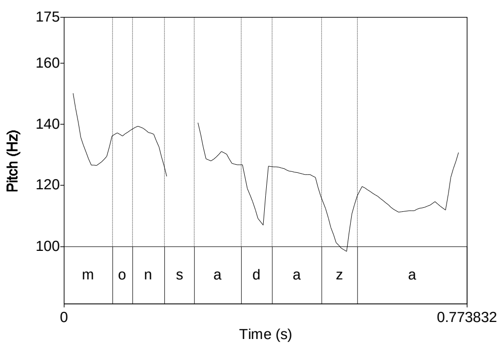
^{2}hin^{3}zaw^{0}si^{1}khla



^{2}mon^{2}sa^{0}da^{3}za



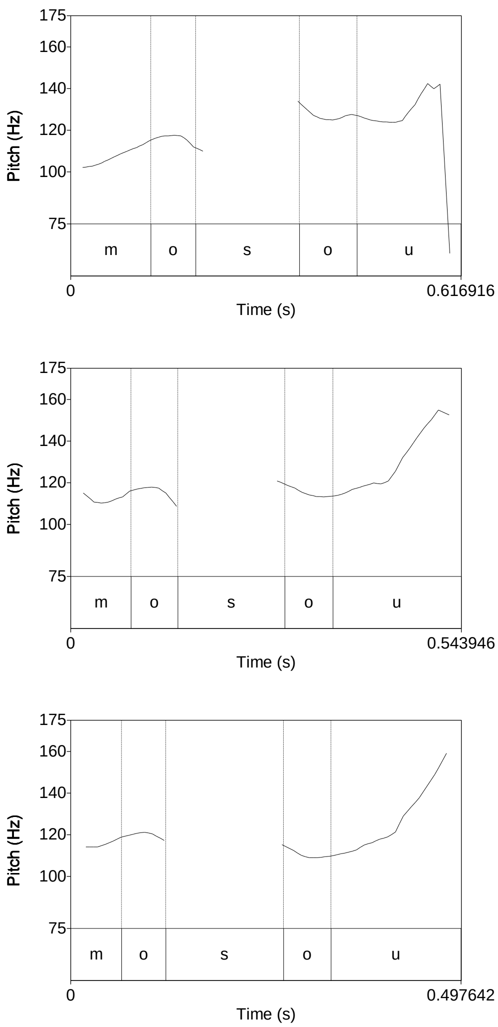




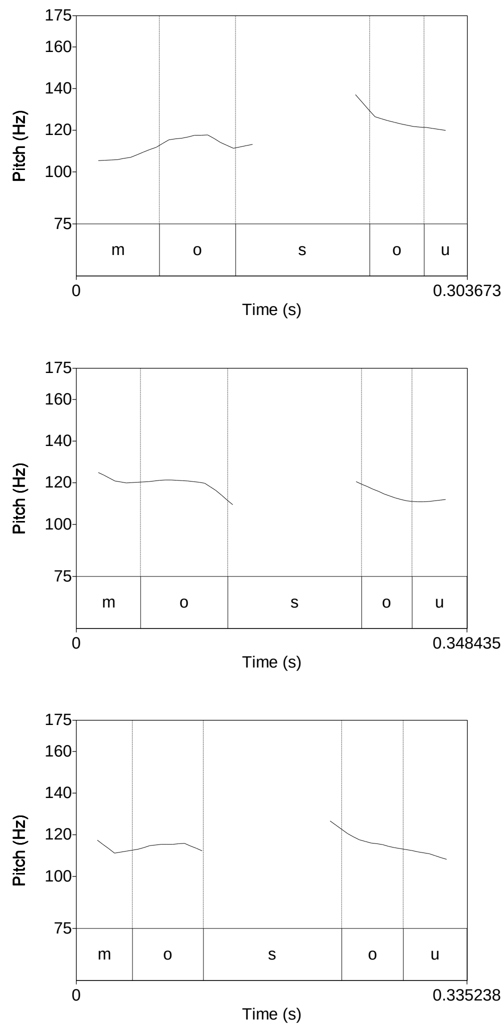
Plural Suffixation

A. The null suffix

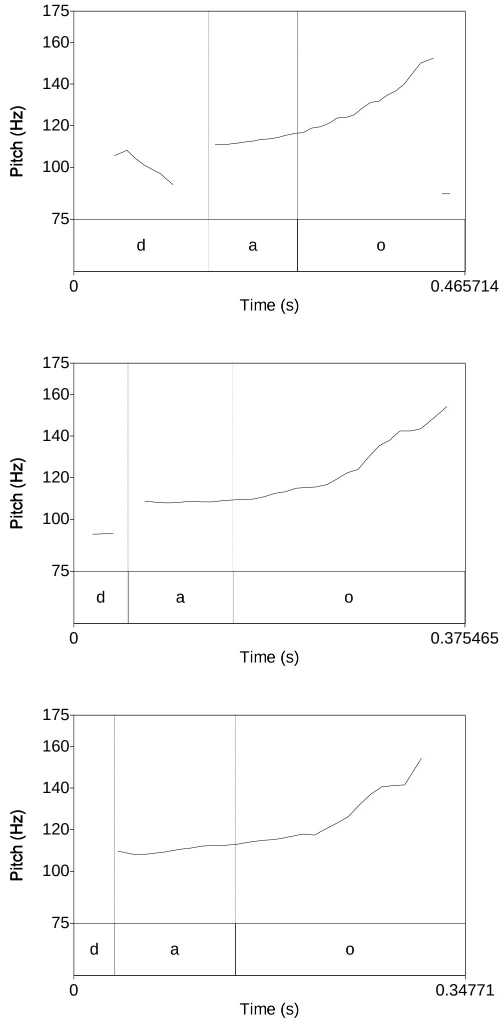
mo^{H}sow



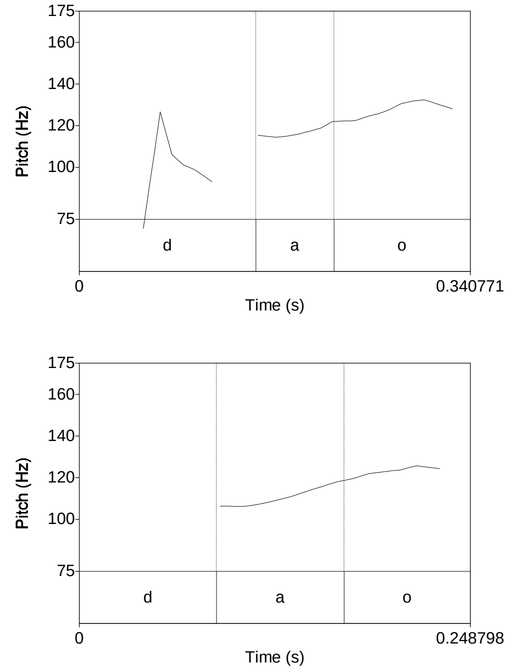
mo^{H}sow -Ø→ mo^{H}sow



^{H}daw

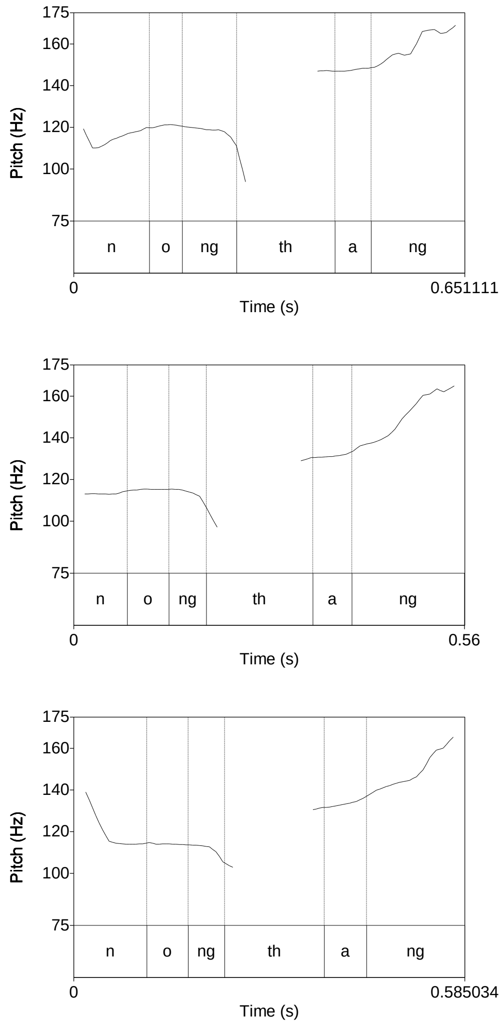


^{H}daw - Ø→ ^{H}daw

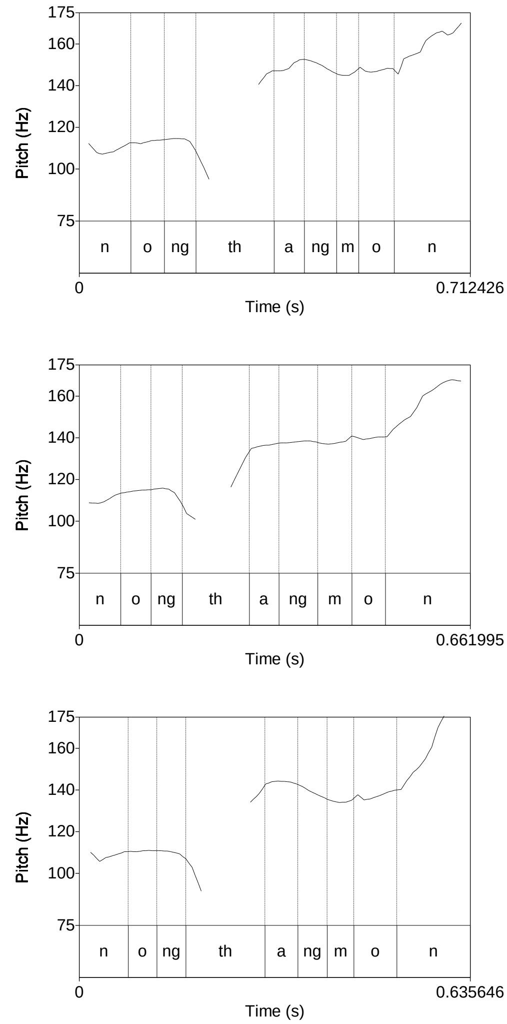


B. *-mon* suffix

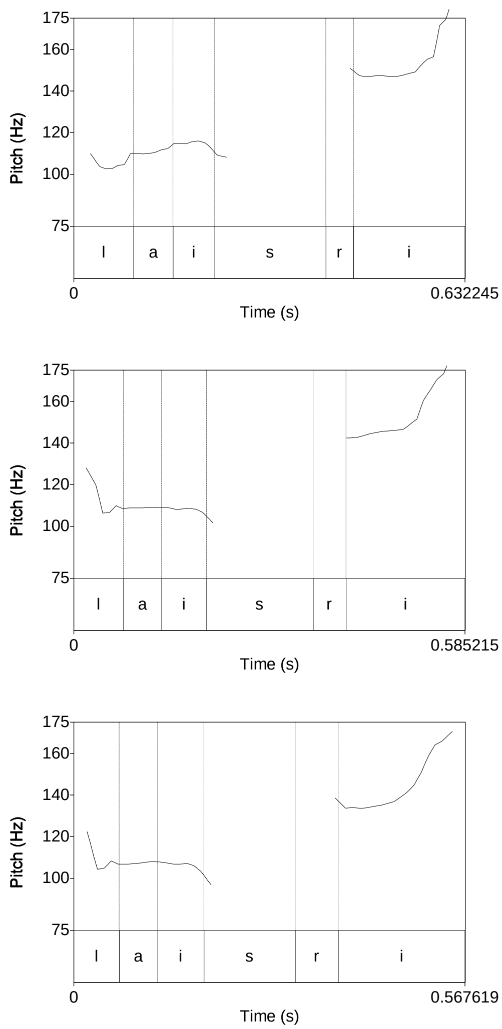
nong^{H}thang



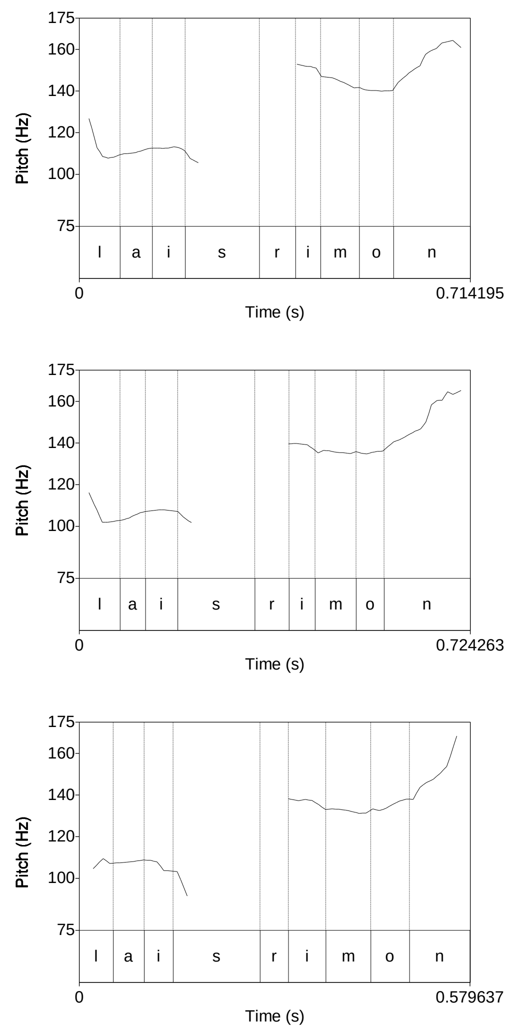
nong^{H}thang-mon→nong^{H}thang^{H}mon



lay^{H}sri

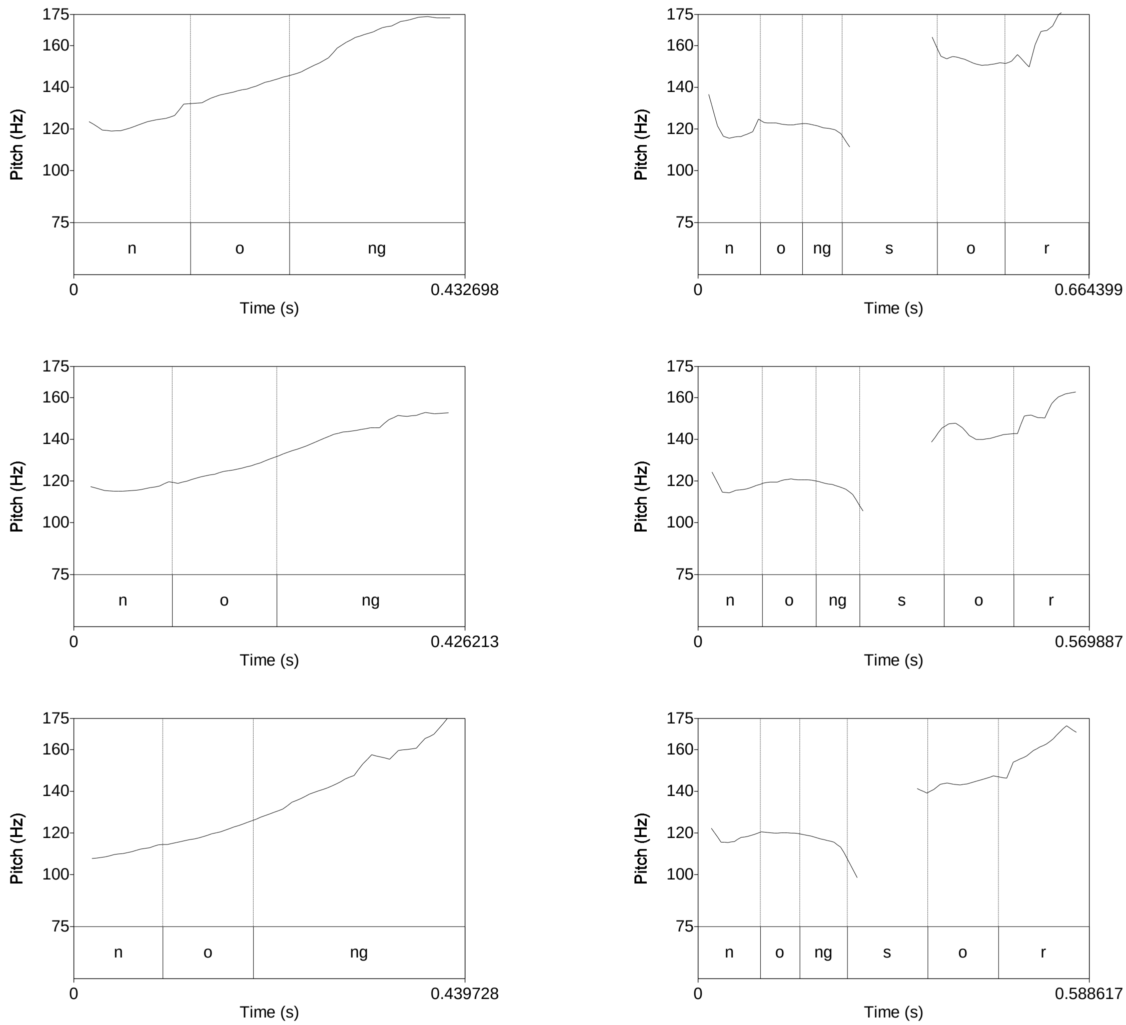


lay^{H}sri-mon→lay^{H}sri^{H}mon

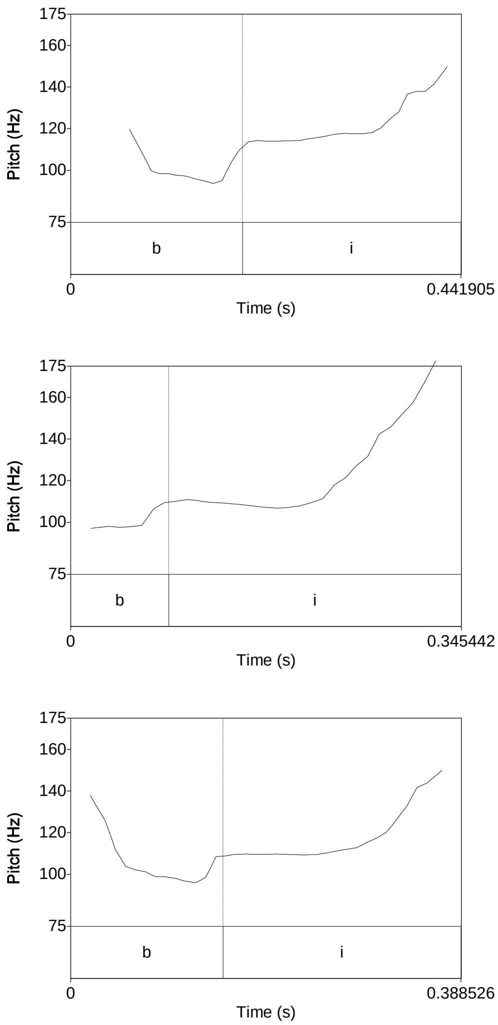


C. –*sor* suffix

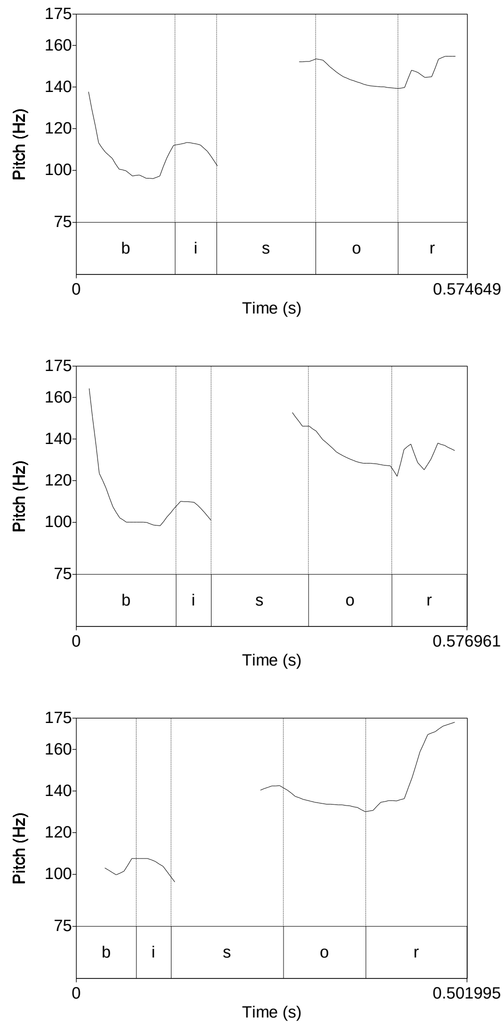
^{H}nong **^{H}nong-sor→nong^{H}sor**



^{H}bi

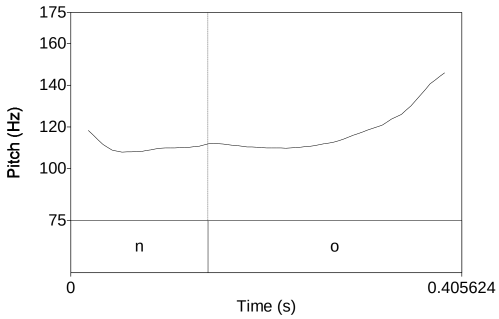


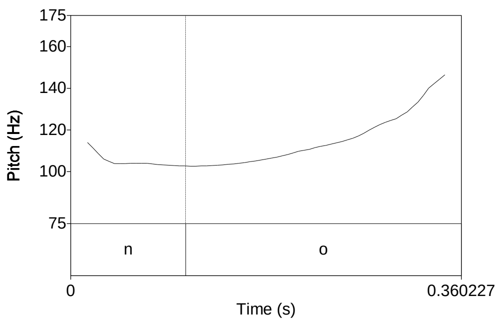
^{H}bi-sor→bi^{H}or

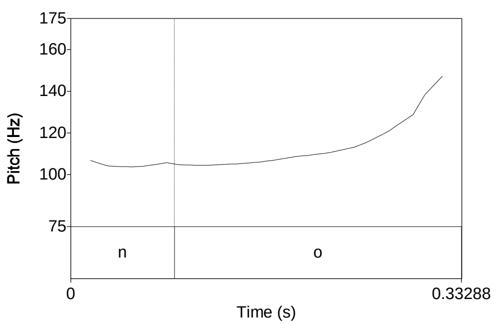


D. –*phor* suffix

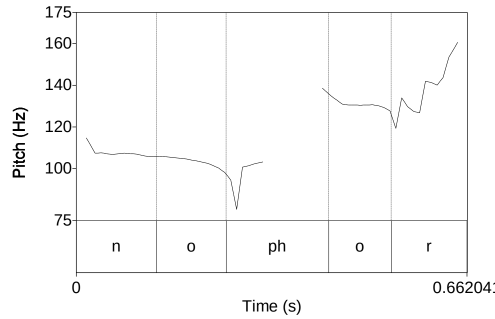
^{H}no

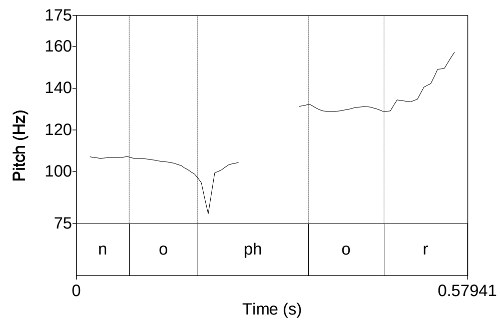




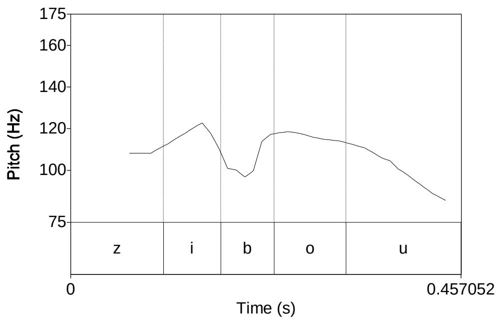


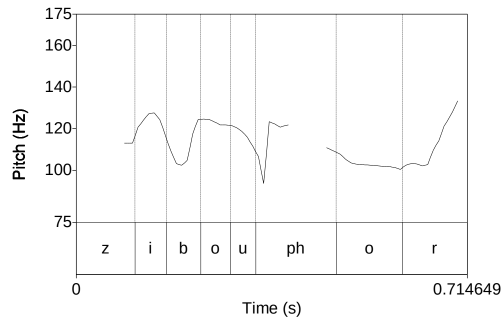
^{H}no-phor→no^{H}phor

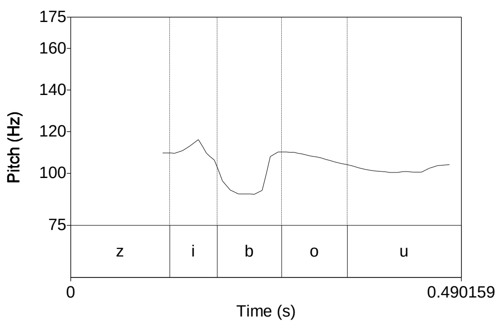


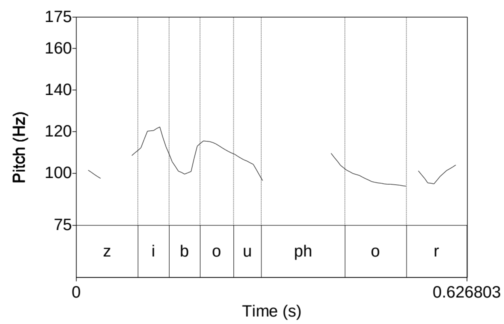


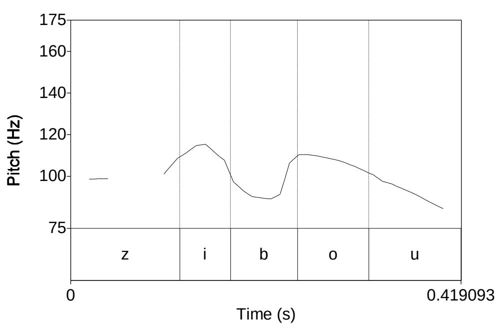
zi^{L}bow **zi^{L}bow -phor→zibow^{L}phor**

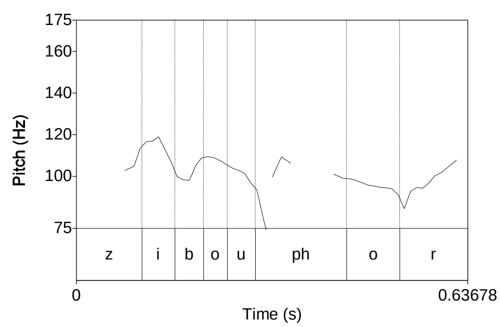




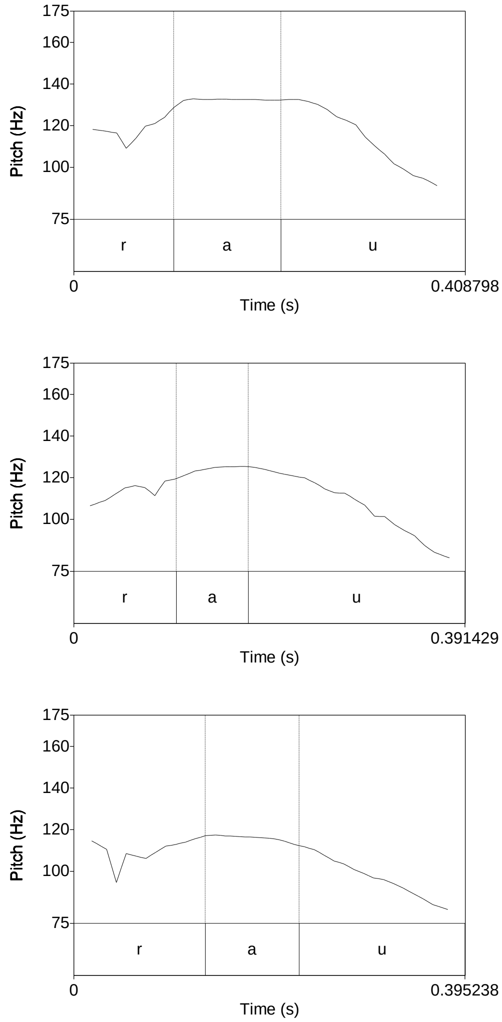




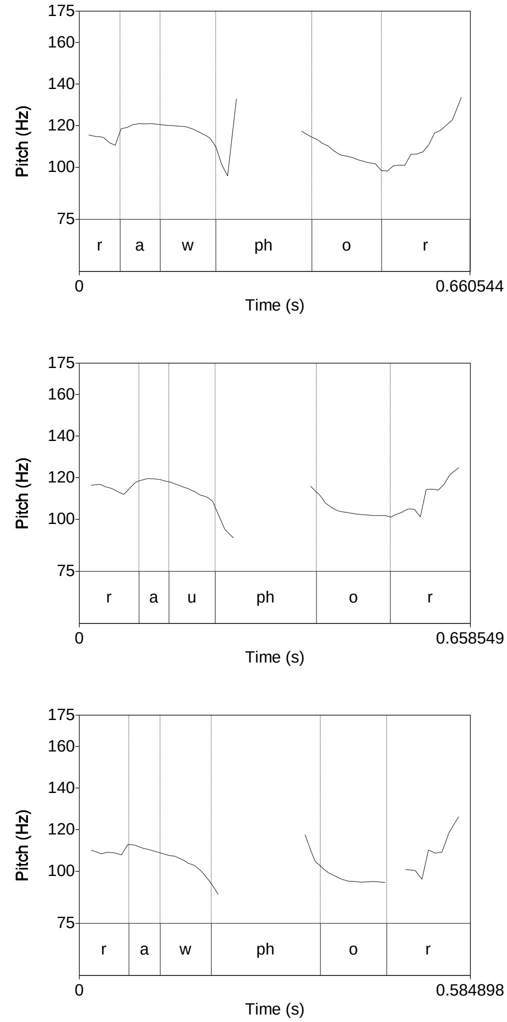




^{L}raw



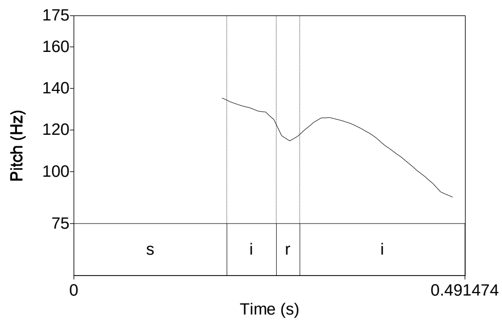
^{L}raw-phor→raw^{L}phor

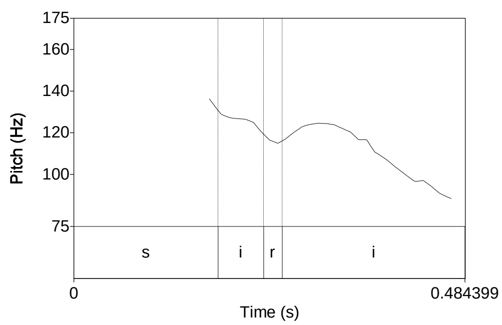


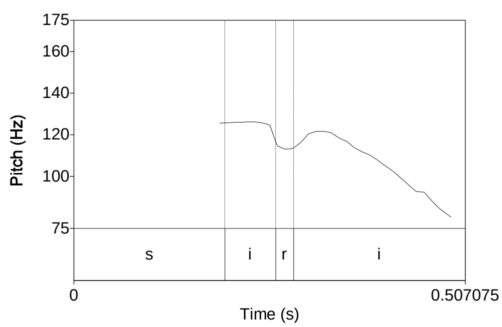
Causative affixation

A. phi-

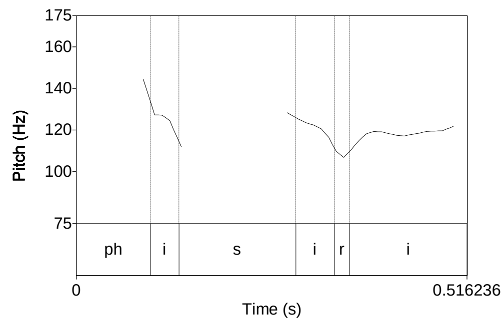
si^{L}ri

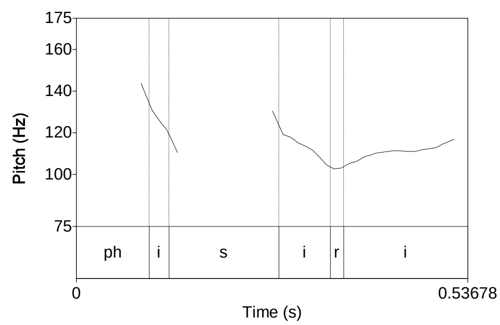


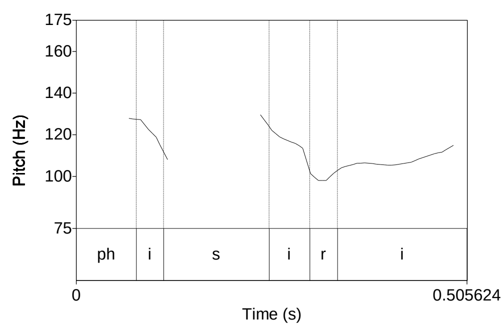




phisi^{L}ri

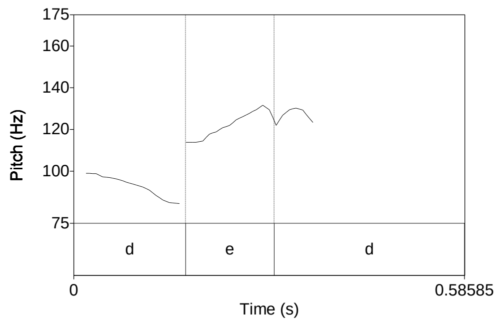


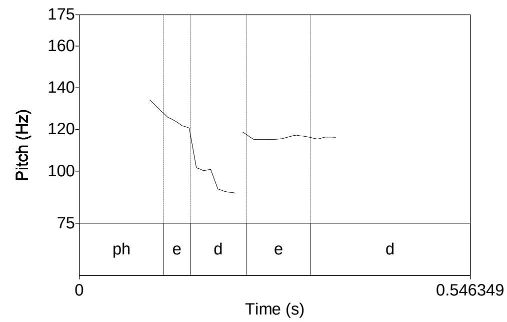


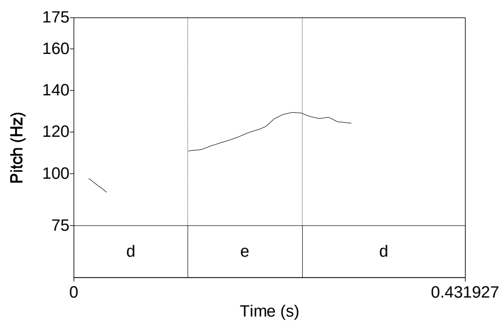


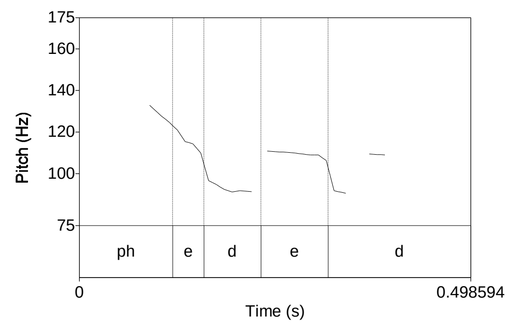
B. phe-

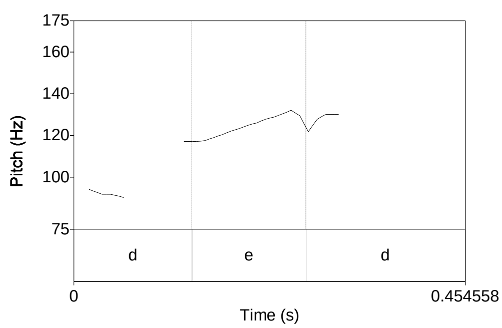
^{H}ded | **phe^{H}ded**

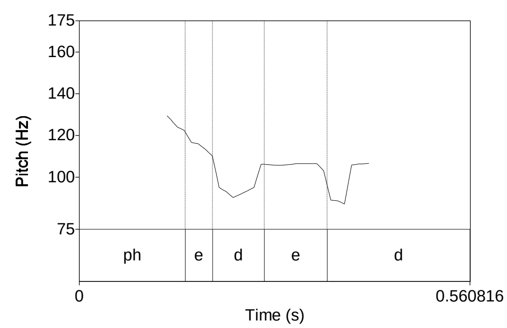




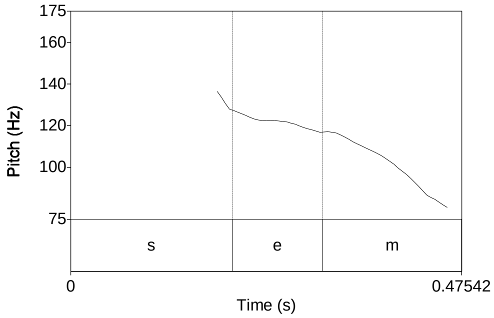


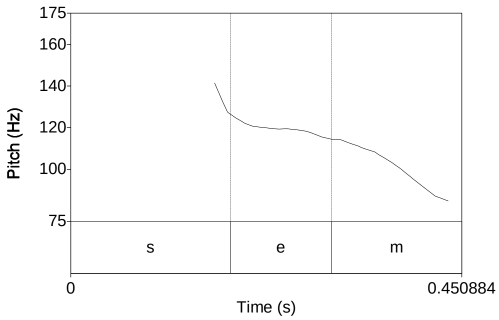


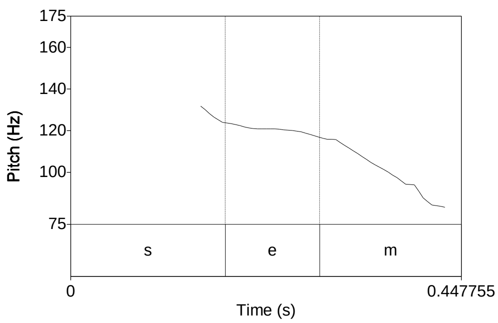




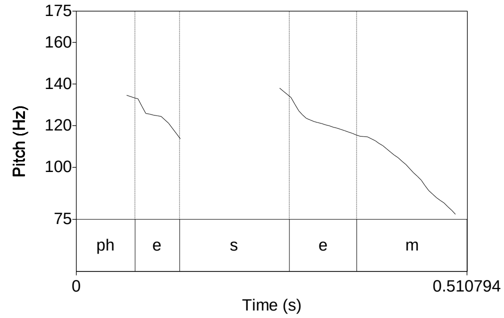
^{L}sem

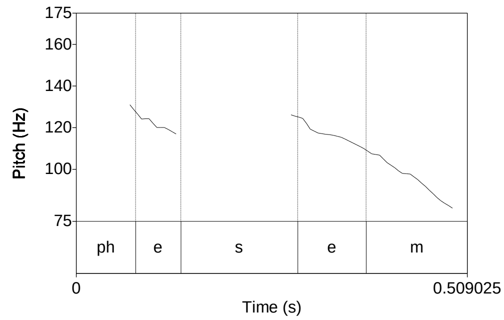


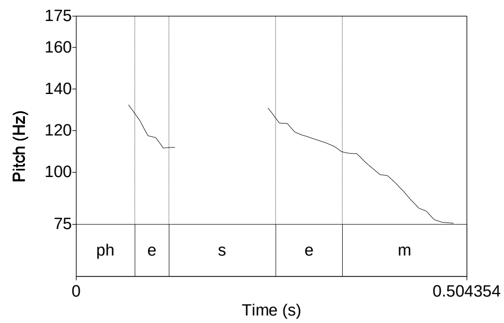




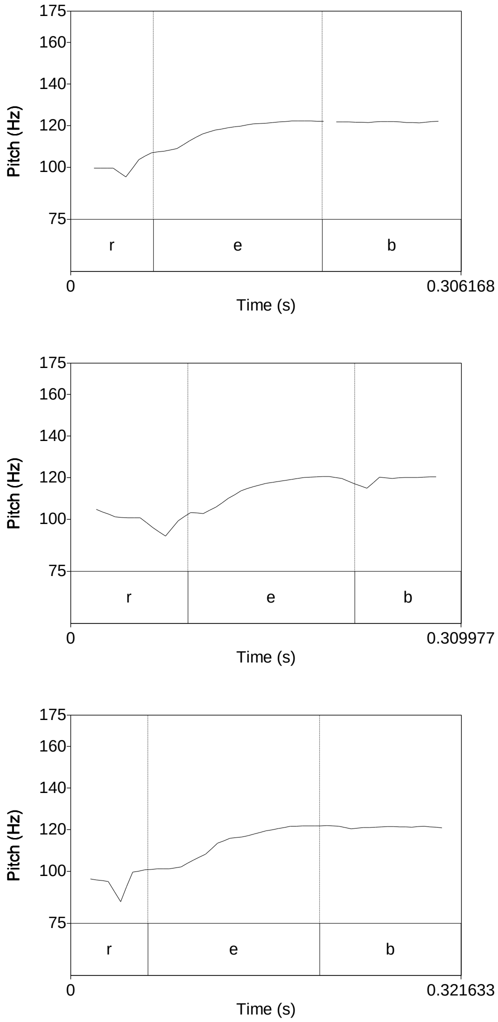
phe^{L}sem



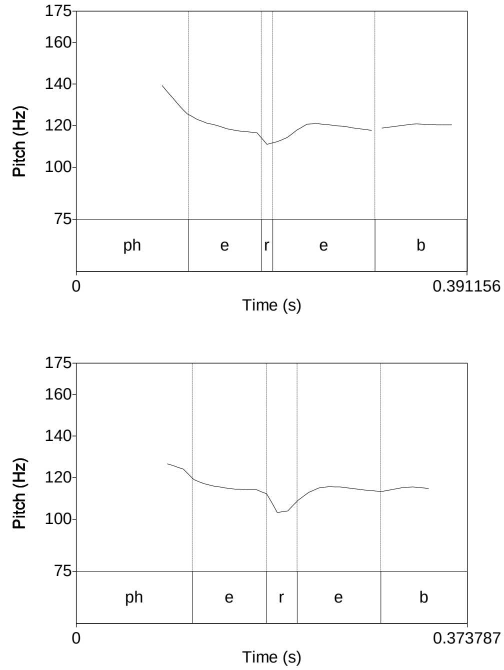




^{H}reb

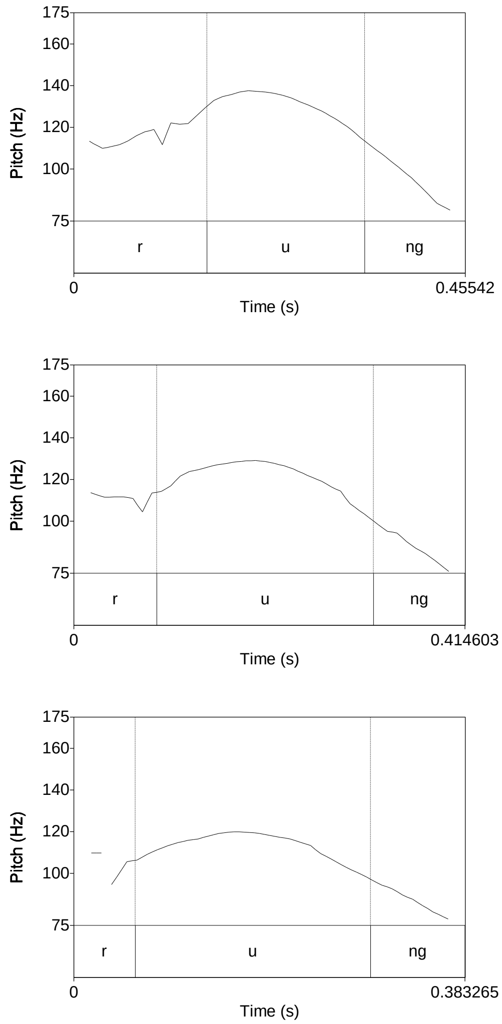


phe^{H}reb

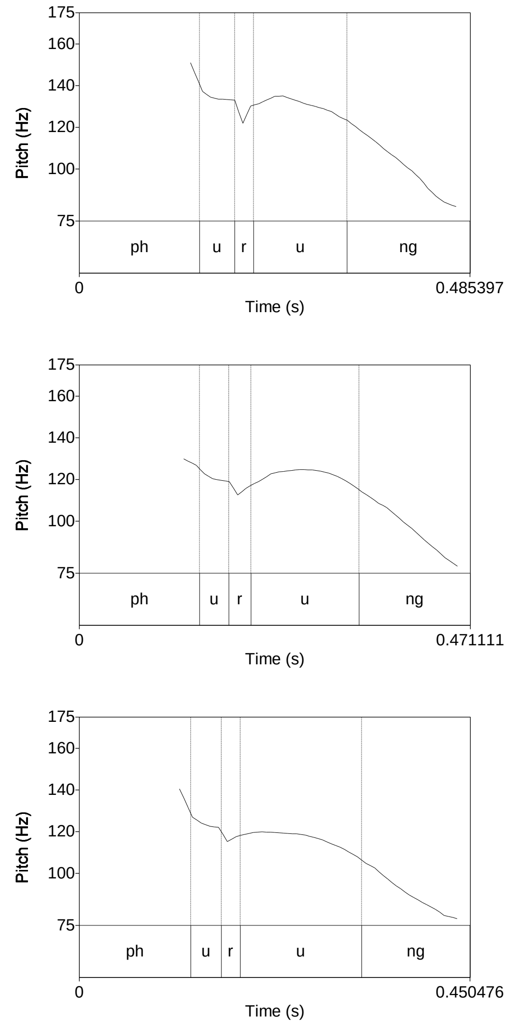


C. phu-

^{L}rung

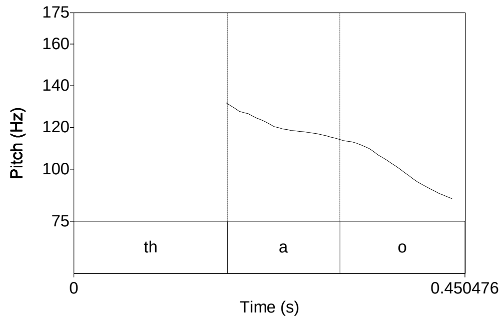


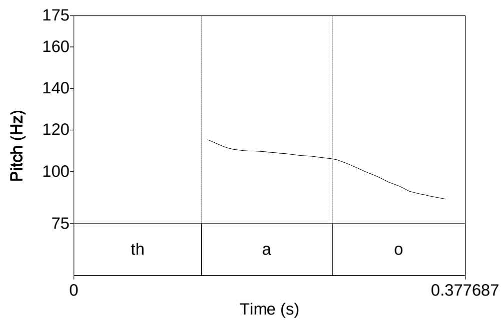
phu^{L}rung

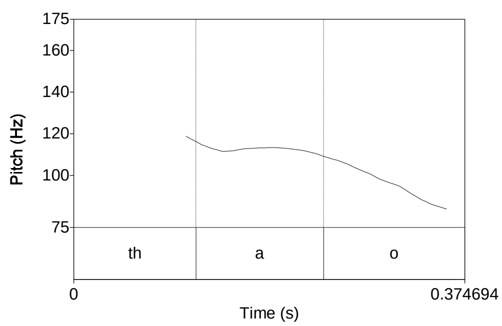


D. pho-

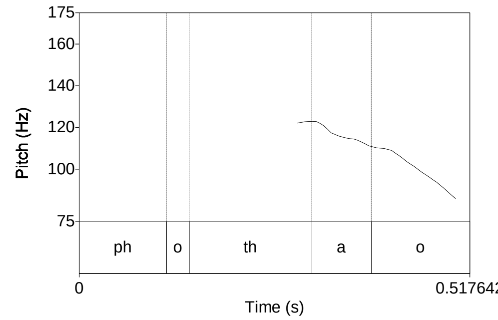
^{L}thaw

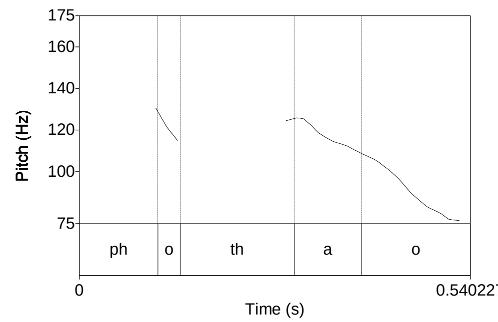


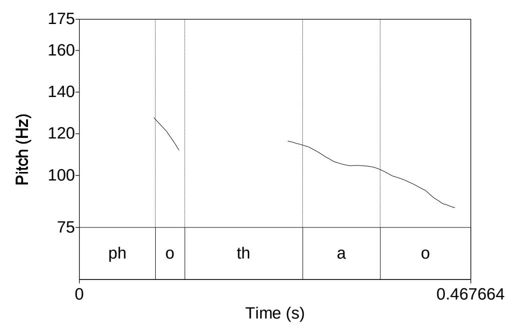




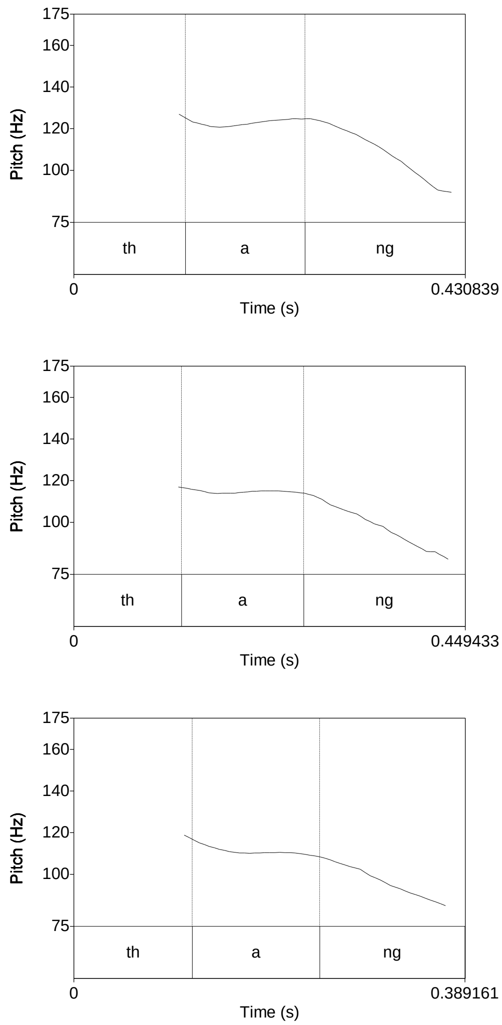
pho^{L}thaw



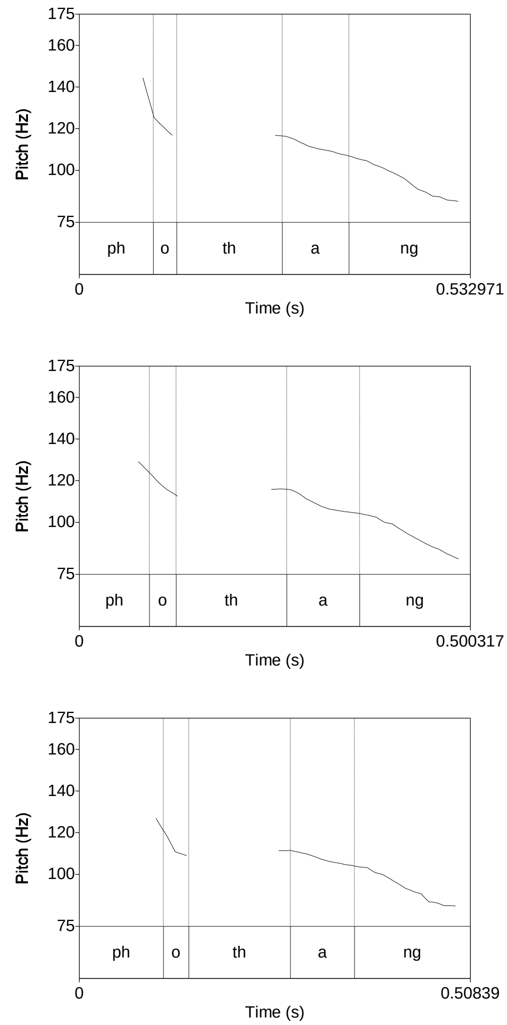




^{H}thang

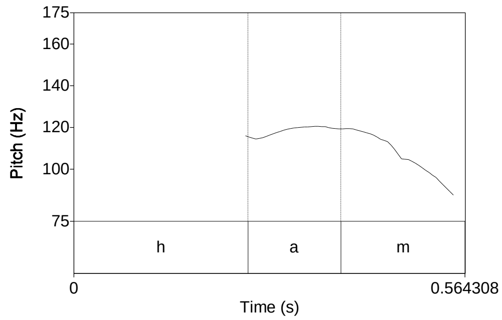


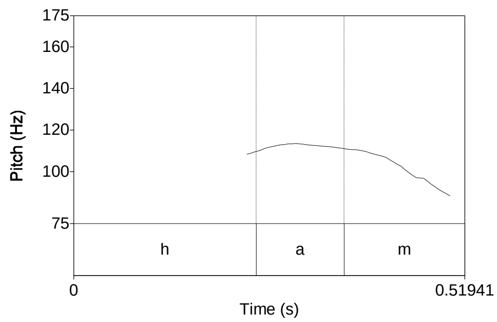
pho^{H}thang

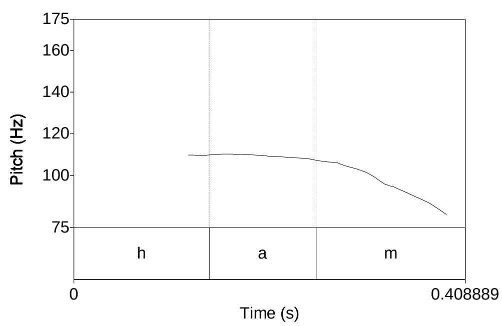


E. pha-

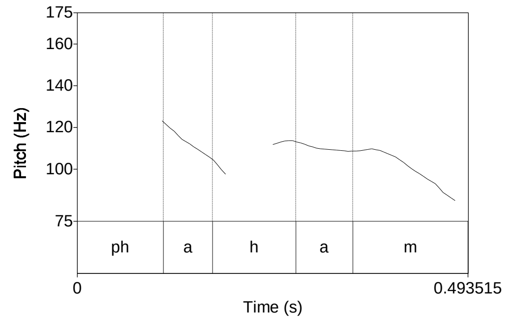
^{L}ham

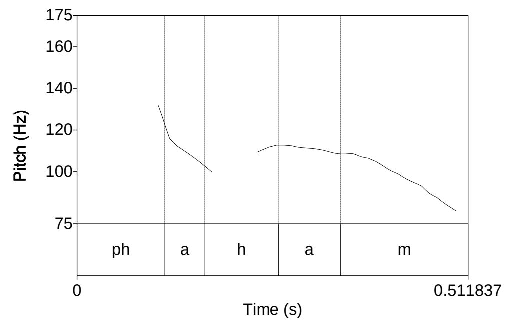


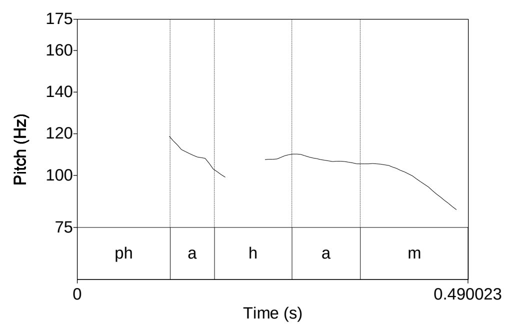




pha^{L}ham

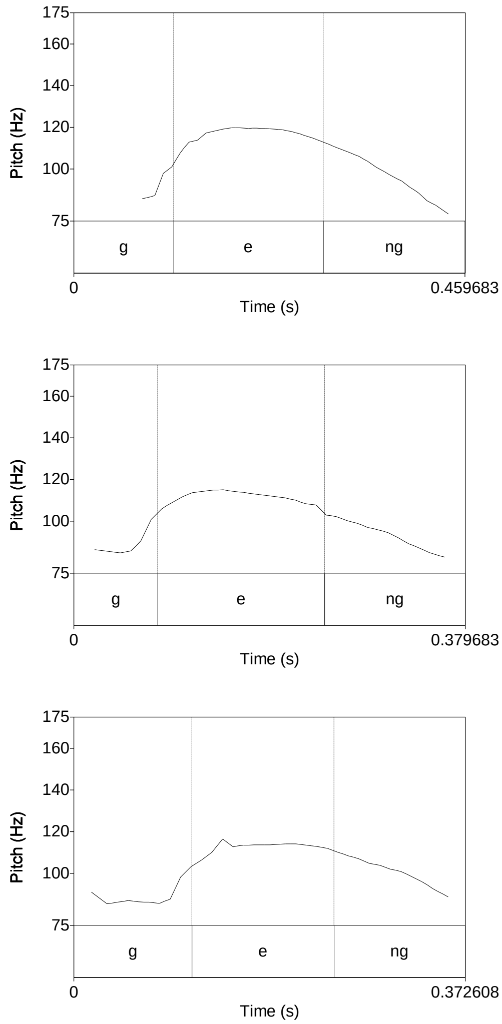




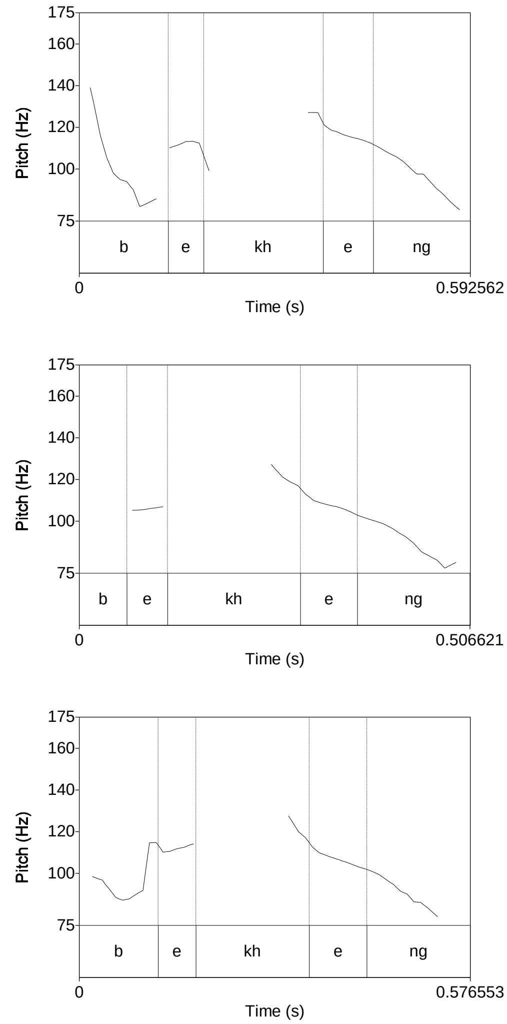


F. bV-

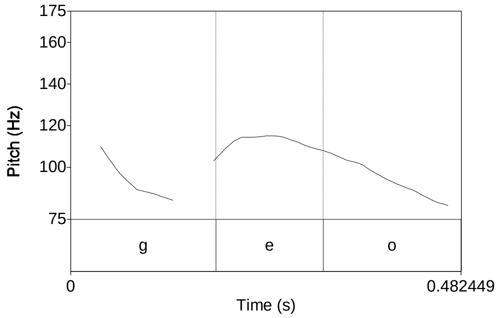
^{H}geng

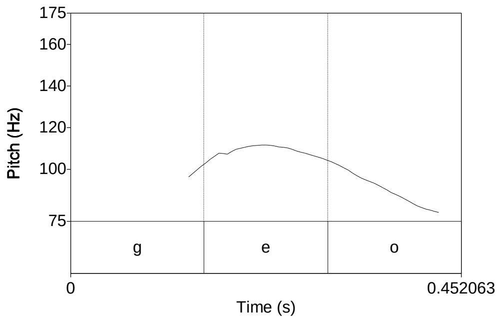


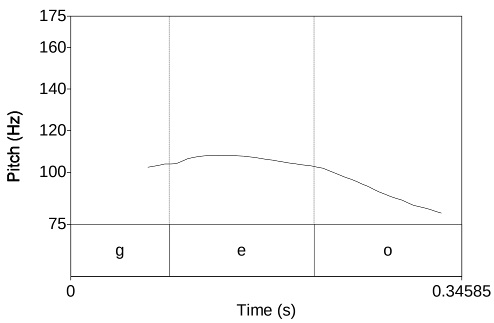
be^{H}kheng



^{L}gew







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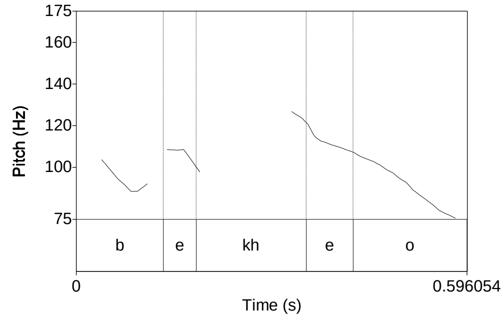
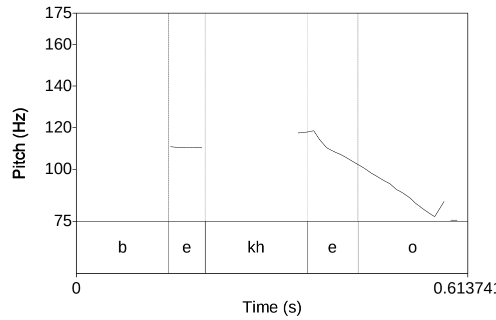
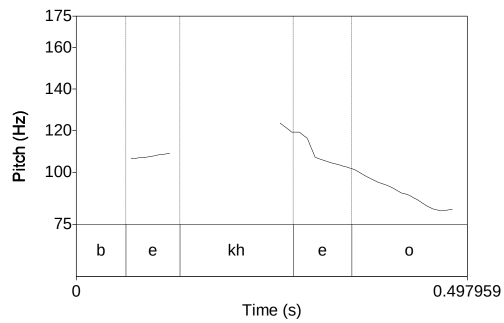
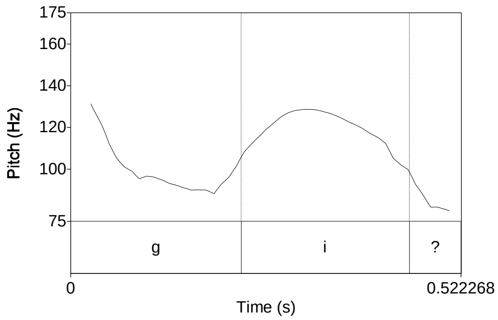


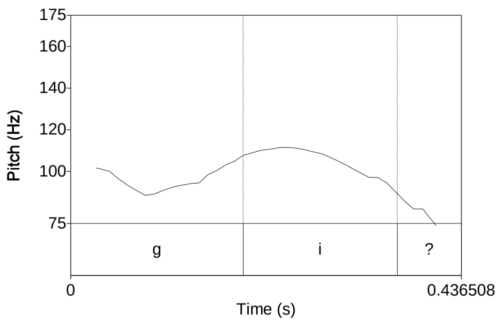


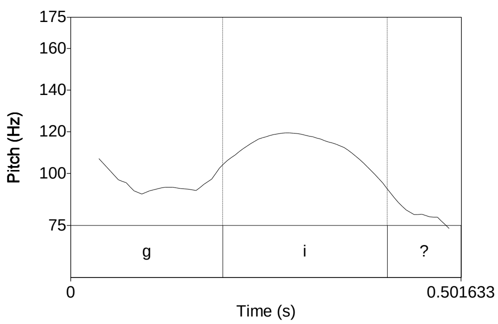


G. sV-

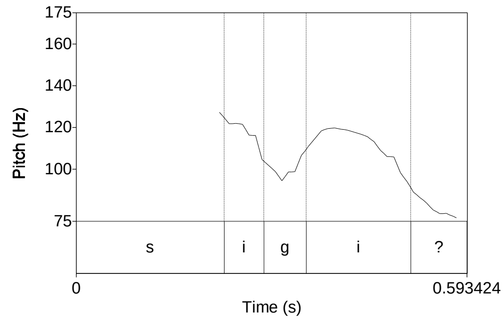
^{H}gi

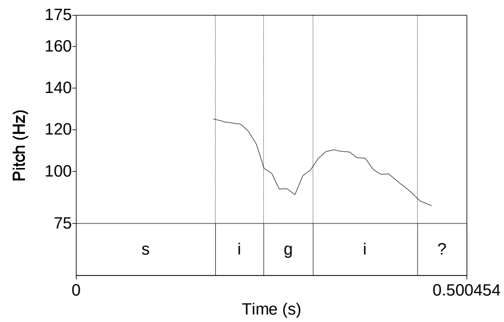


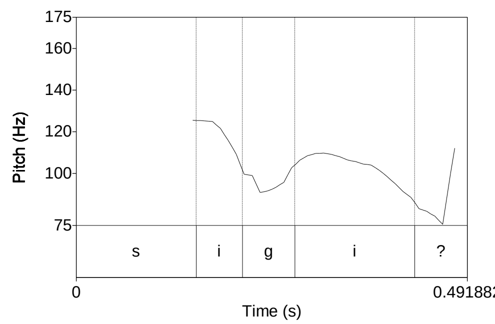




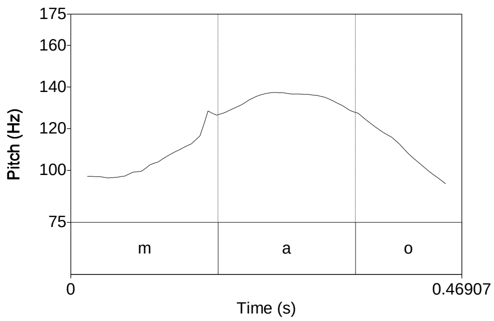
si^{H}gi







^{L}maw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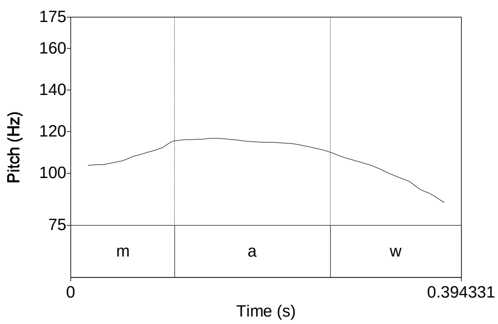
160
140
120
100
75
Pitch (Hz)
m
a
o
0
0.46907
Time (s)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140
120
100
75
Pitch (Hz)
m
a
w
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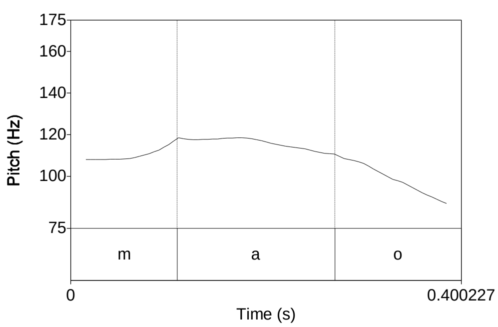
Time (s)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Pitch (Hz)
m
a
o
0
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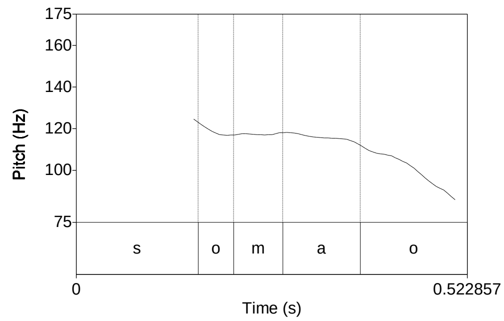
Time (s)

so^{L}maw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Pitch (Hz)
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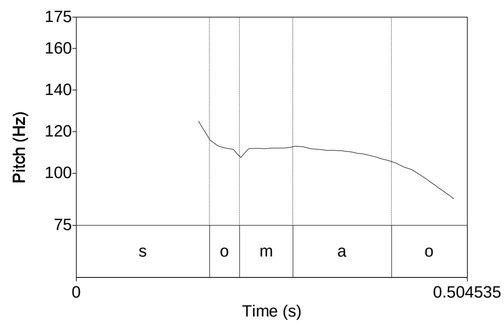
Time (s)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a
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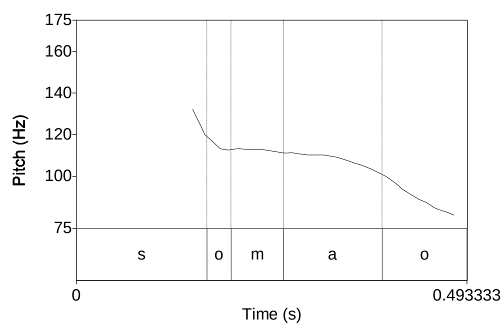
Time (s)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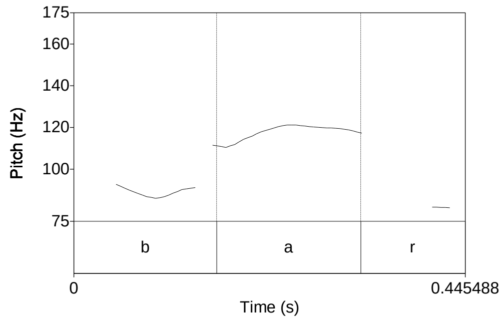
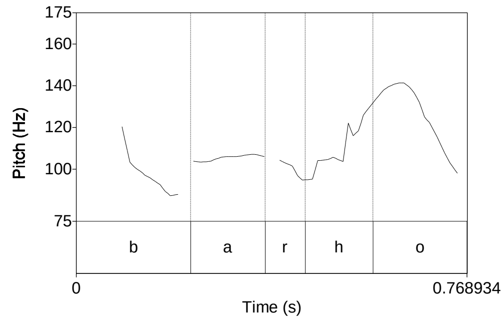
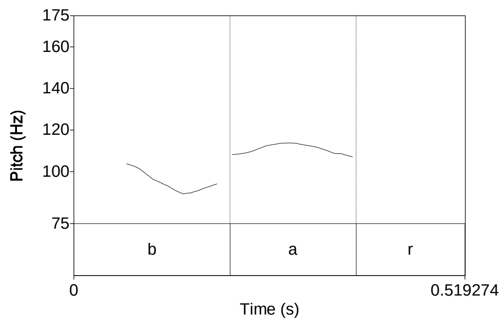
120
100
75
Pitch (Hz)
s
o
m
a
o
0
0.493333
Time (s)

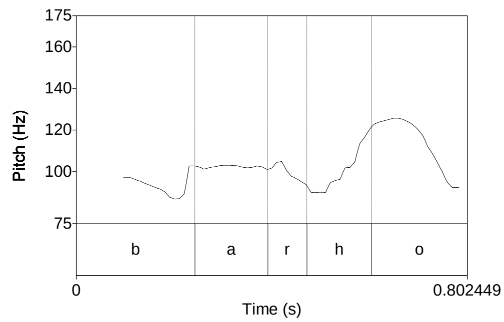
H. –^{L}ho

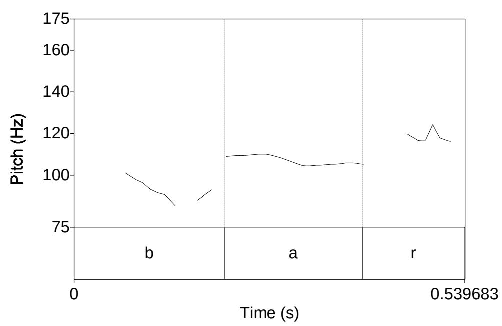
^{H}bar | **^{H}bar^{L}ho**

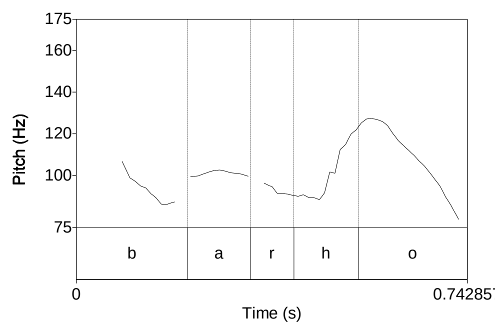




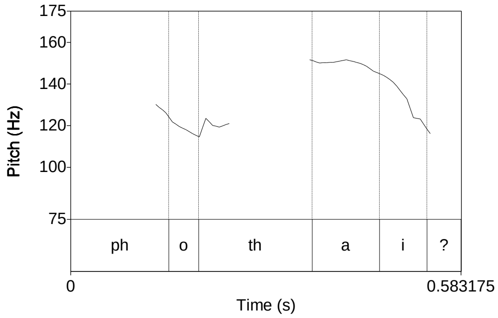


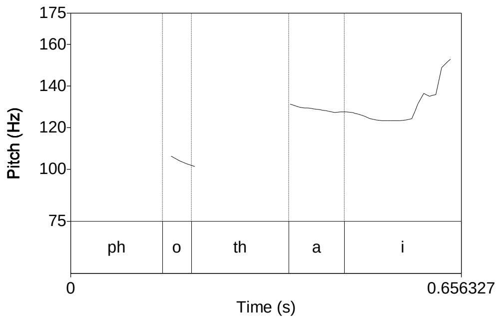


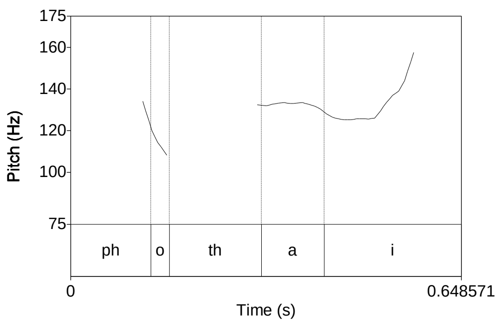




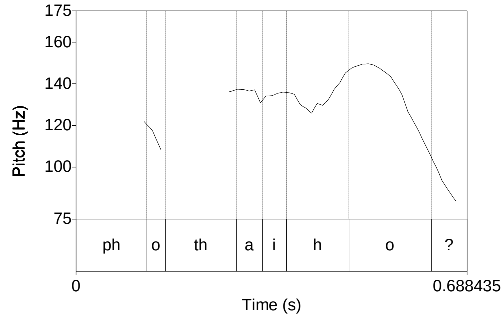
pho^{H}thay

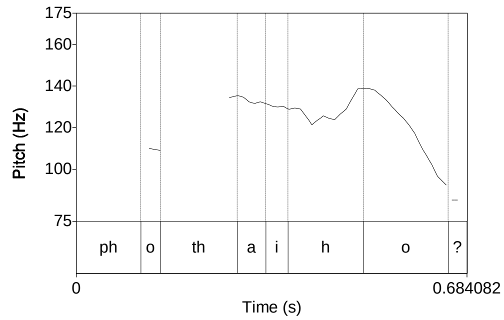


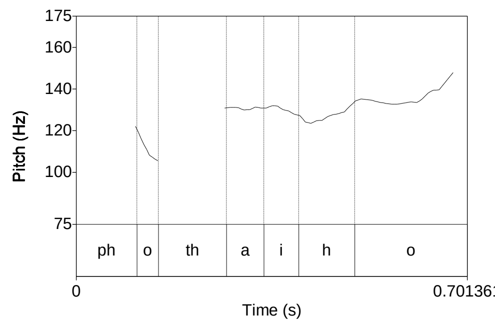




pho^{H}thai^{L}ho







Appendix III

List of OT constraints used in this work

ALIGN-L (DT, PRWD): Each default tone should align with the left edge of the domain.

ALIGN-R (PRWD, LT): Each right edge of the domain should align with the T.

DEP- DT: No insertion of default tones.

DEP-LT (H, L): No insertion of High and Low lexical tones.

***DISASSOCIATE:** No removal of association lines.

MAX Sf LT : No deletion of suffix lexical tones.

MAX Stm LT: No deletion of stem lexical tones.

NO LONG DT: A default tone must be associated with at most one TBU.

NO LONG LT: A lexical tone must be associated with at most one TBU.

NOCONTOUR: A TBU may be associated with at most one tone.

OCP: Adjacent identical elements are prohibited.

SPECIFY (LT, PRWD): A prosodic word must be associated with a tone.

SPECIFY T: A TBU must be associated with a tone.

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