SOME ASPECTS OF PROMINENCE IN ASSAMESE AND ASSAMESE ENGLISH

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A dissertation submitted in partial fulfilment of the requirements for the award of

MASTER OF PHILOSOPHY IN ENGLISH
(**Linguistics and Phonetics**)

CENTRAL INSTITUTE OF ENGLISH AND FOREIGN LANGUAGES
HYDERABAD 500007
July 2001

Abstract

This dissertation establishes the pattern of prominence in Assamese and Assamese English. It shows for the first time that Assamese exemplifies a left – to – right trochaic system with an iterative binary rhythm. However, this rhythmic profile is disturbed by the occurrence of closed syllables deemed to be heavy.

To support our intuitive judgements of prominence in Assamese with acoustic evidence, we conducted some experiments on PRAAT (a computer software for speech analysis). In chapter 3, we report the preliminary experiments which reveal that the acoustic correlate of primary prominence could very well be syllable duration and a low tone. Moreover, our intuitive judgements of prominence were vindicated by the surface phonetic realization of the F_0 contours in our acoustic experiments. In a sequence of two light syllables, a distinct low tone on the first light syllable indicated primary prominence. In a light and heavy sequence, the F_0 contour manifested as a plateau, instead of a falling trough, indicating the assignment of prominence to the following heavy syllable. In addition, the syllable duration of the prominent syllable was consistently longer than the other syllable. The fact that vowel duration was not found to be a significant correlate of prominence in the language is not surprising, as vowel length is not phonemic in the language. However, a clear picture of the correlate of secondary prominence did not emerge. Our tentative hypothesis regarding acoustic correlates for prominence is:

1) Syllable duration, computed after eliminating variability dependent on utterance length.

2) Low tone associated on non-final feet, as the right edge of the word is associated with a high tone.

In chapter 4, the pattern of prominence is analyzed within the framework of Optimality Theory. We rank a set of universal constraints, to arrive at an optimality theoretic grammar of the language. These constraints also help us to establish the prosodic typology of the language. The language seems to allow only moraic trochees, which consists of two types of feet, LL (two light syllables) and H (a single heavy syllable). This is ensured by a high ranked FEET TYPE TROCHAIC and FEET BINARITY. While rhythmic prominence is accounted for by the domination of PARSE SYLLABLE over ALL FEET LEFT. Partial sensitivity to syllable weight is accounted for by the undominated *CLASH over WSP.

Chapter 5 takes a brief look at Assamese English. It shows that the prominence pattern of Assamese English is identical with that of Assamese, and the English vowel system is re – interpreted by the Assamese speakers to fall in line with that of Assamese.

List of symbols and abbreviations used:

#	-	morpheme boundary
§	-	section
σ	-	syllable
μ	-	mora
>>	-	is better than, greater than, dominates
<<	-	lesser than
´	-	primary prominence
`	-	secondary prominence
AE	-	Assamese English
Ft Bin	-	FEET BINARITY
FT TRO	-	FEET TYPE TROCHAIC
H	-	Heavy syllable
L	-	Light syllable
OT	-	Optimality theory
PARSEσ	-	PARSE SYLLABLE
SCA	-	Standard Colloquial Assamese
Syll	-	Syllable
WSP	-	Weight to Stress Principle

For transcriptions IPA 1993 has been used.

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CHAPTER 1

INTRODUCTION

0. Introduction

The aim of this dissertation is to help us understand prominence in Assamese and Assamese English, and also to gain an insight into the components of universal grammar which are responsible for the wellformedness of surface metrical forms.

0.1 The state and the language

Assamese, like Bangla and Oriya, is considered to be one of the offshoots of the so-called Magadhan Apabhramsa dialect. This dialect has been recorded as the Indo – Aryan dialect of Eastern India during the formation stage of Middle Indo Aryan, and Assamese therefore can be said to date back to 13 century AD. The state is inhabited by nearly 13 million people, and Assamese is spoken by the majority of the population. Assamese is the anglicized name of [ɔȟɔmiya], the language and the people of [ɔȟɔm]. The variety of [ɔȟɔmiya](Assamese) that we will take into consideration is Standard Colloquial Assamese (henceforth SCA). The language spoken in the state of Assam is the easternmost variety of Indo – Aryan group of languages. The state comprises Lakhimpur on its easternmost border and Goalpara on the western side, sharing its borders with North Bengal. On all sides, the state is surrounded by people belonging to the Tibeto-Burman and Austric linguistic groups. Some varieties of Assamese Creoles are also spoken in the neighbouring states of Nagaland and Arunachal Pradesh. SCA is a variety of Assamese that is generally spoken in Eastern Assam, and though not confined to any distinctly homogeneous region or group of people, it can be broadly identified as the language of the plains of Assam.

In our analysis, we will also look at the English spoken by SCA speakers. We will try to ascertain the degree to which the English spoken by native speakers of SCA conforms to the native varieties of English. We will endeavour to arrive at the amount of carry – over, if any, from SCA. Even though this study of SCA English is not intended to directly improve the English spoken in the region, certainly it may have considerable pedagogical implications.

2.0 Theoretical Background

Our observations of prominence in Assamese will be analyzed in the framework of Optimality theory (Henceforth OT). Hence, in this exposition we will try to give a background of the major theoretical insights of OT. Optimality Theory is a linguistic theory proposed by Prince and Smolensky (1993) and McCarthy and Prince (1993 a b). OT is a theory developed within the broad framework of the generative paradigm.

The central hypothesis of generative linguistics today is that languages are characterized by universal properties, the properties that are observed again and again in the world's languages. This also leads to another related objective of linguistics, i.e., to determine and characterize possible language variation. The term 'markedness' is commonly used in linguistics to refer to this continuum. Unmarked properties are those that are found virtually in all languages, and marked properties are the relatively uncommon ones attested in a large number of languages. Any theory of linguistics must be adequately equipped to characterize this distribution. For example, the following types of patterns are observed consistently in the world's languages.

Often observed:

- Reduction of stressed vowels.
- Epenthesis of vowels to break consonant clusters (CC > CVC)
- Epenthesis of consonants to break hiatus (VV > VCV)
- Formation of homorganic nasal codas.

Never observed:

- Reduction of stressed vowels.
- Epenthesis of vowels into vowel clusters (VV > VVV)
- Epenthesis of consonants to create consonant clusters (CC > CCC)

An explanatorily adequate linguistic theory must be able to derive these characteristics from the formal properties of Universal Grammar.

OT's viewpoint of UG is radically different from rule based, derivational theories. In classical rule-based generative theories, UG is assumed to be a set of inviolable principles and parameters. Moreover, these theories make procedural changes at different stages to an input to produce the resultant output. But the primary action in OT is evaluative: the output is the optimal member of a set of candidate output forms. OT defines UG as a set of universal constraints along with GEN- generator which is richly specified for representational categories. For its evaluation, it uses the sole mechanism constraint ranking. To put it briefly, OT is a theory that attempts to account for language universals based on the observed end products (output based). Derivational approaches to phonology on the other hand, attempt to account for language universals by focussing on observed processes (algorithm based). Archangeli and Langendon (1997) summarize the problematic issues addressed by OT.

- It defines a clear and limited role for constraints.
  a. Each constraint is universal.
  b. Constraints are ranked in EVAL.
- It eliminates the rule component entirely.
  Different constraint rankings in EVAL express language variability.
- It focusses research directly on language universals.
  Each constraint is universal.
- It resolves the "non – universality of universals" problem.
  Universals don't play the same role in every language.

The primary hurdle in derivational processes is that the derivations create intermediate stages of representation, which may not be attested in any language. This drawback has been overcome in OT. In an OT model, since there are no derivations, creating non – attested intermediate representation does not arise in the first place. Moreover, the notion of markedness is no longer peripheral to the theory as in derivational theories and is the stuff of which universal constraints are made. For example, distilling such ideals might give us constraints like the following:

- "Coda nasals should not have an independent place of articulation".
- "Syllables should not have codas".
- "Words should not contain consonant clusters".

- “Every lexical category must contain a prosodic category - foot”.
- “All the lexical material specified for a word should be preserved on the surface.” (Maximise Input - Output).
- “All the surface material included in a word should be lexically specified.” (Maximise Output - Input).

CON(straints)

Constraints in OT, stated in universal terms, apply pressure to a phonological system. The pressure can either be in favour of changing things (*markedness constraints*; favouring elimination of marked structures) or in favour of preserving things (*faithfulness constraints*; favouring preservation of the initial structure). Therefore, all grammars perform the function of resolving this conflict depending on the preference of individual languages.

The fundamental insight of OT is the idea that the grammar of every language is a domain of conflicting forces. These ‘forces’ are represented in OT by constraints, each of which is a statement or a stipulation about some aspect of the grammatical output form. Constraints in OT are in principle violable. The function of a grammar in OT is to assign a specific constraint ranking. Language particular ranking is the most important and perhaps the only method in OT for explaining how and why languages differ from one another. The ranking in a particular language is, in theory, a total ordering of a set of universal constraints. We will discuss at greater length the nature of constraints and constraint ranking in the following sections.

1.2 Basic architecture of OT

OT being a surface - oriented constraint based theory of phonology must address:

a) Input – output mapping

- A method of generating output structures given a specific input.
- A method for mediating input-output relations (i.e., deletion, epenthesis, featural change)

Choosing the actual output

- A notion of ‘constraint’ and ‘constraint violation’.
- A method for mediating constraint conflicts.

b) Language variation and Factorial Typology

- A method for predicting possible/ impossible languages through reranking of the constraints of UG.

Apart from CON, the set of ranked constraints, OT assumes two other constructs, namely, GEN (Generator) and EVAL (Evaluator).

1.1.1 GEN(erator)

OT defines a function GEN (short for generator) that admits the set of candidate surface structures from which the output form is selected. GEN is the repository of linguistic constructs like features, prosodic structures etc. In other words, the function of GEN is to generate a candidate set for every input. The essential property of GEN is to generate any conceivable output candidate for an input. This property is called the freedom of analysis. Even though GEN is capable of generating infinite candidate sets for every output, it needs to be noted that GEN produces only logically possible candidate sets. Hence an OT grammar does not employ serial derivations to produce correct surface forms – as all structural changes are achieved in one step by means of a parallel derivation.

1.1.2 EVAL(uator)

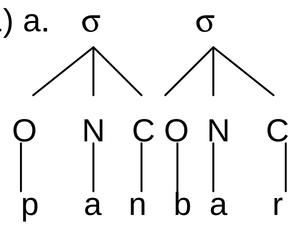
EVAL uses the language's constraint hierarchy to select the optimal candidate(s) for a given input from among the candidates produced by GEN. EVAL uses the ranking of the violable constraints. The constraint hierarchy for a language is its own particular ranking of CON, the universal set of constraints. The optimal output, the one that is selected by EVAL is the one that is best satisfied by these constraints. Satisfaction is achieved by minimal violation of constraints and minimal violations are computed on the basis of strict ranking of constraints in the constraint hierarchy.

1.1.3 Input – output disparities

P&S propose the *containment* theory of input- output disparities. In this theory Gen provides all possible prosodic parses of input. The input is literally contained in each output candidate. Gen allows input segments to be unparsed in surface candidates and allows surface candidates to overparse (i.e. posit empty structural nodes). Unparsed segments are deleted in the phonetic component. Overparsed structure is filled in the phonetic component. By simply examining the output candidate we can determine whether something has been inserted or deleted in the output. Let us consider a hypothetical lexical form /panbar/. The following is a partial list of the output candidates that Gen may create.

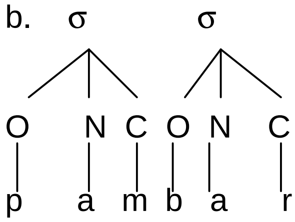
Output candidates:

1) a.



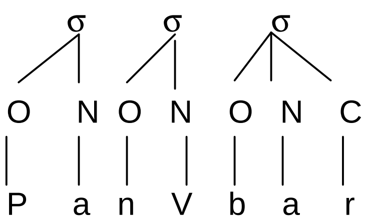
(The “ faithful ” candidate)

b.



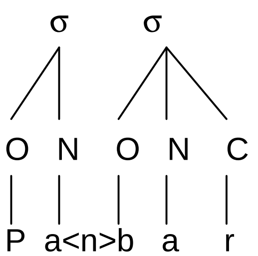
(The featurally unfaithful candidate)

c.



(The epenthesis candidate)

d.



(The deletion candidate)

1.1.3.1 Choosing the output

In OT the output form is chosen through harmonic evaluation of the set of possible output candidates. There are three things we need to layout with respect to how the actual output form is chosen.

- The conditions that determine the output.
- The mediation of constraint conflicts.

- The measurement of non – conformity to constraints.

What are constraints?

- Constraints are universal – every language has every constraint.
- Constraints are general – constraints are not of the form '* X except when Y' or '* [+ nasal] in *cat*'.

Both these assumptions represent the strongest hypothesis we can make about the constraints in UG. Universality facilitates the theory of learning since it posits that the child does not have to learn what the constraint set is. By assuming that constraints are as general as possible, the explanation of 'except when' phenomena falls on the method for mediating constraint conflict.

The illustration below tries to give an idea as to how constraints operate and the way constraint conflicts are resolved. We will use the two constraints

***Coda Place** and **Preserve Place** as examples.

*Coda Place: coda nasals should not have an independent place of articulation.

Preserve Place: If a segment has α place of articulation lexically specified, it should not be pronounced with $-\alpha$ place of articulation.

1.1.4 Resolving constraint conflict

Constraint conflicts are resolved on a language particular basis through positing **strict domination hierarchies**. A constraint C_1 is more important than a constraint C_2 if C_1 dominates C_2 in a constraint hierarchy. Domination is strict in that no number of violations of C_2 can compensate for violation of

C_1. This so called strictness of strict domination in OT entails that “violation of higher - ranked constraints cannot be compensated for by satisfaction of lower ranked candidates” (Kager, 1999). Furthermore, a grammar is a total ordering of the constraint set.

1.1.5 Interpreting an Optimality Theoretic Tableau

The constraint tableau is just an aid in selecting the optimal candidate. These are some conventions that are followed in the literature. The conventions generally followed are given below.

- The pointy finger indicates the optimal candidate.
- Constraints are listed across the top of the tableau with higher ranked (undominated) constraints to the left, and lower ranked constraints to the right.
- A solid vertical line between constraints indicates that the constraints are strictly ranked. A dotted vertical line indicates that no ranking argument exists between two constraints.
- An asterisk indicates single violation of the given constraint. E.g., two asterisks ** indicate that the given candidate violates the same constraint twice.
- Evaluating all the candidates in parallel, from the highest constraint downwards, candidates which violate the highest constraint are eliminated from the process of further evaluation.
- An asterisk with an exclamation mark indicates a fatal violation – a violation that causes an unsuccessful candidate to be out of the running.

1.1.5.1 Choosing the Optimal Candidate

All the candidate outputs are (simultaneously) evaluated for whether or not they violate the cross – linguistic preferences encoded in the universal constraint set. The optimal candidate is determined by the language – specific priority given to each constraint.

2) Grammar A: Coda Place >> Preserve Place (>> indicates strict domination)

Input: \panbar\	*Coda Place	Preserve Place
a. [pambar]		*
b. [paŋbar]	*!	*!
c. [panbar]	*!	

Since *Coda Place dominates Preserve Place, the language prefers the candidate which violates only Preserve Place. Candidate (a) is the optimal candidate since it does not violate the highest ranked constraint * Coda Place – as the coda does not have an independent place specification incurring a violation of the lower ranked Preserve Place. Candidate (c) the ‘faithful’ candidate on the other hand, violate fatally the undominated *Coda Place by retaining the input specification faithfully. Notice that GEN can logically generate a candidate like 2(b) which has a gratuitous ‘place’ specification violating both the constraints.

In the following sections we will try to elaborate on the formal properties of the model.

1.2.1.2 More about constraints

(All constraints are from Prince and Smolensky, 1993)

OT recognizes two types of constraints, faithfulness constraints and markedness constraints.

Constraints that encode a desire to preserve the input unchanged are faithfulness constraints. A language may be more or less concerned about preserving specific aspects of the input, hence different types of *faithfulness constraints*.

General Faithfulness Constraints

- Parse /Max (X): Every X that occurs in the input must also occur in the output. ('Don't delete X's'.)
- Fill / Dep (X): Every X that occurs in the output must have also occurred in the input. ('Don't insert X's.')
- Linearity: The elements (segments) of the output must occur in the same linear order they occupy in the output. ('Don't change the linear order of the elements'.)
- Ident [F]: Where [F] is some feature: if a segment is specified αF in the input, it may not -αF in the output. ('Don't reverse the +/– values of features'.)

Positional faithfulness Constraints

- Ident [voice]/onset: If a segment in onset position is specified α Voice in the input, it may not be specified -α Voice in the output.('Don't devoice onset segments.')

- Max [V]/Stem: Every vowel that occurs inside some stem within the input must also occur in the output.('Don't delete vowels from a stem'.)

Markedness Constraints

Constraints that encode a cross – linguistic preference to avoid specific features/ structures are markedness constraints. These constraints codify the assumption that: if languages generally avoid the structure X, then X must be marked. There are several sub types of markedness constraints:

Pure markedness constraints

- Ons: syllables should have onsets. (Onsetless syllables are bad.)
- *Coda: Syllables should not have codas. (Syllable with codas are bad.)
- *Mid: Vowels should be either high or low. (Mid vowels are bad.)
- *Trimoraic: A syllable may not have more than two moras.

<u>Positional Markedness Constraints</u>

- *Unstrtessed / Mid: Unstressed vowels should be either high or low.
- *Coda/Voice: Coda consonants should not be voiced.

Alignment Constraints: The occurrence of A is marked, unless it is aligned with B.

- Align (Stem, R; Syllable, R): The right edge of every stem must align with the right edge of some syllable. (" No syllabification across the stem + suffix boundary".)
- Align (Word, L; Morpheme, L): The left edge of every prosodic word must align with the left edge of some of them. (Words may not begin with epenthetic material.)

1.2.1.2 **Violability**:

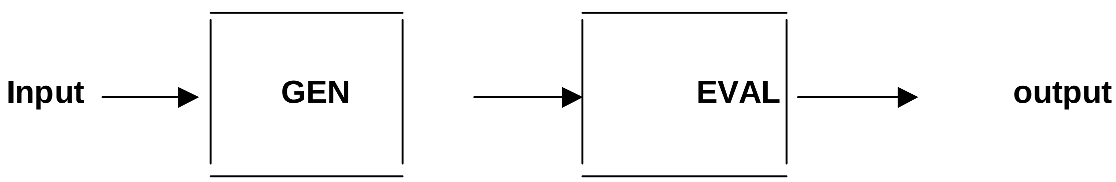
Constraints are violable but violation should be minimal. A Constraint is not violated in OT if there is no overriding reason. And even when a constraint is violated, violation is kept to the minimum. Other things being equal, forms with 'lesser' violations emerge as the winning candidates rather than the forms with 'greater' violations.

1.2.1.3 Optimality: domination and conflict

As we have already stated, optimality is the status of being the most harmonic with respect to a set of conflicting wellformedness requirements. This involves the strict domination of constraints in a hierarchy. This implies that the violation of higher ranked constraints cannot be compensated for by the satisfaction of lower ranked constraints.

The core universal elements of the OT architecture are summarized in the following diagram:

1.2.2.1 Basic OT framework



GEN receives an input and generates a set of candidates. EVAL applies the language – particular constraint hierarchy to this candidate set, locating its most harmonic member, which is judged as the optimal output. The output may be a phonological surface form, a syntactic S-Structure, or some other linguistic object.

1.2.2.2 A summary of the elements of an OT grammar

Finally, we summarize the functions of the core components of OT.

Input forms: A language specific inventory of linguistic elements in their underlying forms. This component of OT grammar is also called 'the lexicon'.

Constraints: A formal representation of cross- linguistic goals/preferences**.** These are thought to be universal, and generally fall into two categories – Markedness constraints and faithfulness constraints.

Gen: A non-language specific mechanism for assigning structure to an input form.

Ranking**:** A language specific prioritization of the universal goals. This ranking is thought to be strict, in that a single violation of a higher constraint is more fatal than any number of violations of lower constraints.

1.3.1.0 OT and prominence

Like other domains of phonology, OT has paid considerable attention to prominence. OT is inherently equipped to capture all types of conflicts between competing metrical forces and to establish prominence relations between prosodic levels by means of its parallel evaluation.

Earlier analysis of stress / prominence dealt with individual languages in terms of parameters. Following Hayes (1981), it was believed that a parametrized approach to prominence would be able to account for myriad types of stress systems because it involved variations only on a small number of themes. The parameters that were used in derivational models were like the following:

(i) Foot type – foot construction is constrained by the Maximal Foot Construction Principle, which ensures that the largest possible foot must be constructed. Degenerate feet are a result of culminativity and exhaustivity. According to culminativity, every content word must contain one stressed syllable and hence one foot. Exhaustivity requires all syllables of a word to be organized into feet.

(ii) Directionality – Directionality determines the direction in which foot construction scans the stress domain. If it starts at the right edge, then it is a right - to - left system. If, on the other hand, it starts at the left edge, it is a left- to – right system.

(iii) Foot dominance – In this foot shape parameter, foot dominance determines the side of the foot where the head is located. In left-dominant feet, left nodes are dominant and right nodes recessive, while the reverse situation holds in right dominant feet.

(iv) Extrametricalty – extrametricality is a concept introduced by Liberman and Prince (1977), and later on used extensively by Hayes (1981). Extrametrical elements are ignored by metrical stress rules, neither regarding its structural descriptions, nor its structural change.

(v) Quantity sensitivity - This foot shape parameter, governs the distribution of light and heavy syllables. In quantity insensitive feet all types of syllables are considered to be of equal weight. Whereas, in quantity sensitive systems, syllables with one mora are considered light and all other syllables heavy.

The OT approach is non-parametric. OT does not have rules and derivations and parameters of foot building. Inspite of this non- parametric approach, OT's mechanism of reranking equips it to capture cross – linguistic variations in metrical systems across languages.

1.4 The plan of the dissertation

In this dissertation we will try to characterize the distribution of prominence in SCA as well as arrive at a satisfactory analysis of prominence characteristics in SCA. Our framework is Optimality Theory, and we will try to interpret the facts of Assamese prominence according to constraint ranking and the interaction of constraints in the constraint hierarchy.

This dissertation is in four chapters. Chapter 2 presents a descriptive account of syllable types in SCA and also the prominence facts of SCA. Chapter 3 presents a preliminary study of the acoustic cues of prominence in SCA. Chapter 4 is an Optimality theoretic account of prominence in SCA, in terms of constraint ranking and constraint hierarchy. Chapter 5 tries to present an overview of prominence in SCA English.

CHAPTER 2

A DESCRIPTIVE ACCOUNT OF PROMINENCE IN ASSAMESE

3.0 Introduction and plan of the chapter

The focus of this chapter is a phonological study of patterns of word level prominence in SCA. While presenting a descriptive account of the rhythmic structure of the language, we will also give a brief overview of the representational basis- metrical phonology. In this chapter, in section 1, we will present a brief exposition to metrical phonology. In section 2, we will discuss some prior research in the area of prominence in SCA. This will lead to the third and final section, which presents a descriptive account of prominence in SCA.

2.1 Theoretical background

Liberman and Prince's (1977) pioneering work laid out the foundation of metrical phonology – a framework extensively applied in stress and rhythm related studies. Prior to this work, prominence was represented as a segmental property of vowels, and often classified into different levels. (Trager and Smith, 1951, Chomsky and Halle, 1968). Lieberman and Prince proposed a model where prominence is to be represented as a <u>relation</u>. In other words, according to the model, prominence is a syntagmatic feature unlike distinctive features, which are paradigmatically contrastive i.e., [± coronal], [± back], [±

round] etc. The fundamental insight of this theory is that prominence is not a primitive content feature but a relational feature, as an outcome of which a given syllable will be prominent not in absolute terms but only in relation to an adjacent syllable bearing lesser prominence.

Relative prominence is encoded in the theory using binary branching tree structures, where if a pair of sister nodes are labeled SW or WS, then S means ‘stronger than’ and W means ‘weaker than’ depending on which node is stronger.

1) Carrot attain

(Hayes, 1985)

Thus stress assignment in metrical phonology involves denoting the relative prominence of sister constituents. Consequently, representing nodes as S or W is dependent on the presence of sister nodes and has no meaning without such a relationship between nodes i.e. an S or W node in isolation can have no meaning. Thus, it follows that nodes must be in the relation [W S] or [SW] and not [SS] or [WW].

2.1.1 Prosodic categories parametrized

Metrical phonology encodes a constituency based relation organizing syllables into higher level constituents. In fact, the constituents of the metrical hierarchy were postulated in a few significant developments after the appearance of Lieberman and Prince’s seminal work. L&P had retained the segmental feature [+ stress], although with a greatly reduced role, in order to formalize the structures as in (2).

2) a. b a n d a n a b a n a n a b. r a b b i h a p p y

+ - + - + - + + + -

W S W W S W S W S W

W

S S

Prince (1980) and Selkirk (1984) proposed that the cumbersome [+ stress] can be replaced by *metrical feet*. The subtrees constructed by each iteration of the stress rule i.e., *feet,* conveniently represented the structures for which the retention of the feature [+stress] was thought necessary in L & P's model, as shown below:

3) a. b a n d a n a b a n a n a

S W W S W

S

F F

W S F

b. rab bi h a p py

S W

F

F F

S W

Under this development, syllables are dominated by feet such that each foot contains one stressed syllable, while the primary stress bearing syllable is the strongest syllable dominated by the strongest foot.

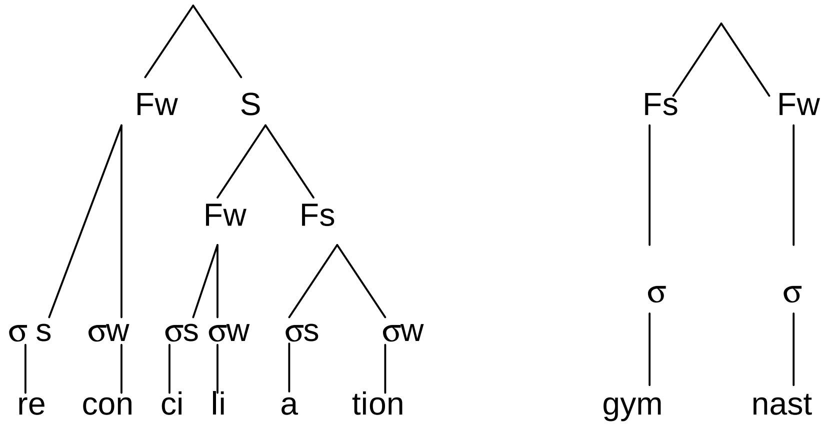
More research in the area of word stress by Halle and Vergnaud (1979), Kiparsky (1979), McCarthy (1979a); Selkirk (1980 b), Prince (1980), Hayes (1980,1986) and many others have been instrumental in evolving a universal grammar of prosodic categories. The subsequent enrichment in the theory has introduced the units mora, syllable, foot and (prosodic) word. In the model of prosodic phonology under consideration here, stress is represented as a hierarchy, the constituency relations of which are expressed in a set of universal prosodic categories. Thus, the prosodic hierarchy (Selkirk 1980, McCarthy and Prince 1984) is as under:

4)

PrWd	Prosodic Word
|	
Ft	Foot
|	
σ	Syllable
|	
μ	Mora

With this hierarchy the following English words are represented as below:

5) a. Word b. Word



(We have ignored mora distinctions here. It will be taken up for discussion later in this chapter).

A stressed syllable is here represented as the strongest syllable of a foot. (In a monosyllabic foot the sole syllable is considered strong). On the other hand a weak syllable is considered stressless.

> "The description of the distribution of stressed and unstressed syllables in words is no longer a matter of rules assigning the feature [+stress], but of rules that indicate (among other things) what constitutes a well-formed foot in the language, often in terms of the nature of the component syllables. On this view, the foot is a unit of phonotactic description, much like the syllable." (Selkirk, 1984, p 14)

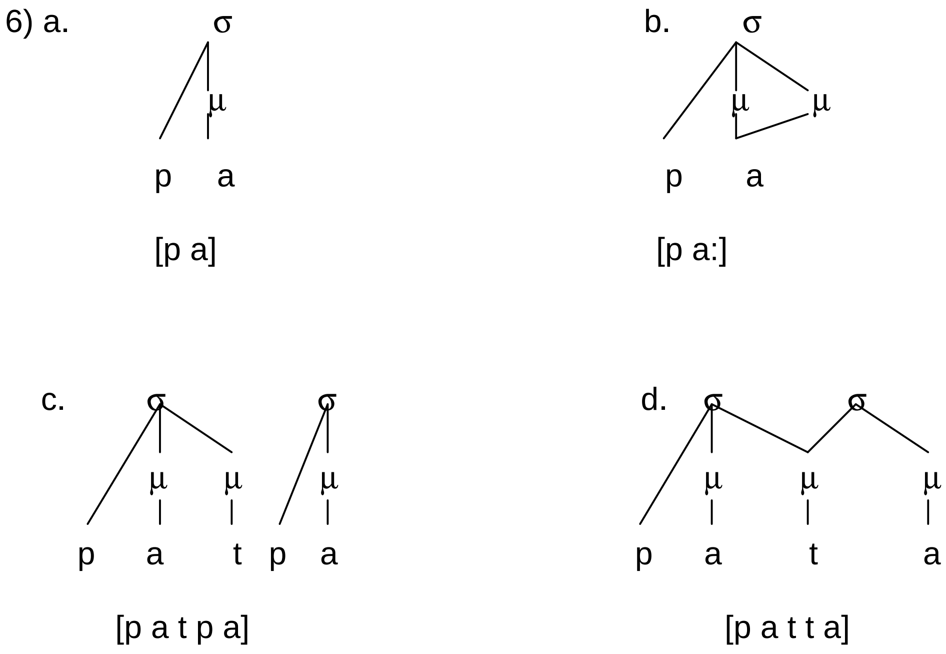
Therefore, stress assignment is expressed in metrical theory in terms of the assignment of metrical feet to a word. However, stress systems of languages either have a tendency towards rhythmic stress on alternating syllables, or placing stress on a particular syllable. Moreover, in scanning a string of syllables in order to construct foot structure, it is assumed that the grammar constructs the largest feet consistent with the segments, and the constraints inherent in the language. In addition, languages are free to construct feet from any edge of the word i.e., left or right. Given two types of feet namely, trochaic and iambic, rhythmic (alternating) stress or stress placed uniquely on a particular syllables and left or right orientation on a word, we have a large range of possibilities most of which are attested across languages. We shall discuss in the next section issues pertaining to syllable quantity. Another crucial factor with far-reaching implication is the notion of minimum size of a foot, which according to recent developments in the theory have been shown to be parametrized. For example, a foot may contain two syllables or minimally just two moras. This leads to the generalization of a strictly binary foot size, which is either bimoraic or bisyllabic but conforms to the binarity requirement at all levels of interpretation. (Kager, 1999, Vijver, 1998). Feet are formally represented as constituents by a pair of brackets enclosing two elements.

A reexamination of (5) above clearly establish another important assumption. Notice that since all content words, i.e, lexical categories are eminently stressable, it follows that lexical categories are prosodic words. By implication, lexical categories must contain a foot minimally.

2.1.2 Moraic theory and syllable structure

We adopt the moraic theory of syllable structure of Hayes (1989). According to this theory, the only designated constituent of the syllable is the unit of weight – the mora and universally, the syllable can be mono or bimoraic depending on whether it is light or heavy respectively.

Moraic representation

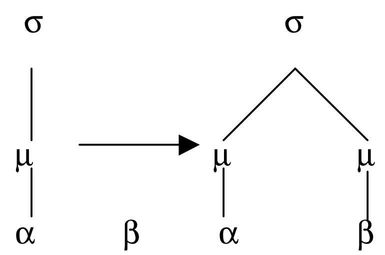


A light syllable as in (6 a) and the final syllable of (6 c) and (6 d) is a monomoraic syllable and a heavy syllable is bimoraic. But a CVV syllable is differentiated from a CVC syllable by the association line linking the mora to the segmental specification. In closed CVC syllables as in (6 c), the second mora of the first syllable is linked to a consonant melody whereas in a CV: syllable the vowel melody is linked to two moras. In the case of a geminate, a single consonant is simultaneously linked to the second mora of the preceding syllable and the onset of the following syllable, as in 6 (d) above.

The only scope for parametric variation in this theory relates to the moracity of the coda consonant. For instance, in some languages CVV and CVC count as heavy and CV as light. Whereas, in some others, CV as well as CVC are light but CV: is heavy. Moraic theory explains the phenomenon with the help of language specific moraic structure rules. Weight by position (Hyman, 1985) a factor which renders closed syllables heavy, is interpreted in this theory in terms of coda consonants which are assigned a mora when they are adjoined to the syllable, by the following schema:

Weight by position

7)



(Hayes,1989)

where σ dominates only μ

To summarize, we quote Hayes (1989)

> "I assume that moras appear in underlying representation, to represent length and syllabicity contrasts. Moras can also be created by

language specific versions of Weight by position rule. Other than that, moraic segments are simply adjoined to the appropriate position: the mora for syllable final consonants. The representations that result appear to be adequate for the two tasks that moraic theory carry out: representation of segment length and of syllable weight."

While (7) accounts for moraic coda consonants, (7) is absent in languages when coda consonants do not contribute to syllable weight.

In this parametric approach, where syllables may dominate one or two moras, a segmental melody may be linked to one or two prosodic nodes, the only constant is that feet must always be binary branching with the left or right node designated as head in trochees and iambs respectively.

2.1.3 The universal metrical inventory

We assume the universal metrical inventory (McCarthy and Prince1986, Hayes 1987,1995, Kager 1993), to enable us to discuss prominence in Assamese.

8) a. Syllabic Trochee ($\acute{\sigma}$ σ)

b. Moraic trochee LL (H)
μ μ μ μ

c. Iamb (LL) (H) (LH)
μ μ μ μ μ μ μ

This inventory is derived from the Iambic - Trochaic law (Hayes, 1991) stated below:

9) <u>Iambic-Trochaic Law</u>

a. Elements contrasting in intensity naturally form groupings with initial prominence.

b. Elements contrasting in duration naturally form groupings with final prominence.

The law as stated above predicts a durational asymmetry between iambic and trochaic systems. Kager (1993) restates the law as follows:

10) a. Trochaic systems have durationally even feet.

b. Iambic systems have durationally uneven feet.

According to Hayes, the foot structures of languages have their moorings in this extra-linguistic principle, but feet always tend to veer towards this rhythmic ideal. He cites the examples of many iambic systems that produce durationally uneven feet at the surface by enforcing lengthening rules. The second syllable of an even iamb may be lengthened by vowel lengthening or by gemination of the following consonant, or the first syllable may undergo vowel reduction. Whereas these processes lead to increased durational contrasts in iambic systems, moraic trochaic systems do not exhibit processes that lengthen the first syllable in a foot so as to prevent durational unevenness. Thus the crucial insight of the iambic – trochaic law is that it explains asymmetries between iambs and trochees by a rhythmic law, which determines foot shapes in the basic foot inventory. McCarthy and Prince (1986) proposed a Quantity / Prominence Homology, which was integrated by Prince (1991) into a single *Grouping Harmony* principle, which expresses relative foot wellformedness as a function (the ratio) of the moraic weight of the second and the first element. This produces a wellformedness hierarchy of trochaic and iambic feet:

11) a. Trochees: [$\sigma(\mu\mu)$], [$\sigma(\mu)\ \sigma(\mu)$] > [$\sigma(\mu\mu)\ \sigma(\mu)$] > [$\sigma(\mu)$]

b. Iambs: [$\sigma(\mu)\sigma(\mu\mu)$] > [$\sigma(\mu\mu)$] , [$\sigma(\mu)\sigma(\mu)$] > [$\sigma(\mu)$]

In this type of foot parsing, both the quantitative trochee [$\sigma(\mu\mu)\ \sigma(\mu)$] and the mono–moraic foot [$\sigma(\mu)$] are allowed, but these occupy lower positions in the hierarchy and therefore they are not optimal.

Thus we can surmise from the above discussion that trochaic systems (those whose feet have initial prominence) are characterized by feet which are optimally even in duration. On the other hand, in Iambic systems (those whose feet have final prominence) durationally uneven feet is unmarked.

In addition to foot structure and foot harmony, there are certain well-established rhythmic principles, which need to be noted here. These notions are *clash* (after Prince 1983) and *lapse* (after Selkirk 1984).

12) a. **Clash:** two adjacent stressed elements.

b. **Lapse:** two adjacent stressless elements.

The relevant units here may be syllables or moras, and languages vary in their choice of the domains with respect to clashes and lapses.

2.2 Earlier work on Prominence in Assamese

Prior to this work, there has not been much research on prominence in Assamese. However, some of the observations that have been made are quite conflicting. Kakati (1972), vouched for the existence of

> "…two different systems of stress in Assamese sharply differentiated from one another in two different dialectical areas. The stress in the Standard Colloquial of Eastern Assam seems to fall in line with the prevailing pan-Indian system in being placed on the penultimate." (p. 69)

Kakati's (1972) treatment of phonology is diachronic and therefore presents the historical development of the language. Working under the traditional framework, his account of stress accent deals extensively on the effect of OIA (Old indo Aryan) stress on what he calls NIA (New Indo Aryan), rather than giving a synchronic description of prominence. He assumes as a hypothesis that

> "In the Sanskrit like languages from which Assamese sprang up, the stress falls on penultimate syllable of the word if it is long; if the penultimate is short, then on the antepenultimate, if that is again short, then on the fourth syllable from the end" (Kakati, 1972, p. 69)

Even though Kakati is aware that length distinctions are not phonemic in present day Assamese, he assumes the aforementioned hypothesis to justify his claim that Assamese falls in line with other Indo–Aryan sister languages in following penultimate prominence inspite of not having any length distinctions. He traces the accentual position of vowels in OIA and its relatively unaltered position in NIA, notwithstanding shortening of long vowels as well as compensatory lengthening of vowels during the process of evolution of the language to its present form.

In our analysis of prominence in SCA, we have shown evidence from acoustic parameters that primary prominence is dominantly initial in the language. Prominence shifts to the next syllable only if the first syllable is light and the second syllable is heavy (owing to WSP). Therefore, primary prominence is never farther than the second syllable and not on the "fourth syllable from the end", as Kakati assumes. The example in (12) illustrates this.

13) (**L**L)(**L**L)L

ħá.bɔ.dʰà.nɔ.ta 'to be careful'

Thus, we are of the opinion that Kakati does not say anything conclusive – either about the prominence type of the language or about any consistent pattern in words of varying syllable sequences." The theory of penultimate stress" in the light of which Kakati seeks to analyze SCA, has been disproved for many Indian languages as well. Such an analysis is not only obsolete but also does not fit in with the pan – Indian system.

Significantly, Goswami (1982) examines prominence in a manner which is quite close to our analysis. Even though his analysis is brief, sketchy and does not conform to modern paradigms, his assertion that primary stress is restricted to the first or second syllable of a word and never beyond the second syllable, is in agreement with our analysis. Goswami, however, does not commit himself to any dominant prominence pattern. Instead, he demonstrates the contrasts exhibited by a set of words occurring in a similar environment. Some of the contrasts illustrated by Goswami (1982) are given below:

14) /bárɔ/ 'twelve' : /parɔ́/ 'pigeon'

/tɜ́rɔ/ 'thirteen' : /tɜrá/ 'oblique'

/kándɔ/ 'action, behavior' : /kandɔ́/ 'you (fam) weep'

/píndɔ/ 'ashes of the dead' : /pindʰɔ́/ 'you (fam) wear'

Goswami (1982) compares these paired contrasts to English noun- verb pairs like,

15) a. [kɔ́n.dʌkt](n) : [kən.dʌkt](v)

b. [prɔ́.djuːs](n) : [prə.djúːs](v)

where the prominence is on different syllables.

We, however, disagree with the comparison offered by Goswami on the following counts:

16) a. SCA does not have any evidence of the kind of noun-verb pairs that Goswami has cited from English. In fact, there is no evidence of zero- derivation from one category to another.

b. SCA, unlike English, does not have lexical stress. Therefore, the examples cited from Goswami (1982), cannot qualify to be factually correct. The predictable nature of stress placement in Assamese rules out any arbitrary stress assignment as in (14) above.

Moreover, Goswami (1982) does not venture to give any independent phonological motivation for the placement of stress on one syllable (either first or second), and the occurrence of any stress shift thereafter. We conclude that these contrasts, if they exist, must be lexical aberrations and cannot be a consistent feature of SCA. Our analysis of SCA does not predict such contrasts and if they exist we would like to consider them as exceptions existing parallely with our predicted forms.

Goswami also posits the phonetic correlates of stress in SCA. According to him, the following are the three different phonetic properties of stress in SCA:

17) a. maximum loudness of the vowel nucleus.

b. High pitch and

c. Length of the vowel, which is half long in closed syllables, and longer in open syllables medially, and before juncture finally.

While examining the phonetic properties of prominence in SCA, Goswami does not seem to have derived the cues from any instrumental evidence. We assume, that his characterization of the phonetic correlates of prominence in Assamese is based on impressionistic judgements. On the other hand, our analysis of the acoustic parameters of Assamese is backed by instrumental evidence (see chapter 3). The acoustic parameters that we have arrived at after conducting several experiments differ from those of Goswami. In our analysis, we did not examine loudness/amplitude as a cue for prominence in SCA utterances, but we strongly disagree with the phonetic properties (16 b) and (16 c), offered by Goswami. The phonetic property, high pitch given in (16 b) and (16 c), as Goswami contends, does not seem to correlate with primary prominence in SCA. It is only syllable length that seems to be significant and not vowel length.

2.3 Prominence in SCA

To enable us to discuss prominence in SCA we will present a general picture of vowels and their length distinctions, if any in § 2.3.1. In § 2.3.2 we will discuss the types of syllables which occur in the language and the prosodic rules and constraints which are responsible for them. In § 2.3.3 we will discuss the prominence patterns attested in disyllables and finally in § 2.3.4 we will give a generalization of the characteristics of prominence in SCA, following our analysis of disyllables. In the following sections, from §2.3.3 – §2.3.6, we characterize the distribution of prominence in SCA in longer sequences, which leads to our reformulated description of prominence in

§2.3.7. Finally, in §2.4, we discuss the prominence patterns attested under affixation.

2.3.1 Vowels in Assamese

The following are the vowels of Assamese:

18)	Symbol	Word	Gloss
i)	[i]	[bil]	'small lake'

[i] is a front, high, unrounded vowel. It occurs in all the positions of a word.

ii)	[e]	[bel]	'bell' (Eng)

[e] is a front, mid, unrounded vowel which occurs in all the positions. The occurrence of [e] in word final positions in monomorphemic words is rare. The only monomorphemic word that could be found was [baze].

iii)	[ɛ]	[bɛl]	'a kind of fruit'

[ɛ] is a front, low unrounded vowel which occurs word initially and word medially in SCA.

iv)	[a]	[bal]	'a swear word'

[a] is a back, low, unrounded, vowel which occurs in all the positions.

v)	[ɔ]	[bɔl]	'strength'

[ɔ] is a back, low, rounded vowel which occurs in all the positions.

vi)	[o]	[bol]	'let's go'

[o] is a back, mid (half – open), rounded, vowel and it occurs in the initial and medial positions.

vii) [ɤ] [bɤl] 'colour'

[ɤ] is back, mid(half- open) unrounded vowel which occurs in all the positions. We can also say that it is the unrounded variety of [o]

viii) [ʊ] [bʊl] 'to walk'

[ʊ] is a back, high, rounded vowel which occurs in all the positions.

It is evident from the paradigm set in (18) that length distinctions are not attested in Assamese. Instances of phonetic lengthening of vowels are also not so frequently attested. The predictability of vowel length has led us to ignore the moracity of syllables of the structure CVV. In other words, since there is no distinction in terms of phonemic length in vowels, the question of considering CVV syllables as heavy does not arise. With regard to diphthongs, Assamese has two types namely, (C)GV and CVG. For example:

19)	(C)GV	Gloss	CVG	Gloss
i)	[aí.ʊ]	'life'	[bi.oí]	'relationship between the two father – in –laws'
ii)	[baí.ʊ]	'air'	[zʊ.aí]	'son – in - law
iii)	[ħeí.a]	'there'	[mɔ.eí]	'only me'

Clearly the latter are bimoraic. As for the former, our prediction is that they must pattern with light syllables. This leaves us with the problem of categorizing CVC syllables, which is discussed in the following section.

2.3.2 Types of syllables in Assamese

One of the aspects of Assamese phonology to receive very little attention is syllabification. We will not go into the details of phonotactic restrictions in syllabification, nor shall we present an inventory of the possible CV sequences in the language. Such an attempt is outside the scope of this investigation. We have already mentioned in § 2.1.2 the issue of syllable weight. In this context, we maintain that the syllable types in the left hand column in (20) below are heavy and consequently bimoraic.

20)	Heavy	Light
i)	(C)VC	CV
ii)	(C)VCC	CCV
iii)	(C)VG	(C)GV

Specifically, all sequences where coda consonants exist will be considered heavy, whereas others will be considered light. Moreover syllables bearing prominence will be indicated in bold typeface (both **H** and **L**). The fact that closed syllables are weight bearing units in Assamese (by WSP) will be borne out in the discussions in § 2.3.3 and § 2.3.4.

2.3.3 Primary prominence in Assamese

21) <u>Disyllables</u>

(**L**L)	Gloss	**(H)**H	Gloss
a. [sɔ́.kʊ]	'eye'	c. [bɔ́n.dɔr]	'port'
b. [rá.ti]	'night'	d. [án.dʰar]	'dark'
L**(H)**		**(H)**L	

e. [zi.bɔ́n] 'life' g. [gɔ́r.bɔ] 'pride'

f. [ba.gán] 'garden' h. [zɔ́n.trɔ] machine'

The examples in § 2.3.3 show that Assamese stresses the initial syllable. However, owing to quantity – sensitivity, if a heavy syllable immediately follows a light syllable, the heavier counterpart emerges as the prominence bearing unit. The pattern that emerges from disyllables can be summarized as below:

22) a. The second syllable is prominent if it is heavy and the first syllable is light.

b. Otherwise the first syllable is prominent.

2.3.5 Generalization

We can draw certain generalizations about the prominence pattern and syllabification in SCA from the pattern attested in disyllables.

23) a. Assamese follows a Trochaic rhythm and therefore stresses the initial syllable.

b. All heavy syllables are stressed, unless there are two heavy syllables (where the second heavy is rendered stressless owing to stress clash). This pattern undoubtedly reinforces our contention that coda consonants are moraic in the language and therefore all VC / CVC / CVCC syllables are labeled heavy (H), in the language. This factor (Weight by position) renders all closed syllables potential stress bearing units. This is to say, that it is possible to construct a foot with any heavy syllable, if there is no danger of stress clash arising out of two adjacent heavy syllables. That stress clash is a device to ensure rhythmicity of a prosodic word has already been discussed in § 2.1.3.

2.3.5 Primary and secondary prominence in Assamese

As already stated Assamese follows a Trochaic (strong-weak) rhythm at the left edge of the word, and therefore invariably stresses the initial syllable. In other words, the main stress always falls at the left edge where foot construction starts. Owing to quantity sensitivity, if a heavy syllable immediately follows a light syllable, the heavier counterpart emerges as the stress-bearing unit. This generalisation is validated even more strongly in trisyllables as discussed below.

Trisyllables

Heavy syllables never occur as primary stress bearing units beyond the second syllable. Coda consonants are moraic in the language therefore attract prominence by virtue of Weight-by-Position (We have excluded CVV's from our discussion as length distinctions are not phonemic in Assamese). This measure also keeps the prohibited *(**L**H) foot at bay. Moreover, in trisyllables only heavy syllables initiate secondary prominence and whenever a stress clash is imminent, it is averted by leaving a syllable unfooted.

24) **Trisyllables**

(**L**L)L		(**L**L)(**H**)	
a. [gɔ́.hɔ.na]	'jewellery'	c. [mɔ́.rɔ.mɔ̀r]	'loved'
b. [zɔ́.hɔ.ni]	'cholera'	d. [zá.za.bɔ̀r]	'vagabond'

L(**H**)L L(**H**)H

e. [a.nɔ́n.dɔ] ‘happiness’ g. [a.rɔ́m.bɔr] ‘luxury’

f. [gʊ.rʊ́t.tɔ] ‘importance’ h. [ɔ.hɔ́ŋ.kar] ‘pride’

(**H**)H(**H**) (**H**)LL

i. [ɔ́n.tɔr.d^{h}àn] ‘disappear’ j. [bɔ́n.dɔ.na] ‘worship’

(**H**)HL (**H**)L(**H**)

k. [bɔ́n.d^{h}ʊt.tɔ] ‘friendship’ m. [án.dʊ.lɔ̀n] ‘agitation’

l. [ɔ́s.tit.tɔ] ‘entity’ n. [gɔ́n.dɔ.gʊ̀l]‘confusion’

As the examples above illustrate Assamese parses under strict binarity avoiding Clash at the syllable level. According to Kager (1992), under this parse, languages group pairs of light syllables (**L**L) and a single heavy syllable (**H**). Kager (1992), cites the example of Yindbarndi which avoids stress on two successive heavy syllables *(**H**H), or on a heavy and a light sequence *(**H**L), preferring only (H) in both the cases. Furthermore, the language parses H LL as (**H**)H(**L**). (Though in the latter respect it is different from SCA in the sense that the language does not parse under strict binarity, as it allows the foot shape (L).) Kager sees this language exemplifying the moraic trochee but imposing an additional avoidance of clashing syllables. This language thus groups the sequence HH as (**H)**H rather than *(**H**)(**H**); similarly,(**H**)(**L**L) is rejected in favour of (**H**)LL.

Similarly, as instantiated in (20), Assamese also avoids Clash at the syllabic and not at the moraic level. Therefore the relevant rhythmic unit for clash is not the mora but the syllable. The stress facts in Trisyllables can be stated as below:

> 25) a. The second syllable is prominent if it is heavy and the first syllable is light;
>
> b. Otherwise, the first syllable is prominent;
>
> c. Final closed syllables bear secondary prominence if the preceding syllable is not prominent.

2.3.6 Prominence in longer sequences in Assamese

Quadrisyllables

In Assamese, multiple prominence in the word arise from an iterative binary parse of syllables, and a metrical lapse of two successive unstressed positions can also occur in the system, at right edges, but this can be attributed to clash in a sequence like L(H)LL. The four syllabled words in (26) below shows rhythmic alternation in Assamese which is sometimes halted at the prospect of Clash.

26) **Quadrisyllables**

(**L**L)(**L**L)

a. [á.ra.dʰɔ̀.na] ‘worship’

b. [á.lʊ.sɔ̀.na] ‘discussion’

(**L**L)L(**H**)

c. [ó.bʰi.bʰa.bɔ̀k] ‘guardian’

d. [ɔ́.ɦa.dʰa.rɔ̀n] ‘extraordinary’

L(**H**)L(**H**)

e. [ʊ.pós.tʰa.pɔ́n] ‘present’

L(**H**)LL

f. [a.bɔ́r.zɔ.na] ‘garbage’

(**H**)LL(**H**) (**H**)L(**LL**)

g. [ħáŋ.bi.dʰa.nìk] ‘constitutional’ h. [ɔ́t.ta.lì.ka] ‘palace’

(**L**L)(**H)**H (**H**)H(**L**L)

i. [mɔ́.nʊ.rɔ̀n.zɔn] ‘entertainment’ j. [ħɔ́m.pɔr.kì.tɔ] ‘related’

(**H**)L(**H**)L (**L**L)(**H**)L

k. [ħɔ́n.ni.bìs.tɔ] ‘included’ l. [ɔ́.nʊ.kɔ̀m.pa] ‘compassion’

27) **Pentasyllables**

(**L**L)(**L**L)L (**L**L)L (**H**)L

a. [ħá.bɔ.dʰà.nɔ.ta] ‘to be careful’ b. [ɔ́.nɔ.bi.sèd.dɔ] ‘inseparable’

(**H**)L(**L**L) (**H**)L(**L**L)L

c. [ɔ.bɔ́r.nɔ.nì.yɔ] ‘indescribable’ d. [pɔí.zza.lʊ̀.sɔ.na]‘deliberation’

(**L**L)(**H**)LL (**L**L)L(**H**)H

e. [ɔ́.ħɔ.mɔ̀r.tʰi.tɔ] ‘not confirmed’ f. [ɔ́.nɔ.bɔ.lɔ̀m.bɔn]

‘resourselessness’

Distribution of prominence in longer sequences can be predicted as follows:

28) a. Foot construction starts from the left. Therefore, in a sequence of light syllables the iterative trochaic profile manifests itself in the form of primary prominence on the leftmost initial, and secondary

prominence on every odd numbered syllable from the left. Stress distribution in these types of sequences is as shown below:

(i) (ˈ LL)(ˌLL) (ˈLL)(ˌLL)L (ˈLL)(ˌLL)(ˌLL)

b. If the second syllable is heavy and the first is light, a foot is constructed on the second, bimoraic syllable.

c. Every heavy syllable has a foot unless preceded by a heavy syllable. (which word be footed).

d. Adjacent syllables cannot be stressed.

e. The leftmost foot is the head foot bearing primary prominence.

2.4 Affixation

To ascertain the way morphologically complex forms follow the rules of prominence formulated in § 2.3.2, we will take into account a few prefixes and suffixes commonly attested in Assamese.

2.4.1 Prefixation

29) a. ħɔ.(mán) 'equal' (ɔ́#ħɔ)(màn) 'unequal'

b. (ħá.dʰa)(rɔ̀n) 'ordinary' (ɔ́#ħa)dʰa(rɔ̀n) 'extraordinary'

c. ka(rɔ́n) 'reason' (ɔ́#ka)(rɔ̀n) 'without reason'

It is evident from the examples in (29) that in derived environments, feet do not respect morpheme boundaries and therefore, prosodic and morpheme boundaries are not necessarily aligned. The prefixation process in the data in (29) then, suggests that morphologically complex forms obey the rules of prominence and foot construction that we have formulated in § 2.3.7. The paradigm sets in (21), (24), (26) and (27), show that under affixation, words follow the general pattern of prominence, rather than retaining the prominence on the base and thereby upsetting the fairly systematic pattern.

Moreover, the inference drawn from the data set in (29) can be summarized like this:

“If the first syllable of the base is L, the prominence shifts to the prefix, otherwise it stays on the base.”

2.4.2. Suffixation

In suffixation also we find that prominence patterns endorse the interaction of the same constraints demonstrated by the monomorphemic and prefixed forms. Consider the examples given in (30).

30) a. (ɦɔ́n)dʰɑn 'trace' (ɦɔ́n)dʰan (#hɪ̀n)

b. (ɦán) ti 'peace' (ɦán) ti (hɪ̀n) 'without peace”

c. ɦɔ.(máz) 'society' (ɦɔ́.ma)(z#ɔ̀t) 'in society”

d. si.(kár) 'hunting' (sí.ka).r#i 'hunter'

e. (ɔ#.ka)(rɔ̀n) 'without reason' (ɔ́#ka)rɔ(n#ɔ̀t) 'without reason'

f. (kɔr) 'do' (ɔ́#kɔ)(rɔ̀.ni) jɔ 'not to be done'

The following patterns emerge from morphologically complex forms as the *(**L**H) form is systematically avoided.

31) a. In prefixes, if the base is L (**H**), prominence shifts towards the left f the prefix is L to form the pattern (**L**L)(**H**)

ħɔ(mán)   ‘equal’   (ɔ́#ħɔ)(màn)

b. If the base is (**H**)σ, then an L prefix does not change the shape of the foot.

(ħán) ti   ‘peace’   ɔ(ħán) ti

c. If the suffix is H, then it always takes some amount of prominence. i.e., if there is a (**H)**H foot in the base then the H suffix gets a secondary prominence.

(ħɔ́n) d^hɑn ‘trace’   (ħɔ́n)d^han (#hìn)

d. If there is an L(**H**) foot on the base then a suffix, either L or H does not change the shape of the foot.

ħɔ(máz)   ‘society’   ħɔ(máz)k^hɔn

e. In a L(**H**) foot , if the suffix is L then prominence does not shift, but may form a foot of the shape(**L**L)L

bɔ.(hág)   ‘april’   (bɔ́. ha).gi

f. If the base is L(**H)**H, then the addition of a L does not alter the prominence .

ɔ.(hɔ́ŋ)kar   ‘pride’   ɔ.(hɔ́ŋ)ka .ri.

g. If the base is L(**H**), then an L suffix might change the foot shape as under.

si. (kár)   ‘hunting’   (sí.ka).r#i

To summarize, sequences are syllabified *after* affixation and the generalization stated for monomorphemic sequences hold good for morphologically complex sequences as well. In short, prominence placement in SCA is non-cyclic. The examples demonstrate that the moraic trochee parameter remains intact even in affixation since feet do not respect morphological boundaries in morphologically complex forms, thereby showing that prominence is fairly systematic and predictable in Assamese.

General characteristics

Thus Assamese follows a strong – weak rhythmic profile in which foot is always bimoraic, as prominence always requires a bimoraic minimum. Thus in Assamese the domain for the construction is limited to the mora only. This factor limits the foot shapes to either [σ(μμ)] or [σ(μ)σ(μ)]. Thus every foot in the language contains minimally and maximally two elements of identical status i.e. two moras. In order to facilitate this, Assamese strictly prohibits the *(**L**H) foot, and therefore preserves its trochaic profile by disbanding all marked foot constructions. Moreover, the language displays considerable sensitivity to quantity in all positions, unless there is a possibility of upsetting the rhythmic goals of the language by the occurrence of stress clash.

CHAPTER 3

A PRELIMINARY INVESTIGATION OF THE PHONETIC CORRELATES OF PROMINENCE IN ASSAMESE

3.0 Introduction and plan of the chapter

In this chapter, we will present the findings of a preliminary investigation of the acoustic correlates of prominence in Assamese. For this purpose, we will divide the chapter accordingly. After recapitulating the stress facts of SCA, in section 1, we will discuss the probable acoustic cues of prominence. In section 2, we will discuss the methodology we have adopted in order to investigate the plausible acoustic cues of prominence in SCA. In sections 3, 4, 5 and 6, we will present the experiments that we conducted to probe the relevance of some well-established cues for determining prominence in SCA. In the seventh and final section we will discuss the results of our investigation and their theoretical implications.

3.1.0 Summary of stress facts in SCA

Recall, that in Chapter 2, we had characterized the distribution of prominence in Assamese, as below:

1) a. Primary prominence is on the second syllable if it is heavy, and the first is light, if not,
   b. Primary prominence is on the first syllable.
   c. Secondary prominence is on the first of alternating light syllables.
   d. A heavy syllable is prominent if the preceding syllable is not prominent.
   e. Stress on adjacent syllables is prohibited.

These observations were however based on intuitive judgments and not based on any experiments. In this chapter, we will try to find out the acoustic correlates of the intuitively felt prominent syllables in Assamese. We conducted the experiments on a computer software exclusively meant for speech analysis. On the basis of these experiments we tried to ascertain the acoustic cues for prominence in Assamese.

3.1.1 Investigation of acoustic correlates

Extensive research in phonetics has shown that cues for prominence are numerous and variable. Prominent among them are pitch, duration and intensity. The complexity of the possible cues has been recorded by many researchers. E.g., Gimson 1956, Fry 1955, Vanvik 1961, Bolinger 1958, Lehiste 1970, Beckman 1986. Beckman (1986) has used the term 'stress accent' for languages like English where accentual patterns have considerable influence in loudness and other phonetic attributes such as higher pitch and greater duration. On the other hand, she uses ‘pitch accent’ for languages which use only an increase in pitch and no other phonetic correlate to indicate prominence. e.g. Japanese.

3.1.2 Duration

Duration is a significant cue of prominence in many languages. In English, this result has been proved in many studies by Lehiste (1973), Lieberman (1960), Fry (1953) and Beckman (1986). Beckman calculated mean difference ratios, and found that the stressed syllable nucleus is consistently longer relative to the unstressed syllable nucleus. Duration measurements can be of two types, namely, vowel duration and syllable duration. Whereas vowel duration measures only the voiced portion of vowel periodicity, syllable duration involves the computation of the duration of the entire syllable.

3.1.3 Fundamental frequency and pitch

As we have already said, the term prominence has been shown to be realized phonetically in different ways in different languages. Phoneticians have observed that one of the primary cues for prominence in the utterance may be pitch. However, pitch as used here, does not necessarily imply a prominent high pitch. A regular and consistent change of pitch in all the tokens can qualify to be a cue for stress. Lehiste (1970), summarizing most of the important correlates of stress concludes, “… it appears that in all studies fundamental frequency provided relatively stronger cues for the presence of stress”(p 131). She thinks that duration plays a larger role than intensity, but does not deny that “ in many languages, fundamental frequency combined with intensity, provides the decisive cue: in others duration is the most dependable correlate of stressedness" (p 138). Beckman has shown that, English accentual patterns have significant correlates in the peak and average vowel amplitude patterns, fundamental frequency and mean vowel duration ratio patterns. However, Beckman's investigations demonstrate that, contrary to earlier studies, fundamental frequency cannot be regarded as the only 'robust cue', but duration and amplitude patterns can also be equally important, and any hierarchical ordering of cues can be misleading.

3.1.3.1 Relationship between pitch and frequency

Beckman (1986) describes the pitch of a pure tone as a " nonlinear, monotonically increasing function of its frequency; the higher the frequency the higher the pitch, with identical increments of frequency producing smaller and smaller increments of pitch at higher and higher frequency ranges. However the pitch of a complex tone is complicated by the presence of components at more than one frequency"(p 107). Ritsma (1976) is also of the opinion that the correspondence between pitch and F_0 should not be interpreted as meaning that the component at the fundamental frequency is responsible for the pitch, but only that the pitch values of different harmonic tones with equal fundamental frequencies will be equal. In the F_0 range relevant for speech, it is the third through fifth harmonics which are actually dominant in the perception of pitch. We can surmise from these observations that the two terms fundamental frequency and pitch are not synonymous even though they are used to mean the same thing. But it is certain that whatever we hear as pitch is dependent on fundamental frequency.

3.1.4 Intensity and loudness

The relationship between loudness and intensity is very similar to the relationship between frequency and pitch. To put it simply, the intensity criterion is relative to the loudness factor and vice versa, so that an increase in the intensity leads to a corresponding increase in the loudness function. However, loudness is affected by other attributes like frequency, presence of other sounds in the environment, spectral energy distribution, and duration.

In the following sections, we will present a report of a preliminary investigation of measurements and subsequent analysis of only two phonetic parameters relating to prominence in SCA namely, pitch and duration. At the outset, we state that, we are not outranking other phonetic attributes to claim that fundamental frequency is our primary cue. Since, F_0 and duration, both independently, gave considerable evidence to verify our phonological representation of prominence, we decided to keep aside intensity, another potential cue for prominence, for further research. This is only a preliminary investigation and we are not establishing any hierarchy of stress cues.

3.2.0 Methodology

The methodology adopted to conduct our experiments is discussed in the following sections.

3.2.1 Speakers

The production experiment was conducted in the following manner. Four native speakers (two male and two female) of SCA produced the target declarative utterances in a single intonational phrase avoiding emphasized constituents. To ensure uniformity in the manner of utterance or more precisely to avoid unwanted accentual variation, the speakers chosen for the task belonged to the same region or contiguous areas of the state. They were educated speakers of SCA, in the sense that they could read from a written Assamese script. The words of the corpus were written down in Assamese script and not transcribed so that a semblance of ‘naturalness’ was retained, while articulating the sentences. The utterances were read at a normal speech rate and recorded in a sound proof room.

3.2.2 The corpus

The corpus consisted of words of almost all syllable types and combinations. One example of each kind is given below:(see appendix I,II,IV for a complete list)

2) Disyllables

i. (LL) - [za.ba], ii. L(H) -[ba.gan]

iii. (H)L -[zɔn.trɔ] iv. (H)H - [bɔn.dɔr]

Trisyllables

v. (LL) L -[gɔ.hɔ.na] vi. (LL)(H) - [mɔ.rɔ.mɔr]

vii. L(H)L -[gʊ.rʊt.tɔ] viii. (H)HL -[ɔs.tit.tɔ]

ix. (H)H(H) -[ɔn.tɔr.dʰan] x. (H)HL -[bon.dʰʊt.tɔ]

xi. (H)LL -[bɔn.dɔ.na] xii. (H)L(H) - [an.dʊ.lɔn]

Longer sequences

xiii. (LL)(LL)[a.ra.dʰɔ.na] xiv. (LL)(LL)L - [ħa.bɔ.dʰa.nɔ.ta]

xv. (LL)(LL)(LL) -[ɔ.nɔ.grɔ.ħɔ.rɔ.ta]

As the sequences show, the corpus consisted of disyllables, trisyllables as well as very long sequences like pentasyllables and hexasyllables. A few criteria that we kept in mind about the segments chosen for the words in this corpus needs to be noted.: In order to avoid segmental perturbations the following measures were taken.

- As far as possible, only voiced consonants were taken so that the fundamental frequency contour was not affected.

- The vowels in a word were either similar or vowels of the same height. Vocalic effects have been reported to influence fundamental frequency and pitch. Some vowels have an intrinsic $F_{0,}$ owing to their height. In other words, there exists a direct correlation between variation in fundamental frequency values of some vowels and their height. (Hombert 1978, Rossi and Autessere, 1981; Steele, 1985). For instance, the SCA [i] might have this quality, as the F_0 consistently showed a rise whenever an [i] occurred. Therefore, as far as possible, words containing this vowel were avoided in our study.

As stated in Beckman (1986), common spectral cues were used for boundary criteria. In some cases the exact point of voice onset was difficult to determine, but as far as possible measurements were made to the nearest 5 – 10ms. Most of the cues used for determining boundaries were taken from Peterson and Lehiste (1960) and Beckman (1986). For example – the burst spike was the boundary cue used for end of stop closures, and sudden changes of intensity at higher frequencies as a cue for vowel - nasal boundaries. However, a reliable segmentation of the SCA [r], in the intervocalic position was difficult as [r] is a continuant, and in some varieties there is also a tendency to elide it.

3.2.3 Sentence frame used in the corpus

Since our aim was to investigate word stress only, all the words were put in a frame sentence, to get the desired accentual effect. The frame sentence was

3) [mɔi_______ bu|i ko|u]

This sentence when translated into English read “I X said”. We chose the sentence so that the target word occurs in the sentence middle position. This was to ensure that the words in the corpus were devoid of sentence final intonational effects. The preceding vowel was not a hurdle in segmenting the utterances because there was an intervening pause after the word [mɔi].

3.2.4 Digitization of the corpus and the use of the software PRAAT

As already mentioned, we recorded the target sentences in a sound proof room. We digitized the recorded utterances by using the line – input option from the sound card of PRAAT.

These recordings were transferred to PRAAT (a system for doing speech analysis), a very flexible tool for doing phonetics. It offers a wide range of procedures, including spectrographic analysis, articulatory synthesis, and neural networks. For our study we used PRAAT’s standard speech analysis tools.. PRAAT offers a range of choices in terms of processing sound signals. We used PRAAT’s option of down sampling the signals from a higher to a lower frequency. We converted the signal from 22KHz to 10KHz for males and 11KHz for females, in order to improve the quality of the sound. For the purposes of our analysis, we used the signals digitized in this frequency.

To enable us to make correct measurements of duration and fundamental frequency, we chose to use PRAAT's labeling mechanisms to segment speech waveforms and attach labels to it. It is possible to use PRAAT for intensity, spectrogram and pitch analysis through its Analysis window. By using the pitch display window, which shows the emergence of fundamental frequency as a function of time, we were able to calculate the mid point of the syllable nucleus.

However, PRAAT offers more tools for accurate measurements. With the help of these, a plot of the acoustic signal can be created on the 'picture window'. These pictures can be saved on disks. This in brief, summarizes the way we analyzed the speech waveforms with the aid of the software PRAAT.

Furthermore, after extracting the F_0 trace for each utterance, the measurements of duration and frequency, which were taken from the pitch display window, were labeled according to a labeling scheme. This scheme has been divided into four tiers to label and segment the following key points of the F_O contour.

4) TIER 1: labels all the segments.

TIER 2: labels mid – point F_0 value of syllable nucleus.

TIER 3: labels duration of syllable nucleus.

TIER 4: labels duration of the syllable.

3.2.5 Statistics

For our analyses, ratio values were derived for each token from the acoustic measurements.

The ratio for both durational values as well as F_0 values were the same. Logarithmic ratios for the various measurements were simply computed by subtracting the mean value of the first vowel / syllable from that of the second vowel.

5) Average F_O ratio = $Hz_{average}(S_1) - Hz_{average}(S_2)$

Here S_1 stands for the first syllable, whereas S_2 stands for the second syllable of every utterance. A negative value in this computation is supposed to indicate a falling tone for the first syllable.

6) Average duration ratio = $ms_{average}(S_1) - ms_{average}(S_2)$

In this ratio, a resultant positive value is supposed to indicate longer duration of the first syllable, and a negative value is meant to indicate a longer second syllable.

Moreover, statistical significance tests were carried out to find out the rate of sampling errors. Statistically significant difference tests tell us of the probability of a difference or relationship occurring as a result of chance sampling errors. By accepting p =. 05, we accept a 5 in 100 chance of the difference due to sampling errors, or 95 in 100 chance of not being due to sampling error. If the value of the result is less than .05, then we accept the result of the T-test to be statistically significant.

3.2.6 Prior work on related languages:

Very little work has been done on acoustic correlates of prominence in Indian languages. In a study conducted by Wiltshire and Moon (2000) on acoustic correlates of prominence in Indian English they found the following results.

7) a. A low pitch value

b. Longer duration of the stressed syllable.

c. Increased amplitude on the stressed syllable.

Further, Wiltshire and Pickering (2000) have also stated that there are considerable differences in the acoustic correlates of stressed syllables in American English vs. those of the same syllables in Indian English.

Thus, it is not untenable to assume that there may be some unique correlates of prominence in Indian languages. We are dealing specifically with SCA only and not making assumptions about other Indian languages.

3.3.1 Experiment 1: Duration value measurements

The duration measurements were made from the display window of the analysis menu. As stated in Beckman (1986), common spectral cues were used for boundary criteria, for all the tokens. As we have already discussed, we took into consideration certain common cues for determining voiced onsets and boundary cues. Most of the cues used for determining boundaries were taken from Peterson and Lehiste (1960) and Beckman (1986).

For each target token, the duration values of both the syllable nucleus as well as the whole syllable was taken. For measuring vowel periodicity, only the voiced portion of the vowel was used for consideration. The voiced portion is commonly taken for measurements of these kinds, because only a syllable nucleus that is voiced throughout will be favourable, for choosing the midpoint of the nucleus as the point of F_0 measurement in a syllable.

3.3.2 Durational Differences of Vowels.

	Vowel 1			Vowel 2	Difference
8) (L**L)** **[zaba]**					
Average	**. 20**			**.18**	**.2**
Paired t-test:	**.22**	**>**	**.05**	not significant	
9) L(H**)** **[zabɔr]**					
Average	**.2**			**.275**	**.1075**
Paired T-test	**.78**	**>**	**.05**	not significant	
10) (H)**H** **[bɔndɔr]**					
Average	**.185**			**.262**	
Paired T-test	**.58**	**>**	**.05**	not significant	

3.3.3 Results

To ascertain the influence of duration on prominence in SCA, we calculated the durational values of both the syllable nucleus as well as the entire syllable. However, the overall picture relating vowel length to prominence was not entirely satisfactory. In a statistical study conducted for syllables of all combinations, it was found that vowel periodicity difference couldn't be considered as a significant correlate of prominence in SCA. A few illustrations of the significance tests conducted are given above. Even though there was a difference in the mean ratios when the length of the first vowel was subtracted from the second, the T-Tests that we conducted have shown that the difference in duration of vowels is not statistically significant. Vowel duration can be expected to be an unreliable cue for prominence for many reasons. Primarily, because vowel length in Assamese is predictable and therefore it is non- phonemic. Secondly, as stated earlier, the vowels themselves may have intrinsic duration depending on their height.

3.4.1 Experiment 2: Syllable Duration

Since, the results obtained from the length of vowel periodicity did not help us in ascertaining prominence in SCA, we measured syllable duration as well for each token in the corpus, in a manner similar to the measurement of vowel duration. We also conducted the same statistical significance tests for syllable length. Significantly, the whole syllable duration did give us a clear indication of its relation to prominence. Some of the statistical findings are illustrated to give a sample of the results of the two – tailed paired tests.

3.4.2 Durational differences of syllables

	Syllable 1	Syllable 2	Difference
11) (**L**L) [zaba]			
Average	.20	.18	.2(approx)

Paired T – Test	.17	<	.05	**Not significant**	

12) L(**H**) [zabɔr]

Average	.21			.32	.11
Paired T- Test	.04	>	.05	**Significant**	

13) (**H**)H [bɔndɔr]

Average	.355			.21	.134
Paired T- Test	.006	>	.05	**Significant**	

3.4.3 Results: Syllable duration

The statistical significance test calculated by two – tailed paired T – test has shown that syllable duration is a better indicator of prominence in Assamese than vowel duration. However, we can ignore the results of the (LL) sequence, because the natural lengthening of the final vowel in an (LL) sequence, makes accurate measurements difficult. The mean durational chart (fig 1, see appendix III) also shows that the prominent syllable is uniformly longer than the nonprominent syllable. Since we have established this for all other sequences including (L(H) etc.), we will accept syllable length as the reliable cue for prominence instead of vowel periodicity.

3.5.1 Experiment 3: Fundamental Frequency value measurements

Fundamental frequency is a significant cue in many languages. In English for example, Beckman has shown that there is a simple rising pattern in the F_0 in the trochaic and a falling pattern in the iambic words, indicating prominence in each. The computer system calculated the fundamental frequency of phonation between points that we marked with the help of cursors.

In order to investigate how prominence patterns are borne out in F_0 contours we will discuss sequences of light syllables first, and then proceed to discuss syllable types of light and heavy combinations.

14) (LL)

(**L**L) [zaba]	Syllable 1		Syllable 2	Difference
Average	165		184	
T – Test	.o4	>	.05	Significant

3.5.2 Results: F_0 Value of (LL)

F_0 behaviour in the analysis of two light syllables showed a consistent pattern. The first syllable showed a pitch drop in all the LL sequences. Even though the syllable onset started with a high pitch there was a low- fall on the syllable nuclei (of the first syllable). The mean ratio for the second syllable was consistently negative, and the individual values of each test word token showed that the F_0 value of the first syllable was uniformly lower than the second in all the sequences of light syllables.

15) (**L**L)L [gɔhɔna]

(**L**L)L	Syllable 1		Syllable 2	Difference
Average	170		189.5	
T- Test	.008	>	.05	Significant

3.5.3 Results: F_0 Value of (LL)L

The general trend of the fundamental frequency contour in the LLL sequence is consistent with the pattern attested in disyllables. The first syllable demonstrates a distinct low fall and thereafter the F_0 trace continues to rise till the mid – point of the final syllable. Thus, LLL also validate the results found in LL.

16) (**L**L)(**L**L) / (**L**L)(**L**L)L/ (**L**L)(**L**L)(**L**L)

[aradhɔna]	**S 1**	**S2**	**S 3**	**S 4**	**S 5**	**S 6**
Average	.10	.16	.15	.14		

Difference1: **.6** **Difference 2:** **.1**

T- Test **.01** **>** **.05** **Significant**

17) [ɔpɔrazita]

	S 1	**S2**	**S 3**	**S 4**	**S 5**	**S 6**
Average	**.**085	.17	.12	.11	.17	

Difference1: **.255** **Difference 2:** **.1**

T-Test **.001** **>** **.05** **Significant**

18) [ɔɦabɔdʰanɔta]

	S 1	**S 2**	**S 3**	**S 4**	**S 5**	**S 6**
Average	.10	.20	.13	.15	.15	.15

Difference 1: **.10** **Difference2: -.2**

Difference3: 0

T –Test **.01** **>** **.05** **Significant**

(In the figures given above, 'S' stands for syllable, Difference 1 stands for difference between the mean average ratios of the first and the second syllables, Difference 2 stands for the difference between the mean ratios of the second and third syllable and Difference 3 stands for the difference between the mean ratios of the fifth and the sixth syllables. However, the T-Tests have been conducted only for the first and the second syllable values.)

3.5.4 Results : F_0 Value of (LL)(LL) / (LL)(LL)L / (LL)(LL)(LL)

Our preliminary findings show fairly conclusively that the correlate of primary prominence is a low rise. However, recall that intuitively we had argued for rhythmic prominence in SCA. Of the three tokens that we examined, in (LL)(LL)L and (LL)(LL)(LL) tokens, a significant lowering can be observed. Similarly, the final foot which, does not have an unparsed syllable on its right as in (LL)(LL) and (LL)(LL)(LL) does not seem to exhibit this lowering effect.

It is interesting to interpret iterativity as rendered in a acoustic signal, tentatively, low fall in a non final foot and high elsewhere. However, we hesitate to make a commitment on the cue for secondary accent on the basis of such meagre data.

The pattern for primary prominence attested in disyllables is evident in the longer sequences also – the primary stress bearing unit (i.e., the first syllable) has a distinct pitch drop. The figure 2 (see appendix IV) shows that the mean fundamental frequency of the first syllable is consistently lower than that of the second syllable.

As we said earlier, our claims for secondary prominence need more evidence. We could not get the appropriate statistical results from the experiments conducted, even though the F_0 contours supported our contention. For example, the syllable duration values taken for all the syllables show that only the difference between the first and the second syllables is statistically significant. However, for the following syllables, even though there existed a nominal difference between the third and the fourth, and between the fifth and the sixth, the statistical computation of these did not show any significance. However, it is a fact that even though we could not get the appropriate statistical results, the third syllable duration was longer than the fourth, and the fifth was longer than the sixth.

3.5.5 Findings

Our findings at this stage have a distinct bearing on the acoustic correlates of SCA for primary prominence and secondary prominence.

a. The finding for primary prominence was unequivocal. Primary prominence manifested in the form of the longest syllable duration in the entire word. This was supported by statistical evidence also, as all the differences were found to be statistically significant.

b. Vowel length did not prove to be of any consequence for either primary or secondary prominence. The raw syllable length duration, yielded in secondary prominence, though not as long as the syllable bearing primary prominence, was longer than the others. We leave our hypothesis that, rhythmic alternation can be said to be present in SCA and acoustically manifested in the form of longer syllable duration, for future research.

3.6.0 Prominence in sequences with H (i.e., a heavy syllable)

In L(H) sequences, the F_0 contour was intriguing because it did not fall into the expected pattern. As already stated in Chapter 2, Assamese demonstrates quantity sensitivity. Coda consonants are moraic and consequently heavy syllables more often than not bear some degree of prominence. This quantity sensitivity was acoustically manifested in the form of a low pitch, which spreads over from the first light syllable to the following heavy syllable. In other words, the first syllable pitch contour is almost a plateau instead of a downtrend and it continues till the initiation of the second syllable. There is a steady rise in the second syllable and the mid point fundamental frequency value of which is not significantly higher than the first syllable. This pattern is slightly modified in a L (HL) sequence. Here, the pitch contour is a plateau till the end of the first syllable. The F_0 of the preceding light syllable gets linked to the following heavy syllable to indicate primary prominence. This pattern can be summarized like this:

3.6.1 Findings

1) In an (**L**L) sequence, there is a distinct low fall on the first syllable.
2) In an L(**H**), instead of a low fall on either of the syllables, the F_0 trace is a like a plateau, where there is no sharp rise or fall. We interpret this as a contour where the low pitch of the first syllable spreads over to the second syllable to indicate prominence on the second syllable. The fact that this is not the pattern in a (**L**L) sequence further validates our claim.

The figures in Appendix IV will demonstrate the legitimacy of our claim. Moreover, the statistics given below shows that the difference between fundamental frequency values from the first syllable to the second is not significant.

3.6.2 Fundamental frequency values L(**H**)

19)	[zabɔr]	Syllable 1	Syllable 2
	Average	**165**	**162**

Paired T- Test	**.13**	**<**	**.05**	**Not significant**

20)	[bagan]	Syllable 1	Syllable 2
	Average	**148**	**168**
	Paired T- Test	**.07 <**	**.05 Not significant**

Moreover, syllable duration was a pointer towards the placement of primary prominence. The second syllable was consistently longer than the first in L(**H**) sequences. Moreover, the statistical tests conducted to verify our observations also gave supporting evidence.

3.6.3 Syllable duration values L(**H**) / L(**H**)L / L(**H**)H

21)	[zabɔr]	**Syllable 1**	**Syllable 2**		**Difference**
	Average	.21	.32		11
	T- Test	.003	>	.05	**Significant**

22) [anɔndɔ]

	Syllable 1	**Syllable 2**	**Syllable 3**	**Difference**
Average	.095	.26	.12	25.05
T –Test	.04 >	.05	**Significant**	

23) [anɔndɔr]

	Syllable 1	**Syllable 2**	**Syllable 3**	**Difference**
Average	.10	.26	.21	.5
T –Test	.0006 >	.05	**Significant**	

3.7.0 A discussion of the significant findings relating to F_0

a. F_0 trace indicates primary prominence in the form of a significant low tone in the first syllable in any sequence of light syllables - (LL), (LL)L, (LL)(LL)L, (LL)(LL)(LL).

b. When there is a heavy syllable for instance in a sequence like L (H), F_0 trace indicates primary prominence in the form of a low tone which spreads from the preceding light syllable. Theoretically, this phenomenon is quite viable. We have already discussed quantity sensitivity and the theoretical formulation of the Weight – to Stress Principle explaining the stress related effects of syllables bearing greater weight. To put it in brief, the fact that the preceding syllable in an L(H) sequence is deprived of prominence inspite of its initial position, is due to the reason that the following syllable is heavy, and therefore more deserving. The phenomenon translated acoustically into a plateau, and not a high or a low tone can be demonstrated with the help of the diagrams given below:

24)

The plateau signifies that, even though by virtue of its initial position the preceding light syllable vies for a low tone, the weight of the following syllable attracts the prominence, and this pull of the heavier syllable manifests itself not in the form of regular low high contour but a remarkably flat F_0 excursion, which is neither high nor low.

At the same time the rise instead of a dip signifies that, since the position of the heavy syllable is final and not initial it implicitly has a high tone instead of a low one, yet manages to remain sufficiently low because of its weight and as a corollary, prominence. The association of the low tone with the heavy, second syllable results in a low tone plateau till the mid second vowel signaling prominence on the second syllable.

Conclusion

The acoustic signal manifested in F_0 contours can show the following patterns depending upon the nature of the component syllables:

a) Primary prominence invariably manifests itself as a low tone in any given sequence of light syllables. Syllable duration is significantly greater in the first syllable.

b) In sequences of LH an LHL syllables the low tone is carried over from the preceding light syllable, indicating the fact that heavy syllables are stress bearing units.

c) Rhythmic alternation in Assamese may be correlated with greater syllable duration and lower pitch on the head of non-final feet, which is overridden by the high tone associated with the right edge of the word.

Thus in this preliminary investigation, we found adequate evidence to support the intuitive judgments which we made in the preceding chapter. In fact all the acoustic parameters confirmed our observations of primary prominence in Assamese. Therefore, we can claim that the following are the plausible cues for prominence in Assamese:

a) low tone in the syllable nuclei.

b) Syllable duration.

As we have already mentioned, this is only a preliminary investigation. Moreover, we have not included intensity, which is also deemed to be a significant correlate of prominence. Finally, our observations about secondary prominence are purely tentative. Further study in this area may throw some more light on the prominence of SCA, if intensity is also taken into consideration.

CHAPTER 4

AN OPTIMALITY ACCOUNT OF PROMINENCE IN ASSAMESE

5.0 Introduction and plan of the chapter

In this chapter, we analyse the patterns of prominence in SCA, in the Optimality theory framework (Prince and Smolensky,1993, McCarthy and Prince, 1993 a, b, Kager, 1999). However, before we proceed with an optimality theoretic account, we will try to see in section 1 if there are any limitations in the derivational approach.

In this chapter we have four sections. The first section discusses the derivational approach and compares it with the OT approach. In this section we also try to present a background of the OT approach to stress systems. In the second section we deal with prominence in SCA and try to account for it using the OT framework. We invoke all the constraints that are necessary to deal with sequences of light syllables in SCA. In the third section we discuss quantity sensitivity and the various additional constraints involved in characterizing weight effects in SCA. In the fourth and final section, we posit the final constraint hierarchy for SCA and it is followed by a discussion of the metrical forces which are responsible for this hierarchy of violable constraints.

4.1.1 Limitations in alternative methods.

A derivational account of the stress facts of Assamese would involve the following stages.

1) a. Assign syllables.

b. Build trochees iteratively (LL and H) from left to right.

c. Unparse the right adjacent H and LL foot next to a H foot.

d. Assign main stress to the leftmost foot.

Let us see how these rules can be applied to some words in the language.

2)	bɔndɔr	ɔntɔrdʰan	bɔndɔna	
	bɔn.dɔr	ɔn.tɔr.dʰan	bɔn.dɔ.na ----------	(i)
	(bɔ́n)(dɔ́r)	(ɔ́n)(tɔ́r)(dʰán)	(bɔ́n)(dɔ́na)-------------	(ii)
	(bɔ́n)dɔr	(ɔ́n)tɔr(dʰán)	(bɔ́n) dɔ na -------------	(iii)
	(bɔ́n).dɔr	(ɔ́n).tɔr.(dʰàn)	(bɔ́n).dɔ.na -----------	(iv)

Needless to say, the derivational approach necessitates intermediate stages of representation not attested in the language. For instance, the stage in (2. (ii)) would over generate the number of feet leading it to produce an intermediate stage for which we do not have any empirical evidence. Moreover, the inherent rhythmic factors are glossed over, as the steps in (3.1) do not provide any explanation as to why unparsing was necessitated. Thus while the derivation enumerates various stages of stress placement in the language, it does not incorporate an adequate explanation of the fact that Assamese strives for ideally shaped moraic foot of the shapes (LL) and (H), and at the same time *Clash is defined not at the moraic level but at the syllabic level, which forbids the construction of (H) and (LL) feet immediately after an (H) foot.

4.1.2 OT and prominence

we just saw how a rule based grammar produces non-observed intermediate phonological forms, which are inconsistent with the phonology of the language. The grammar of OT, on the other hand, prevents the generation of arbitrary intermediate forms as it is output oriented and produces the output forms in a single interaction rather than a series of derivational steps. Moreover, unlike rule based processes, explanatory adequacy is satisfied as explanation is formally incorporated into the analysis through constraint ranking. The output candidate in an OT framework is selected from a set of candidate output forms. A hierarchy of violable constraints then assesses them. The most harmonic or the optimal candidate is the one that least violates constraints and emerges victorious. Therefore, we adopt the optimality theoretic approach for explaining the pattern of prominence in SCA. In the analysis that we are going to present in the following sections, derivational mechanisms and parameters are replaced by well established universal constraints in the OT literature stating wellformedness conditions on output forms and ranked in a language particular hierarchy.

4.1.4 A set of metrical constraints

(All constraints are from Kager 1999, Prince and Smolensky 1993)

Research till date has shown that Optimality Theory has dealt with prominence quite satisfactorily. In this section we will attempt to give an account of the common preferences in prominence systems. Constraints are universal in OT. Hence these constraints are supposed to be cross – linguistically present in all metrical systems. OT assumes many of the representations of metrical phonology and these have been translated into violable constraints. We begin with a few constraints in the following sections.

4.1.3.1 Rhythm: FT- Bin, Parse Syll, and All – Ft – X

We present below some of the constraints and their definitions as they will be required for our analysis.

3) FT BIN

Feet are binary under moraic or syllabic analysis.

A foot must obligatorily contain two elements i.e., either two moras or two syllables. A vital function of Ft- Bin is to avoid degenerate feet (L), which contain a single light syllable. Under moraic analysis, this constraint would enforce that every foot is of the shape (H) or (LL). Whereas in a syllabic analysis this constraint would enforce the domination of two syllables by a foot irrespective of their weight. We will see as we go along that SCA selects the moraic interpretation of FT BIN

4) PARSE SYLL

Syllables are parsed by feet.

When syllables are not parsed by feet, they are assumed to be metrified as immediate daughters of the PrWd. If this constraint is fairly high ranked in a language, it would mean that every syllable of the language must obligatorily be parsed by feet leading to rhythmic prominence.

5) *CLASH

No stressed syllables are adjacent. This is a rhythmic requirement in languages, which is responsible for ensuring an alternating pattern of stressed and unstressed syllables. *Clash is a theoretical development that can be traced to pre - OT work (Liberman 1975, Liberman and Prince 1977, Prince 1983, Hammond 1984, Selkirk 1984).

4.1.3.2 Culminativity and GrWd = PrWd and Word minima

The culminative property of constraints ensures that a grammatical word must be a prosodic word as well.

6) GrWd = PrWd

A grammatical word must be a PrWd.

According to the hierarchy of prosodic elements, every prosodic word dominates at least one foot. The GrWd = PrWd along with the prosodic hierarchy ensures that every word has at least one stressed syllable. This is the culminative property of words. This property is also related to the notion of the word minimum – a requirement that a word should have at least two moras or two syllables minimally, depending on the prosodic typology of the language. This can be enforced in languages in various ways – epenthesis of a vowel in a monomoraic word, making a monomoraic word bimoraic etc. This constraint can also be indirectly interpreted as establishing the requirement that every grammatical word must have minimally one foot.

4.1.3.3 Demarcative stress: Align Wd

The placement of stress at the edges of a domain is universally attested in prominence systems: this is characterized as the demarcative property of metrical systems. In OT this demarcative property of metrical is translated into alignment constraints which require the cooccurrence of edges of categories.

These constraints serve to place stress on a foot standing at the specified edge of the word.

7) a. ALIGN – WD LEFT

Align (PrWd, Left, Ft, Left)

Every PrWd begins with a foot on the left edge.

b. ALIGN – WD RIGHT

Align (PrWd, Right, Ft, Right)

Every PrWd begins with a foot on the right edge.

These constraints are functionally opposed to ALL – FT – LEFT and ALL – FT- RIGHT. Instead of making a requirement about feet, they make a requirement of word edges. Accordingly, they are violated when no foot is present at the specified edge of the word.

In addition to ALIGN constraints, we also require another type of constraint schema that would account for the contrast between rhythmic and unbounded stress systems. For example, certain languages have only demarcative stress i.e., either at the left or the right edge (with trochaic and iambic variation with or without extrametricality.) However, there are many languages like SCA attesting rhythmic prominence which necessitates multiple feet. Let us discuss some of these linguistic preferences that can be represented with the help of factorial typologies. It shows how a simple reranking of constraints can account for variations in language systems regarding iterativity. Kager (1999) has discussed these systems and shown how through constraint ranking the grammar can determine criteria which were described in earlier derivational paradigms as bounded and unbounded systems. The factorial typology given below is the one for unbounded systems, with only one foot at the designated edge of the word. This pattern is ensured by the undominated ALL FT X (With X taking the values 'left' or 'right'), since it prohibits iterativity by allowing only one foot at the absolute edge of the word.

8) ALL FT X >> PARSE SYLLABLE

Can be exemplified as:

9) (σσ) σ σ σ >> (σσ) (σ σ) σ

(unidirectional non iterative)

As opposed to this another group of languages is characterized by rhythmic alternation and the factorial typology for these type of languages can be expressed as under:

10) FT BIN >> PARSE SYLL >> ALL- FT - X

can be illustrated as 11 below:

11) (σσ)(σσ) σ >> (σσ) σ(σ σ), (σσ) σ σσ

(unidirectional iterative binary system)

This ranking schema guarantees a strictly alternating binary rhythm. This can be attributed to PARSE SYLLABLE, which dominates ALL FT X. Furthermore, feet are arranged in such a manner that they are as close as possible to the specified edge. Rhythmic prominence in SCA as exemplified by the sequence of light syllables is an example of this factorial typology.

4.1.3.4 Quantity sensitivity and foot form: WSP and RH TYPE

Another cross-linguistic preference of great significance is that of quantity sensitivity, which ensures that heavy syllables are prominent. The relevant constraint is the Weight – to – Stress Principle:

12) WSP

Heavy syllables are stressed. (Kager,1999)

This consonant when it is high ranked, ensures that coda consonants are moraic and therefore the syllable is eminently stressable in general.

Two additional foot form constraints to determine the rhythmic type of feet are:

13) a. RH- TYPE= I (. *)

Feet have final prominence.

b. RH- TYPE= T (* .) (Kager,1999)

Feet have initial prominence.

Anther constraint that preserves the quantitative make – up of the foot shapes in a language, is stated in terms of the constraint given below:

14) RH – CONTOUR (* .)

(μ μ)

A foot must end in a strong – weak contour at the moraic level.

(Kager,1999)

Cross linguistic evidence of metrical systems shows that there is a preference in trochaic systems for quantitative evenness and iambic systems for quantitative asymmetry (Hayes, 1989 etc). To put it briefly, this constraint is a statement of the rhythmical composition of metrical systems which underlies the quantitative asymmetry in the foot inventory. Languages which rank this constraint very high in their constraint ranking, employ strategies to avoid (HL) trochees or (LL) iambs(Kager,1999).

4.1.3.5 Universal Metrical Inventory

Typologically, language systems can be divided into the following types

15) a. Iambic: Systems which have final prominence.

b. Trochaic: Systems which have initial prominence.

Moreover, these rhythmic units may be divided according to the following universal metrical inventory (McCarthy and Prince 1986, Hayes 1987, 1995, Kager 1993):

16) a. Syllabic trochee (quantity - insensitive): (σ́σ)

b. Moraic trochee (quantity – sensitive): (LL) (H)

c. Iamb: (LL) (H) (LH)

We will see later that SCA selects moraic trochee, which has the foot shapes:

17) i. (LL) ii. (H)

Moraic trochees are so called because they satisfy the bimoraic parameter by virtue of the fact that the component syllables contain segmental material, which qualifies the bimoraic requirement. This criteria encodes that feet should contain only two moras – which can be interpreted as either two light syllables, or a single heavy syllable of the shape CVC or CVV or both – where the final consonant or the vowel / glide constitutes another mora. However, SCA does not attest CVV patterns as vowel length is not phonemic in SCA. Languages have different preferences for the selection of a heavy syllable – CVC, CVV or both. We have already shown in Chapter 2 that in SCA coda consonants are moraic and therefore CVC /CVG patterns are considered heavy.

In our OT account of the metrical patterns of Assamese, we will proceed in a systematic manner i.e. we will start with sequences of light syllables, and then deal with heavy syllables, so as to account for quantity sensitivity in

SCA. We will then try to arrive at a constraint hierarchy, which will be adequate to account for all and only the metrical patterns attested in the language.

Recall, that in chapter 2 we had stated the pattern of prominence in a sequence of light syllables as follows:

18) a. Primary prominence is on the initial syllable.

b. Secondary prominence is on odd numbered syllables.

These can be translated into an OT framework by ranking the constraints involved. Constraints in OT terms are formal representations of cross-linguistic preferences and therefore these are thought to be universal.” The null hypothesis is that all constraints are universal and universally present in all languages” (Prince and Smolensky, 1993).

19) (LL) Gloss (LL)L Gloss

a. (sɔ́. ku) ‘eye’ b. (zɔ́.hɔ).ni ‘cholera’

c. (rá.ti) ‘night’ d. (gɔ́.hɔ).na ‘jewellery’

Let us see how these facts are dealt with in OT grammar by ranking a set of constraints. By looking at prominence in Assamese as a domain of conflicting forces we will see how these conflicts are resolved by comparing an actual surface output with a set of probable candidates.

4.2 A set of metrical constraints

It has been cross-linguistically attested that rhythmic alternation of strong and weak syllables is a strong preference in metrical systems. As we have already discussed in Chapter 2, this pattern is represented in metrical systems with rhythmic units called *feet.*

This rhythmic requirement is expressed in the constraint FT – BIN (Prince, 1980, Kager, 1989, 1999, Prince and Smolensky 1993).

20) FT- BIN

Feet are binary under moraic or syllabic analysis.

This requirement stipulates that feet must obligatorily contain either two moras or two syllables. The data given above corroborates the fact this stipulation, as FT BIN is respected in SCA in all the sequences of light syllables. We can establish this constraint as one of the preferences operative in the metrics of SCA. As already stated, and corroborated by the data set in (2), Assamese demonstrates a Trochaic rhythm and therefore attests the foot form constraint – FT-TYPE TROCHAIC This constraint can be stated as below.

21) FT – TYPE TROCHAIC

Feet have initial stress. (Prince and Smolensky, 1993).

This constraint requires that the assignment of prominence be on the first mora of the foot only. To interpret the SCA data, we will have to create a constraint hierarchy involving both the constraints FT BIN and FT TYPE TROCHAIC.

In earlier derivational models, the preference of metrical systems to choose one edge of a word (left or right), was expressed with the concept of edgemarking. This concept has been translated into OT terms by invoking the following pair of metrical alignment constraints.

22) a. ALIGN- WD- LEFT

Align (PrWd, Left, Ft, Left)
Every prosodic word begins with a foot. (Kager,1999)
(EDGEMOSTin Prince and Smolensky, 1993)

b. ALIGN – WD – RIGHT

Align (PrWd, Right ,Ft, Right)

Every prosodic word ends in a foot.

Alignment constraints guarantee the association of the ‘head’ foot with the specified edge of the word. It is a well attested cross – linguistic preference for stresses to demarcate specific edges of prosodic domains.

For the set in (19) then, we need the three constraints ALIGN L, FT BIN, FT TROCHAIC. The following constraint hierarchy is postulated to show that at this stage, all the three constraints are unranked (indicated by dotted partitions).

23)

Input: zɔ.hɔ.ni	FT TRO	FT BIN	ALIGN L
1.☞ (zɔ́.hɔ).ni			
2 (zɔ.hɔ́).ni	*!		
3. (zɔ́).hɔ.ni		*!	
4. zɔ.(hɔ .ní)	*!		*!

It is obvious from the data in (19) that SCA respects ALIGN- WD-LEFT, along with the other two inviolable constraints. For a complete constraint hierarchy to emerge from the data, we need a more complete metrification and therefore more constraints. Therefore, consider the paradigm set in (19) again. To satisfy the metrical arguments of the paradigms in (19), we will need some more constraints. We will try to see the implications of the constraints in their specific ranking in the constraint hierarchy.

Therefore, let us look at the data in (24), which we have not integrated into our discussion as yet.

24) (LL)(LL)

a. (á.ra).(dʰɔ̀.na) ‘worship’ b. (á.lʊ).(sɔ̀.na)

‘discussion’

(LL)(LL)L (LL)(LL)(LL)

c. (ħá.bɔ).(dʰà.nɔ).ta ‘to be careful’ d.

(ɔ́.ħa).(bɔ̀.dʰa).(nɔ̀.ta)

‘carelessness’

The paradigm set in (24) demonstrates the following points: FT TYPE TROCHAIC, FT BIN are constraints which are never violated and hence they are undominated. And the sequences of light syllables we have looked at till now also show that ALIGN LEFT is never violated and hence it is undominated. We now come to ALL FEET and PARSE SYLLABLE – the two constraints which are responsible for rhythmic prominence as we mentioned earlier.

25) ALL FT LEFT

Align (Ft, Left, PrWd, Left)

Every foot stands at the left edge of the prosodic word. (Kager,99).

As we discussed earlier, this constraint is functionally opposed to the constraint ALIGN LEFT, because while this constraint makes a requirement about feet in terms of edges, ALIGN LEFT makes a requirement about edges, in terms of feet. Violations of the former, which is a gradient constraint, will be computed on the number of syllables between a foot and the left edge of the word. This constraint is responsible for stipulating the requirement that the left edge of every foot coincides with the left edge of a PrWd. This stipulation is satisfied whenever there is single foot standing at the left edge of every word.

We had not included this constraint earlier because it did not perform a function distinct from ALIGN LEFT in di- and trisyllables.

We need more constraints to arrive at a constraint hierarchy where constraints will militate against one another and thereby we will be able to establish a constraint hierarchy where there is a fierce competition between the metrical forces at work.

26) PARSE SYLLABLE

Syllables are parsed by feet. (Kager, 99)

The exhaustive parsing of the forms in (24) is a piece of evidence supporting the invoking of the constraint in (26). According to this constraint all syllables have to be compulsorily parsed by feet.

As we said earlier, it is PARSE SYLLable which forces multiple feet on long sequences and the ranking is already given. i.e.,

27) PARSE SYLL >> ALL FT L.

Let us examine a four syllabled word to see how the constraint hierarchy works.

The data show that it is more important to respect FT BINARITY and FT – TYPE TROCHAIC, than it is for all feet to be on the left. Therefore, we can rank order the constraints as below:

28) FT – TROCHAIC, FT BINARITY,

ALIGN LEFT,

PARSE SYLLABLE >> ALL FT LEFT

The constraint hierarchy in (28) is based on four syllabled words which do not give us any evidence for ranking PARSE SYLLABLE with respect to the undominated constraints. However, if we turn to three and five syllable words, the ranking of PARSE SYLLABLE becomes clear as PARSE SYLLABLE is a violable constraint.

29) (ħá.bɔ).(dʰà.nɔ)ta >> (ħá.bɔ).(dʰà.nɔ).(ta)

The example above shows PARSE SYLL will have to be ranked lower than the other undominated ones.

30) FT – TROCHAIC, FT BINARITY, ALIGN LEFT
>>
PARSE SYLLABLE
>>
ALL FT LEFT

It is noteworthy that in all the examples given above ALIGN LEFT is vacuously satisfied, and we do not have any real arguments to rank ALIGN LEFT relative to the others. However, we will co rank ALIGN LEFT along with FT – TROCHAIC, FT BINARITY because it is undominated till now, and we will find out its true place in the hierarchy only when a more complete metrification emerges. However, PARSE SYLLABLE will have to be ranked above ALL FT LEFT to ensure rhythmic prominence. It is mandatory that the language parses all and only the syllables which satisfy the binarity criteria. This criterion automatically relegates ALL FT LEFT to a lower position in the hierarchy. Therefore, ALL FT LEFT is ranked lower than the other constraints.

The constraint hierarchy given below ranks all the constraints shown to be active till now. The ranking order will suffice to illustrate our claim that rhythmic prominence emerges because ALL FT LEFT is dominated by PARSE SYLLABLE.

31)

	FT TRO	FT BIN	ALIGN L	PARSE σ	ALL FT L
a.☞(á.ra).(dʰɔ̀.na)					**
b. (á).(rà.dʰɔ).na		*!		*	*
c. (a.rá).(dʰɔ̀.na)	*!				**
d. a.ra.(dʰɔ́.na)			*!	**	**
e.(á.ra).dʰɔ.na				**	

The candidate in (31e) violates PARSE SYLLABLE twice even though it satisfies ALL FT LEFT, hence it is non - optimal when compared with (31 a). Whereas, even though the optimal candidate violates ALL FT LEFT twice, it emerges victorious, because it satisfies the higher ranked PARSE SYLLABLE. The tableau that we have posited in (31) can be rank ordered as a constraint hierarchy.

32) FT TYPE TROCHAIC, FT BINARITY, ALIGN LEFT

>>

PARSE SYLLABLE

>>

ALL FT LEFT

We will try to account for longer sequences with the same constraint hierarchy.

The forms in (19) and (24) will be satisfied by the constraint hierarchy posited in (32). The tableau in (33) illustrates our point.

33)

Input ħá.bɔ.dʰà.nɔ.ta	FT TRO	FT BIN	ALIGN L	PARSE σ	ALLFT L
a.☞(ħá.bɔ).(dʰà.nɔ).ta				*	**
b. (ħa.bɔ́)(dʰa.nɔ̀)ta	*!*			*	**
c. (ħá) (bɔ̀.dʰa) (nɔ̀.ta)		*!			*, ***
d. ħa.(bɔ́.dʰa).(nɔ̀.ta)			*!	*	*,***
e. (ħá.bɔ).(dʰà.nɔ).(tà)		*!			**,****

We would like to mention the fact that -ta is a suffix in /ħá.bɔ.dʰà.nɔ.ta/

and that morphology plays no role in prominence placement in SCA. Likewise, even prefixed forms do not play any part in the assignment of prominence. For example:/ ɔ.nɔ.grɔ.ħɔ.rɔ.ta./ where the /ɔ.nɔ/ is a prefix. This constraint hierarchy can account for both prefixation and suffixation as shown by the tableaux below:

34)

Input: ɔ.nɔ.grɔ.ħɔ.rɔ.ta	FT TR	FT BIN	ALIGN L	PARSE σ	ALL FT L
☞ 1.(ɔ́.nɔ)(grɔ̀.ħɔ)(rɔ̀.ta)					**,****
2. (ɔ́)(nɔ̀.grɔ)(ħɔ̀.rɔ)ta		*!		*!	*,***
3.(ɔ nɔ́)(grɔ̀.ħɔ)(rɔ̀.ta)	*!				**,****
4.ɔ.nɔ(grɔ́ ħɔ)(rɔ̀ ta)			*!*	**	**,****

However, to generate an exhaustive constraint hierarchy, we have to take into account heavy syllables also. It is needless to say that the hierarchy that we have postulated till now would be insufficient to address the forces working in sequences including heavy syllables. Therefore, in the next section we will discuss the new constraints that we will need (if any), and the consequences that it will imply for the hierarchy that we have postulated for the sequences of light syllables.

4.3.0 Quantity-sensitivity

As the examples illustrated in Chapter 2 have demonstrated, quantity-sensitivity plays a dominant role in the rhythmic profile of the language. Therefore, we need to address the notion of syllable weight through constraint interaction.

4.3.3 WSP and *CLASH

Prior to OT, quantity – sensitivity was considered to be an absolute - probably even highly polarized, binary parameter according to which a language could be either quantity - sensitive or quantity-insensitive (a parameter which a language could either switch 'on' or 'off'). For example Hayes (1980) postulated the 'universal metrical inventory', according to which languages either chose quantity-sensitive foot shapes (moraic trochee) or quantity –insensitive foot shapes (syllabic trochee). However, language typologies have revealed that quantity sensitivity cannot be strictly parametrized, because there are languages that demonstrate varying degrees of quantity - sensitivity. Moreover, it is plausible to assume that quantity-disrespecting systems are more so due to the interaction of constraints, rather than any selection of quantity avoiding parameter. Kager (1992a, 1993, 1999) observes that clash avoidance often translates itself into quantity disrespecting systems. Alber (1997), proposes that '… a rather limited set of stress pattern constraints can generate metrical systems of varying degrees of quantity sensitivity…'She exemplifies the metrical stress patterns of German and Finnish on the one hand and Estonian on the other to show that as a result of the complex interaction of some constraints which favour weight effects and others that obscure them, German is partially quantity sensitive and Estonian is almost totally quantity insensitive. Alber (1997) claims that without reference to any other parameter of quantity sensitivity or insensitivity these constraints can look after the weight effects of any language. She also translates the *Iambic- Trochaic Law* into a constraint :

35) "ITL: feet must observe the Iambic/Trochaic Law. The components of a trochaic foot must be equal, the elements of an iambic foot must contrast in quantity." (Alber,1997)

The significance of this constraint lies in the fact that this constraint translates the universal metrical inventory into a statement of quantity sensitivity rather than one of headedness. In Kager (1999), foot form constraints were interpreted in terms of the *headedness* of the headedness parameter.

However, the headedness parameter is not so effective in distinguishing weight effects in the metrical patterns of languages. Varying degrees of quantity sensitivity can be realized crucially by the ranking of the following constraints:

36) *CLASH, WSP and PARSE SYLLABLE

4.3.4 Quantity sensitivity in SCA

Our primary concern is to determine how rhythmic and quantitative constraints affect the stress pattern in Assamese. As we proceed, we shall see how these constraints interact to derive a partially quantity sensitive metrical pattern for SCA. Let us take into consideration the data set given below:

37) L (H) Gloss

a. zi.(bɔ́n) 'life'

b. pa.(tál) 'hell'

c. sɔ.(raí) 'bird'

It is evident from the data that Assamese relates syllable weight to prominence. We can postulate that there is a constraint enforcing quantity – sensitivity in the language and the operation of this constraint unfailingly stresses the heavy syllable. In OT literature the constraint that realizes this property in languages is the Weight-to-Stress Principle (Prince 1983, Prince and Smolensky 1993, Kager 1999).

38) WSP

Heavy syllables are stressed.

This constraint relates metrical prominence to syllable weight. The effect of this is that heavy syllables receive primary prominence, even at the cost leaving the neighbouring environment (mostly light syllables) stressless. The suboptimal form below stresses the light syllable. This violation is not tolerated in the metrical pattern of the language.

39) pa.(tál) >> (pá.tal)

4.3.3 Reformulated FT BIN

The other aspect of quantity sensitivity is related to the foot shapes that are permitted by the metrification patterns of the language. We have already integrated the headedness parameter of iambic and trochaic systems by incorporating FT TYPE TROCHAIC into our hierarchy. But while dealing with quantity sensitivity we need to incorporate another parameter into the other undominated constraint FT- BIN. SCA selects the moraic type of foot form, which necessitates this parameter. Our definition of FT BIN will have to be reformulated to incorporate the concept of mora. I.e., all types of feet which satisfy the bimoraic parameter will be considered binary. This reformulation qualifies even a single heavy syllable (H) to be binary, as it is bimoraic. The optimal form in (39) above with the stressed final syllable fulfils this stipulation, even though it is a single syllable since it is bimoraic. Thus, the typology of Assamese is the moraic trochee with only two types of feet namely, (LL) and (H).

Let us try to rank order all the constraints that we have invoked in the preceding sections, with the help of some examples. As we have already shown in (40):

40) pa.(tál) >> (pá.tal)

WSP >> ALIGN (HDFT,LEFT, PR WD,LEFT).

In the preceding sections, our hierarchy showed that ALIGN LEFT is undominated in the language. But the example in (40) shows that it is ranked below WSP, and therefore, no longer undominated.

The undominated status of FT BIN and FT TYPE TROCHAIC are maintained even in sequences with heavy syllables. Even though in the example given above these three constraints are satisfied, the interaction of these constraints in the hierarchy and the purport of the interaction becomes visible only when another constraint * CLASH is introduced into the hierarchy. However, the ranking of the other constraints can be inferred from the *transitivity* of strict domination. Since we have already shown that WSP dominates ALIGN-LEFT, therefore, by transitivity ALIGN-LEFT needs to be ranked above all the others. This result is shown in the Constraint Hierarchy given below:

41) WSP >> ALIGN LEFT >> PARSE SYLLABLE >> ALL FT LEFT

Let us integrate WSP with the other inviolable candidates and consider its implications. In the examples below, WSP is undominated as all the heavy syllables receive prominence because of the constraint. As we have already stated WSP makes it obligatory for any language to assign prominence to all the heavy syllables, either inside or outside a foot. In both the examples below the prominence of the heavy syllables are more important than the prominence of other light syllables, this constraint at this point of the hierarchy seems to be undominated. Therefore, in the hierarchy below, we rank WSP along with the other undominated constraints.

42).

In put :[bɔn.dʰɔ]	FT TRO	FT BIN	WSP	ALIGN L	PARSE σ	ALL FT L
a.☞ (bɔ́n).dʰɔ					*	
b. (bɔn.dʰɔ́)	*!	*	*!			
c. bɔn.(dʰɔ́)		*!	*	*	*	*

In the tableaux above, the candidates (42 b) and (42 c) are suboptimal because they violate WSP, whereas the optimal candidate (42 a) respects WSP. The pattern can be reaffirmed using a longer sequence also.

43)

Input : [a.nɔn.dɔ]	FT TYPE TROCHAIC	FT BIN	WSP	ALIGN LEFT	PARSE σ	ALL FT LEFT
a.☞ a.(nɔ́n).dɔ				*	**	*
b. (a.nɔ́n).dɔ	*!	*!			*	
c. (á)nɔn(dɔ̀)		*!*	*!		*!	**

In the tableau above, (43c) fatally violates WSP, and therefore it is suboptimal, on the other hand, (43a) respects WSP, along with FT BIN and FT TYPE TROCHAIC and therefore it is the optimal candidate.

At this point let us evaluate a sequence like (LL)(H) and see how the rhythmic effects are maintained with the combined operation of FT BIN and WSP.

44)

Input : [mɔ.rɔ.mɔr]	FT TRO	FT BIN	WSP	ALIGN L	PARSE σ	ALL FT L
a.☞ (mɔ́.rɔ)(mɔ́r)						**
b. (mɔ.rɔ́) (mɔ́r)	*!					**
c. (mɔ́.rɔ) mɔr			*		*!	

In the tableau above, the optimal candidate (44a) respects both FT BIN, FT TROCHAIC as well as WSP . Whereas the other two violates one of the three inviolable constraints. Therefore, until now in the hierarchy, it is important to respect all the three constraints.

To sum up, the hierarchy that has evolved for metrification till now, has the following order:

45) FT TYPE TROCHAIC, FT BIN , WSP

>>

ALIGN LEFT

>>

PARSE

>>

ALL FT LEFT

4.3.4 *CLASH

Another strong preference related to the distribution of stresses in SCA is the compulsory avoidance of adjacent stressed syllables. This preference is translated into the constraint *CLASH.

46) *CLASH

No stressed syllables are adjacent.

This requirement forbids the occurrence of two stressed syllables – i.e., a back-to-back parsing of two stressed syllables is prohibited by this constraint. In the example given below, the suboptimal form violates the constraint *CLASH because both the stressed syllables occur adjacent to each other.

47) (bɔ́n).dɔr >> (bɔ́n)(dɔ́r)

However, in the example given above the constraint WSP has been violated. This constraint is violated by any heavy syllable that is not prominent, either inside a foot or outside a foot. Therefore, the ranking logic in (48).

48) *CLASH >> WSP

We shall see in the following sections *CLASH is also undominated in the language, along with the three other constraints which we have successfully ranked in the preceding discussions. However, the violation of WSP, and the corresponding enforcement of *CLASH over WSP is indicative of the fact that WSP is not inviolable as we had said earlier, and therefore it has to be reranked.

4.3.5 A constraint hierarchy

49) a. (H)HL

(ɔ́s).tit.tɔ

b. (H)L(H)

gɔ́n.dɔ.gʊ̀l

c. (H)H(H)

ɔ́n.tɔr.dʰàn

d. (H)LL

bɔ́n.dɔ.na

e. L(H)L

gʊ.rʊ́t.tɔ

f. L(H)H

ɔ.hɔ́ŋ.kar

If we consider the examples given above, the hierarchy of ranking arguments can be expressed as given below. This involves the reranking of WSP, which we had considered to be an undominated constraint earlier.

50) FT TYPE TROCHAIC, FT BIN, *CLASH >> WSP >> ALIGN

The crucial example as per the Constraint Heirarchy in (50), is the harmonic candidate of (51):

51) (bɔ́n).dɔr >>(bɔ́n)(dɔ́r)

However, we have left out ALIGN LEFT and ALL FT LEFT from the tableau above. As we have already incorporated the rest of the constraints into the hierarchy, the ranking of ALIGN-LEFT can be inferred from the *transitivity* of strict domination. We have already shown that FT BIN and * CLASH dominate WSP, and WSP dominates ALIGN-LEFT. Therefore, by transitivity ALIGN-LEFT needs to be ranked below all the others. This result is shown in the tableau below:

52)

Input:	FT TROCHAIC	FT BIN	*CLASH	WSP	ALIGN LEFT	PARSE σ	ALL FT LEFT
a.☞ (bɔ́n).dɔr				*		*	
b. (bɔ́n .dɔr)		*!		*			
c. (bɔ́n).(dɔ̀r)			*!				*

The table above displays the interaction of the constraints invoked in the preceding sections. The undominated constraints ensure that feet are not only minimally and maximally bimoraic, but also that they militate against any adjacent stress. The ranking of *CLASH above WSP is an indication of the fact that the language respects quantity-sensitivity, but only to the extent that it will allow stress on adjacent syllables. It is not mandatory for the language to stress all heavy syllables. The constraint WSP can be violated minimally i.e. every heavy syllable is almost obligatorily stressed, unless it occurs in an environment where it clashes with another heavy syllable. ALIGN (HD FT, L, PR WD, L) is the one in which feet are as close as possible to the designated edge, as it is violable by other higher ranked constraints like FT BIN and WSP, and therefore orientation to the left edge is restricted by these constraints.

Let us figure out how (H)L(H) and (H)H(H) perform in the tableaux below so that we can postulate the final Constraint Hierarchy.

53)

Input: [gɔn.dɔ.gʊl]	FT TYPE TROCHAIC	FT BIN	*CLASH	WSP	ALIGN LEFT	PARSE SYLL	ALL FT LEFT
a.☞ (gɔ́n).dɔ.(gʊ̀l)						*	**
b. (gɔn.dɔ́).gʊl	*!	*!		*		*	
c. (gɔ́n. dɔ)(gʊ́l)		*!					**
d. (gɔn dɔ́).(gʊ̀l)	*!	*!	*!	*			**

In the tableau above, the optimal candidate satisfies the moraic interpretation of FT BIN, therefore, it is selected. Whereas, if (53a) is compared to (53c), then we can see that the violation of the moraic interpretation of FT BIN, proves costly for the candidate, and it is not selected.

In the example given above, WSP would have been fatally violated if the final heavy syllable did not receive secondary prominence. Moreover * CLASH is not violated because there is an intervening light syllable. FT BIN is satisfied because both the prominent syllables are heavy syllables and therefore bimoraic.

54)

Input: ɔn.tɔr.dʰan	FT TYPE TROCHAIC	FT BIN	*CLASH	WSP	ALIGN LEFT	PARSE σ	ALL FT LEFT
a.☞(ɔ́n).tɔr.(dʰàn)				*		*	**
b. (ɔ́n.tɔr).(dʰàn)		*!		*			**
c. ɔn.(tɔ́r).(dʰàn)			*!	*	*	*	*,**
d. ɔn.tɔr.(dʰán)				* *!	**	**	**

In the tableau given above, the suboptimal candidates violate the high ranked candidates therefore they are eliminated. Whereas the most optimal candidate violate only ALL FT LEFT , and therefore it is selected. On the other hand, in this example, the emergence of secondary prominence can be attributed to WSP. But the WSP violation of the intermediate heavy syllable is not a fatal violation as it satisfies * CLASH, which is undominated.

Thus secondary prominence is taken care of by FT BIN, WSP and PARSE SYLLABLE, whereas *CLASH blocks it whenever there is any possibility of the occurrence of two adjacent stressed syllables. Whereas in a sequence of light syllables, Iterativity was ensured by an undominated FT BIN and PARSE SYLL ,which dominate ALL FT LEFT, in a sequence with heavy syllables, however, there are other constraints which are responsible for secondary prominence along with PARSE SYLL. Since feet have to be bimoraic, there is no problem in assigning secondary prominence in syllables of the shape (H). For eg. (LL)(H). Here, the constraints FTBIN, WSP and PARSE SYLLABLE are actively involved in the assignment of secondary prominence.

4.4 Final Constraint Hierarchy

We have expanded our constraint hierarchy to include two more constraints which need to be integrated into the Constraint Hierarchy in the following manner:

55) FT TYPE TROCHAIC, FT BIN, *CLASH

>>

WSP

>>

ALIGN LEFT

>>

PARSE SYLLABLE

>>

ALL FT LEFT

The tableau in (56) attests the adequacy of the constraint hierarchy that we have postulated.

56)

Input: [ħaŋ.bi.dʰa.nik]	Ft Type Trochaic	Ft Bin	*Clash	WSP	Align left	Parse σ	All Ft Left
☞a.(ħáŋ).bi.dʰa (nìk)						**	***
b.(ħáŋ.bi)(dʰá. nik)		*!*!		*!			**
c.(ħáŋ).(bì.dʰa).(nìk)			*!				*,***
d.(ħáŋ).bi.(dʰà.nik)		*!		*			**
e.ħaŋ.(bi.dʰá).(nìk)	*		*!	*!	*!	*	*,***
f.(ħáŋ.bi).(dʰà).nik		*!*		*!		*	**

Thus the final constraint hierarchy of SCA shows that the three non-violable constraints must be satisfied even at the cost of violation of all the lower ranked ones. This is not difficult to achieve because these constraints are not competing with each other. FT BIN ensures the construction of the desired foot shape, be it (LL) or (H) and once this is accomplished *CLASH prohibits prominence in the neighbouring syllable. FT BIN establishes the ideal foot shape, whereas *CLASH is a rhythmic constraint. Once the higher ranked candidates are satisfied the lower ranked WSP and ALIGN L constrain the stressable elements in the desired optimal candidate, by insisting on a certain degree of prominence on heavy syllables and a leftward orientation of the *head foot* and *Prosodic Word* as shown by (e) in the tableau. Moreover, in the language, even though FT BIN dominates WSP, they do not militate against each other in all contexts. FT BIN is satisfied whenever the foot shapes comply with the bimoraic criteria. This means that FT BIN will not be violated even if all heavy syllables are stressed. But this constraint ensures that a sequence of (LL) is not excluded from metrical parsing and stress assignment. Unlike FT BIN, the other undominated constraint constantly militates against WSP. Thus this pattern creates a peculiar pattern in Assamese. In the literature of OT, it has been shown that systems in which *CLASH supercedes WSP in the domination hierarchy, can be classified as partially quantity insensitive metrical systems. In this language, the ranking of FT BIN along with *CLASH shows that it is almost veering towards a quantity sensitive system. This tendency has been restricted by the rhythmic requirement enforced by *CLASH. Thus, in the language, WSP will favour weight effects wherever no risk of stress clash arises.

Conclusion

We conclude that, Assamese has a metrical system where feet are obligatorily bimoraic and are parsed exhaustively in a left – to - right direction. It also clamps a strong ban on adjacent stressed syllables resulting in alternating stress on sequences of heavy syllables or back-to-back parsing of sequences of light syllables, with stress on the initial syllable.

CHAPTER 5

SOME ASPECTS OF PROMINENCE IN ASSAMESE ENGLISH

5.0 Introduction and plan of the chapter

Unlike acquisition of the first language, which is accomplished with remarkable ease, the pattern for second language learning is neither smooth nor as efficient as that of the first language. Even after long exposure and expert instruction, only a few manage to achieve a native like competence in the target language. Until now, various theories of Second Language Acquisition have been offered to explain the phenomena. Contrastive analysis (Lado, 1957), one of the earliest approaches held that language learning whether of a first or second language, is a form of habit formation. Following Chomsky's critique of behaviouralism, (which also cast doubts on CA), a new line of research was initiated by the CC (Creative Construction) hypothesis (Dulay, 1982), which proposed that Second Language Acquisition was a process not of habit formation but of grammar construction mediated by an internalized language acquisition device (LAD). Later research has successfully applied the insights of current linguistic theory to Second Language Acquisition research. These researchers have suggested that the principles of Universal Grammar are operative even during the acquisition of a second language, so much so that they found regular acquisition patterns irrespective of L1. However, these researchers have agreed that Second Language Acquisition exists in various stages of approximation to the respective target languages.

The scope of our present inquiry is very limited. Even though we agree that language universals play a major role even while acquiring a second language, it cannot be discounted that one's native tongue exercises a dominant role in the acquisition of the phonology of another language. Even though Second Language Acquisition is constrained by the principles of universal grammar as well as the universal nature of language acquisition, nonetheless, it is well attested that one's native tongue being one's best friend as well as worst enemy, hinders a complete acquisition of a second language to some extent, though not entirely.

We do not take upon ourselves the burden of theorizing and arguing for any specific theoretical paradigm on the issue of Second Language Acquisition. In the following discussion, we will only present a descriptive account of the aspects of prominence of the speakers of Assamese English (henceforth AE).

What we call AE is the English spoken by the educated speakers of Assamese. Moreover, it can be considered as a variety of Indian English. Even though studies have been conducted to investigate prominence in Indian English as a language type (Choudhary, 1993), and other varieties such as Tamilian English (Vijaykrishnan, 1978), etc., there has been no research at all to study the characteristics of AE.

In this chapter, we will briefly summarize the pattern of prominence in SCA and English, in the first section. In the second section, we will compare the patterns of prominence in AE with that of English. We will try to account for the deviations as far as possible. In the third section we will summarize the patterns of prominence in AE and analyze the AE patterns using the Optimality Theory framework.

5.1 A brief summary of prominence in Assamese English

Recall that in Chapter 2, we had given a descriptive account of SCA, where we had characterized the SCA prominence as below:

1) a. Primary prominence is on the second syllable if it is heavy, and the first syllable is light, if not,
   b. Primary prominence is on the first syllable.
   c. Secondary prominence is on the first of alternating light syllables.
   d. A heavy syllable is prominent if the preceding syllable is not prominent.
   e. Stress clash is avoided.

5.2 **A brief summary of prominence in English**

However, there are some fundamental differences in the organization of prominence in SCA and that of English. English follows a Germanic stress pattern where stress is lexical as well as regular (rule bound). We will try to give a cursory description of stress in English. Stress feet in English are maximally binary. It is left dominant and quantity sensitive only at the right edge of the word. Moreover, stress feet in English are constructed from right to left. Apart from these features some of the distinguishing characteristics of stress in English are given below:

English is a quantity sensitive language to the extent that it crucially depends on vowel length and syllable weight. (Halle,1977)

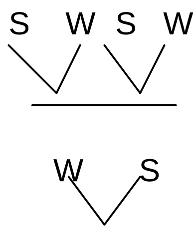
E.g., divine obscene

2) Word trees may be freely left branching or right branching.

(Kiparsky 1979, Hayes 1980).

In a configuration N_1 N_2 , N_2 is strong if

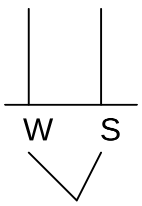
a) It branches: gemination



b) The tree dominates a verb or adjective, N_1 doesn't branch, and

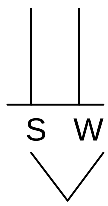
N_2 doesn't dominate – ate or –ize:

Bombard



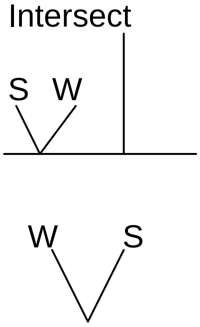
but

donate



c) The tree dominates a verb, N_2 dominates a stem:

Intersect



Otherwise N_1 is labeled strong.

3) i. The basic regularity of the English stress system appears in verbs and unsuffixed adjectives. They are stressed on the final syllable if

it has a long vowel or ends in a string of at least two consonants; otherwise, the penultimate is stressed.

a) verbs obéy molést astónish

atóne usúrp devélop

b) adjectives divíne robúst cómmon

discreét ovért illícit

The pattern is evidently quantity sensitive, but it is remarkable that final stress occurs with ‘two’ final consonants, as in the second column. Hayes (1980), proposes that word final consonants are extrametrical, by a rule called consonant extrametricality.

ii) With nouns, the most regular cases have stress on one syllable to the left of where it appears in verbs and suffixed adjectives. That is, a heavy penult is generally stressed; the antepenultimate is stressed if the penult is light.

América	Arizóna	agénda
Díscipline	factótum	appéndix
Lábyrinth	elítist	amálgam

Hayes proposed a rule which marks word final rimes as extrametrical in English nouns, called noun extrametricality.

iii) Morphological information also plays a role in the assignment of stress in English. For example, adjectives which end with suffixes such as – ed, - ous, - ent, - ant, and – ive have different stress patterns depending on the suffix. (Stress in English is sensitive to different suffixes in different ways, but we do not go into the details here.) Many derived adjectives follow the pattern of regular nouns.

Munícipal	adjectíval	fratérnal
Magnánimous	desírous	treméndous

These adjectival suffixes are marked extrametrical and they are referred to as adjective extrametricality. (exception – ic).

To sum up, the rules of Long Vowel Stressing and English Stress Rule interact with three extrametricality rules to produce a complex pattern of prominence in English.

4) Moreover, another aspect which distinguishes the English stress system is the cyclic application of stress. Chomsky and Halle (1968), proposed that English stress rules apply cyclically, assigning stress after each process of derivation. For e.g.,

```
    1                          1
indent                     detest --------------   cycle 1


 3  4  1                    3  4  1
Indentation                detestation ---------- cycle 2
```

Notice that the primary stressed syllable of cycle 1 has been demoted to the fourth level on cycle 2.

Comparing the above two examples with the ones below drives home the point regarding cyclicity.

```
  1       3                  1     3
Compensate                  confiscate ------      cycle 1

  3   0  1                    3  0   1
Compensation                confiscation -----     cycle 2
```

In these words, the second syllables are stressless because in the words of the inner cycles these syllables are stressless.

However this is the SPE (1968) model and many modifications of this rule have been offered by Kiparsky (1979), Selkirk (1980), Hayes (1982) and several others.

(This is far from an exhaustive description of prominence in English. There are more complete descriptions as well as explanations, the relevant literature can be found in Hayes (1980), Burzio (1994) etc. Our analysis is based on Hayes (1980). It is quite simplistic as it only gives only a basic outline of the patterns, so as to enable us compare it with the patterns of prominence in Assamese English.)

5.2.1 **Comparison of prominence in AE and English**

Look at the LL / LLL paradigms given below. The prominence pattern for the SCA English forms is always initial. Whereas the corresponding native forms are sometimes initial and sometimes not. In 3) the patterns in AE and English are the same.

5)	Word	P F in English	PF in A E
a.	Coffee	[kɔ́.fi]	[kɔ́.fi]
b.	Happy	[hǽ.pi]	[hǽ.pi]
c.	Pity	[pí.ti]	[pí.ti]
d.	Camera	[kǽ.mə.rə]	[kɛ́.mɛ.ra]
e.	Cinema	[sí.nə.mə]	[sí.ne.ma]

However, in the following words prominence in A E is different from prominence in English.

6)	Word	P F in English	PF in AE
a.	Taboo	[tə.bʊ́ː]	[tɛ́.bu]
b.	Payee	[pei.íː]	[pɛ́.i]
c.	Rupee	[rʊː.píː]	[rʊ́.pi]
d.	Tomato	[tə.mɑ́ː.təʊ]	[tɔ́.mɛ.to]
e.	Marina	[mə.ríː.nə]	[mé.ri.na]

The striking difference between native English and AE is that all instances of vowel length in English have been eliminated in AE. Further morphological information, in this case, –ee as a stress attracting suffix, is lost in AE. In both cases, the direction of change is towards SCA which lacks phonemic vowel length and where morphology is irrelevant for assigning prominence.

5.3.2 Comparison of HH foot shapes

The following words of the syllable shapes HH are sometimes compatible with the native forms and sometimes not. This is because of the fact that whatever is considered heavy by SCA speakers of English is not necessarily considered the same by native English speakers (because of consonant extrametricality, noun extrametricality etc.)

7)	Word	P F in English	PF in AE

a. Syntax	[sín.tæks]	[sín.tɛks]
b. Tempest	[tém.pest]	[tɛ́m.pɛst]
c. Insect	[ín.sekt]	[ín.sɛkt]
d. disguise	[díz.gaiz]	[díz.gaiz]

HH – primary prominence on different syllables.

8)	WordP F in English	PF in AE
a. Confess	[kən.fés]	[kón.fes]
b. Intent	[in.tént]	[ín.tent]
c. Complain	[kəm.pleím]	[kóm.plein]
d. Baptize	[bæp.taíz]	[bɛ́p.taiz]

5.3.3 Comparison of LH foot shapes

In the words with the SCA pattern L H given below primary prominence is on the same syllable, in both the English and AE systems.

9)	Word	P F in English	PF in AE
	a. Divine	[di.vaín]	[di.bʰaín]
	b. Molest	[məu.lést]	[mɔ.lést]
	c. robust	[rəu.bʌ́st]	[ro.bást]
	d. overt	[əu.vɜ́ːt]	[o.bʰért]

However, in the disyllables with the pattern LH given below, prominence occurs on different syllables in the two systems.

10)	Word	P F in English	PF in AE
	a. Garage	[gǽ. rɑːʒ]	[ge.réz]
	b. Damage	[dǽ.midz]	[dɛ.mɛ́z]
	c. Balance	[bǽ .ləns]	[bɛ. lɛ́ns]
	d. Tenant	[té.nənt]	[tɛ.nɛ́nt]

5.3.4 English Noun – Verb distinctions in AE

Moreover, the distinction between noun – verb pairs in English is not systematically maintained in AE, where prominence is based entirely on the comparative weight of the first and second syllables.

11) Word		P F in English	PF in AE
	Noun	Verb	
a. Transfer	[trǽns.fɜː]	[træns.fɜ́ː]	[tréns.fer]
b. Permit	[pɜ́ː.mit]	[pə.mít]	[pér.mit]
c. Export	[ék.spɔːt]	[ik.spɔ́ːt]	[ék.sport]
d. Produce	[prɔ́.djʊːs]	[prə.djʊ́ːs]	[prɔ.djʊ́ːs]

As we have already said, the composition of the foot is solely determined by syllable weight in SCA. Whereas in English, other factors participate to create a complex pattern of stress in the language. The SCA patterns are carried over to A E also.

5.3.5 Secondary prominence in AE

Secondary prominence is iterative in sequences of light syllables in Assamese. Let us see the pattern of secondary prominence in AE.

12) Word	P F in English	PF in A E
a. Stability	[stə.bí.lə.ti]	[sté.bi.lì.ti]
		(LL)(LL)
b. Inability	[ì.nə.bí.lə.ti]	[í.ne.bì.li.ti]
		(LL)(LL)L
c. Illogicality	[i.lɔ̀.dʒi.kǽ.lə.ti]	[í.lɔ.zì.kɛ.lì.ti]
		(LL)(LL)(LL)
d. Inadequacy	[i.nǽ.di.kwə.si]	[í.nɛ.dì.kwɛ.si]
		(H)L(LL)L
e. Condensation	[kɔ̀n.den.seí.ʃən]	[kɔ́n.den.se.sɔ̀n]
		(H)HL(H)
f. Generation	[dʒè.nə.reí.ʃən]	[zɛ́.nɛ.re.sɔ̀n]
		(LL)L(H)
g. Congratulation	[kən.græ̀.tʃʊ.leí.ʃən]	[kɔ́n.gre.sʊ̀.le.sɔ̀n]
		(H)L(LL)(H)

We see that foot shape is according to the AE syllabification, where all English long vowels and diphthongs have been reduced to a single mora.

Thus we can see that iterativity appears in A E as in SCA. This is evident in the stressing alternating light syllables in a sequence of light syllables, in both SCA and AE. On the other hand, we can also see that even in AE all coda consonants are considered moraic. Therefore, heavy syllables are stressed, if stress clash does not arise. Secondary prominence emerges due to the stressing of alternating light syllables. However, iterativity is impeded, in the presence of heavy syllables. English does not follow this pattern. Coda consonants are moraic in English, but due to the rules of consonant extrametricality, the syllables that are considered heavy in SCA, are not necessarily heavy in English.

5.4 OT analysis of SCA English prominence

Since the facts of prominence placement in AE are carried over from SCA, the same constraint hierarchy will also account for prominence facts of AE. In this section, we shall illustrate the working of the Constraint Hierarchy proposed for SCA on English words. We assume that the English words have been appropriately modified to suit the segmental requirements of AE, for ease of presentation. Of course, in OT, there is no need for ‘fixing’ the input representation one way or the other since the Constraint Hierarchy responsible for the segmental inventory of the language will automatically select the required output (irrespective of the input vis-a- vis ‘Lexicon Optmization’ in OT). We have ignored all these segmental effects in our presentation of AE prominence.

Let us take an LLL sequence in AE, to demonstrate the working of the constraint hierarchy that we had posited for SCA.

13)

Input: Tomato	FT TRO	FT BIN	*CLASH	WSP	ALIGN L	PARSE σ	ALL FT L
a.☞ (tɔ́.mɛ)to						*	

b. (tɔ́).(mɛ̀.to)		*!	*!				*
c. (tɔ́.mɛ).(tò)		*!					**
d. (tɔ.mɛ́).to	*!					*	
e. tɔ.(mɛ́.to)					*!	*	*

The optimal candidate (13 a) incurs only one violation of PARSE SYLLABLE compared to the fatal violation of the other candidates. The other candidates violate one or more of the undominated constraints and therefore they are rejected. However, to find out the conflicting preferences we will have to test the constraint hierarchy with longer sequences; i.e., whether the same constraints that are responsible for rhythmic prominence in SCA, are responsible for prominence in A E as well. Moreover, to determine the effects of quantity sensitivity, we will examine how the hierarchy performs with sequences containing heavy (closed) syllables.

Consider first a six syllabled sequence of light syllables.

14.

Input: 'Illogicality'	FT TRO	FT BIN	*CLASH	WSP	ALIGN L	PARSE σ	ALL FT LEFT
.☞(í.ˈɔ).(zì.kɛ)(ˈì.ti)							**,****
b.(i.ˈɔ́)(zì).kɛ.(ˈì.ti)	*!	*!	*			*	**,****
c. (í)(ˈɔ́.zì)(kɛ.ˈì)ti	*!	*!	*!			*	*,***
d. i.(ˈɔ.zí)kɛ.(ˈì.ti)	*!				*	**	*,***
e.(í.ˈɔ). zI.kɛ (ˈì.ti)						**!	****
f..i.(ˈɔ́. zì).(kɛ̀ˈi)ti					*	**	*,***

Comparing the two candidates (14e) and (14a) above, we can see that whereas candidate (14e) makes fatal violations of PARSE SYLLABLE. candidate (14 a) comes out unscathed in this ranking. Even though the latter makes more violations of ALL FT LEFT, than the former it does not affect the ranking, as it is the lowest ranked in the hierarchy. Finally, candidates (14 f) the one closest to English pronunciation is non optimal as it violates ALIGN L.

Thus we can see that PARSE SYLLABLE and FT BIN are responsible for reinforcing iterativity in A E also. All the candidates which violate these two constraints are rendered invalid by the strict operation of these two constraints.

Let us see how weight effects are realized in A E. We will try to see if the constraints which enforce that heavy syllables should be prominent enforce the same regulations in A E also or not. Let us take the example 'Condensation'.

15).

Input: Condensation	FT TRO	FT BIN	*CLASH	WSP	ALIGN L	PARSEσ	ALL FT LEFT
.☞(kɔ́n) den.se(sɔ̀n)				*			***
b.(kɔ́n.den)(sé.sɔn)		**		* *			**
c.(kɔ́n).(dèn)(sè) sɔn		*	*! *	*		*	*,**
d.kɔn.(dén.se). sɔ̀n		*		*!*	*	**	*

Notice that candidate 15 (b) and (d) violate FT BIN as SCA selects the moraic interpretation of foot binarity requiring that a foot dominate precisely two moras.

Thus we can see that the weight effects that are there in SCA also emerge in A E, to the effect that *CLASH is one of the predominant aspects of A E prominence. WSP ensures that all heavy syllables are assigned prominence, provided there is no stress clash. Therefore, the same constraint hierarchy that characterizes prominence in SCA , is responsible for the assignment of prominence to A E as well Thus we can summarize our findings in the dissertation with the Constraint hierarchy for SCA and AE as in 16 below.

16) RH-CONTOUR, FT TYPE TROCHAIC, FT BIN, *CLASH

>>

WSP

>>

ALIGN LEFT

>>

PARSE SYLLABLE

>>

ALL FT LEFT

We would like to end our discussion of AE with a cursory look at English diphthongs and their interpretation in AE.

17)

Diphthongs

English	AE	Words	PF in AE	
a. [ei]	[ɛ]	delay	[dí.lɛ]	(monomoraic)
b. [əʊ]	[o]	fellow	[fé.lo]	(monomoraic)
c. [iə]	[i.e]	real	[rí.e.li]	(disyllabic)
d. [ɛə]	[e.a]	air	[e.ár]	(disyllabic)
e. [ʊə]	[ʊ.o]	poor	[pʊ́.or]	(disyllabic)
f. [ai]	[ai]	deny	[di.naí]	(bimoraic)

g. [aʊ]   [aʊ]   allow   [e.laʊ́]   (bimoraic)

It is interesting to note that in the last two examples the final syllables are bimoraic and hence heavy. The fact that only the English diphthongs [ai] and [aʊ] are interpreted as bimoraic in AE should not come as a surprise, as the diphthongs exist in SCA, where also they are interpreted as bimoraic.

Thus we see that the English vocalic system is re – interpreted in AE to make it fall in line with that of SCA and once the moraic values of vocalic elements are adjusted, AE patterns exactly like SCA as far as prominence is concerned.

SELECT BIBLIOGRAPHY

Alber, Birgit (1997) Quantity sensitivity as the result of constraint interaction. In G. E.Booij and J. van de Weijer (eds.), *Phonology in progress: progress in Phonology*. HILphonology papers III. The Hague: Holland Academic Graphics,45.

Beckman Mary E (1986) *Stress and Non – Stress Accent*. Dordrecht: Foris.

Bolinger, Dwight (1958) A theory of pitch accent in English. *Word* 14, 109-149. Reprinted in Abe and Kanekiyo, 1965, 171-81

Burzio, Luigi (1994) *Principles of English stress*. Cambridge University Press.

Chaudhary, Shreesh Chandra (1993) Issues on Indian English phonology: *World Englishes* 12:3, 375-83

Chomsky, Noam (1957) *Syntactic structures*. The Hague: Mouton.

Chomsky, Noam and Morris Halle (1968) *The sound pattern of English*. New York. Harper and Row.

Clements, George N. and Samuel J. Keyser (1983) *CV phonology: a generative theory of the syllable*. Cambridge. Mass.: MIT Press.

Fry, Dennis B (1955). Duration and intensity as physical correlates of linguistic stress. *Journal of the Acoustical Society of America* 27, 765-68.

Goldsmith, John (1990) *Autosegmental and metrical phonology*. Oxford: Blackwell.

Goldsmith, John (ed.) (1995) *The handbook of phonological theory*. Oxford: Blackwell.

Goswami, G. C. (1982) *Structure of Assamese*. Department of Publication, Gauhati University.

Halle, Morris and Jean – Roger Vergnaud (1987) *An essay on stress*. Cambridge, Mass

Hayes, Bruce (1980) A metrical theory of stress rules. PhD dissertations, MIT. [Published 1985, New York: Garland]

(1985) Iambic and trochaic rhythm in stress rules. In M. Niepokuj, M. VanClay, V. Nikiforidou, and D. Jeder (eds.), *Proceedings of the Berkeley Linguistics Society* 11. 429 – 46.

(1987) A revised parametric metrical theory. In J. McDonough and B. Plunket (eds.) *Proceedings of the North East Linguistic Society* 17. 274 – 89

(1989) Compensatory lengthening in moraic phonology. *Linguistic Inquiry* 20. 253 – 306.

(1995) *Metrical stress theory: principles and case studies*. University of Chicago Press.

Hogg, R. and C. B. McCully (1987) *Metrical Phonology: a coursebook*. Cambridge: Cambridge University Press.

Hyman, Larry (1985) *A theory of phonological weight*. Dordrecht: Foris.

Kager, Rene (1989) *A metrical theory of stressand destressing in English and Dutch*.

Dordrecht: Foris.

(1992 b) Are there any truly quantity – insensitive systems? In L. A. Buszard - Welcher, L. Lee, and W. Weigel (eds.), *Proceedings of the Berkeley Linguistics Society* 18. 123 –132.

(1993) Alternatives to the iambic – trochaic law. *Natural Language and Linguistic Theory*. 11. 381 –432.

(1995) Review of Hayes 1995. *Phonology* 12. 437 – 64.

(1999) *Optimality Theory*. Cambridge University Press.

Kakati, B. K. (1972) *Assamese, its formation and Development. Department of Publication*, .Gauhati University. 3rd edn., Lawyer's Book Stall, Gauhati.

Kenstowicz, Michael (1994 a) *Phonology in generative grammar*. Oxford: Blackwell.

Lehiste, Ilse. (1970) *Suprasegmentals*. MIT Press.

Liberman, Mark and Alan Prince (1977) On stress and linguistic rhythm. *Linguistic Inquiry* 8. 249-336.

Lieberman, Philip and Shiela E. Blumstein (1988) *Speech physiology, speech Perception, and acoustic phonetics.* Cambridge University Press.

McCarthy, John and Alan Prince (1986) Prosodic morphology. Ms., University of Massachusets, Amherst and Brandeis University, Waltham, Mass. [Annotated Version 1996, issued as Technical report no. 32, Rutgers Center for Cognitive Science.]

(1990) Foot and word in morphology: the Arabic broken plural. *Natural Language and Linguistic theory* 8. 209 – 83.

(1993 a) Generalized Alignment. In G. E. Booij and J. van Marle (eds), *Yearbook of Morphology 1993*. Dordrecht: Kluwer. 79 –153.

(1993 b) Prosodic Morphology I: constrant interaction and satisfaction. Ms.,University of Massachusetts. Amherst and Rutgers University. [To appear as Technical report no. 3, Rutgers University Center for Cognitive Science. Cambridge, Mass.: MIT Press.]

Peterson Gordon E., and Ilse Lehiste (1960) Duration of syllable nuclei in English. *Journal of the Acoustical Society of America* 32, 693-703.

Pickering, Lucy and Caroline Wiltshire. (2000). The prosody of Indian – English TAs. teaching discourse. *World Englishes*. 19:2, 173-83

Prince, Alan (1980) A metrical theory for Estonian quantity. *Linguistic Inquiry* 11. 511 – 62.

Prince, Alan and Paul Smolensky (1993) Optimality Theory: constraint interaction in generative grammar. Ms., Rutgers University, New Brunswick and University of Colorado, Boulder. [To appear as Technical report no. 2, Rutgers University Center for Cognitive Science. Cambridge, Mass.: MIT Press.]

Ritsma, R. J. (1962) Existence region of the tonal residue *I. Journal of the acoustical Society of America* 34, 1224 -29.

Rossi, Mario, and Denis Autessere (1981) Movements of the hyoid and the larynx and the intrinsic frequency of vowels. *Journal of Phonetics* 9, 233-49.

Selkirk, Elizabeth O. (1980) The role of prosodic categories in English word stress. *Linguistic Inquiry* 11. 563-605.

(1984) *Phonlogy and Syntax*: the relation between sound and structure. Cambridge, Mass.: MIT Press.

Smolensky, Paul (1993) Harmony, markedness, and phonological activity. Handout to Talk presented at Rutgers Optimality Workshop 1, 23 October 1993, New Brunswick, N. J. [ROA-87 , http:// ruccs.rutgers.edu/roa.html]

(1995) On the internal structure of the constraint component *Con* of UG. Handout to talk presented at University of California, Los Angeles, 7 April 1995. [ROA-86, http:// ruccs.rutgers.edu/roa.html]

Steele, Shirley A. (1985) Vowel intrinsic Fundamental Frequency in Prosodic Context. Doctoral Dissertation, University of Texas at Dallas.

Vanvik, A. (1963) Some problems in Scandinavian tonemics; *Phonetica* 10.

Vijaykrishnan, K.G. (1979) Stress in Tamilian English - A study within the framework of Generative Phonology. M. Litt Dissertation, CIEFL, Hyderabad.

Wiltshire, Caroline and Russell Moon (2000) The Phonetic Correlates of Stress in Indian English,. Handout of a paper presented at ‘The International Conference on Stress and Rhythm’ Hyderabad, 11-15 Dec,2000

Appendix I

Statistical significance of vowel duration

word	vowel1	Vowel2	vowel3	P value
zaba	0.12	0.11		
	0.15	0.12		
	0.07	0.08		
	0.08	0.09		**.2951**
zibi	0.08	0.13		
	0.06	0.07		
	0.08	0.11		
	0.08	0.1		**.1790**
zabor	0.15	0.1		
	0.11	0.12		
	0.08	0.1		
	0.08	0.09		**.0032**
bagan	0.07	0.09		
	0.1	0.08		
	0.15	0.13		
	0.12	0.13		**.0020**
andhar	0.12	0.12		
	0.09	0.16		
	0.09	0.1		
	0.08	0.1		**.0111**
bondor	0.14	0.11		
	0.12	0.1		
	0.09	0.08		
	0.08	0.09		**.0065**
bizuli	0.12	0.08	0.09	
	0.1	0.08	0.08	
	0.06	0.06	0.06	
	0.09	0.05	0.06	**.0485**
gohona	0.09	0.07	0.1	
	0.06	0.1	0.13	
	0.07	0.07	0.09	
	0.09	0.05	0.1	**.0360**
zuburi	0.08	0.06		

	0.12	0.08		
	0.08	0.07		
	0.09	0.06		
average	**0.0925**	**0.0675**		**.0348**
				P value
moromor	0.15	0.08		
	0.14	0.08		
	0.09	0.07		
	0.1	0.07		
average	**0.12**	**0.075**		.01104
zazabor	0.1	0.11	0.09	
	0.11	0.09	0.08	
	0.08	0.08	0.06	
	0.09	0.08	0.06	
average	**0.095**	**0.09**	**0.0725**	0.132842
anondo	0.08	0.09	0.1	
	0.09	0.11	0.13	
	0.05	0.06	0.09	
	0.05	0.06	0.1	
average	**0.0675**	**0.08**	**0.105**	**0.046205**
gurutto	0.1	0.06	0.08	
	0.13	0.08	0.07	
	0.08	0.05	0.07	
	0.1	0.05	0.07	
average	**0.1025**	**0.06**	**0.0725**	**0.01047**
anondor	0.05	0.07	0.07	
	0.07	0.11	0.08	
	0.05	0.08	0.08	
	0.06	0.08	0.05	
average	**0.0575**	**0.085**	**0.07**	**.00066**
guruttor	0.07	0.06	0.09	
	0.06	0.1	0.09	
	0.06	0.04	0.07	
	0.08	0.04	0.08	
average	**0.0675**	**0.06**	**0.0825**	
buronzi	0.12	0.1	0.09	
	0.14	0.1	0.11	
	0.09	0.05	0.05	
	0.12	0.06	0.05	
average	**0.1175**	**0.0775**	**0.075**	.**0447**

onzona	0.1	0.07	0.12	
	0.11	0.07	0.11	
	0.06	0.08	0.07	
	0.08	0.07	0.08	
average	**0.0875**	**0.0725**	**0.095**	**.0246**
bondona	0.12	0.09	0.09	
	0.1	0.09	0.07	
	0.08	0.06	0.07	
	0.09	0.05	0.08	
average	**0.0975**	**0.0725**	**0.0775**	
andulon	0.1	0.06	0.11	
	0.1	0.06	0.07	
	0.07	0.04	0.07	
	0.07	0.05	0.08	
average	**0.085**	**0.0525**	**0.0825**	
gondogul	0.08	0.09	0.07	
	0.09	0.08	0.08	
	0.07	0.06	0.07	
	0.07	0.06	0.05	
average	**0.0775**	**0.0725**	**0.0675**	
bondhutto	0.14	0.06	0.09	
	0.14	0.08	0.1	
	0.08	0.05	0.09	
	0.09	0.05	0.08	
average	**0.1125**	**0.06**	**0.09**	
ostitto	0.09	0.07	0.11	
	0.11	0.04	0.11	
	0.12	0.05	0.09	
	0.13	0.05	0.08	
average	**0.1125**	**0.0525**	**0.0975**	
ontordhan		0.08	0.1	
		0.08	0.11	
		0.08	0.06	
		0.09	0.07	
average		**0.0825**	**0.085**	

Appendix II

Mean values and statistical significance of syllable duration

Word	**Type**	**Syll 1**	**syll 2**	**syll 3**	**P value**	**Std Dev**
Zaba	LL	0.21	0.2			
		0.15	0.12			
		0.19	0.19			
		0.17	0.14			
Average		**0.18**	**0.1625**		**0.295167**	**0.03182**
Zibi	LL	0.21	0.21			
		0.22	0.22			
		0.21	0.16			
		0.17	0.16			
Average		**0.2025**	**0.1875**		**0.17907**	**0.024495**
Zabor	LH	0.24	0.3			
		0.18	0.28			
		0.22	0.29			
		0.16	0.23			
Average		**0.2**	**0.275**		**0.003239**	**0.05092**
Bagan	LH	0.16	0.26			
		0.2	0.28			
		0.27	0.38			
		0.23	0.36			
Average		**0.215**	**0.32**		**0.002074**	**0.074594**
Andhar	HH	0.23	0.29			
		0.16	0.34			
		0.16	0.19			
		0.19	0.23			
Average		**0.185**	**0.2625**		**0.111848**	**0.063682**
Bondor	HH	0.37	0.23			
		0.33	0.2			
		0.41	0.21			
		0.31	0.21			
Average		**0.355**	**0.2125**		**0.006512**	**0.08193**
Bizuli	LLL	0.21	0.2	0.16		

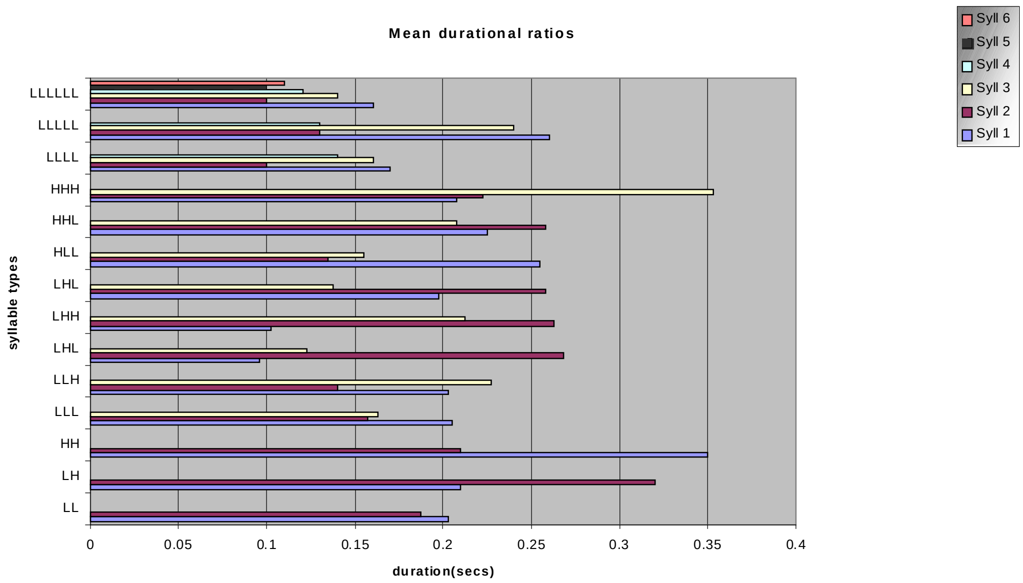
		0.2	0.18	0.16		
		0.22	0.17	0.13		
		0.19	0.16	0.12		
Average		**0.205**	**0.1775**	**0.1425**	**0.048567**	**0.030896**
Gohona	LLL	0.23	0.16	0.16		
		0.18	0.21	0.18		
		0.23	0.16	0.16		
		0.18	0.1	0.15		
Average		**0.205**	**0.1575**	**0.1625**	**0.164489**	**0.036307**
Zuburi	LLL	0.21	0.18	0.14		
		0.13	0.19	0.15		
		0.25	0.14	0.13		
		0.2	0.1	0.13		
Average		**0.1975**	**0.1525**	**0.1375**	**0.33489**	**0.043301**
moromor	LLH	0.21	0.17	0.2		
		0.24	0.15	0.27		
		0.19	0.14	0.23		
		0.17	0.1	0.21		
Average		**0.2025**	**0.14**	**0.2275**	**0.011044**	**0.047098**
Zazabor	LLH	0.25	0.19	0.22		
		0.23	0.18	0.26		
		0.24	0.17	0.25		
		0.17	0.16	0.21		
Average		**0.2225**	**0.175**	**0.235**		
Anondo	LHL	0.1	0.31	0.13		
		0.11	0.29	0.16		
		0.08	0.24	0.09		
		0.09	0.23	0.11		
Average		**0.095**	**0.2675**	**0.1225**		
Gurutto	LHL	0.18	0.21	0.23		
		0.19	0.22	0.19		
		0.18	0.18	0.16		
		0.18	0.2	0.17		
Average		**0.1825**	**0.2025**	**0.1875**		
Anondor	LHH	0.1	0.27	0.22		
		0.13	0.29	0.2		
		0.08	0.26	0.25		
		0.1	0.23	0.18		
Average		**0.1025**	**0.2625**	**0.2125**	**0.000668**	**0.0735**

Guruttor	LHH	0.13	0.21	0.27		
		0.19	0.2	0.22		
		0.19	0.22	0.3		
		0.15	0.21	0.27		
Average		**0.165**	**0.21**	**0.265**		
Buronzi	LHL	0.19	0.27	0.15		
		0.19	0.29	0.15		
		0.23	0.24	0.14		
		0.18	0.23	0.11		
Average		**0.1975**	**0.2575**	**0.1375**	**0.054798**	**0.055288**
Onzona	HLL	0.25	0.13	0.16		
		0.23	0.14	0.16		
		0.22	0.15	0.17		
		0.32	0.12	0.13		
Average		0.225	0.135	0.155	**0.024646**	**0.060728**
bondona	HLL	0.31	0.14	0.16		
		0.33	0.13	0.18		
		0.33	0.14	0.15		
		0.3	0.09	0.13		
Average		0.3175	0.125	0.155		
Andulon	HLH	0.12	0.12	0.3		
		0.1	0.11	0.31		
		0.08	0.11	0.33		
		0.09	0.09	0.28		
Average		0.3175	0.1075	0.305	**0.000177**	**0.100995**
gondogul	HLH	0.33	0.13	0.25		
		0.31	0.12	0.25		
		0.27	0.12	0.27		
		0.25	0.12	0.19		
Average		0.29	0.1225	0.24	**0.002044**	**0.077942**
bondhutto	HHL	0.29	0.22	0.21		
		0.35	0.27	0.24		
		0.3	0.23	0.19		
		0.27	0.23	0.19		
Average		0.3025	0.2375	0.2075	**0.004901**	**0.04814**
Ostitto	HHL	0.25	0.25	0.21		
		0.25	0.26	0.23		
		0.17	0.25	0.19		
		0.23	0.25	0.2		
Average		0.225	0.2575	0.2075		

ontordhan	HHH	0.2	0.24	0.32		
		0.2	0.23	0.41		
		0.21	0.22	0.39		
		0.22	0.2	0.29		
Average		0.2075	0.2225	0.3525	**0.018825**	**0.074889**

SYLLABLE DURATION VALUES

WORD	**SYLL 1**	**SYLL 2**	**SYLL 3**	**SYLL 4**	**SYLL 5**	**SYLL 6**	**SIGNIFICANCE 1**	**SIGNIFICANCE 2**
Alusona	0.13	0.14	0.16	0.11				
	0.1	0.07	0.07	0.1				
	0.1	0.09	0.17	0.12				
	0.07	0.09	0.2	0.12				
Average	**0.1**	**0.0975**	**0.15**	**0.1125**			0.836083	0.210058
aradhona	0.11	0.17	0.16	0.15				
	0.1	0.17	0.15	0.18				
	0.07	0.15	0.15	0.13				
	0.13	0.16	0.16	0.12			0.011507	0.545627
Average	**0.1025**	**0.1625**	**0.155**	**0.145**				
habodhan								
-	0.24	0.15	0.18	0.14	0.16			
ota	0.19	0.18	0.18	0.16	0.17			
	0.19	0.15	0.13	0.12	0.16			
Average	**0.206667**	**0.16**	**0.163333**	**0.14**	**0.163333**		0.183503	0.118083
ohabodha								
-	0.12	0.22	0.13	0.16	0.14	0.16		
nota	0.07	0.18	0.12	0.15	0.1	0.14		
	0.13	0.22	0.15	0.15	0.15	0.16		
Average	0.106667	0.206667	0.133333	0.153333	0.13	0.153333		
							0.011913	0.183503
oporajita	0.09	0.2	0.13	0.12	0.19			
	0.09	0.19	0.17	0.11	0.19			
	0.06	0.14	0.11	0.1	0.14			
	0.1	0.18	0.1	0.12	0.18			
	0.085	0.1775	0.1275	0.1125	0.175		0.001148	0.432389



Mean durational ratios
LLLLLL
LLLLL
LLLL
HHH
HHL
HLL
LHL
LHH
LHL
LLH
LLL
HH
LH
LL
syllable types
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
duration(secs)
Syll 6
Syll 5
Syll 4
Syll 3
Syll 2
Syll 1

Appendix IV

Mean fundamental frequency and statistical significance

Word	Type	Syll 1	Syll 2	Syll 3	P value
zaba	LL	202	211		
		190	230		
		127	142		
		121	128		
average		**HL-160**	**177.75**		.101
zibi	LL	198	235		
		207	220		
		133	155		
		123	127		
average		**HL-165**	**184.25**		.05
zabor	LH				
		196	219		
		114	144		
		120	124		
average		**HL-165**	**162.3333**		.134
bagan	LH	117	133		
		114	126		
		169	211		
		193	203		
average		**HL-148**	**168.25**		.054
andhar	HH	185	221		
		197	213		
		121	135		
		181	215		
average		**HL-171**	**196**		.023
bondor	HH	181	215		
		200	213		
		124	150		
		112	125		
average		**HL-154**	**175.75**		.025
bizuli	LLL	214	226	260	
		215	231	240	

		133	158	161	
		120	143	135	
average		**HL-170**	**189.5**	**199**	.008
gohona	LLL	193	205	233	
		207	206	221	
		115	134	146	
		115	129	132	
average		**HL-157**	**168.5**	**183**	.081
zuburi	LLL	201	221	247	
		223	238	241	
		119	158	169	
		116	126	140	
average		**HL-164**	**185.75**	**199.25**	.0405
moromor	LLH	207	211	223	
		182	196	229	
		125	142	150	
		115	118	138	
average		**157.25**	**166.75**	**185**	.0255
zazabor	LLH	169	197	224	
		195	214	225	
		119	135	141	
		119	129	139	
average		**150.5**	**168.75**	**182.25**	.0290
anondo	LHL	188	206	250	
		201	229	247	
		119	129	137	
		120	128	135	
average		**157**	**173**	**192.25**	.111
gurutto	LHL	127	139	146	
		123	137	117	
		201	219	251	
		210	228	235	
average		**165.25**	**180.75**	**187.25**	.58371
anondor	LHH	197	226	220	
		201	202	220	
		126	139	158	
		115	128	135	
average		**159.75**	**173.75**	**183.25**	.097

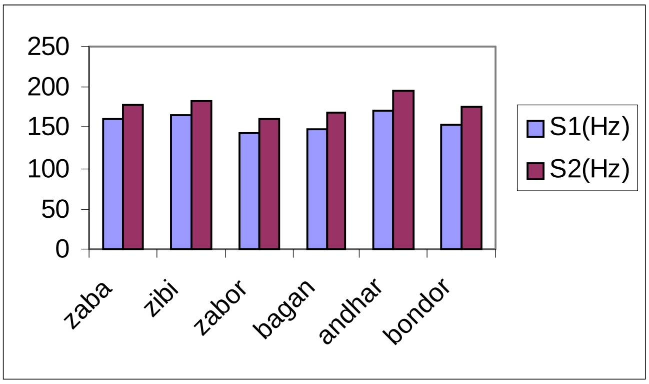
guruttor	LHH	201	219	251	
		210	228	235	
		200	221	248	
		222	258	253	
average		**208.25**	**231.5**	**246.75**	.348
buronzi	LHL	134	158	162	
		126	140	148	
		197	210	251	
		210	211	234	
average		**166.75**	**179.75**	**198.75**	.0600
onzona	HLL	195	237	247	
		202	211	225	
		118	142	143	
		127	139	140	
average		**160.5**	**182.25**	**188.75**	.0522
bondona	HLL	186	215	236	
		201	227	231	
		119	140	142	
		168.6667	**194**	**203**	.008
average					
andulon	HLH	195	235	248	
		197	219	223	
		125	141	141	
		129	132	138	
average		**161.5**	**181.75**	**187.5**	.077
gondogul	HLH	183	223	247	
		194	206	222	
		135	136	139	
		122	130	135	
average		**158.5**	**173.75**	**185.75**	.1727
bondhutto	HHL	201	231	248	
		206	210	226	
average		**203.5**	**220**	**237**	.415
ostitto	HHL	201	238	253	
		189	227	225	
		119	158	153	

		110	154	150	
average		**154.75**	**194.25**	**195.25**	.00013
ontordhan	HHH	200	234	244	
		195	201	236	
		123	141	135	
		127	134	137	
average		**161.25**	**177.5**	**188**	.008

FUNDAMENTAL FREQUENCY VALUES

	syll 1	syll 2	syll 3	syll 4	syll 5	syll 6	Diff 1	Diff 2	Diff 3	T-Test		
alusona	192	218	238	242								
	200	225	258	247								
	128	149	165	164								
	104	107	106	113								
Average	**156**	**174.75**	**191.75**	**191.5**			**18**			**3%**		**0.9**
aradhona	196	211	234	247								
	217	225	237	250								
	129	192	126	174								
	111	108	108	114								
Average	**163.25**	**184**	**176.25**	**196.25**			**21**	**20**		**0.249403**	**0.12535**	
habodhan-	214	223	236	246	247							
ta	214	223	239	240	239							
	122	139	142	151	159							
Average	**183.3333**	**195**	**205.6667**	**212.3333**	**215**		**12**	**7**		**0.048477**	**0.144079**	
ohabodha-	211	225	230	240	238	246						
nota	127	149	152	151	157	159						
	99	124	120	108	93	218						
	201	236	241	242	231							
Average	**159.5**	**183.5**	**185.75**	**185.25**	**179.75**	**207.6667**	**24**	**0**	**28**	**0.01165**	**0.918876**	
oporazita	201	210	229	225	239							
	210	222	236	236	252							
	136	147	156	147	163							
	111	113	118	119	114							
Average	**164.5**	**173**	**184.75**	**181.75**	**192**		**9**	**3**		**0.032665**	**0.27857**	
onogroho-	203	211	229	228	224	227						
rota	113	115	126	126	110	96						
	130	147	150	155	152	150						
	127	149	152	151	157	159						
Average	**143.25**	**155.5**	**164.25**	**165**	**160.75**	**158**	**12**	**1**		**0.071644**	**0.637618**	**0.531787**

Figure 2



Appendix V

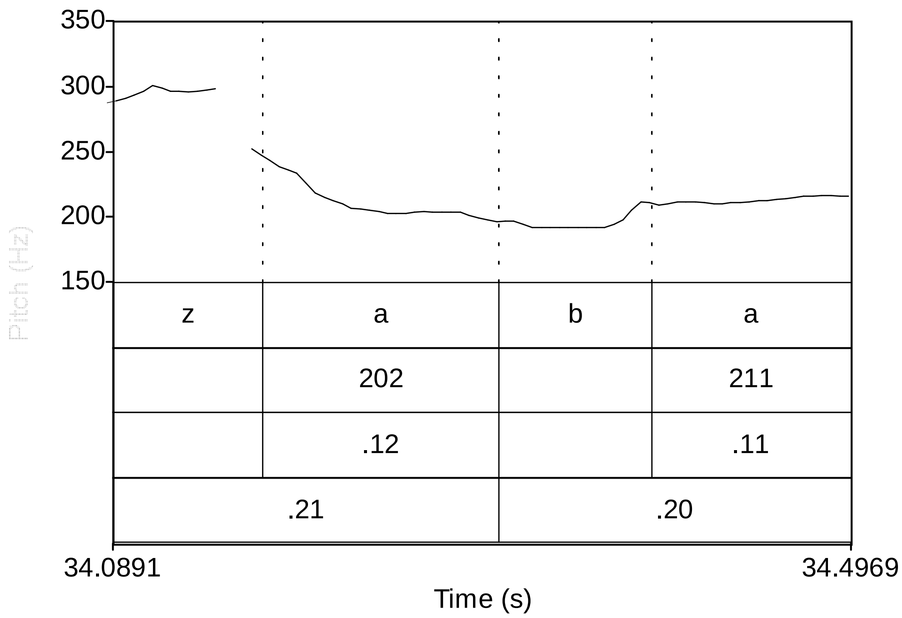
The figures have been taken from PRAAT. Each figure shows the F_0 contour of the words from the corpus spoken by four different speakers. They have been divided into four tiers to label and segment the following key points of the F_0 contour:

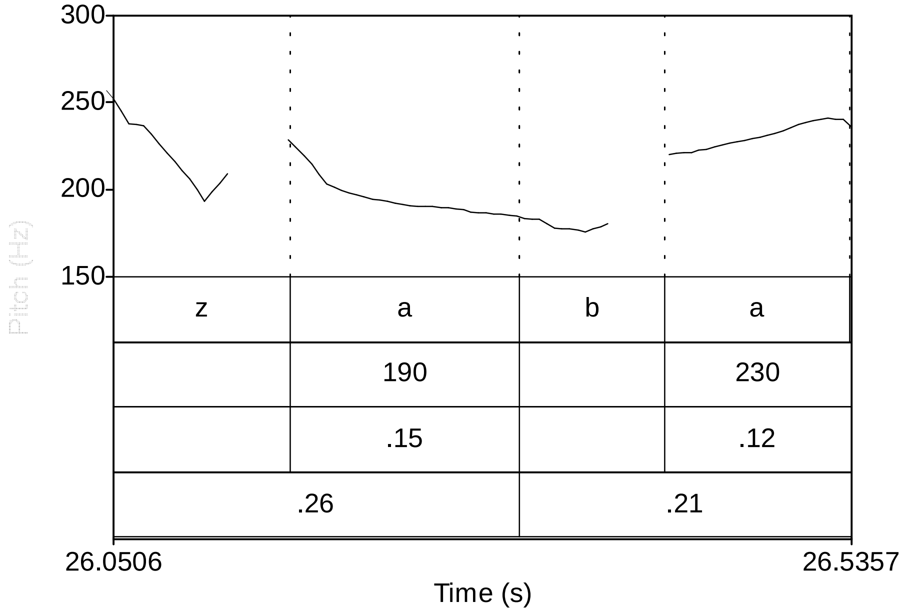
Tier 1: labels all the segments.

Tier 2: labels mid point F_0 value of syllable nucleus.

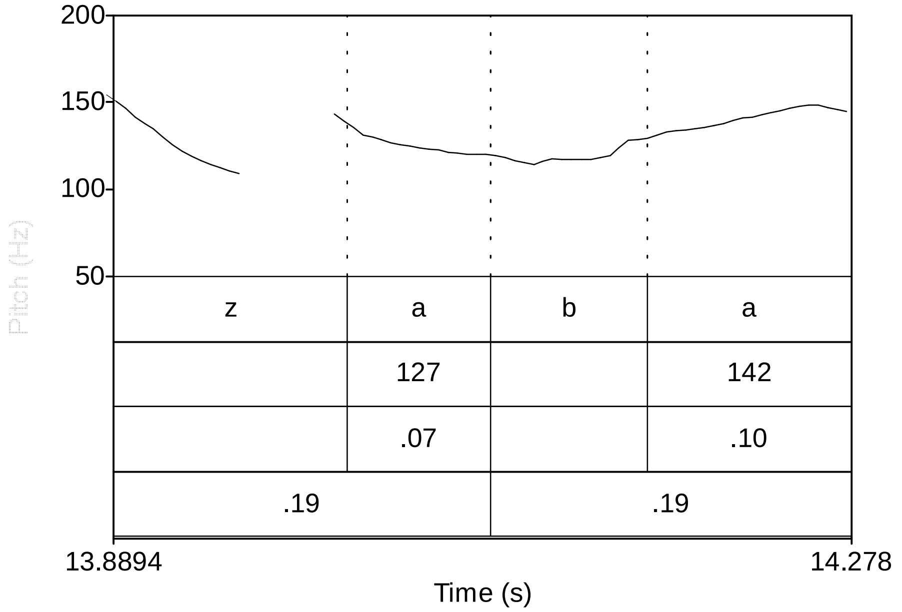
Tier 3: labels duration of syllable nucleus.

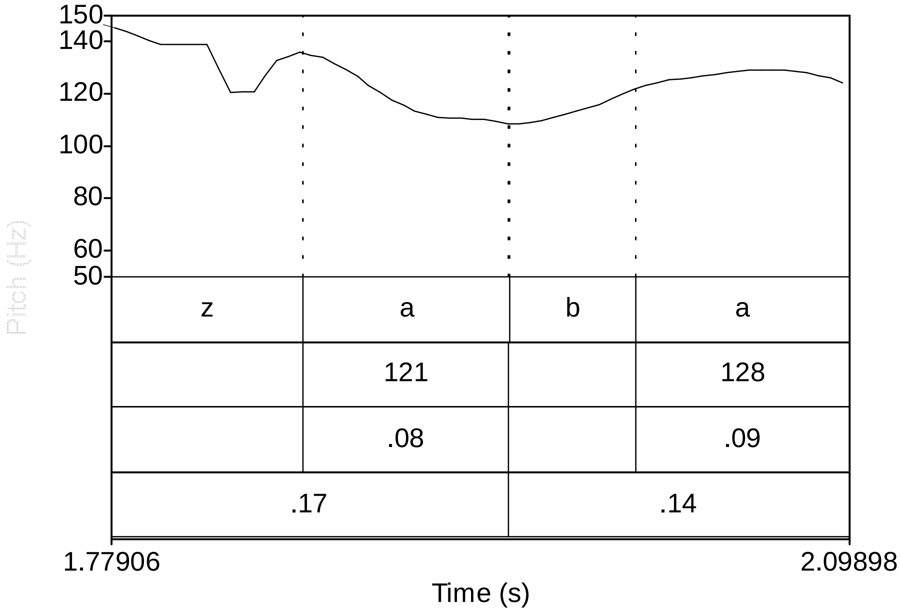
Tier 4: labels duration of the syllable.



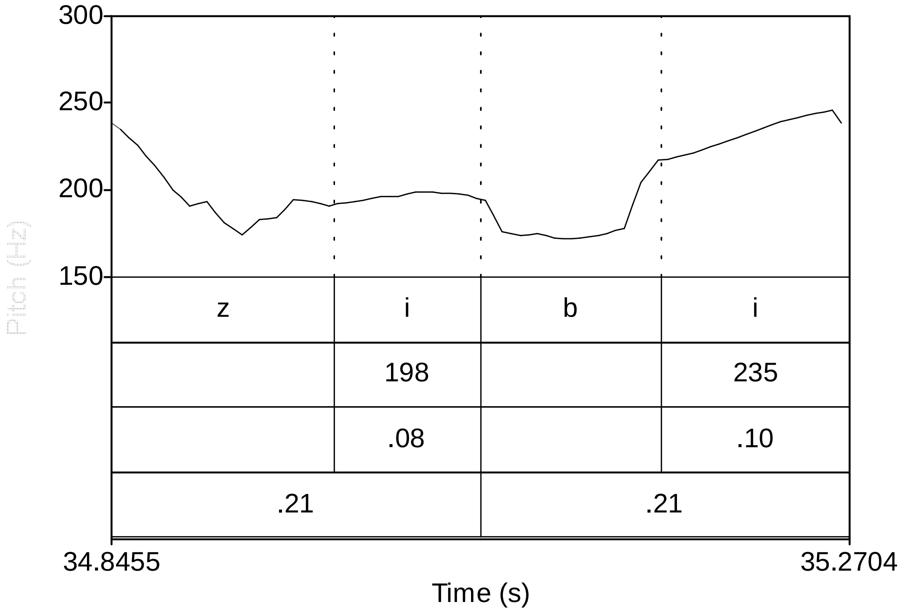

300
250
200
150
Pitch (Hz)
z
a
b
a
190
230
.15
.12
.26
.21
26.0506
26.5357
Time (s)

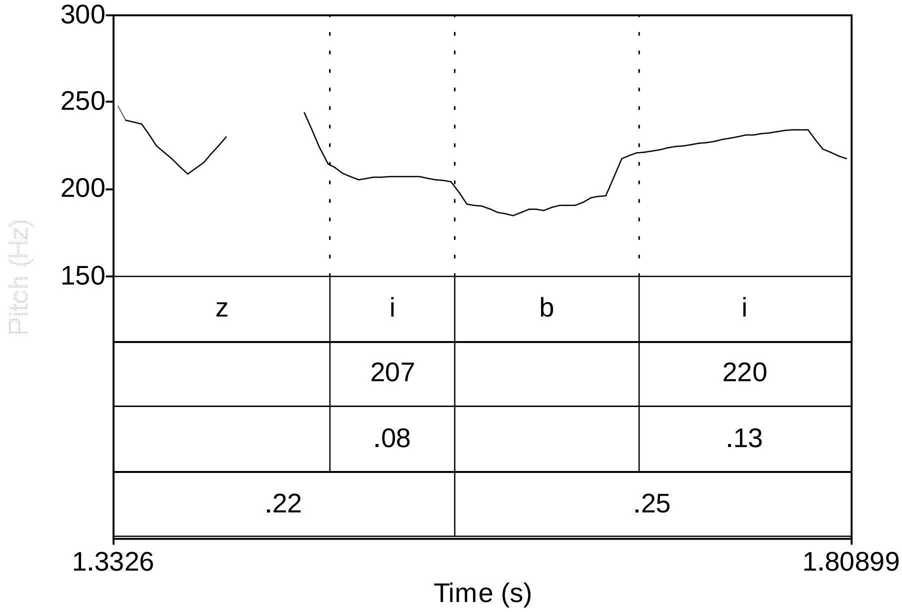
LL- [zaba]


200
150
100
50
Pitch (Hz)
z
a
b
a
127
142
.07
.10
.19
.19
13.8894
14.278
Time (s)

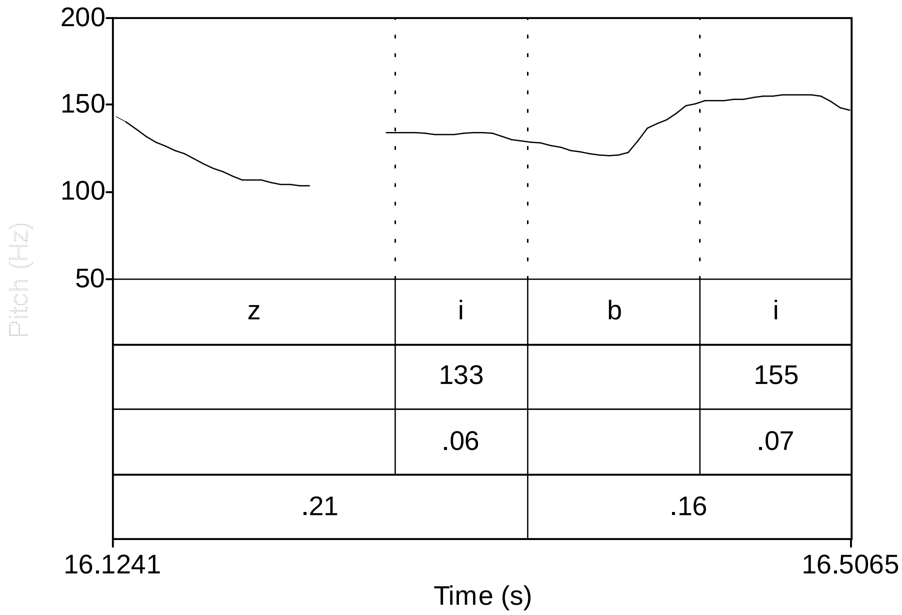

150
140
120
100
80
60
50
Pitch (Hz)
z
a
b
a
121
128
.08
.09
.17
.14
1.77906
2.09898
Time (s)

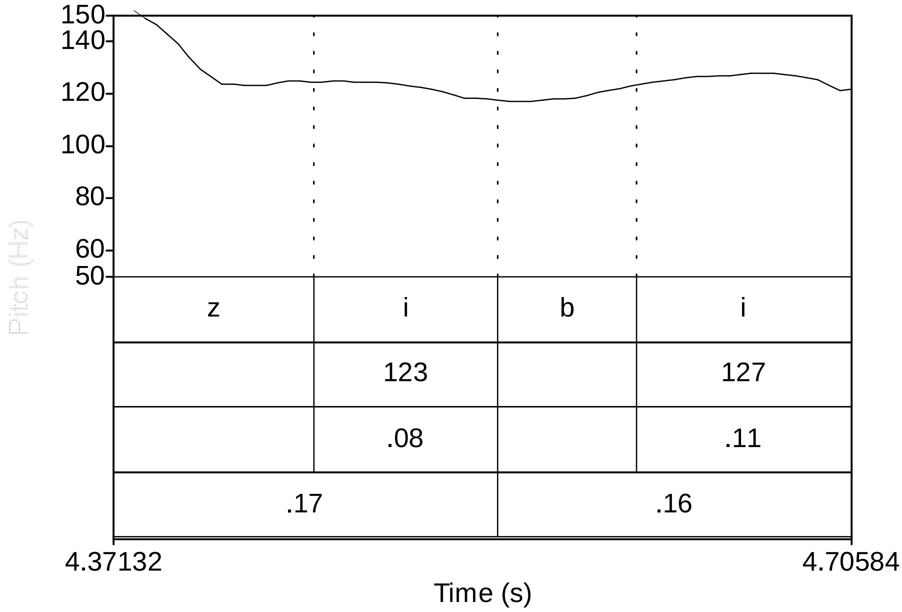
LL-[zaba]


300
250
200
150
Pitch (Hz)
z
i
b
i
198
235
.08
.10
.21
.21
34.8455
35.2704
Time (s)

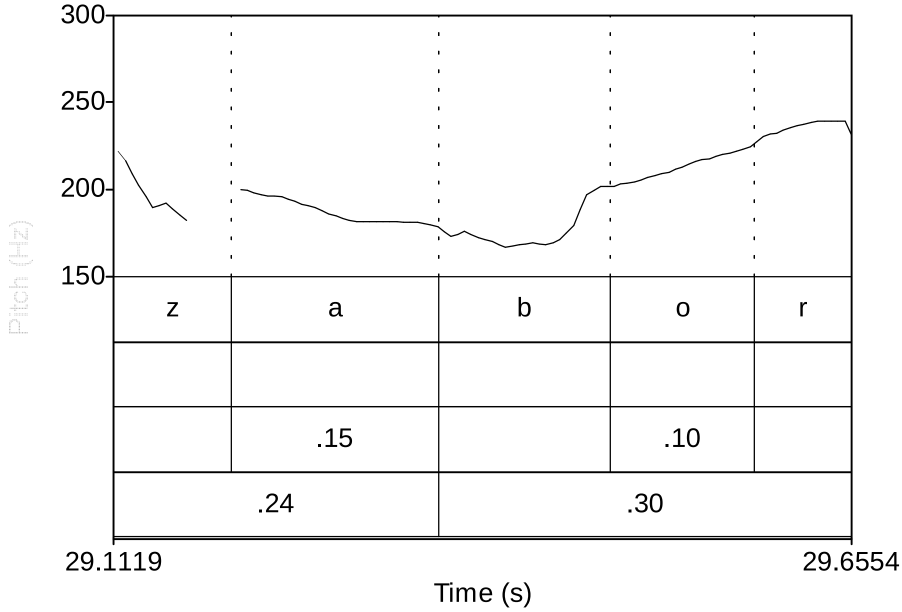

300
250
200
150
Pitch (Hz)
z
i
b
i
207
220
.08
.13
.22
.25
1.3326
1.80899
Time (s)

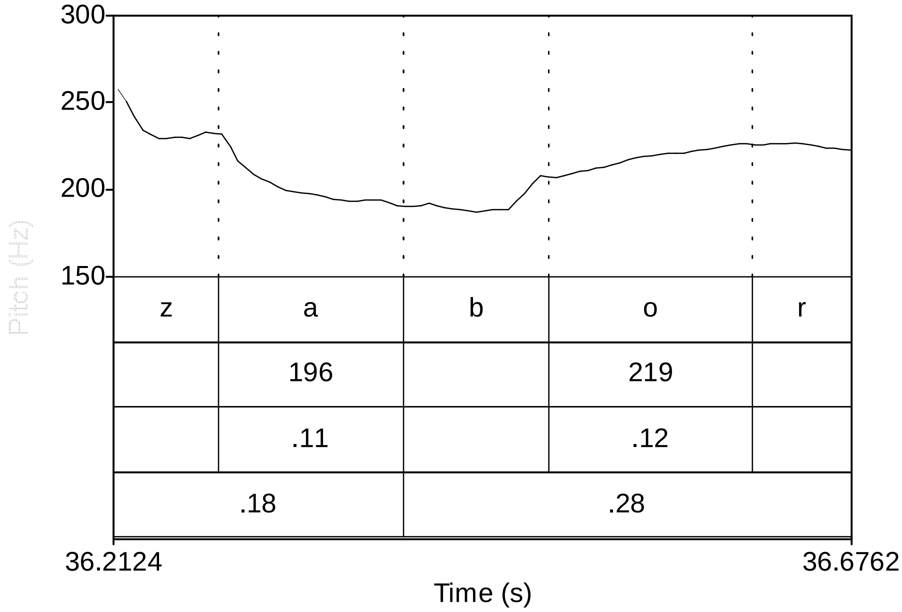
LL-[zibi]


200
150
100
50
Pitch (Hz)
z
i
b
i
133
155
.06
.07
.21
.16
16.1241
16.5065
Time (s)

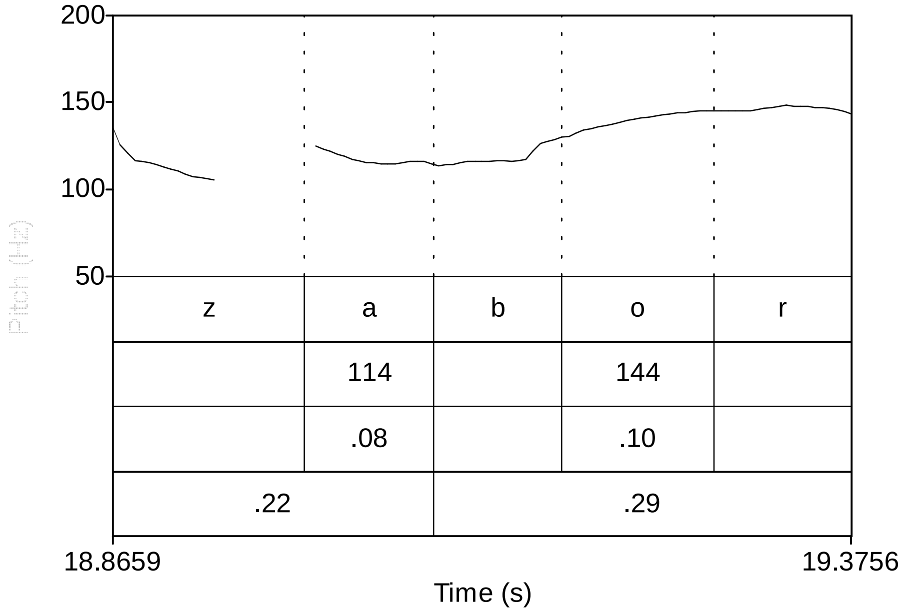

150
140
120
100
80
60
50
Pitch (Hz)
z
i
b
i
123
127
.08
.11
.17
.16
4.37132
4.70584
Time (s)

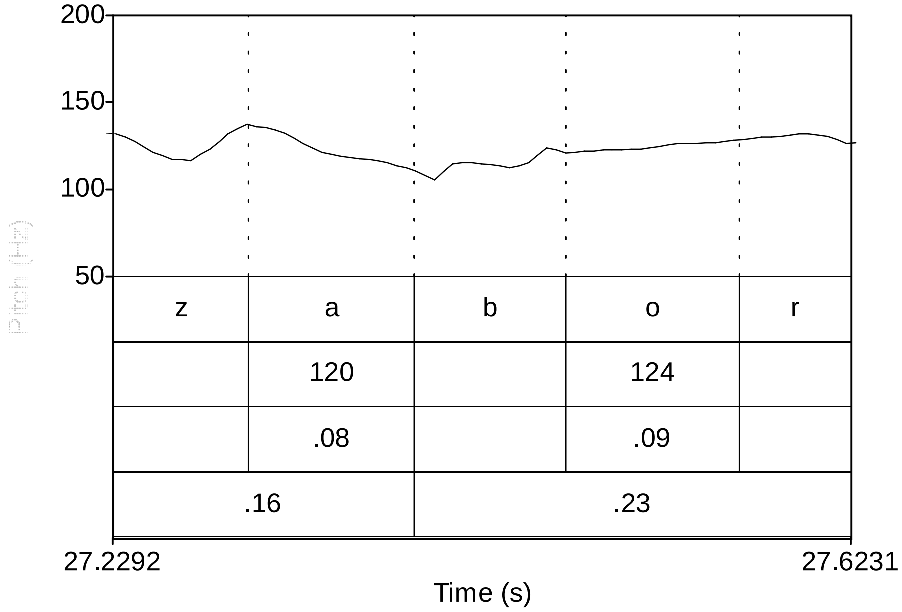
LL-[zibi]


300
250
200
150
Pitch (Hz)
z
a
b
o
r
.15
.10
.24
.30
29.1119
29.6554
Time (s)

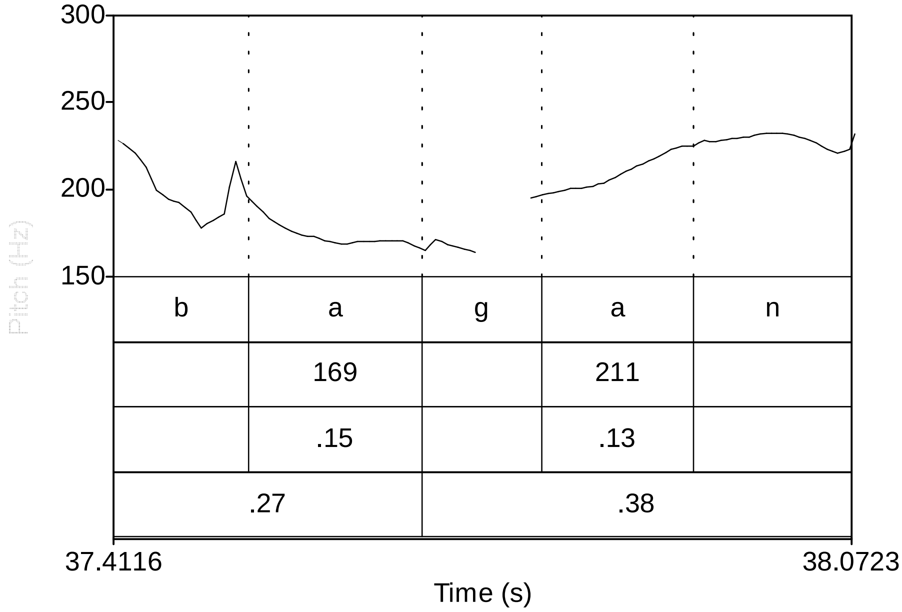

300
250
200
150
Pitch (Hz)
z
a
b
o
r
196
219
.11
.12
.18
.28
36.2124
36.6762
Time (s)

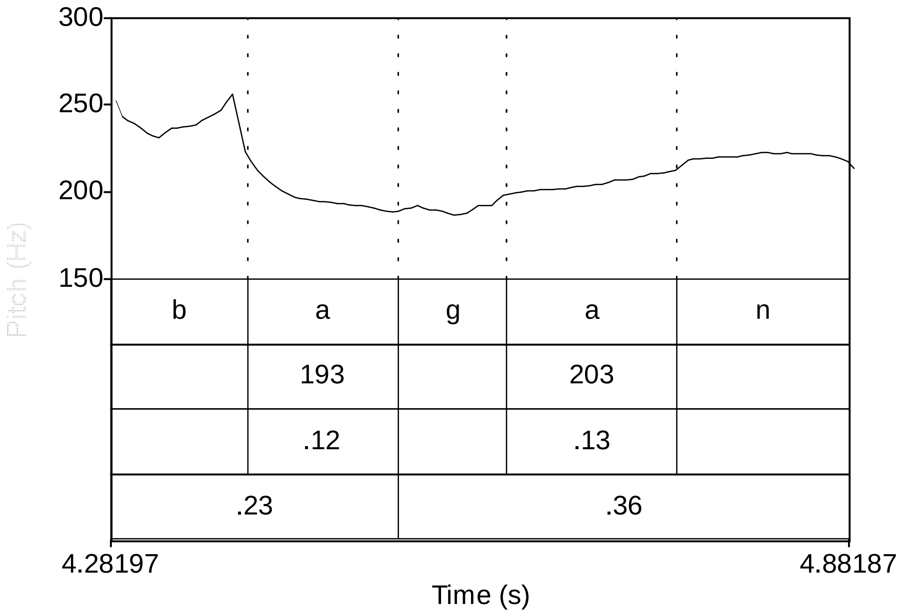
LH-[zabor]


200
150
100
50
Pitch (Hz)
z
a
b
o
r
114
144
.08
.10
.22
.29
18.8659
19.3756
Time (s)

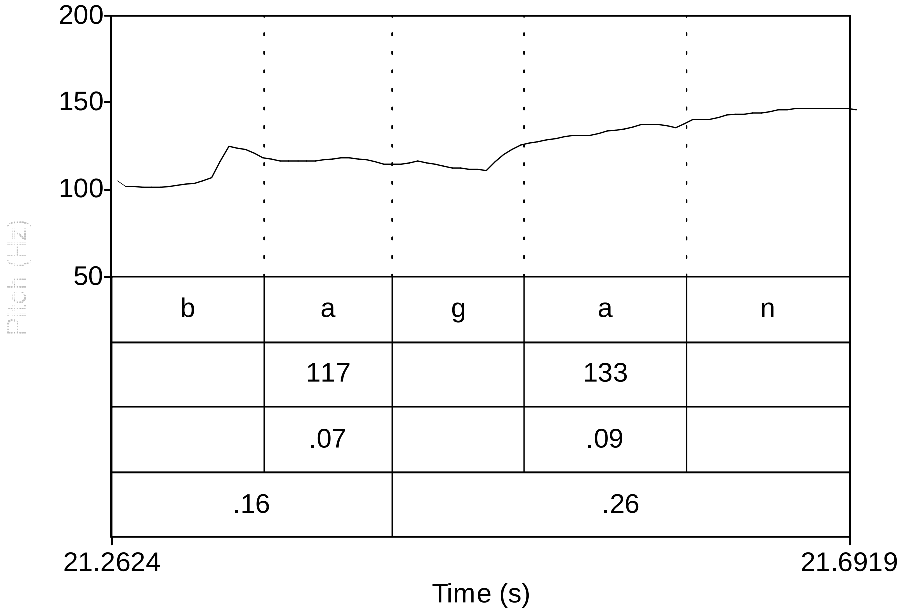

200
150
100
50
Pitch (Hz)
z
a
b
o
r
120
124
.08
.09
.16
.23
27.2292
27.6231
Time (s)

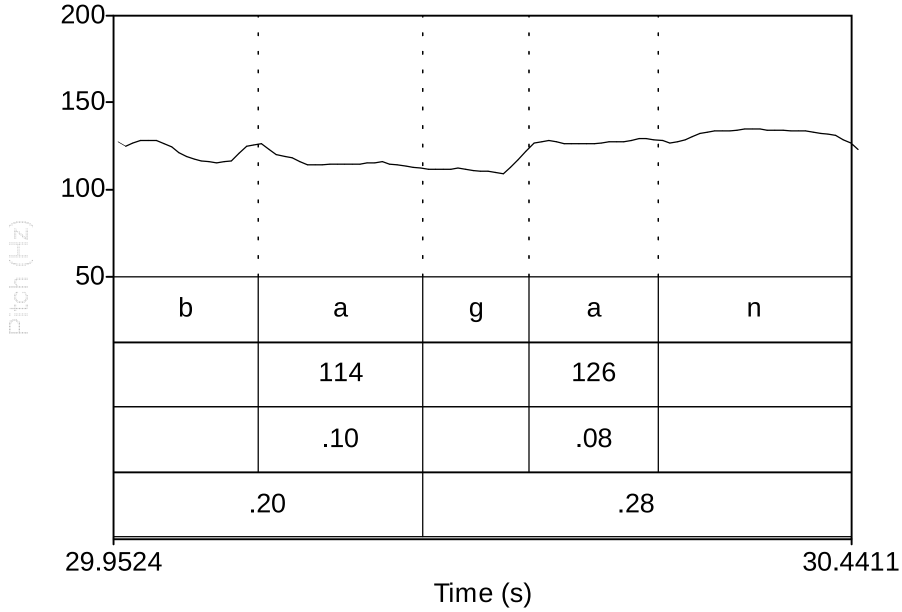
LH-[zabor]


300
250
200
150
Pitch (Hz)
b
a
g
a
n
169
211
.15
.13
.27
.38
37.4116
38.0723
Time (s)

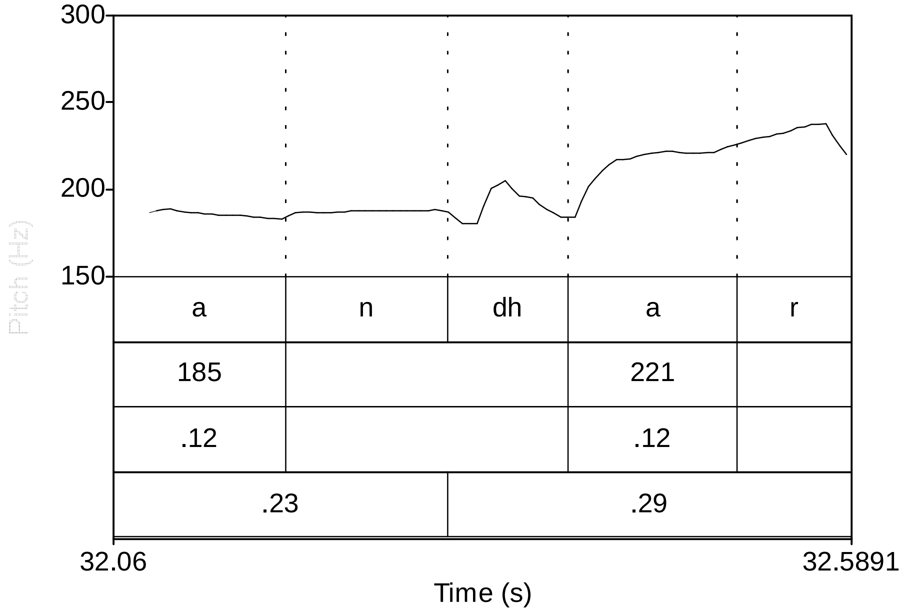

300
250
200
150
Pitch (Hz)
b
a
g
a
n
193
203
.12
.13
.23
.36
4.28197
4.88187
Time (s)

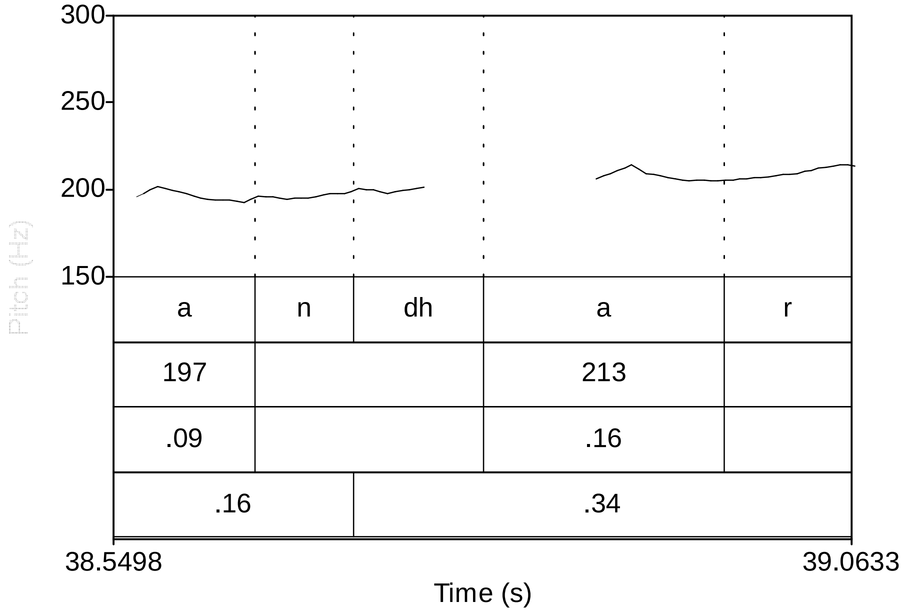
LH-[bagan]


200
150
100
50
Pitch (Hz)
b
a
g
a
n
117
133
.07
.09
.16
.26
21.2624
21.6919
Time (s)

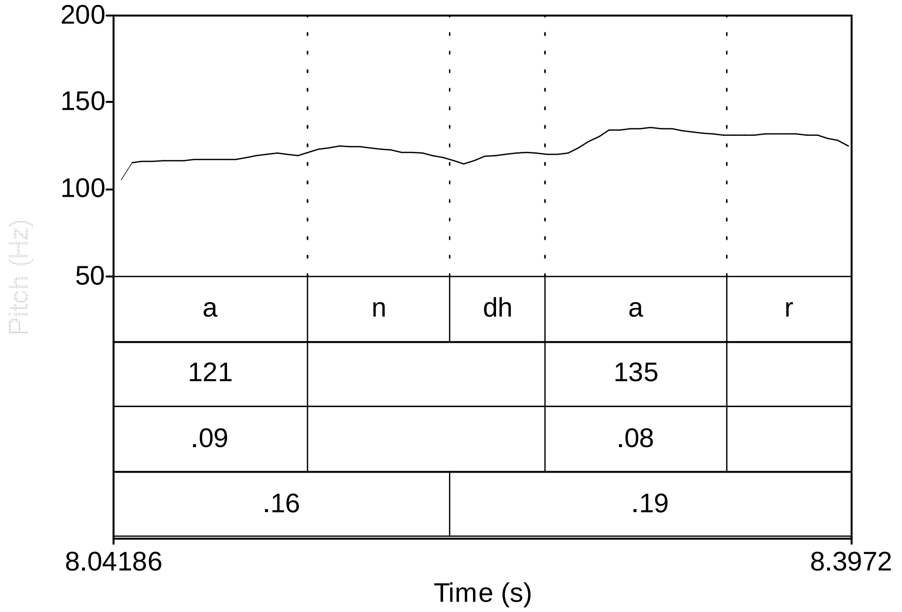

200
150
100
50
Pitch (Hz)
b
a
g
a
n
114
126
.10
.08
.20
.28
29.9524
30.4411
Time (s)

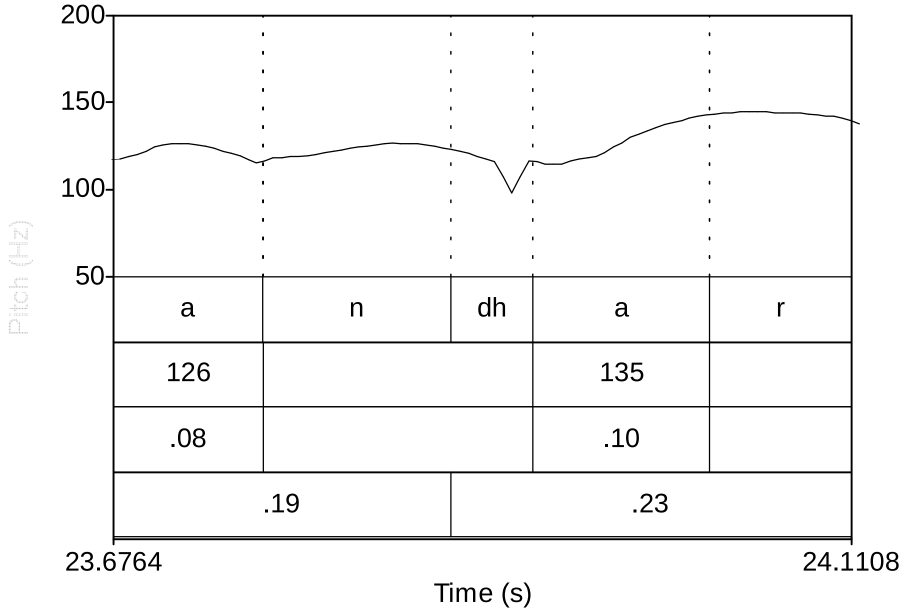
LH-[bagan]


300
250
200
150
Pitch (Hz)
a
n
dh
a
r
185
221
.12
.12
.23
.29
32.06
32.5891
Time (s)

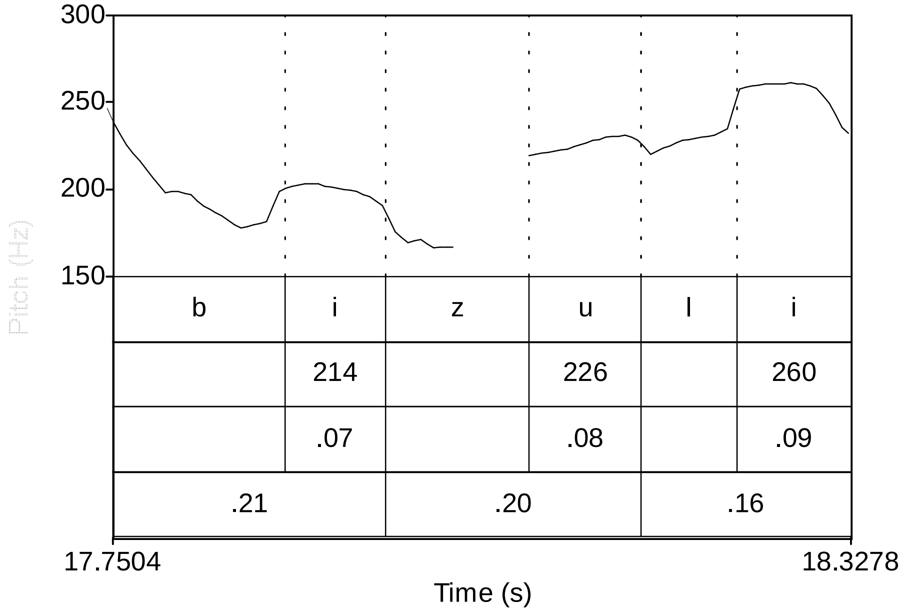


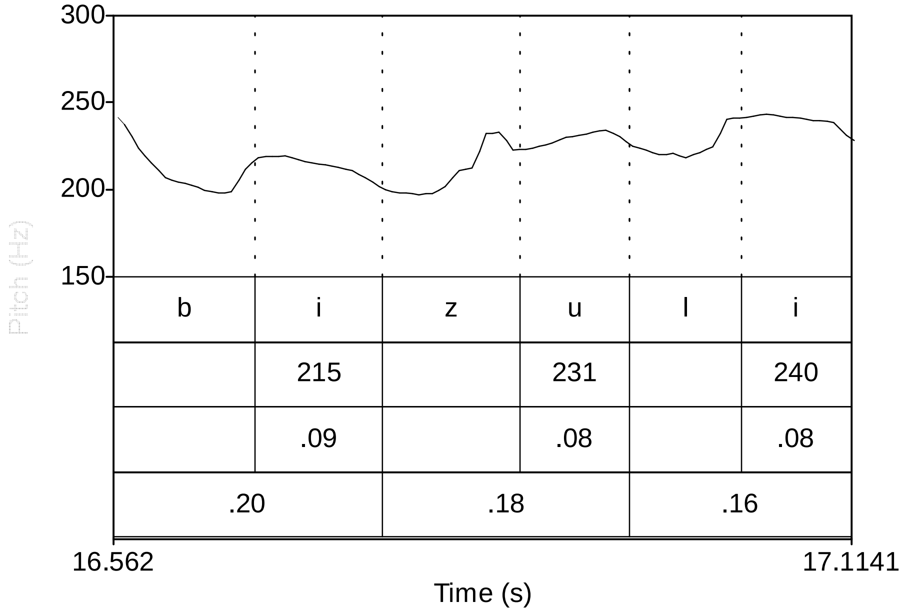
HH-[$\mathrm{and^har}$]



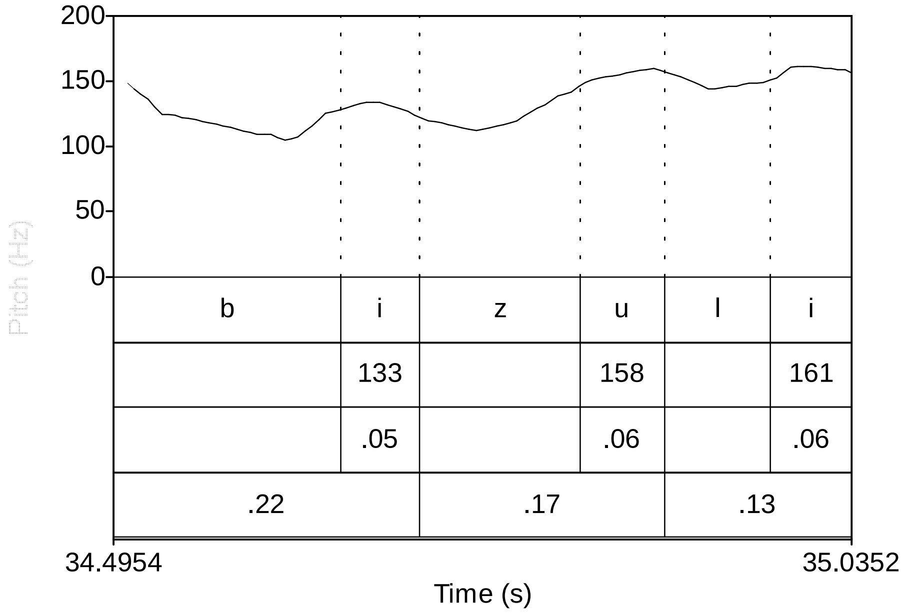

200
150
100
50
Pitch (Hz)
a
n
dh
a
r
126
135
.08
.10
.19
.23
23.6764
24.1108
Time (s)

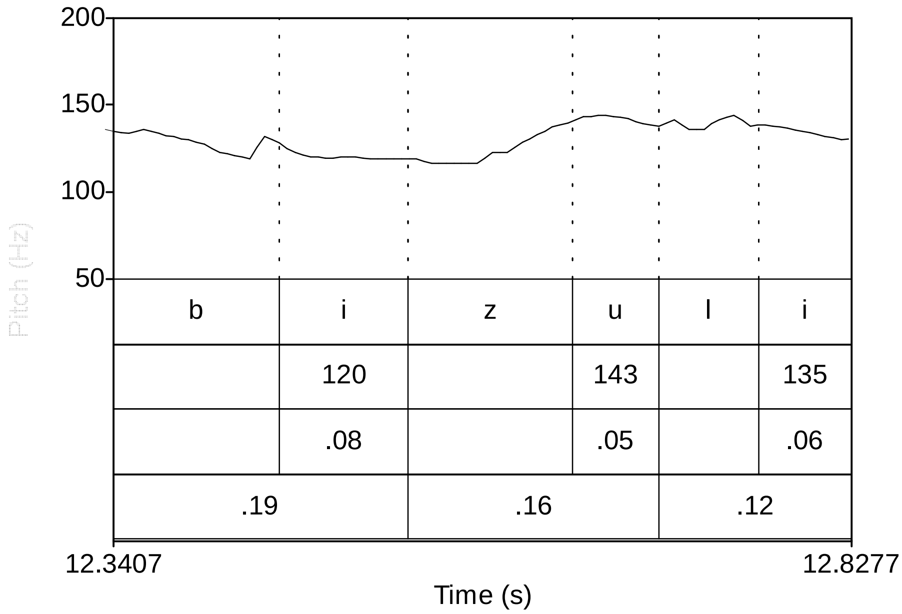
HH-[andʰar]


300
250
200
150
Pitch (Hz)
b
i
z
u
l
i
214
226
260
.07
.08
.09
.21
.20
.16
17.7504
18.3278
Time (s)

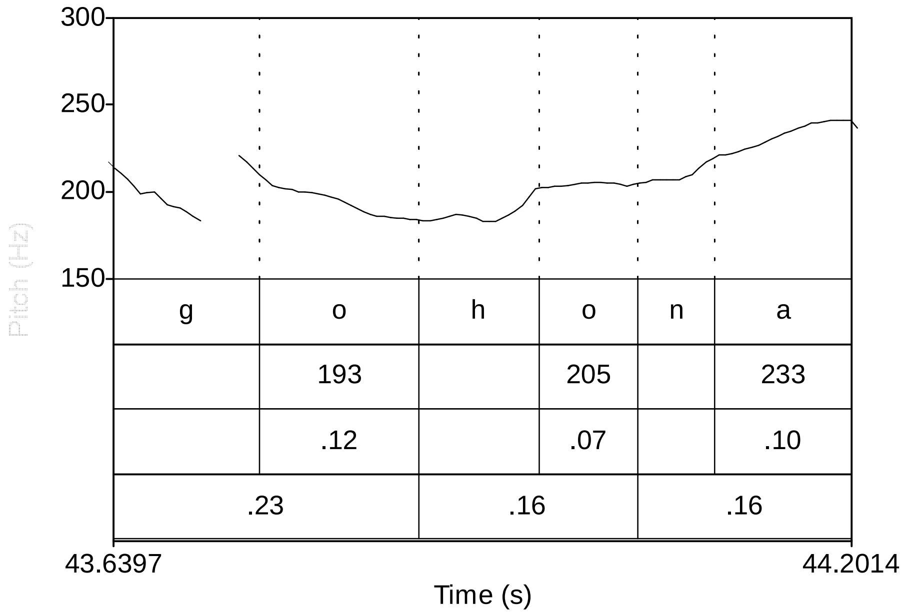

300
250
200
150
Pitch (Hz)
b
i
z
u
l
i
215
231
240
.09
.08
.08
.20
.18
.16
16.562
17.1141
Time (s)

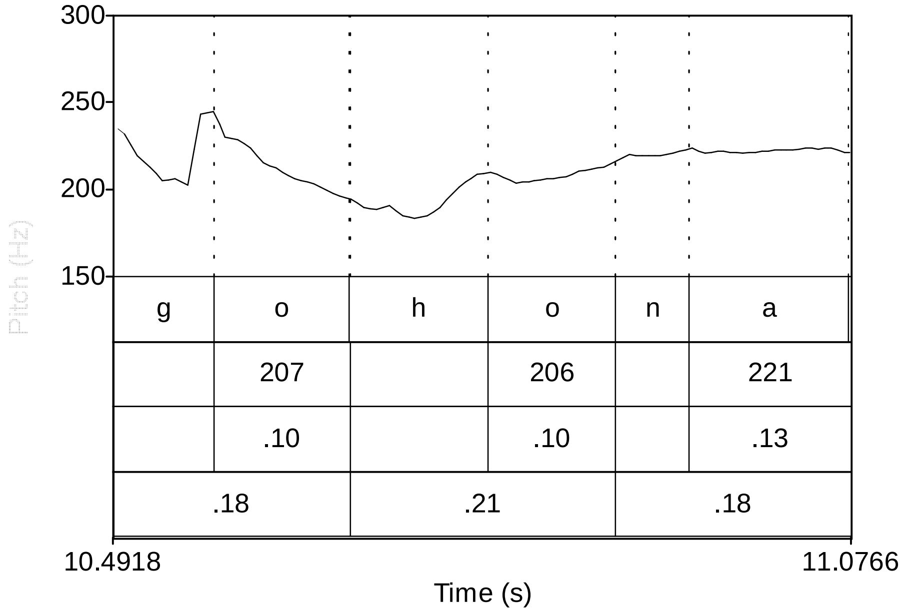
LLL-[bizʊli]


200
150
100
50
0
Pitch (Hz)
b
i
z
u
l
i
133
158
161
.05
.06
.06
.22
.17
.13
34.4954
35.0352
Time (s)

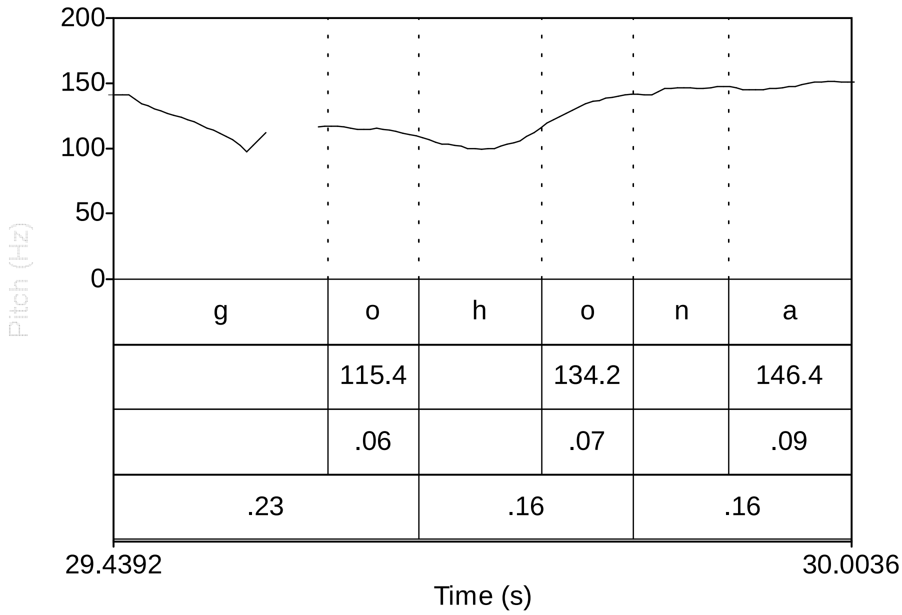

200
150
100
50
Pitch (Hz)
b
i
z
u
l
i
120
143
135
.08
.05
.06
.19
.16
.12
12.3407
12.8277
Time (s)

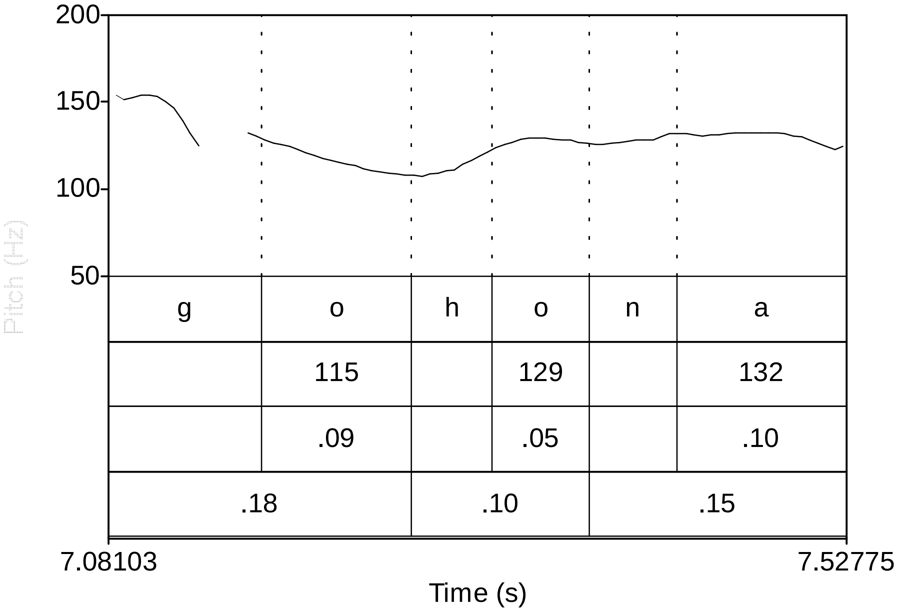
LLL-[bizʊli]


300
250
200
150
Pitch (Hz)
g
o
h
o
n
a
193
205
233
.12
.07
.10
.23
.16
.16
43.6397
44.2014
Time (s)

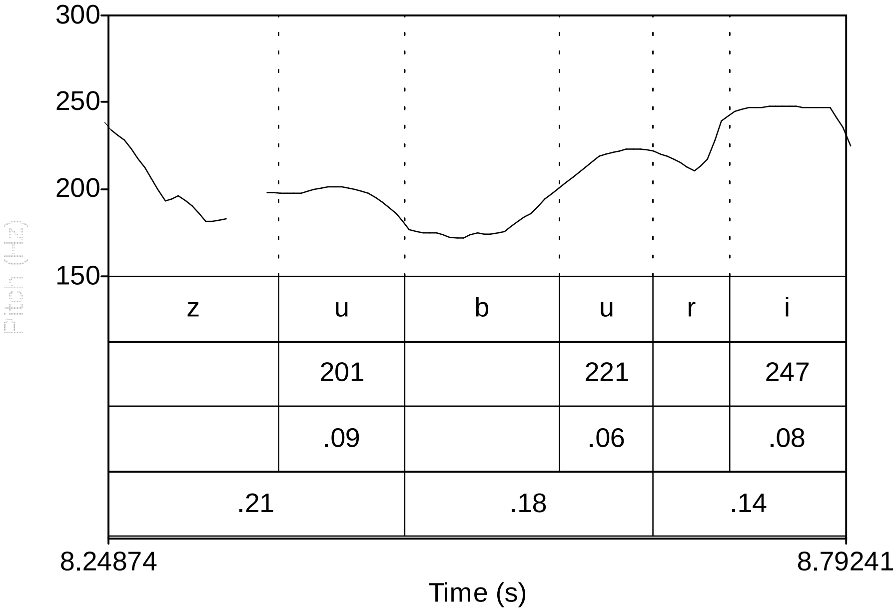

300
250
200
150
Pitch (Hz)
g
o
h
o
n
a
207
206
221
.10
.10
.13
.18
.21
.18
10.4918
11.0766
Time (s)

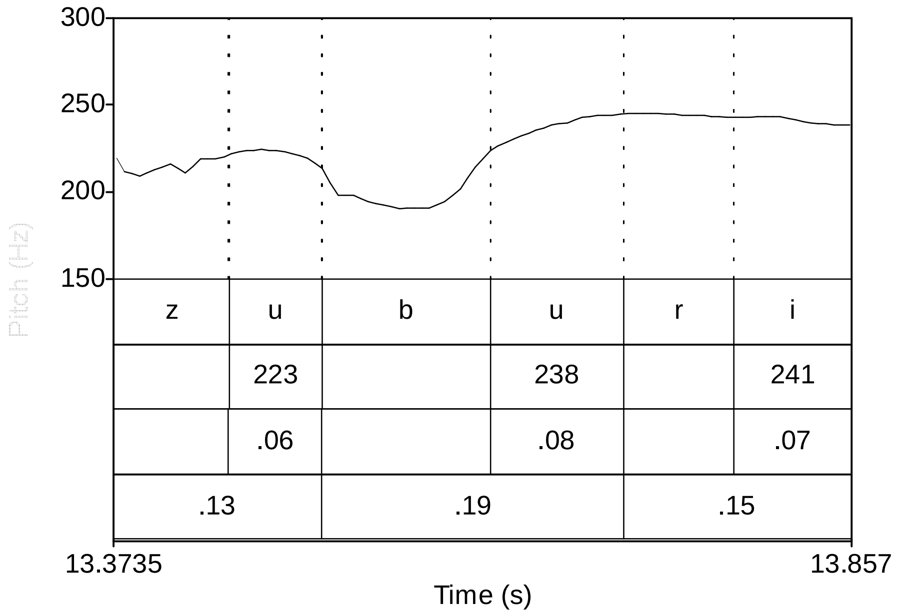
LLL-[gɔhɔna]


200
150
100
50
0
Pitch (Hz)
g
o
h
o
n
a
115.4
134.2
146.4
.06
.07
.09
.23
.16
.16
29.4392
30.0036
Time (s)

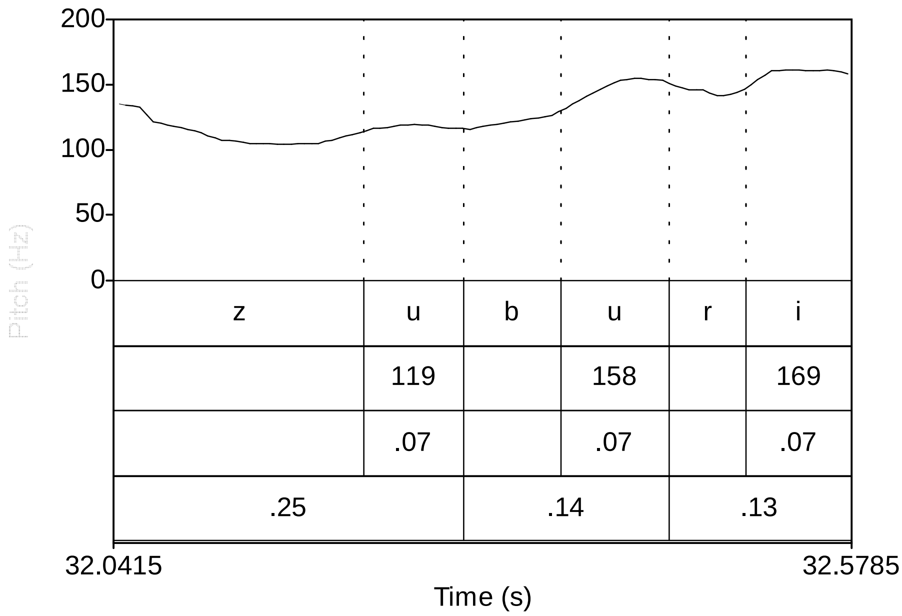

200
150
100
50
Pitch (Hz)
g
o
h
o
n
a
115
129
132
.09
.05
.10
.18
.10
.15
7.08103
7.52775
Time (s)

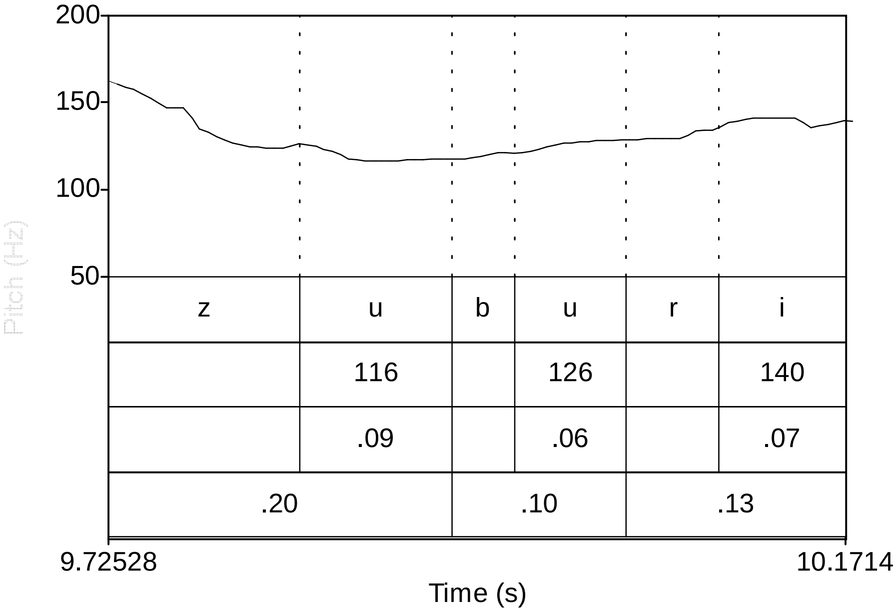
LLL-[gɔhɔna]


300
250
200
150
Pitch (Hz)
z
u
b
u
r
i
201
221
247
.09
.06
.08
.21
.18
.14
8.24874
8.79241
Time (s)


300
250
200
150
Pitch (Hz)
z
u
b
u
r
i
223
238
241
.06
.08
.07
.13
.19
.15
13.3735
13.857
Time (s)

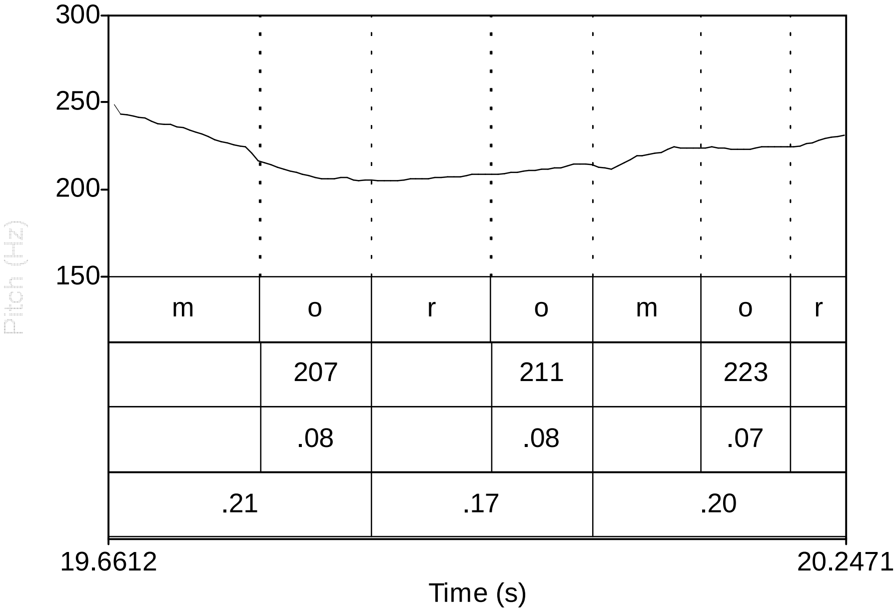
LLL-[zʊbʊri]


200
150
100
50
0
Pitch (Hz)
z
u
b
u
r
i
119
158
169
.07
.07
.07
.25
.14
.13
32.0415
32.5785
Time (s)

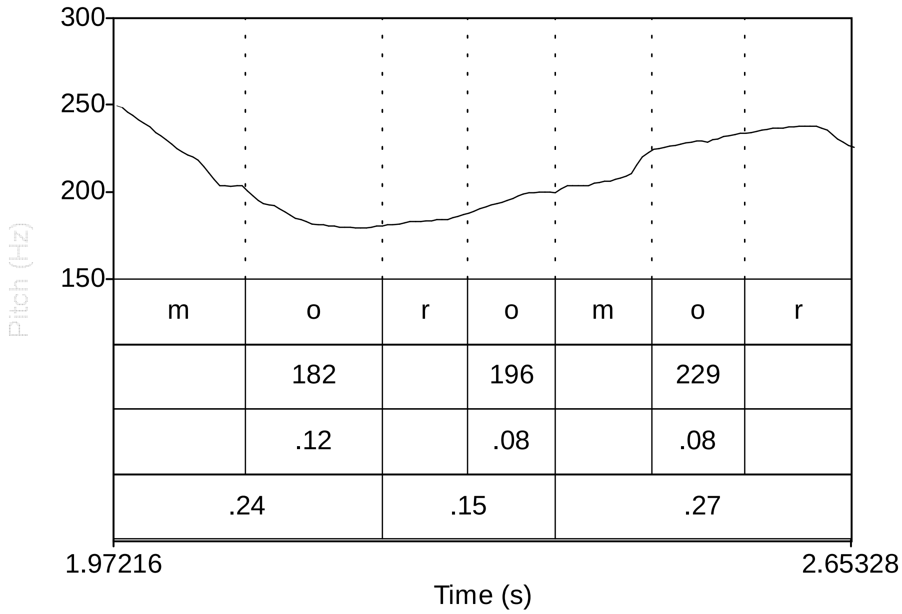


200
150
100
50
Pitch (Hz)
z
u
b
u
r
i
116
126
140
.09
.06
.07
.20
.10
.13
9.72528
10.1714
Time (s)

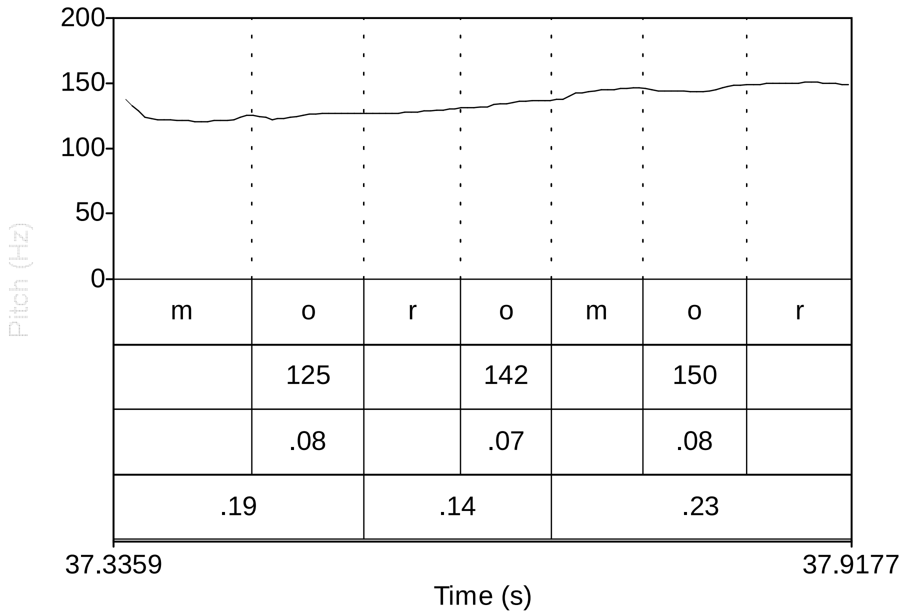
LLL-[zʊbʊri]

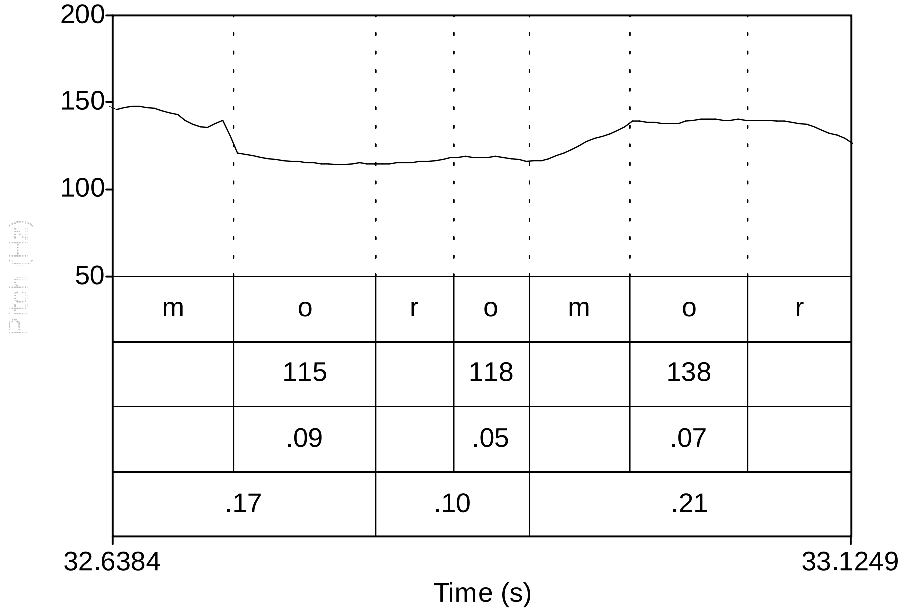


300
250
200
150
Pitch (Hz)
m
o
r
o
m
o
r
207
211
223
.08
.08
.07
.21
.17
.20
19.6612
20.2471
Time (s)

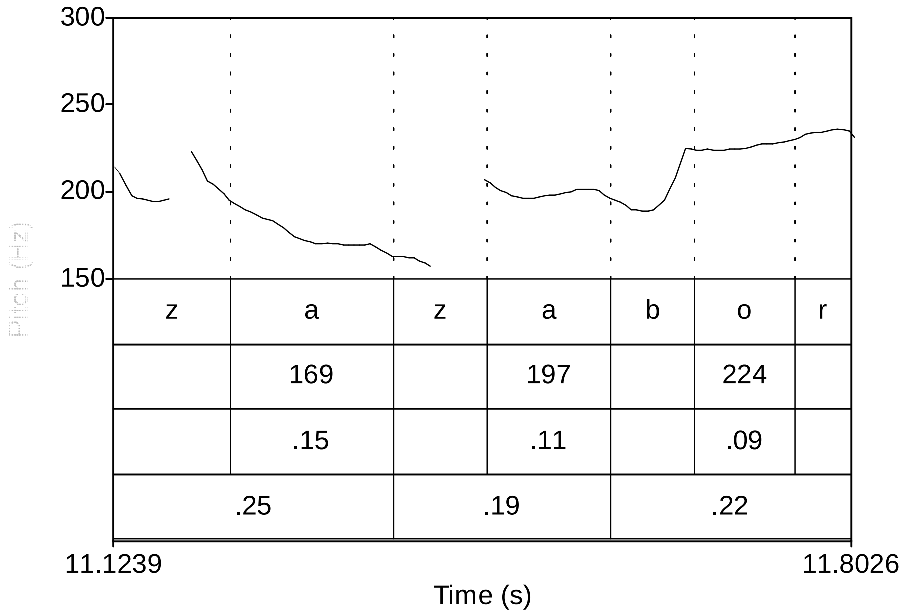

300
250
200
150
Pitch (Hz)
m o r o m o r
182 196 229
.12 .08 .08
.24 .15 .27
1.97216
2.65328
Time (s)

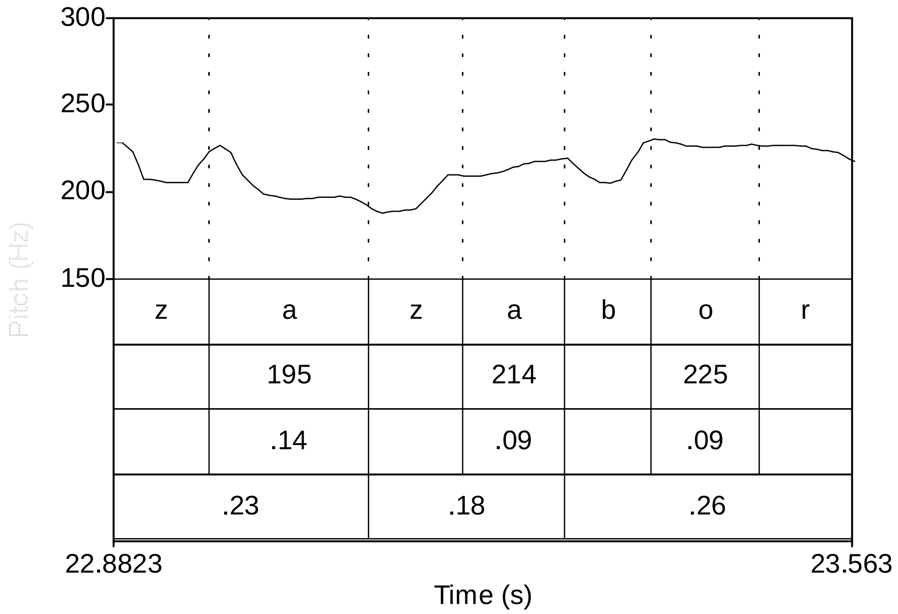
LLH-[mɔrɔmɔr]


200
150
100
50
0
Pitch (Hz)
m o r o m o r
125 142 150
.08 .07 .08
.19 .14 .23
37.3359
37.9177
Time (s)

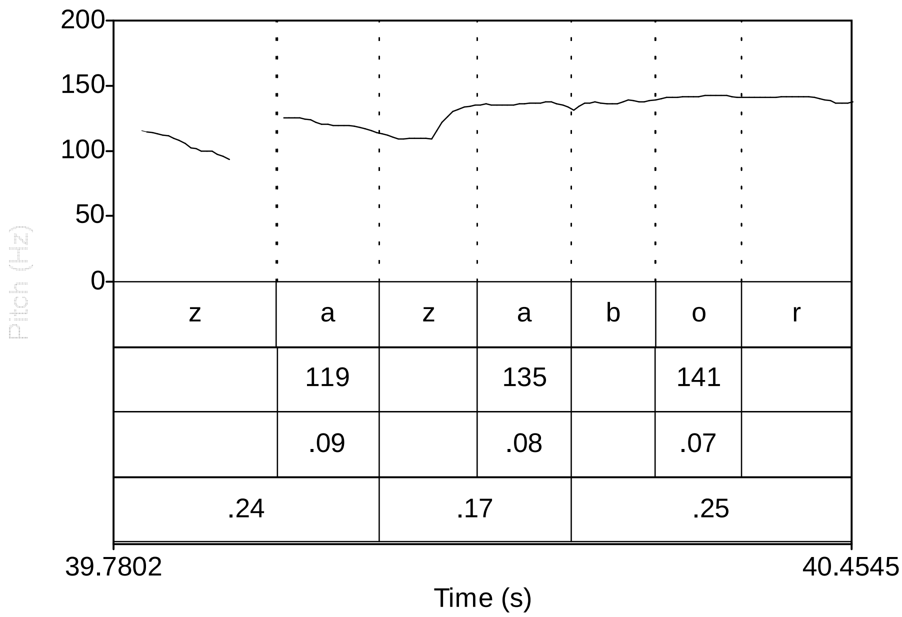

200
150
100
50
Pitch (Hz)
m o r o m o r
115 118 138
.09 .05 .07
.17 .10 .21
32.6384
33.1249
Time (s)

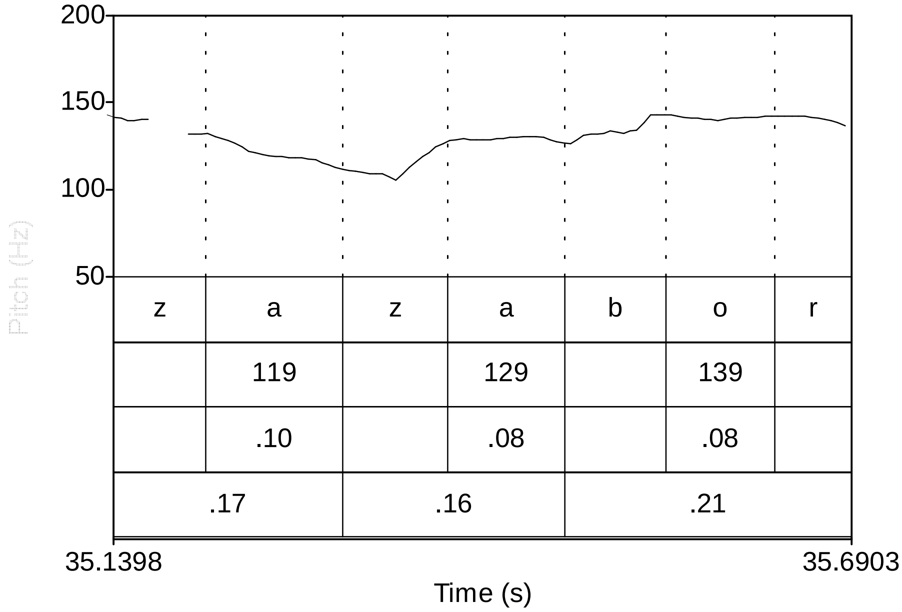
LLH-[mɔrɔmɔr]


300
250
200
150
Pitch (Hz)
z a z a b o r
169 197 224
.15 .11 .09
.25 .19 .22
11.1239
11.8026
Time (s)

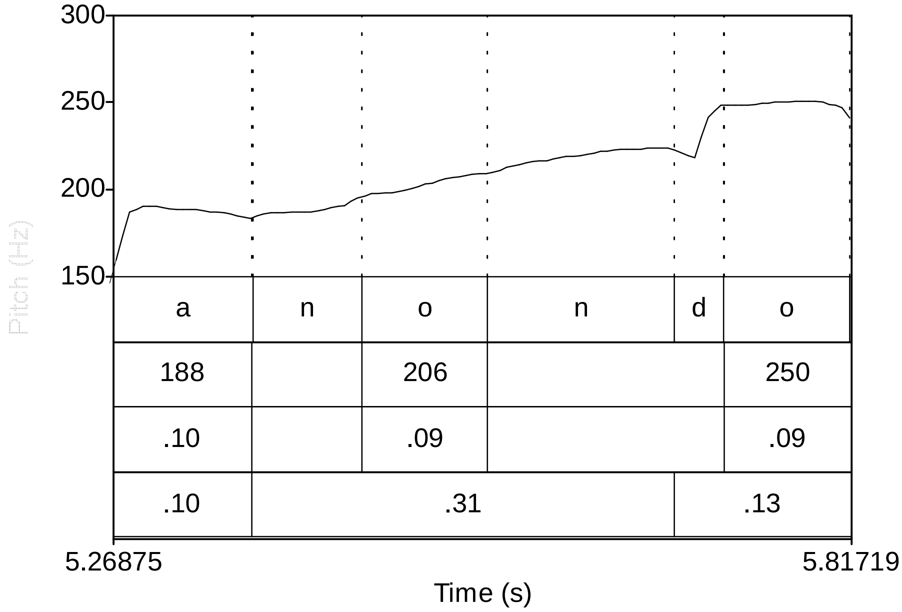

300
250
200
150
Pitch (Hz)
z
a
z
a
b
o
r
195
214
225
.14
.09
.09
.23
.18
.26
22.8823
23.563
Time (s)

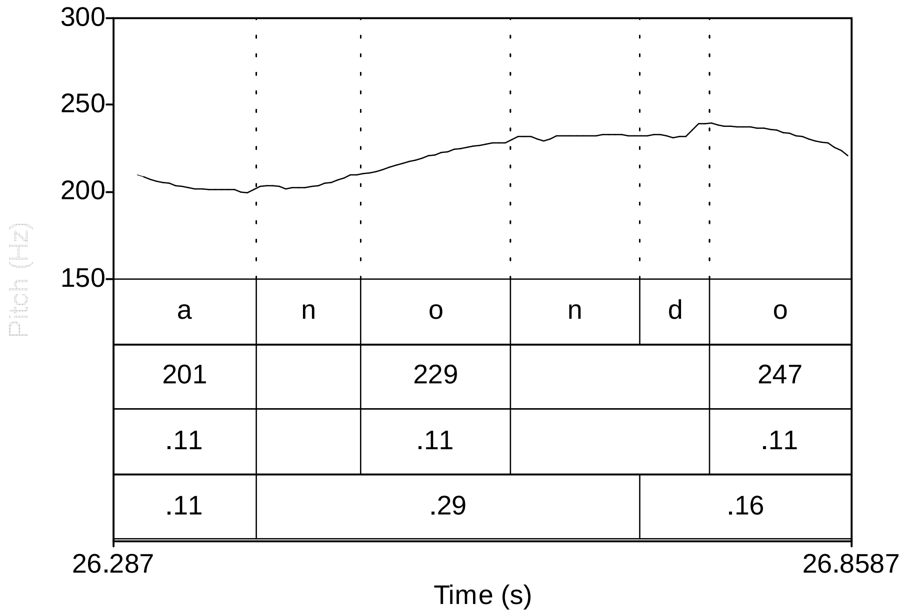
LLH-[zazabor]


200
150
100
50
0
Pitch (Hz)
z
a
z
a
b
o
r
119
135
141
.09
.08
.07
.24
.17
.25
39.7802
40.4545
Time (s)

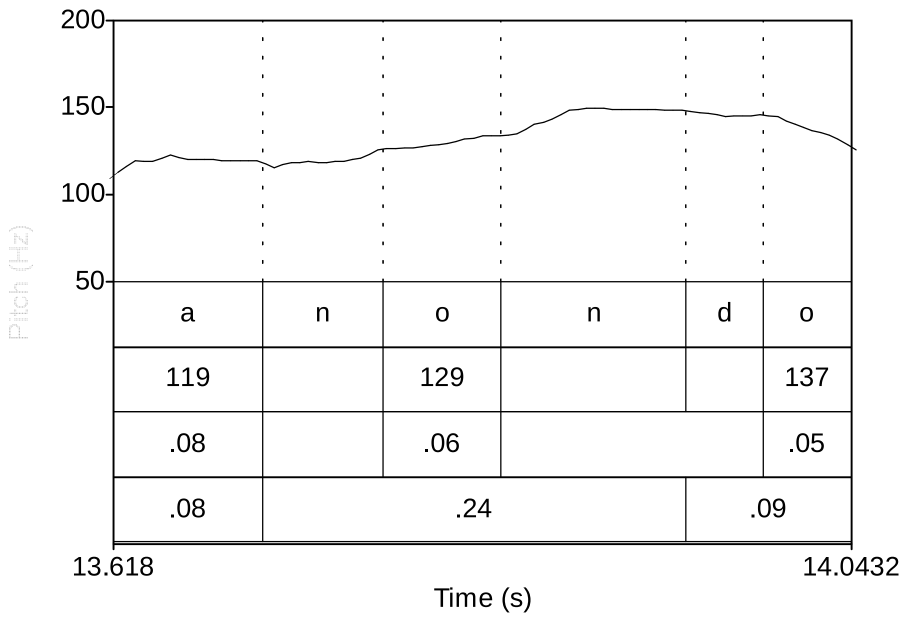

200
150
100
50
Pitch (Hz)
z a z a b o r
119 129 139
.10 .08 .08
.17 .16 .21
35.1398
35.6903
Time (s)

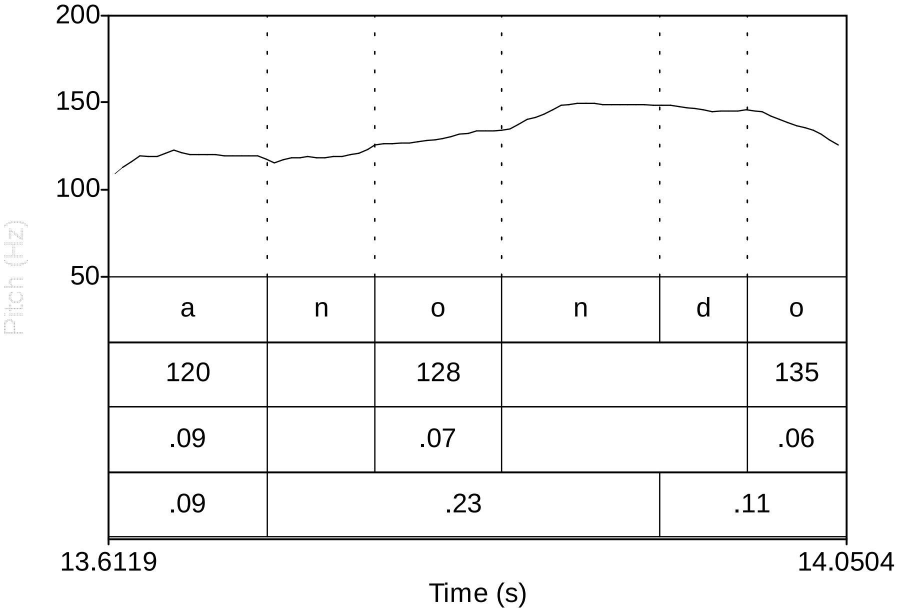
LLH-[zazabɔr]


300
250
200
150
Pitch (Hz)
a n o n d o
188 206 250
.10 .09 .09
.10 .31 .13
5.26875
5.81719
Time (s)

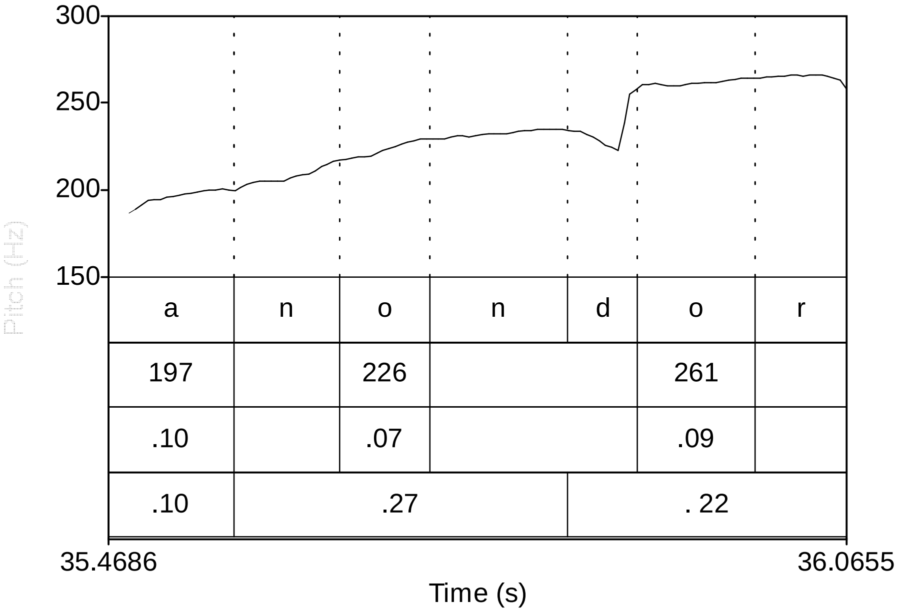

300
250
200
150
Pitch (Hz)
a
n
o
n
d
o
201
229
247
.11
.11
.11
.11
.29
.16
26.287
26.8587
Time (s)

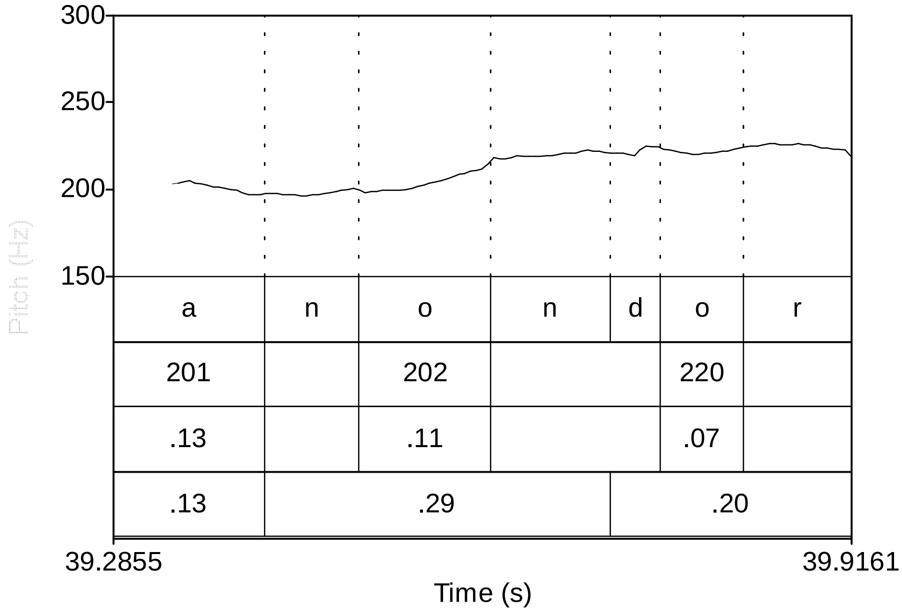
LHL-[anɔndɔ]


200
150
100
50
Pitch (Hz)
a
n
o
n
d
o
119
129
137
.08
.06
.05
.08
.24
.09
13.618
14.0432
Time (s)

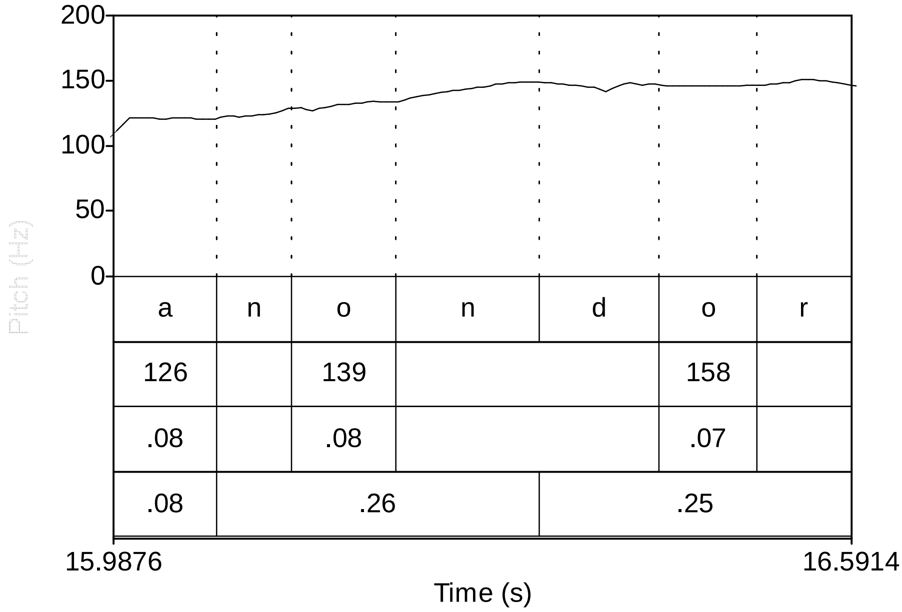

200
150
100
50
Pitch (Hz)
a
n
o
n
d
o
120
128
135
.09
.07
.06
.09
.23
.11
13.6119
14.0504
Time (s)

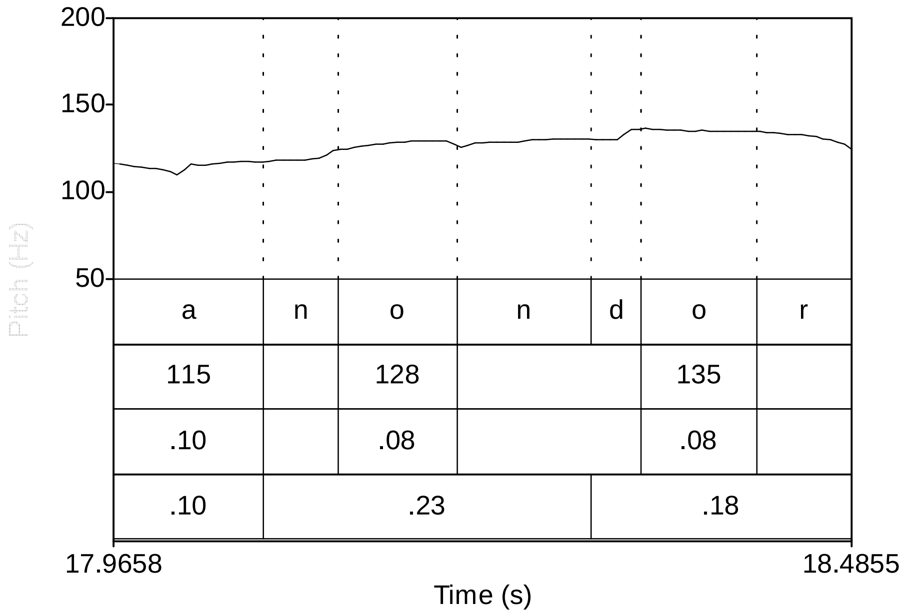
LHL-[anɔndɔ]


300
250
200
150
Pitch (Hz)
a
n
o
n
d
o
r
197
226
261
.10
.07
.09
.10
.27
. 22
35.4686
36.0655
Time (s)

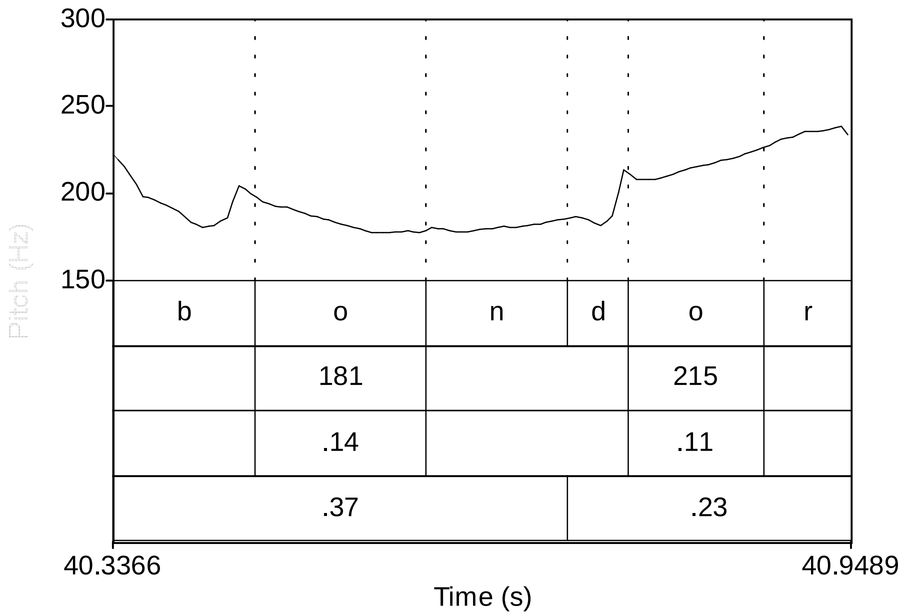

300
250
200
150
Pitch (Hz)
a
n
o
n
d
o
r
201
202
220
.13
.11
.07
.13
.29
.20
39.2855
39.9161
Time (s)

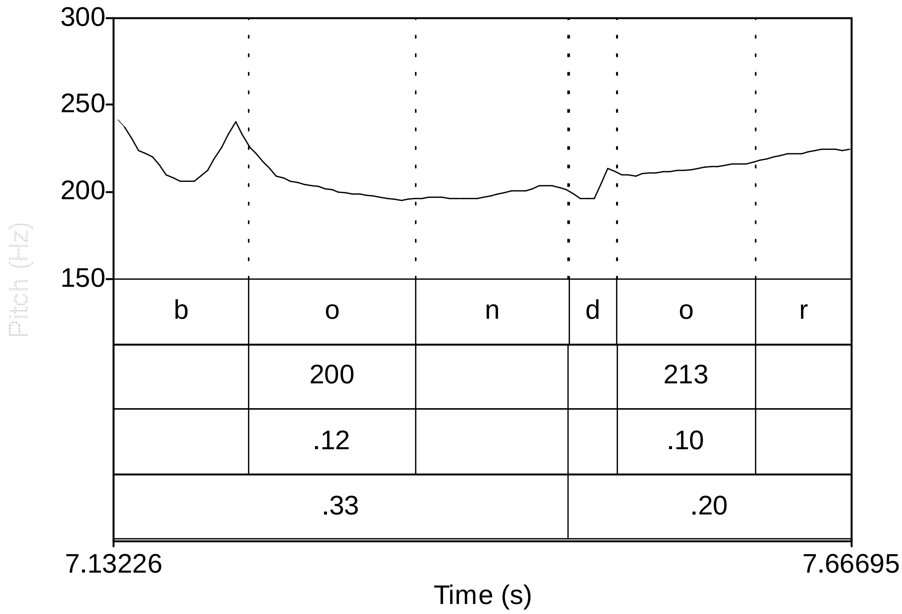
LHH-[anɔndɔr]


200
150
100
50
0
Pitch (Hz)
a
n
o
n
d
o
r
126
139
158
.08
.08
.07
.08
.26
.25
15.9876
16.5914
Time (s)

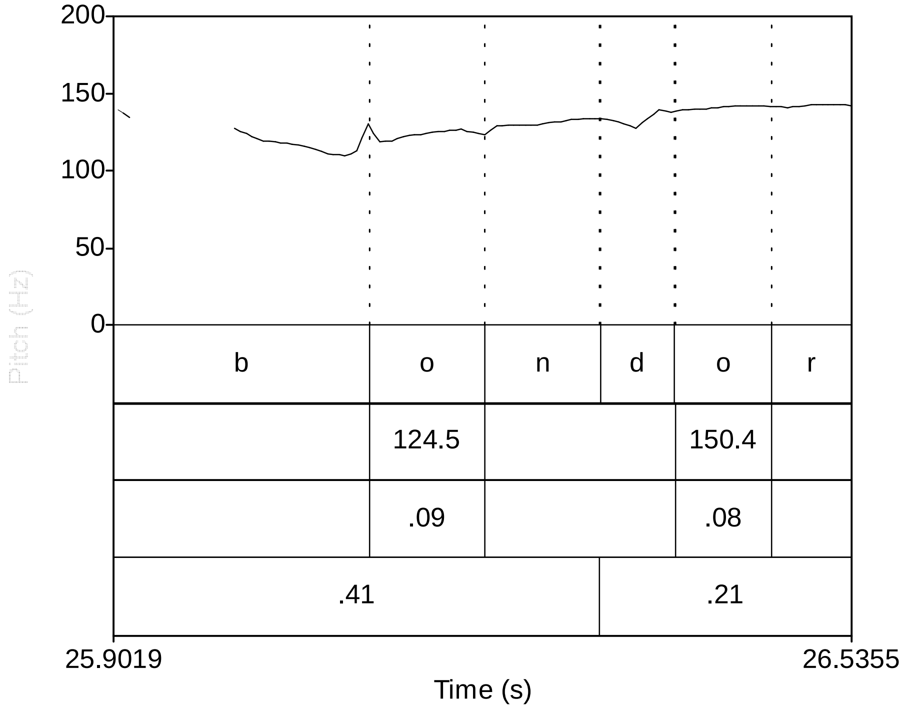

200
150
100
50
Pitch (Hz)
a
n
o
n
d
o
r
115
128
135
.10
.08
.08
.10
.23
.18
17.9658
18.4855
Time (s)

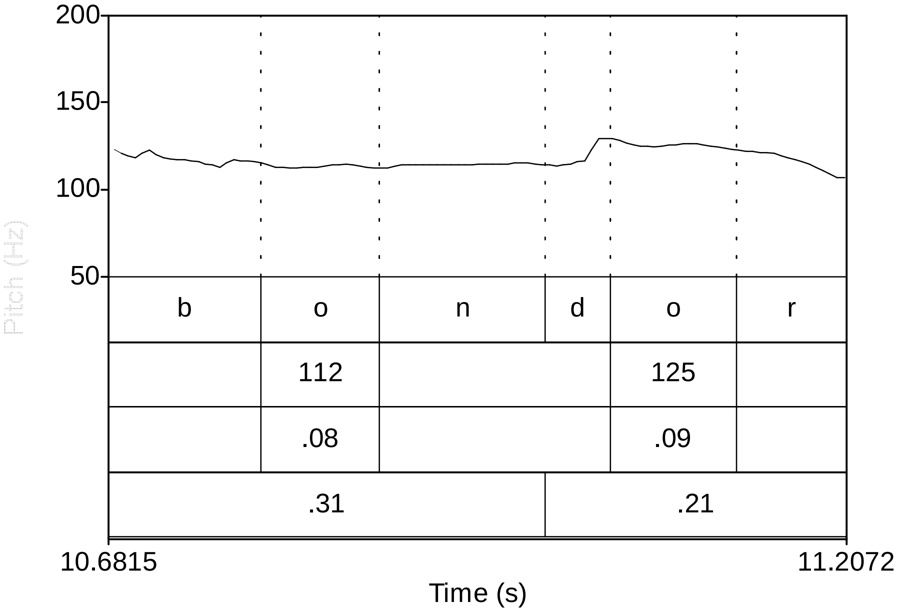
LHH-[anɔndɔr]


300
250
200
150
Pitch (Hz)
b
o
n
d
o
r
181
215
.14
.11
.37
.23
40.3366
40.9489
Time (s)

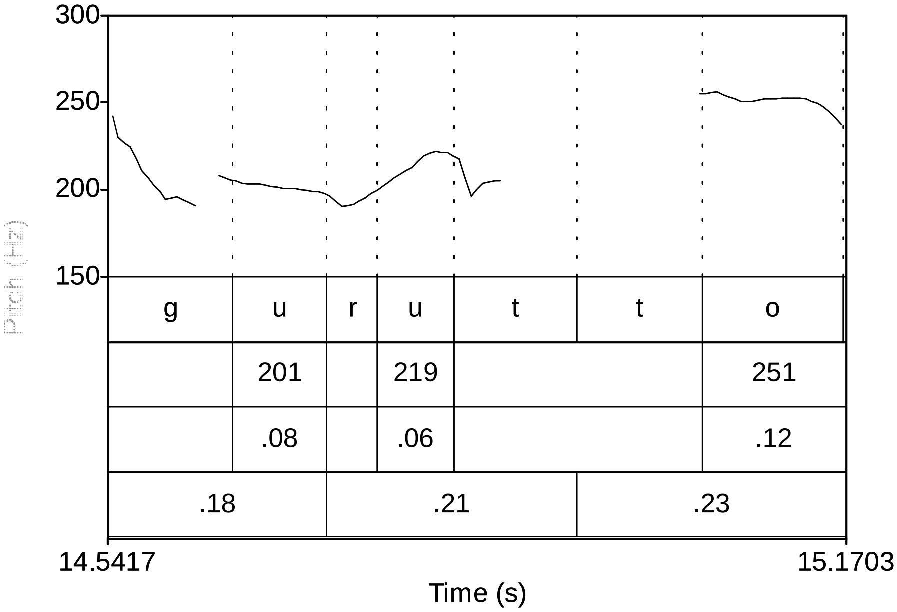

300
250
200
150
Pitch (Hz)
b
o
n
d
o
r
200
213
.12
.10
.33
.20
7.13226
7.66695
Time (s)

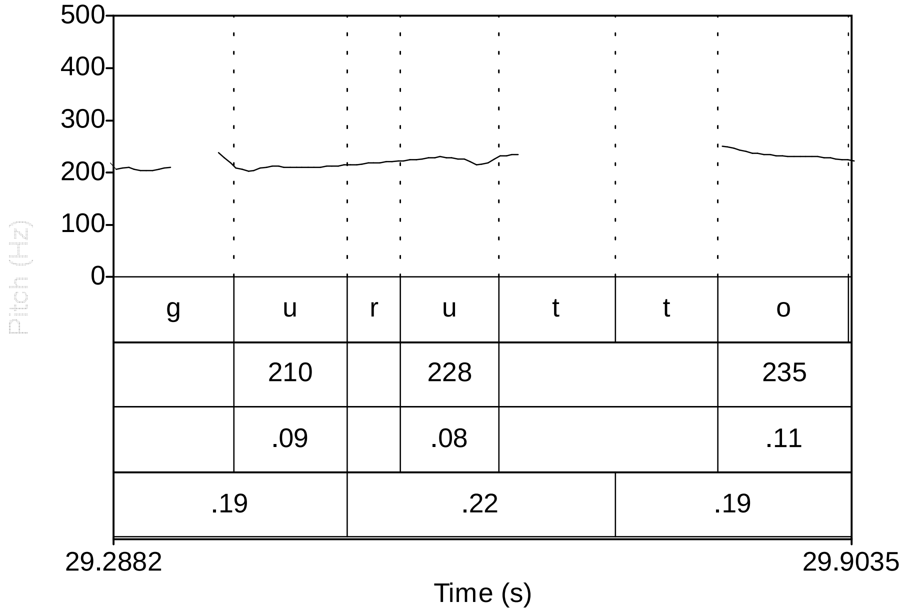
HH-[bɔndɔr]


200
150
100
50
0
Pitch (Hz)
b
o
n
d
o
r
124.5
150.4
.09
.08
.41
.21
25.9019
26.5355
Time (s)

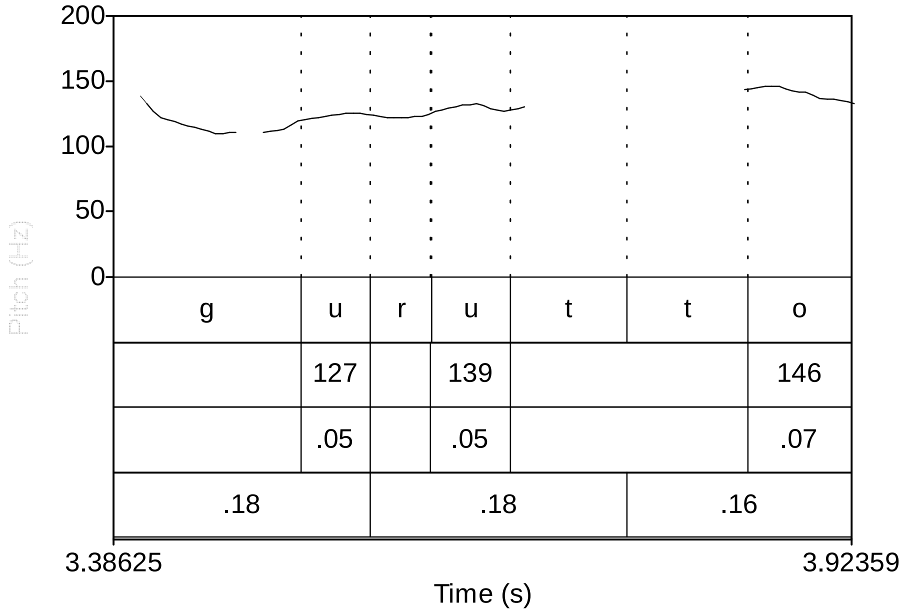

200
150
100
50
Pitch (Hz)
b
o
n
d
o
r
112
125
.08
.09
.31
.21
10.6815
11.2072
Time (s)

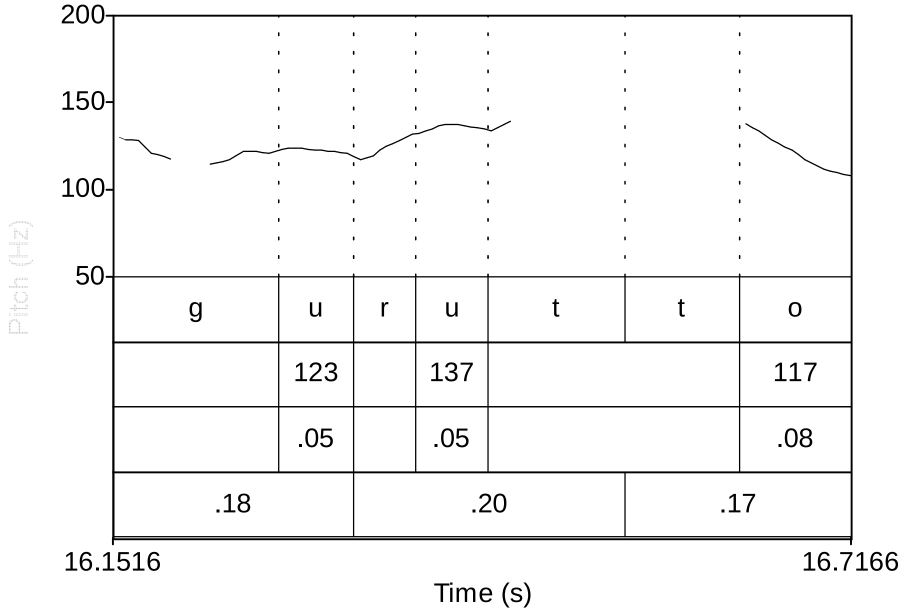
HH-[bɔndɔr]


300
250
200
150
Pitch (Hz)
g
u
r
u
t
t
o
201
219
251
.08
.06
.12
.18
.21
.23
14.5417
15.1703
Time (s)

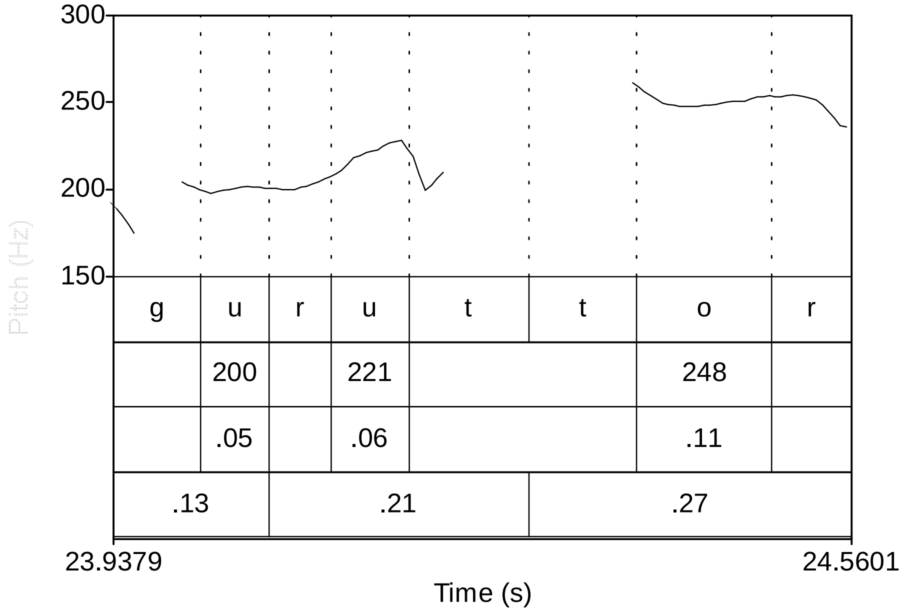

500
400
300
200
100
0
Pitch (Hz)
g
u
r
u
t
t
o
210
228
235
.09
.08
.11
.19
.22
.19
29.2882
29.9035
Time (s)

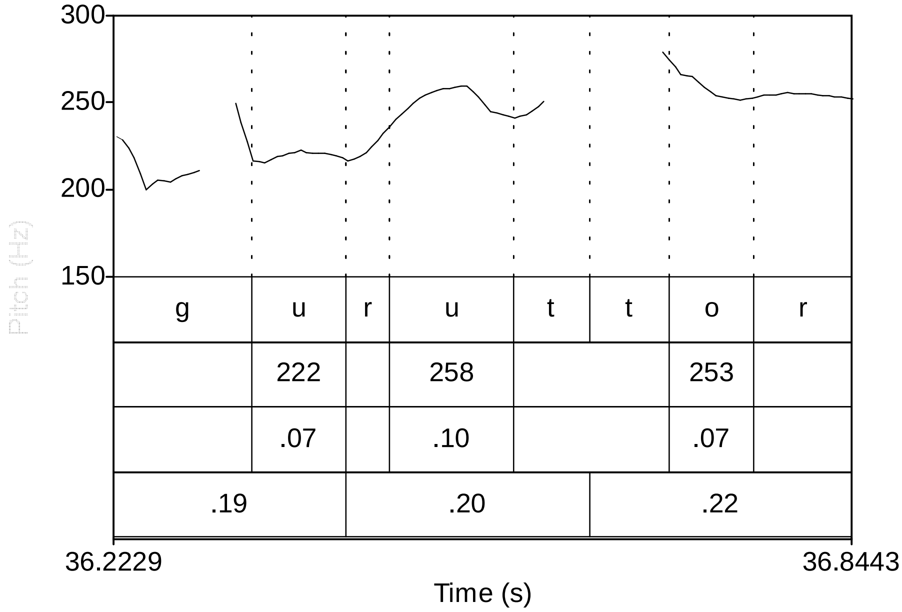
LHL-[gʊrʊttɔ]


200
150
100
50
0
Pitch (Hz)
g
u
r
u
t
t
o
127
139
146
.05
.05
.07
.18
.18
.16
3.38625
3.92359
Time (s)

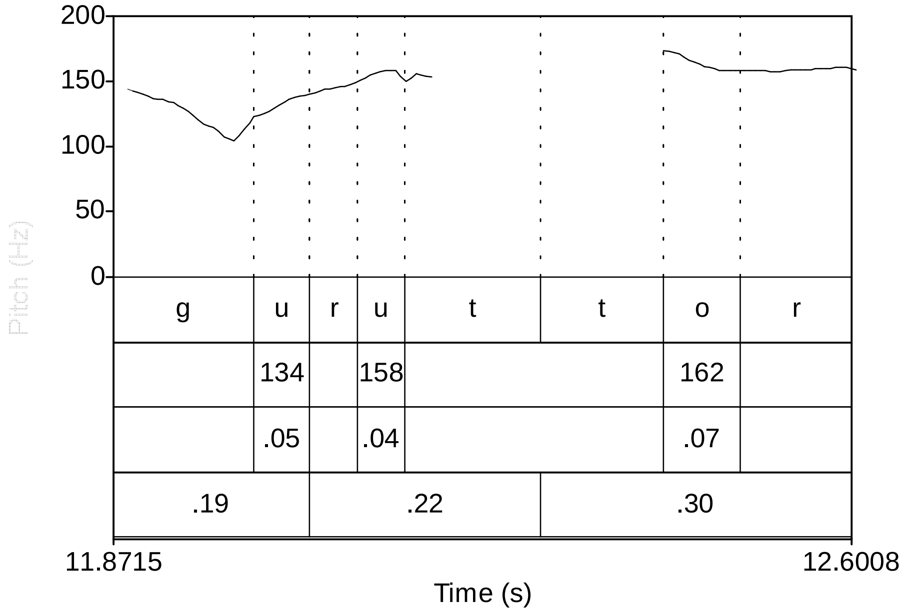

200
150
100
50
Pitch (Hz)
g
u
r
u
t
t
o
123
137
117
.05
.05
.08
.18
.20
.17
16.1516
16.7166
Time (s)

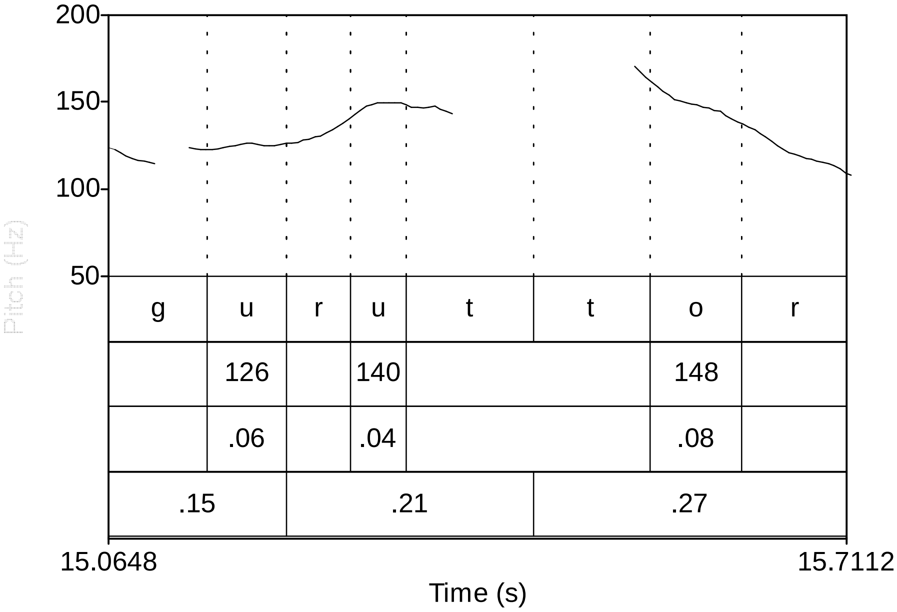
LHL-[gʊrʊttɔ]


300
250
200
150
Pitch (Hz)
g
u
r
u
t
t
o
r
200
221
248
.05
.06
.11
.13
.21
.27
23.9379
24.5601
Time (s)

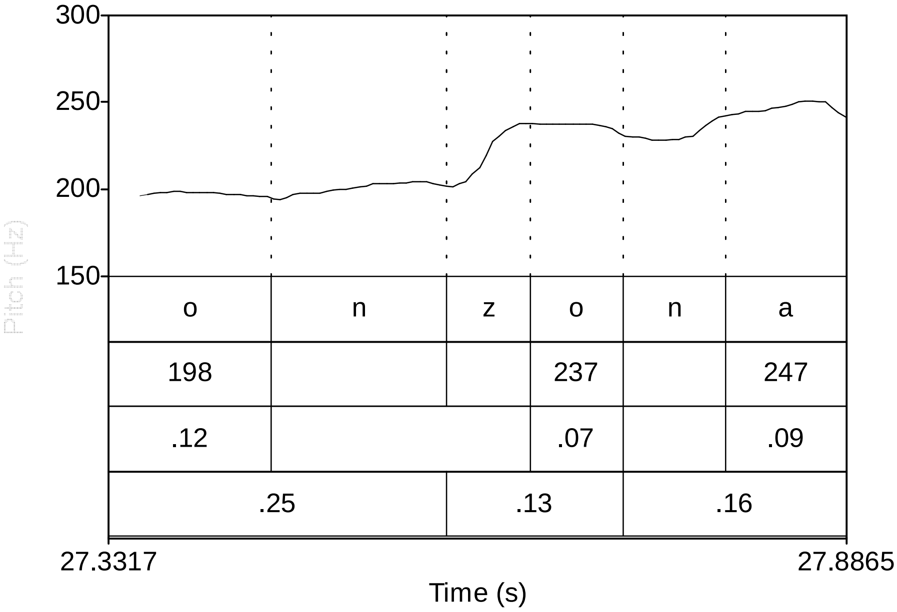


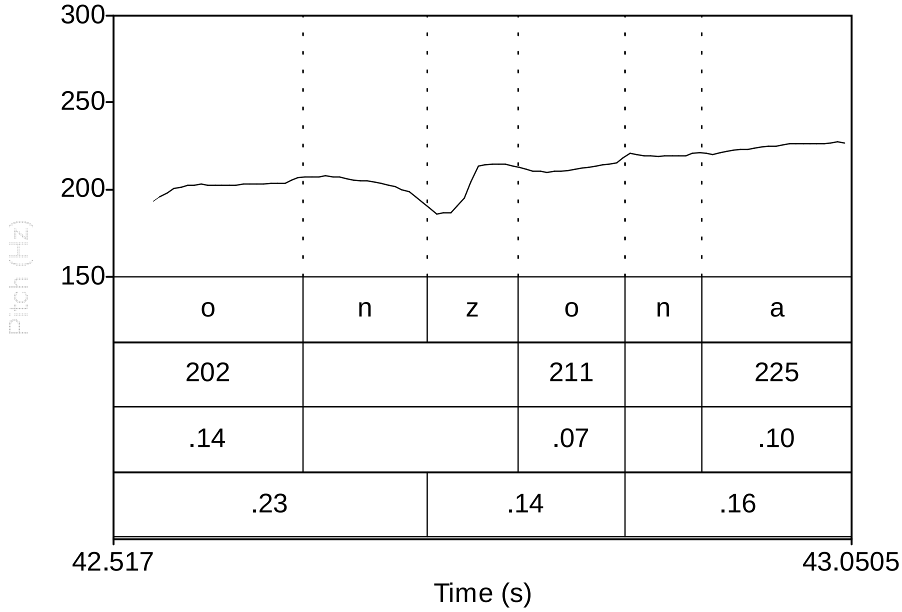
LHH-[gʊrʊttɔr]



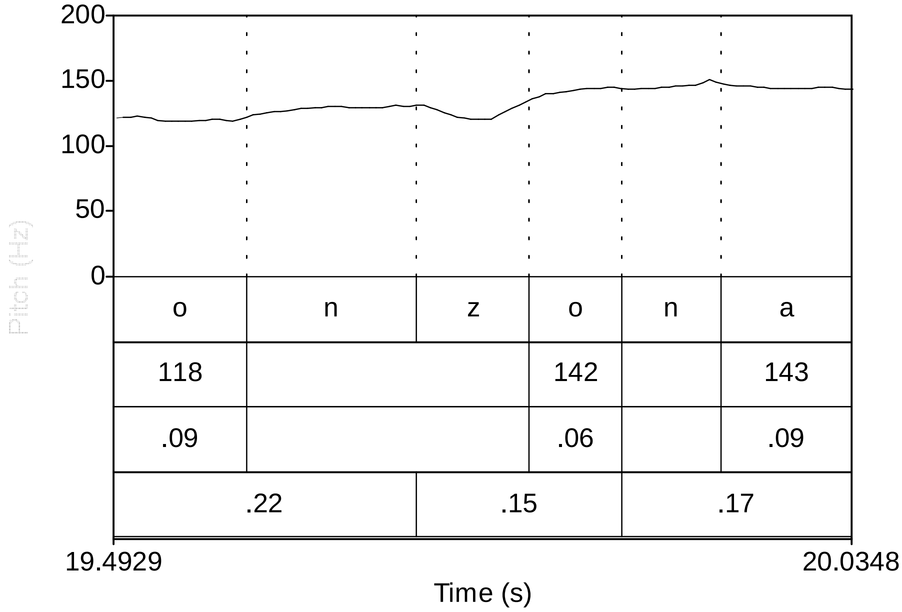


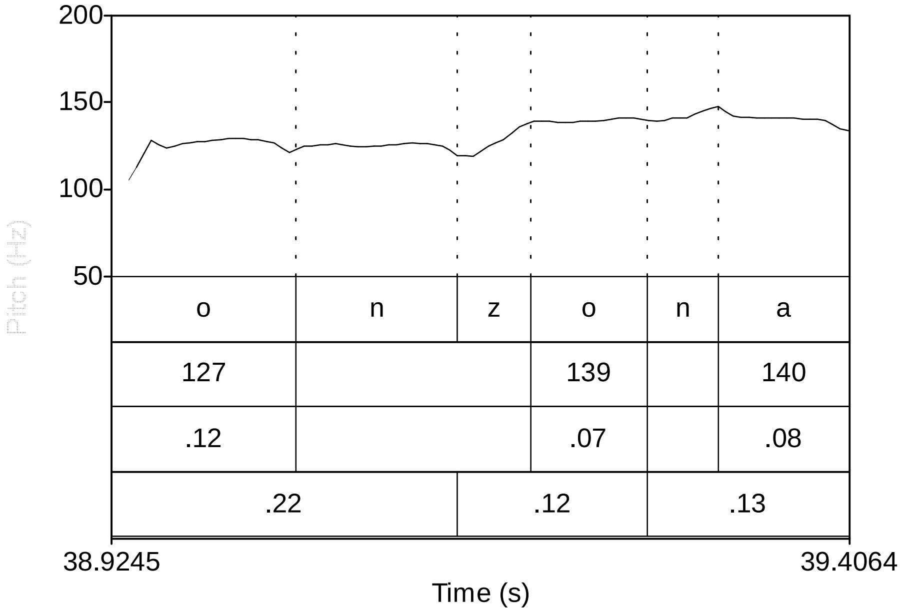
LHH-[gʊrʊttɔr]



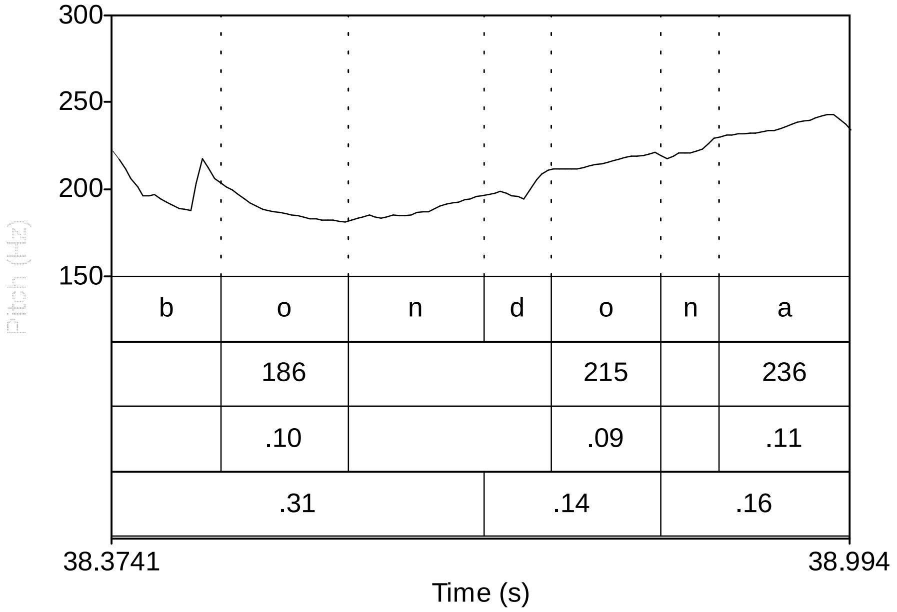

300
250
200
150
Pitch (Hz)
o
n
z
o
n
a
202
211
225
.14
.07
.10
.23
.14
.16
42.517
43.0505
Time (s)

HLL-[ɔnzɔna]


200
150
100
50
0
Pitch (Hz)
o
n
z
o
n
a
118
142
143
.09
.06
.09
.22
.15
.17
19.4929
20.0348
Time (s)


200
150
100
50
Pitch (Hz)
o
n
z
o
n
a
127
139
140
.12
.07
.08
.22
.12
.13
38.9245
39.4064
Time (s)

HLL-[ɔnzɔna]


300
250
200
150
Pitch (Hz)
b
o
n
d
o
n
a
186
215
236
.10
.09
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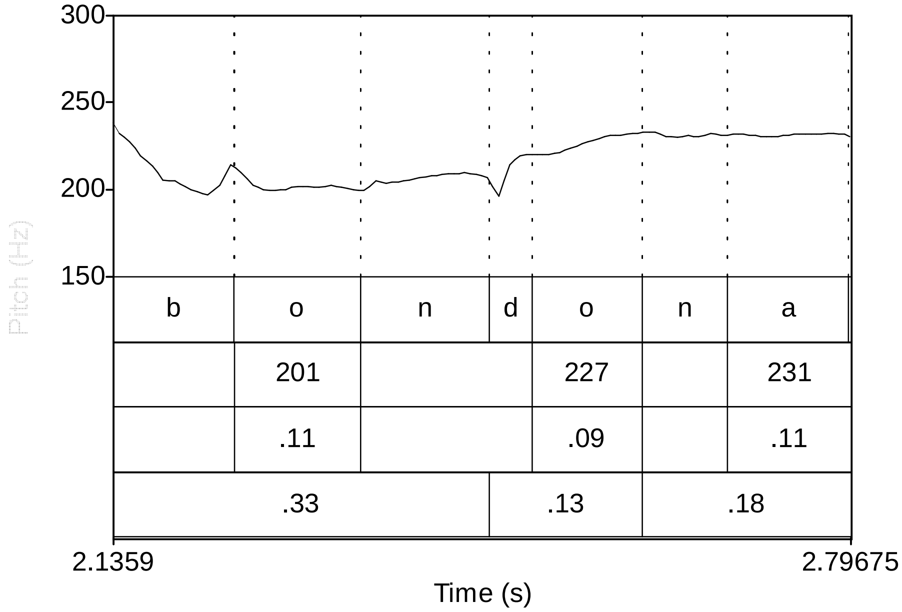
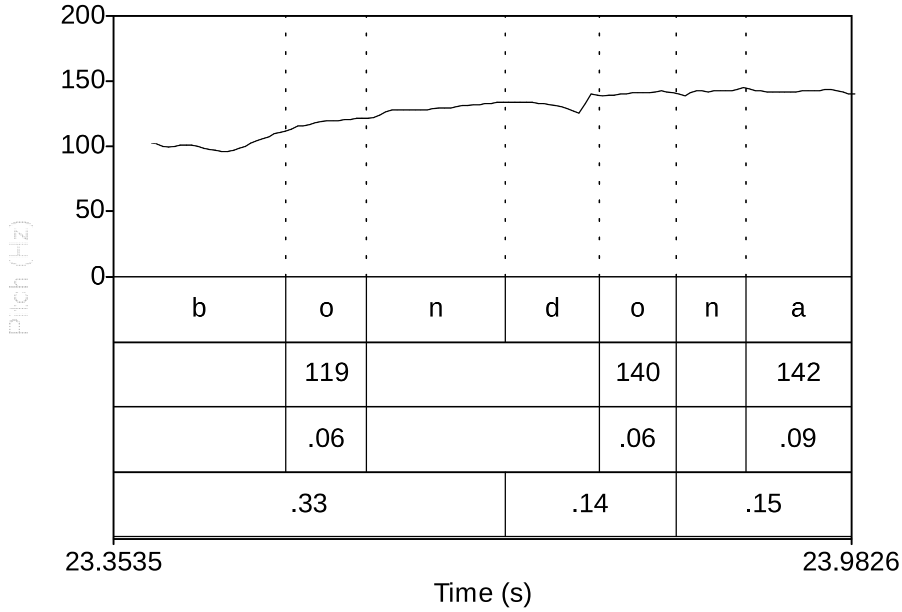
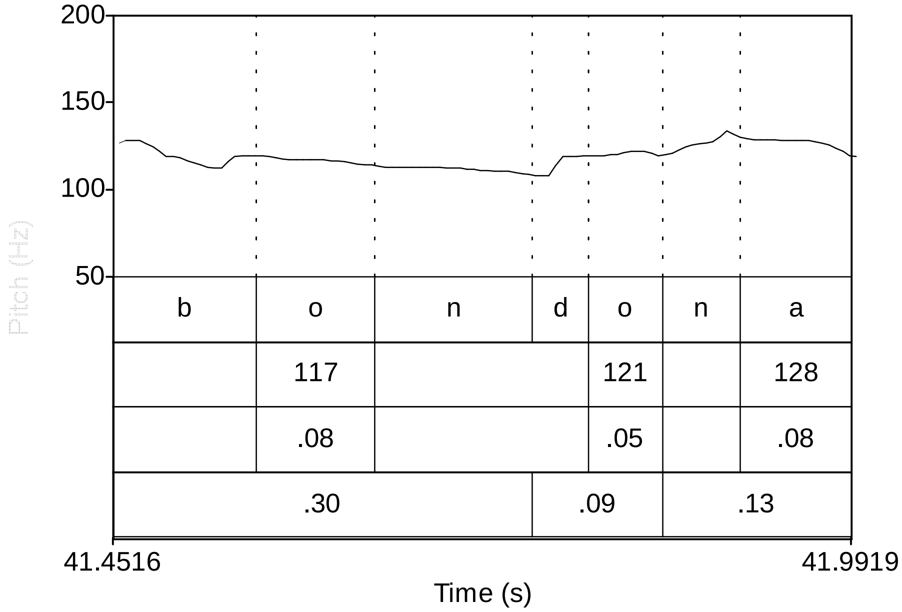
38.3741
38.994
Time (s)

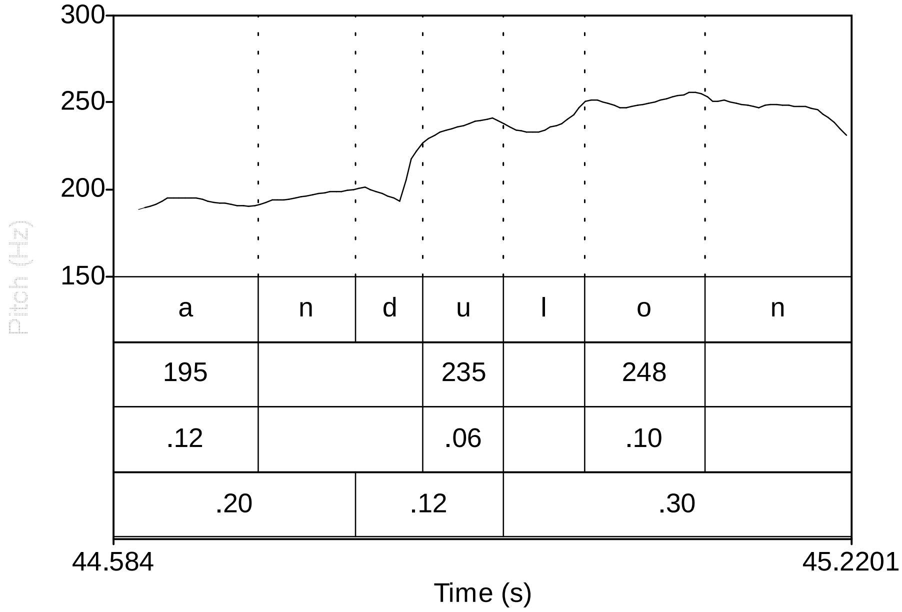

300
250
200
150
Pitch (Hz)
b
o
n
d
o
n
a
201
227
231
.11
.09
.11
.33
.13
.18
2.1359
2.79675
Time (s)

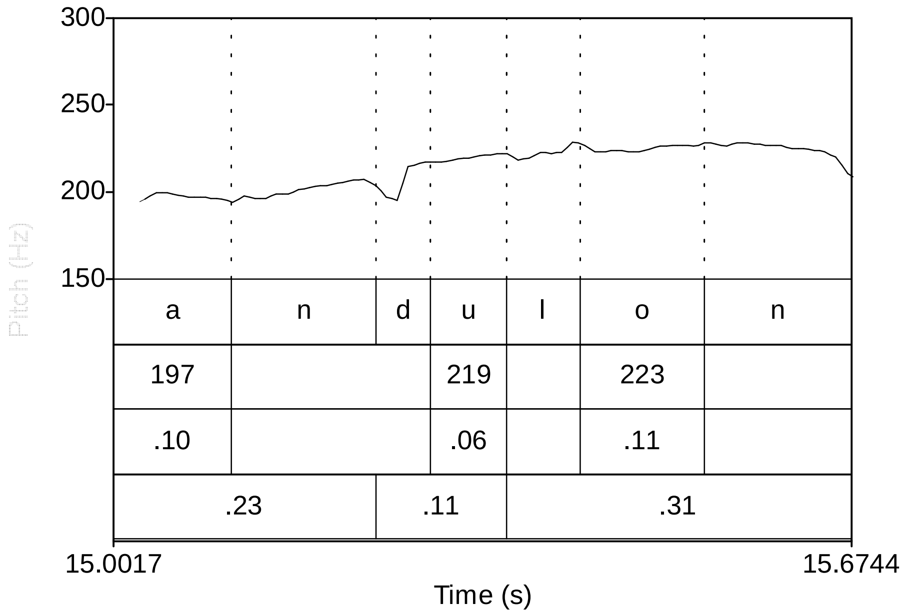
HLL-[bɔndɔna]


200
150
100
50
0
Pitch (Hz)
b
o
n
d
o
n
a
119
140
142
.06
.06
.09
.33
.14
.15
23.3535
23.9826
Time (s)


200
150
100
50
Pitch (Hz)
b
o
n
d
o
n
a
117
121
128
.08
.05
.08
.30
.09
.13
41.4516
41.9919
Time (s)

HLL-[bɔndɔna]


300
250
200
150
Pitch (Hz)
a
n
d
u
l
o
n
195
235
248
.12
.06
.10
.20
.12
.30
44.584
45.2201
Time (s)


300
250
200
150
Pitch (Hz)
a
n
d
u
l
o
n
197
219
223
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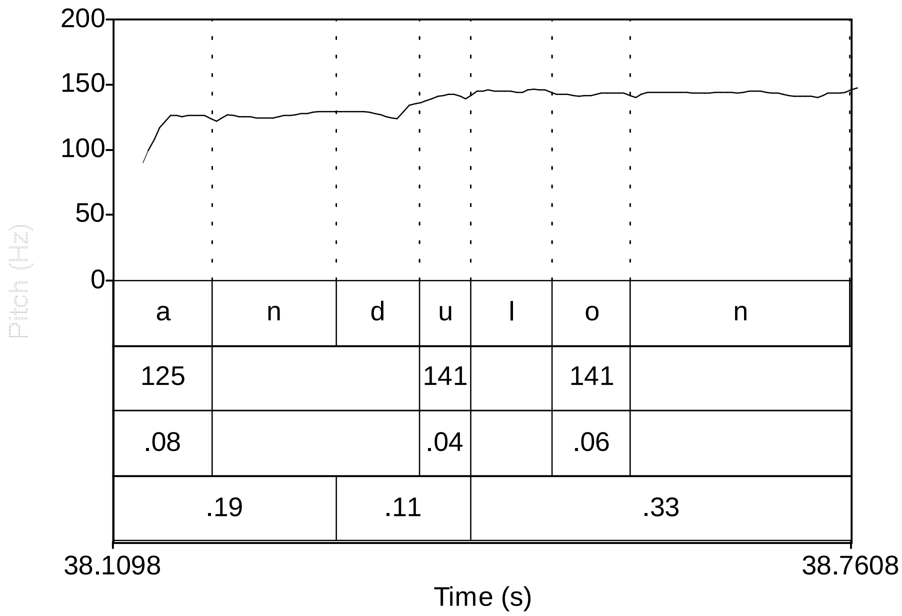
.06
.11
.23
.11
.31
15.0017
15.6744
Time (s)

HLH-[andʊlɔn]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150
100
50
0
Pitch (Hz)
a
n
d
u
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o
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141
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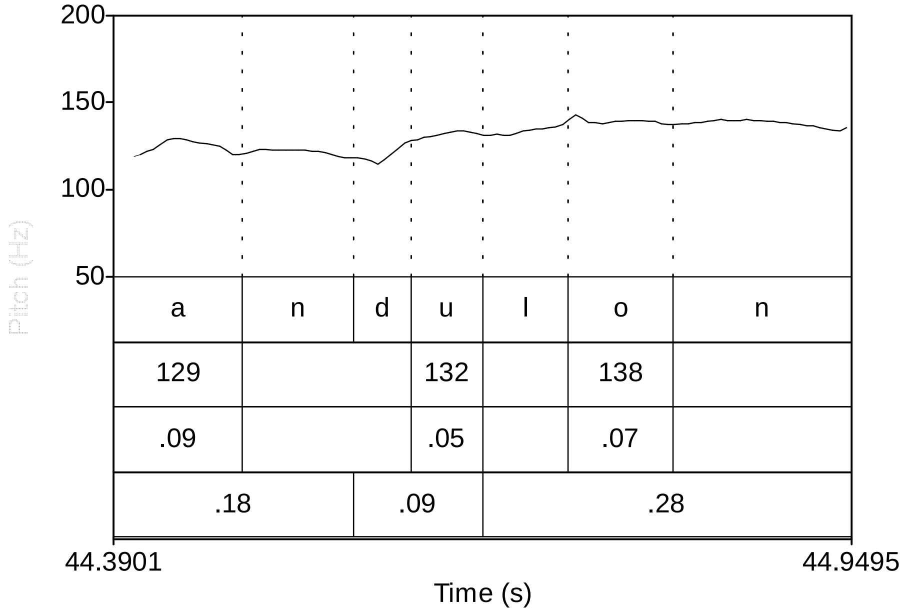
.04
.06
.19
.11
.33
38.1098
38.7608
Time (s)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100
50
Pitch (Hz)
a
n
d
u
l
o
n
129
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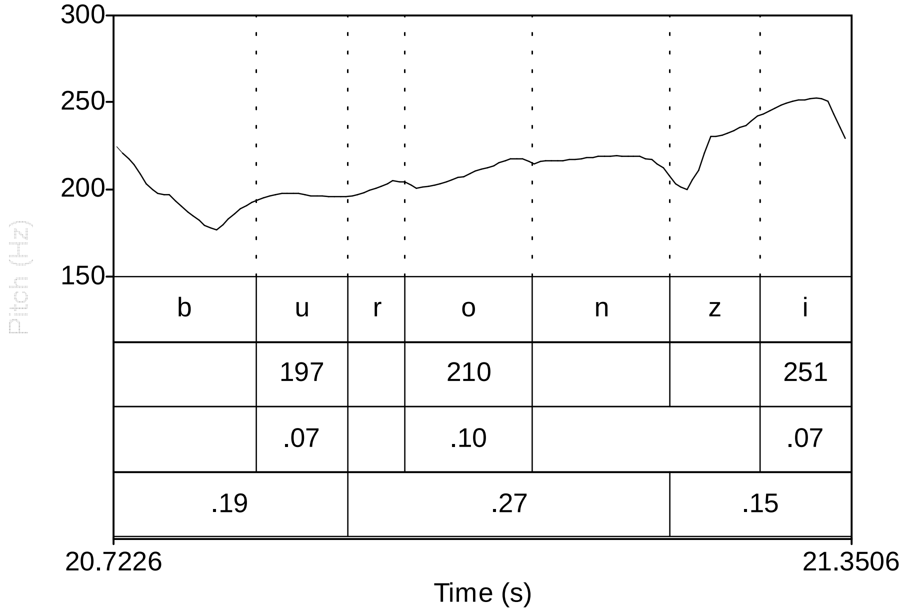
.18
.09
.28
44.3901
44.9495
Time (s)

HLH-[andʊlɔn]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250
200
150
Pitch (Hz)
b
u
r
o
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z
i
197
210
251
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.10
.07
.19
.27
.15
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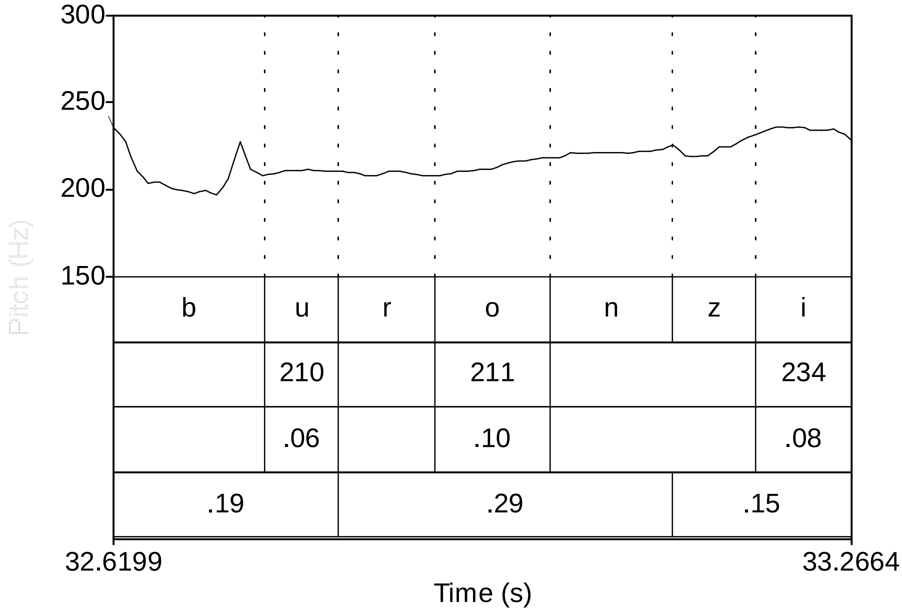
21.3506
Time (s)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200
150
Pitch (Hz)
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u
r
o
n
z
i
210
211
234
.06
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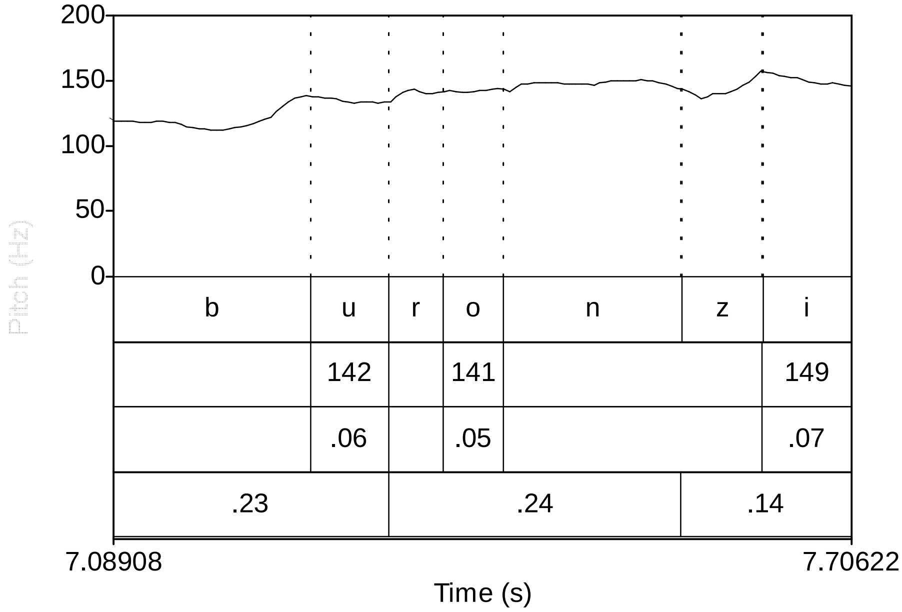
.08
.19
.29
.15
32.6199
33.2664
Time (s)

LHL-[bʊrɔnzi]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150
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Pitch (Hz)
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u
r
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z
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141
149
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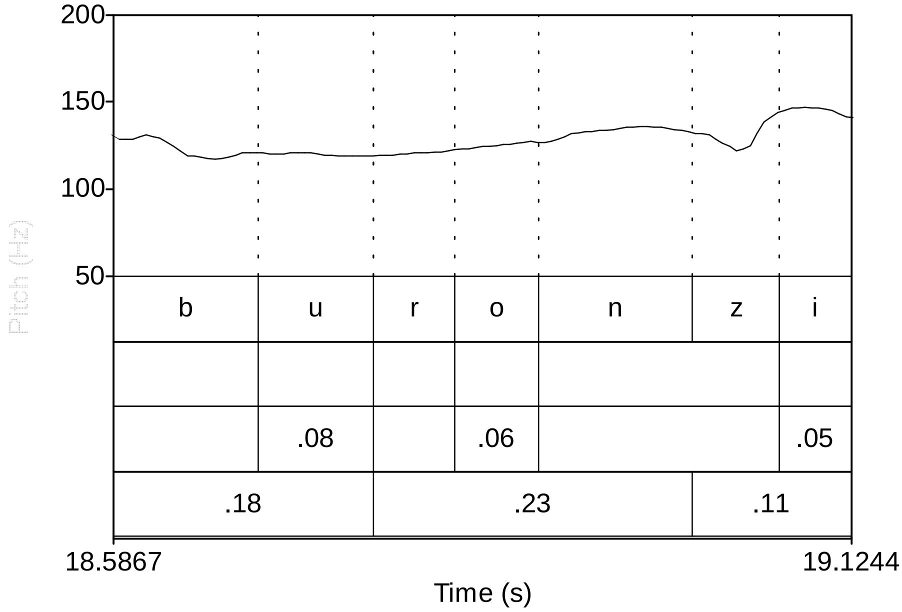
.05
.07
.23
.24
.14
7.08908
7.70622
Time (s)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150
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Pitch (Hz)
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u
r
o
n
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.08
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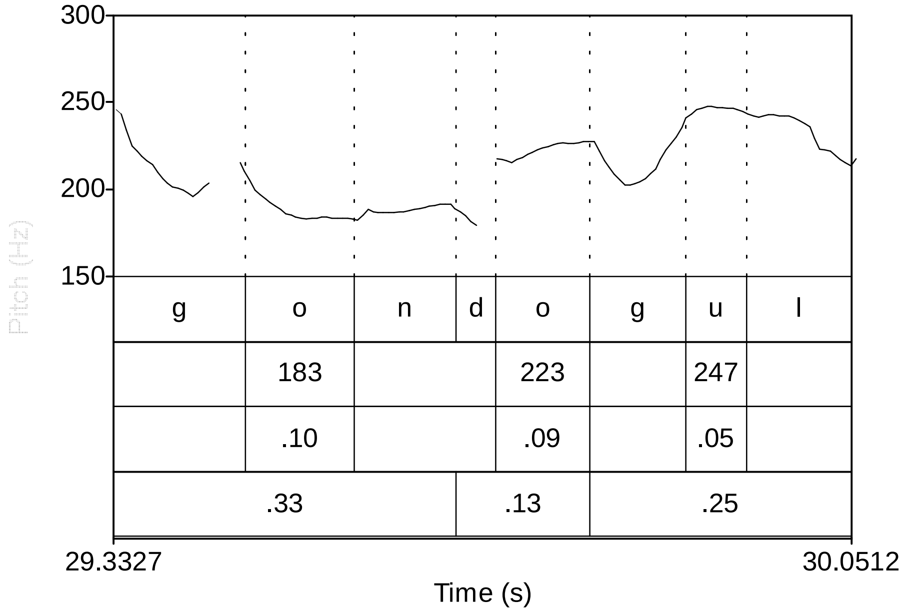
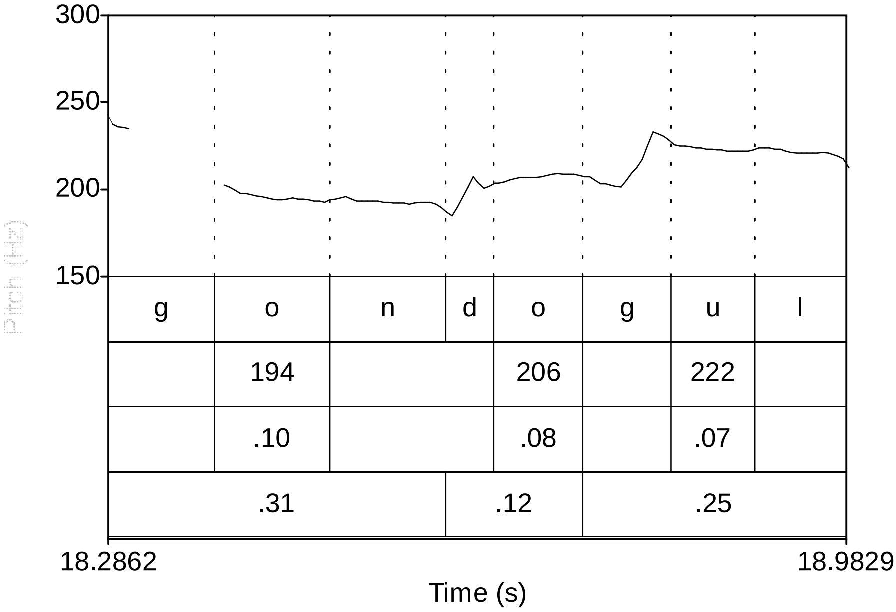
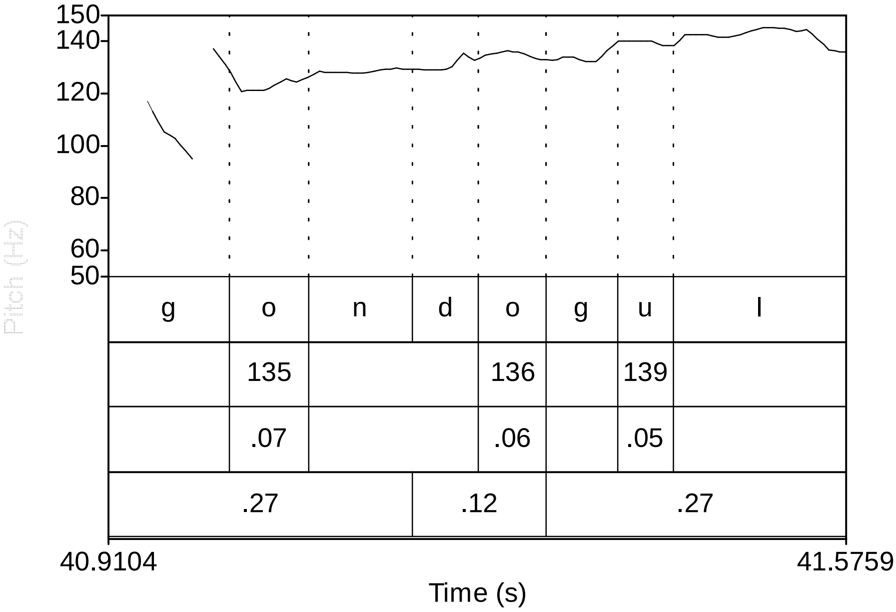
.05
.18
.23
.11
18.5867
19.1244
Time (s)

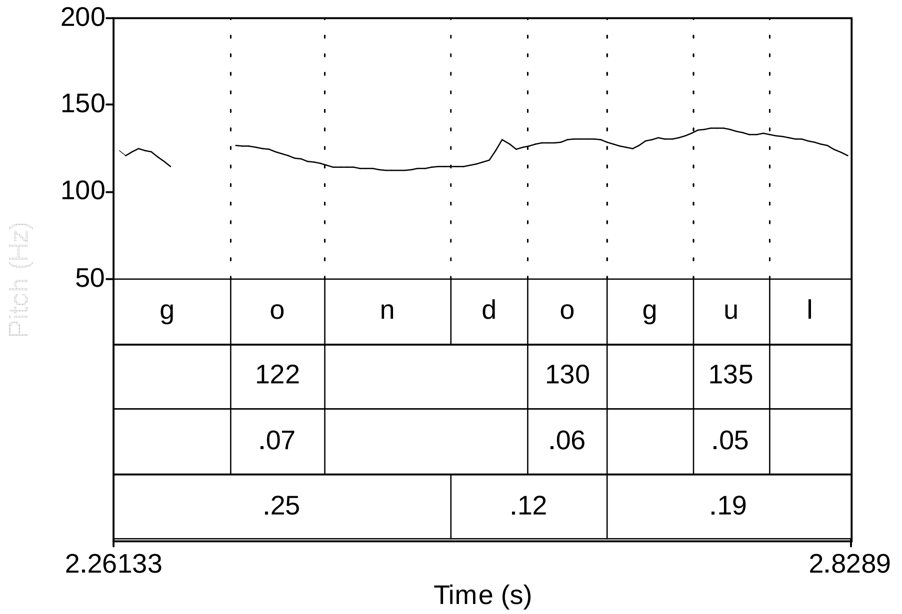
LHL-[bʊrɔnzi]


300
250
200
150
Pitch (Hz)
g
o
n
d
o
g
u
l
183
223
247
.10
.09
.05
.33
.13
.25
29.3327
30.0512
Time (s)

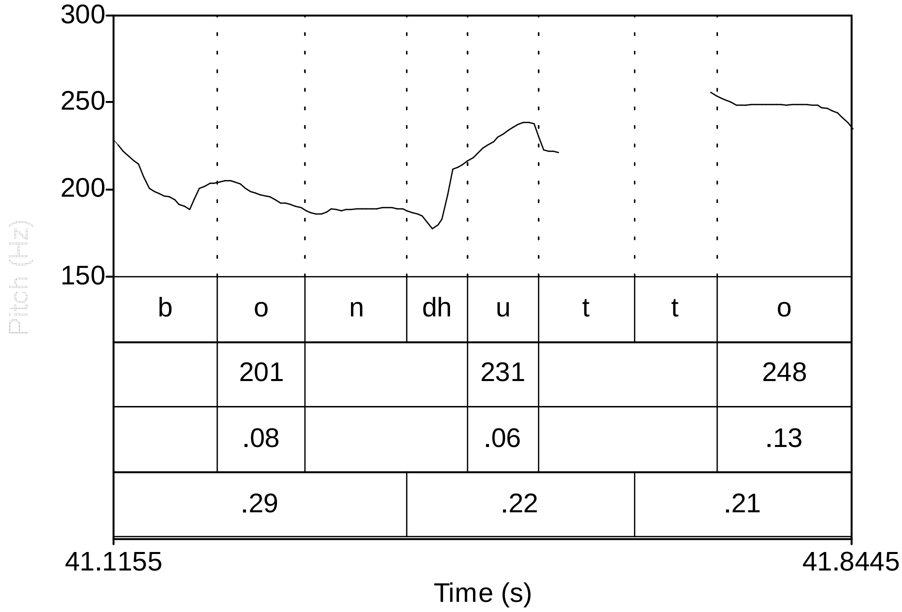


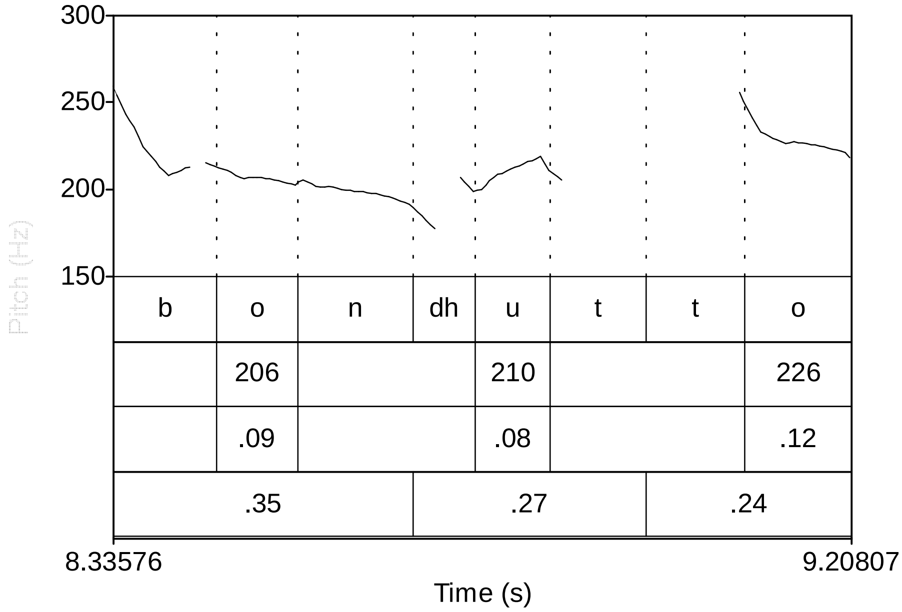
HLH-[gɔndɔgʊl]



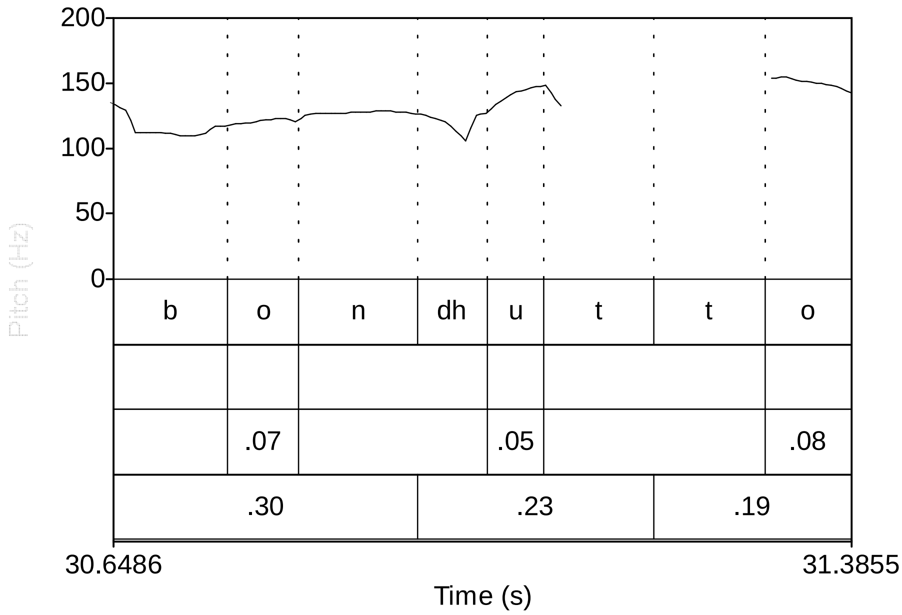


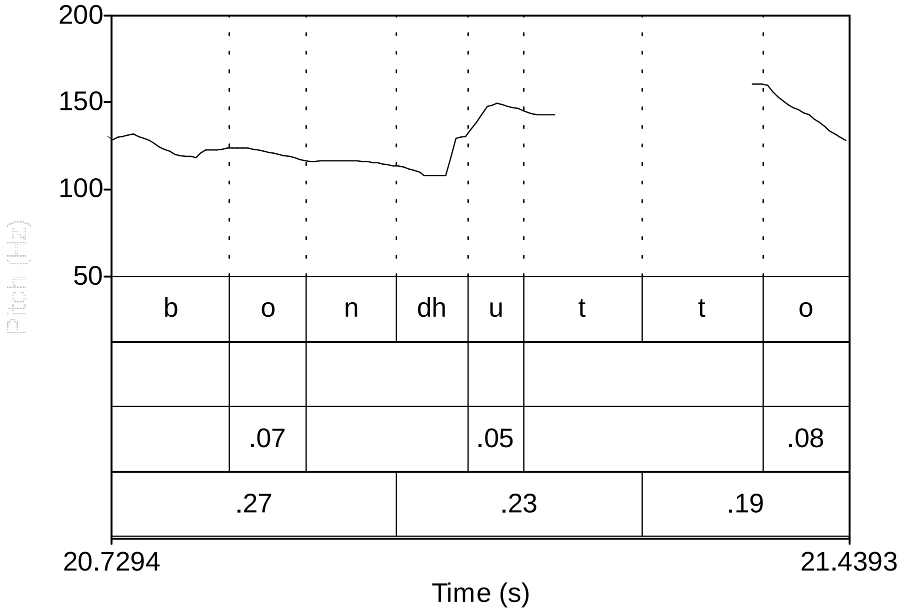
HLH-[gɔndɔgʊl]



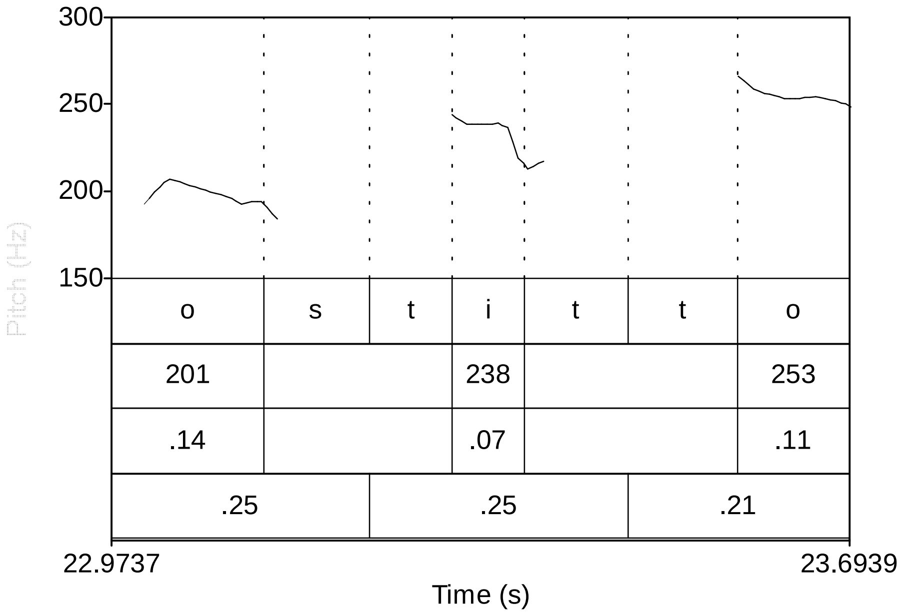


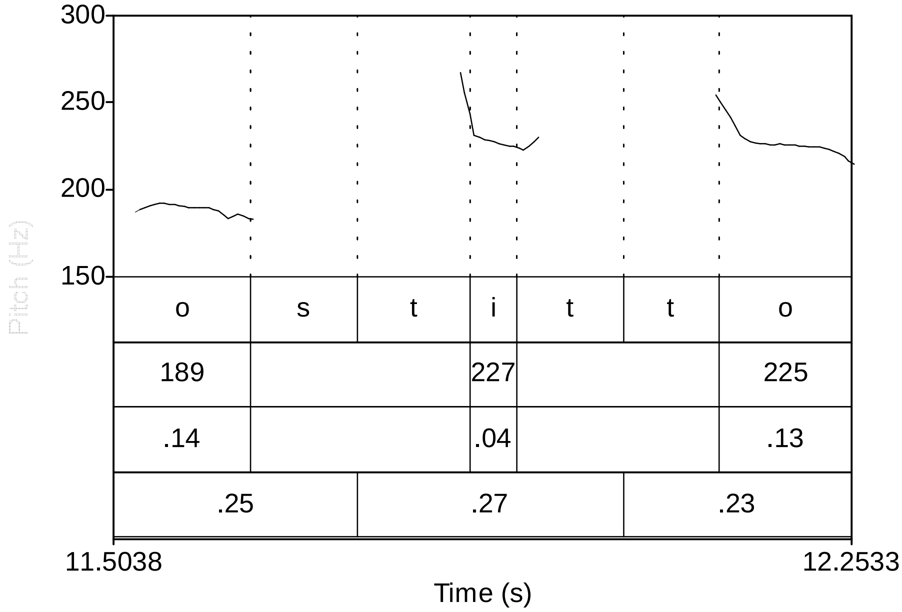
HHL-[bondʰʊttɔ]



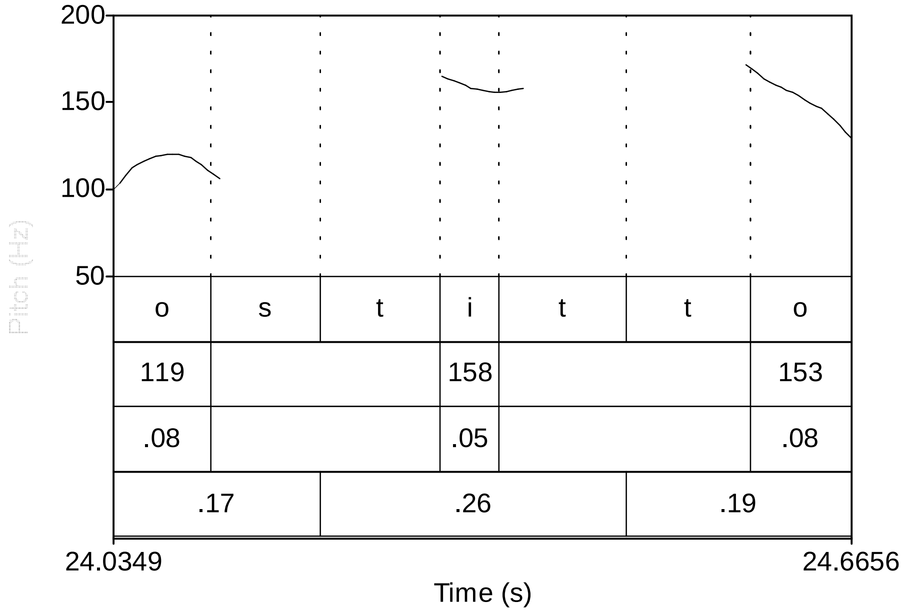


HHL-[bondʰʊttɔ]




300
250
200
150
Pitch (Hz)
o
s
t
i
t
t
o
189
227
225
.14
.04
.13
.25
.27
.23
11.5038
12.2533
Time (s)

HHL-[ɔstittɔ]


200
150
100
50
Pitch (Hz)
o
s
t
i
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t
o
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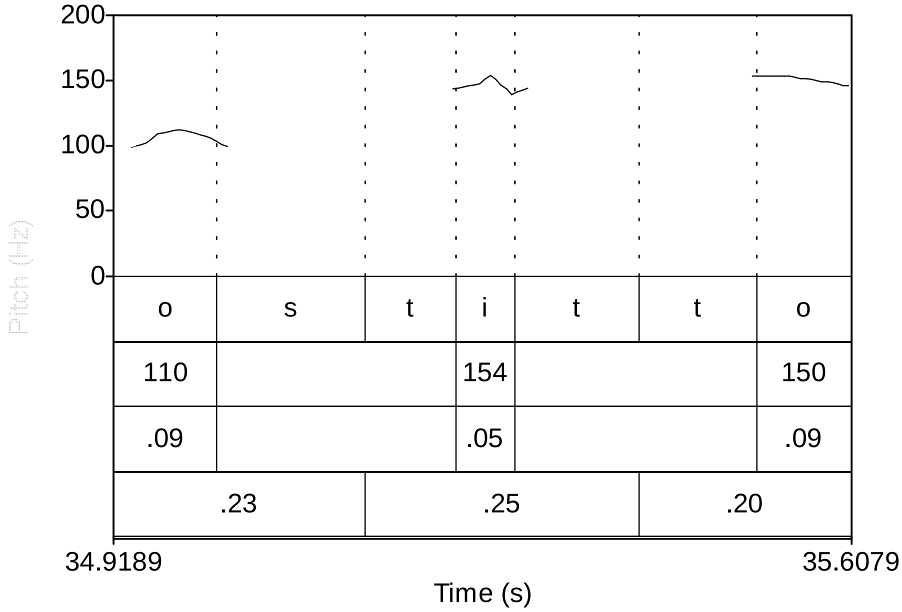
158
153
.08
.05
.08
.17
.26
.19
24.0349
24.6656
Time (s)


Pitch (Hz)
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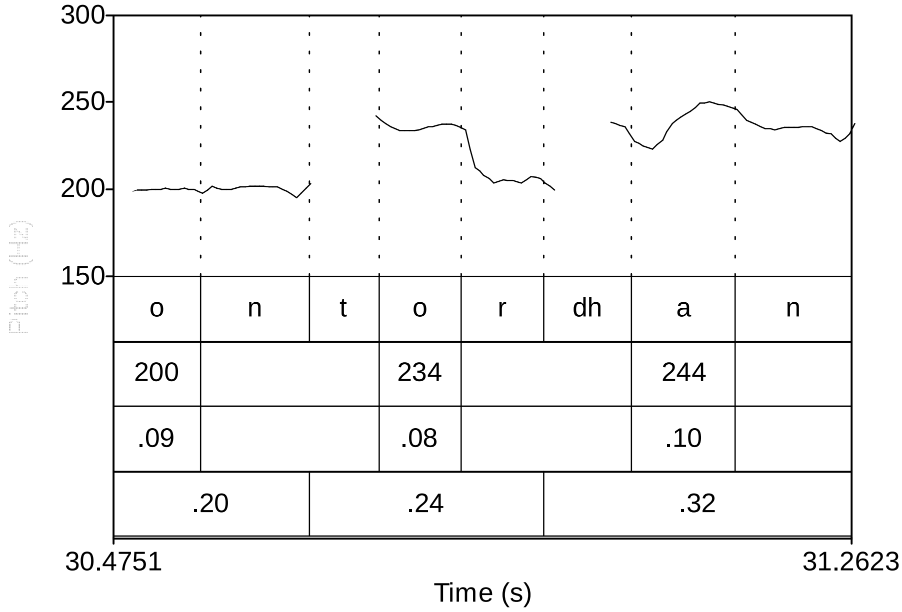
100
50
0
o
s
t
i
t
t
o
110
154
150
.09
.05
.09
.23
.25
.20
34.9189
35.6079
Time (s)

HHL-[ɔstittɔ]


Pitch (Hz)
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200
150
o
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t
o
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dh
a
n
200
234
244
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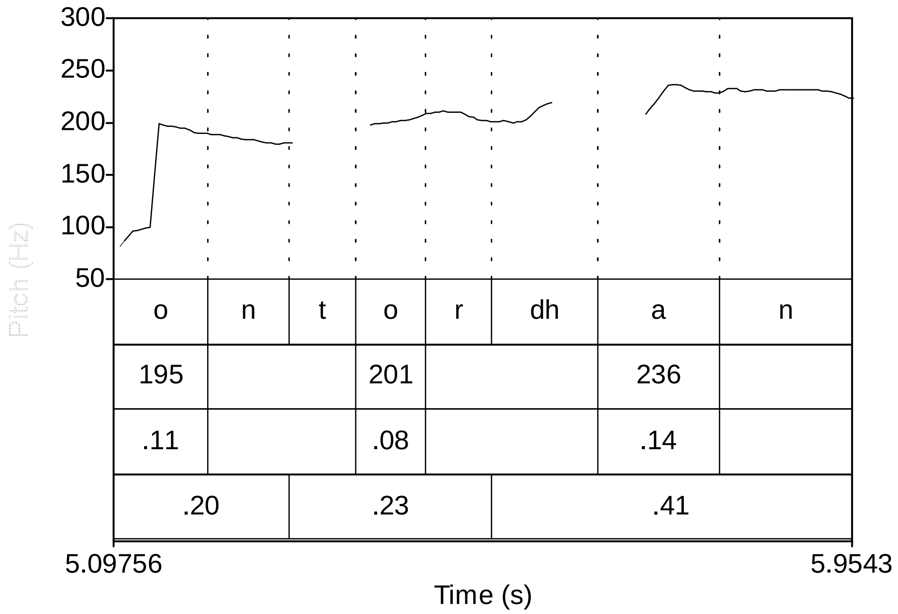
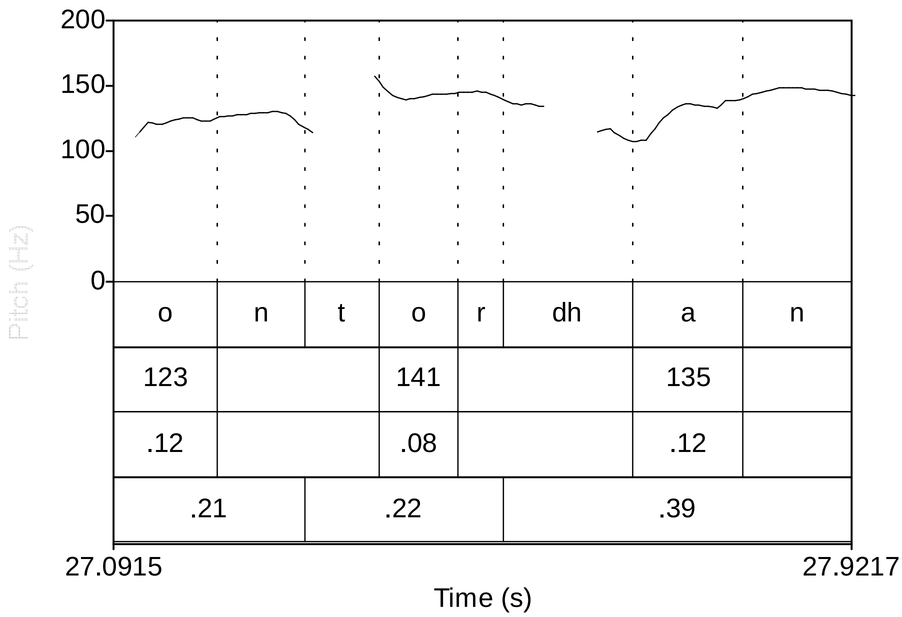
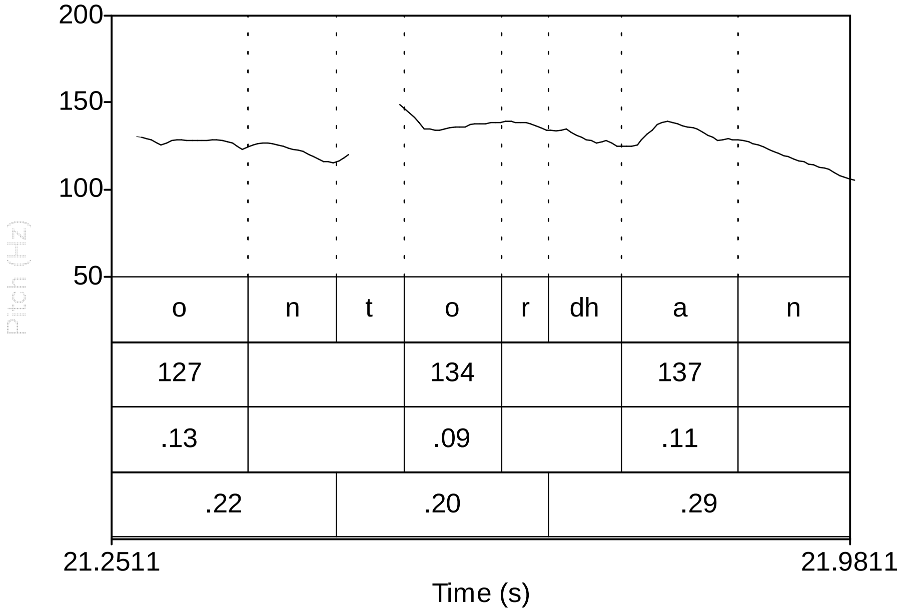
.08
.10
.20
.24
.32
30.4751
31.2623
Time (s)

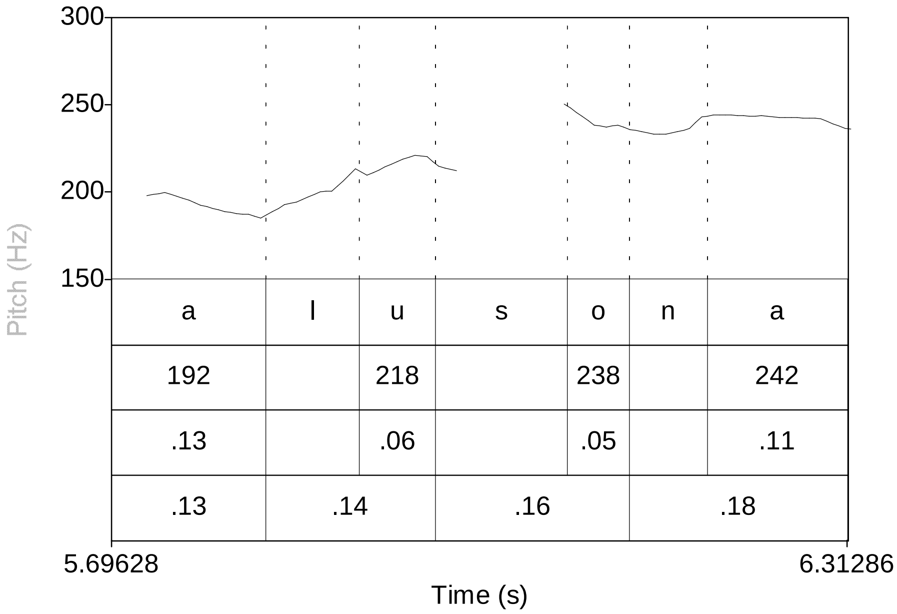


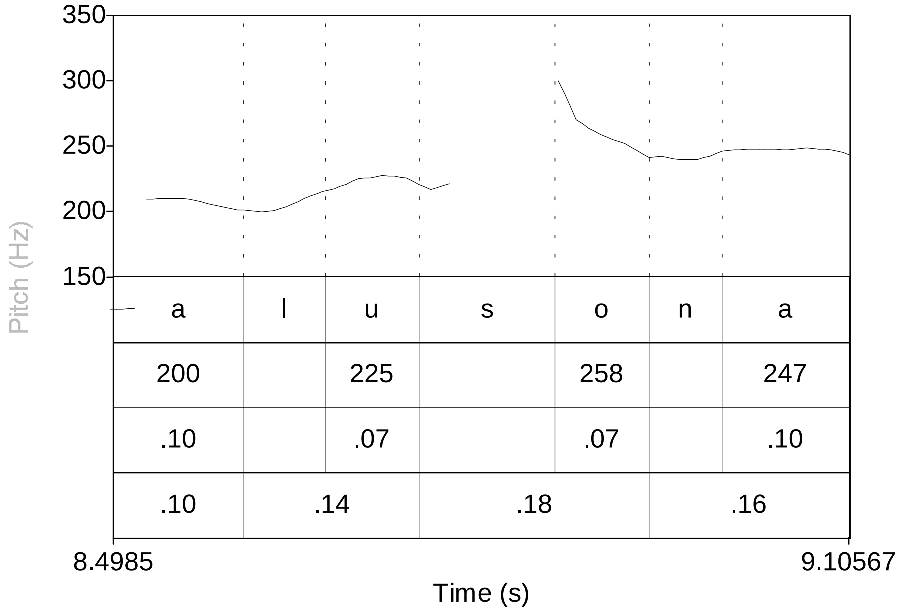
HHH-[ɔntɔrd^{h}an]





HHH-[ɔntɔrdʰan]




350
300
250
200
150
Pitch (Hz)
a
l
u
s
o
n
a
200
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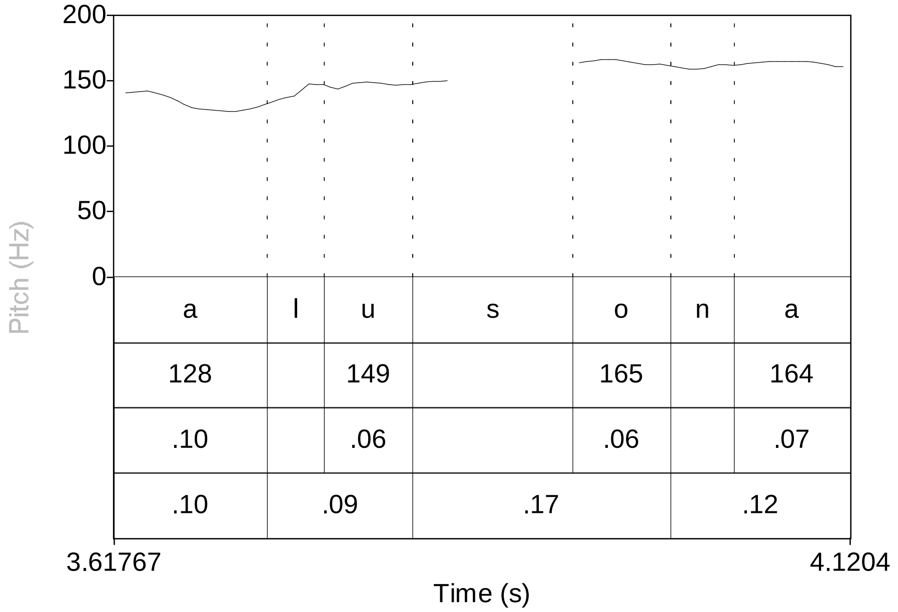
247
.10
.07
.07
.10
.10
.14
.18
.16
8.4985
9.10567
Time (s)


200
150
100
50
0
Pitch (Hz)
a
l
u
s
o
n
a
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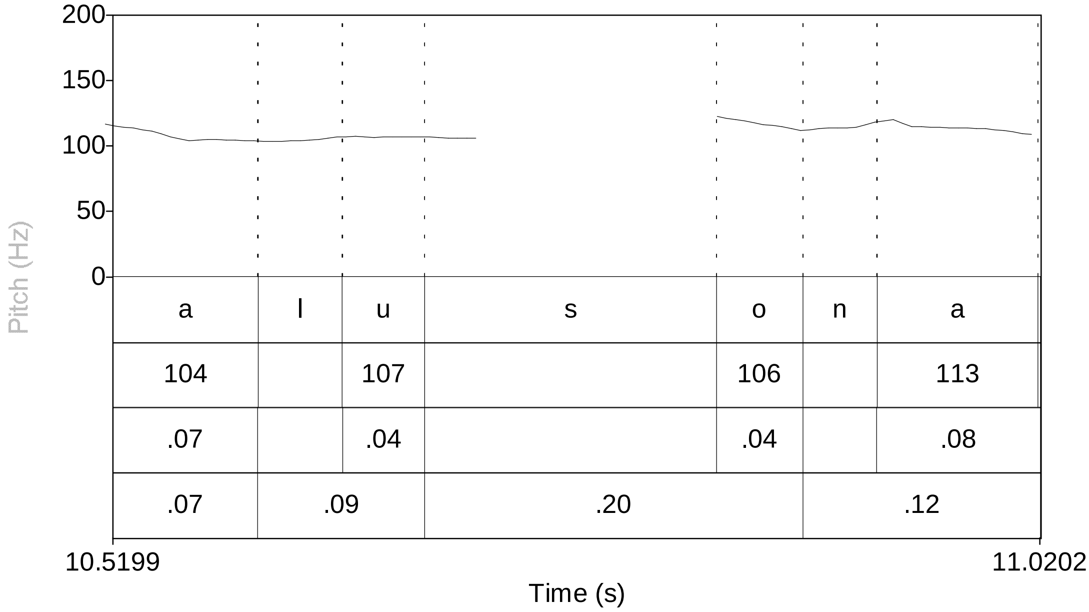
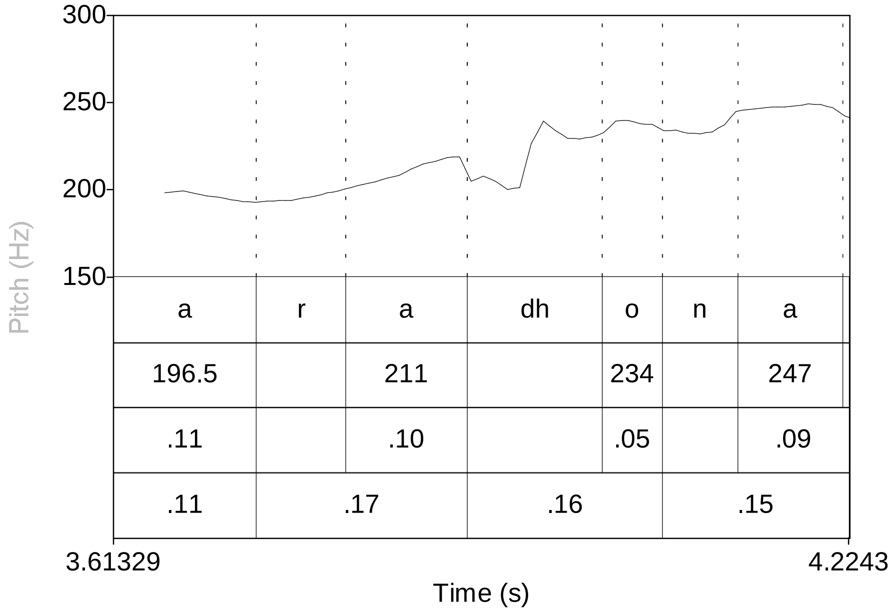
.10
.06
.06
.07
.10
.09
.17
.12
3.61767
4.1204
Time (s)


200
150
100
50
0
Pitch (Hz)
a l u s o n a
104 107 106 113
.07 .04 .04 .08
.07 .09 .20 .12
10.5199
11.0202
Time (s)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200
150
Pitch (Hz)
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.11 .10 .05 .09
.11 .17 .16 .15
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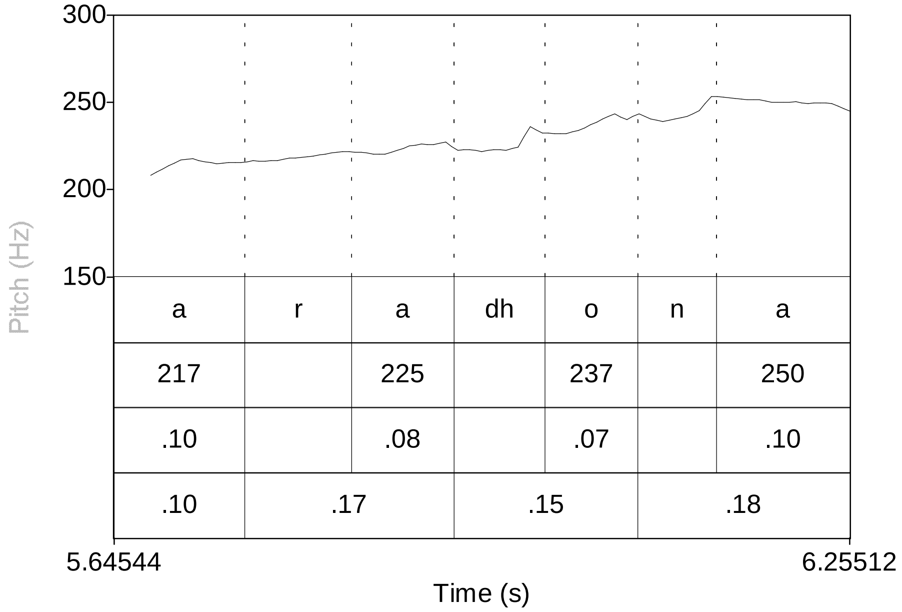
4.2243
Time (s)


300
250
200
150
Pitch (Hz)
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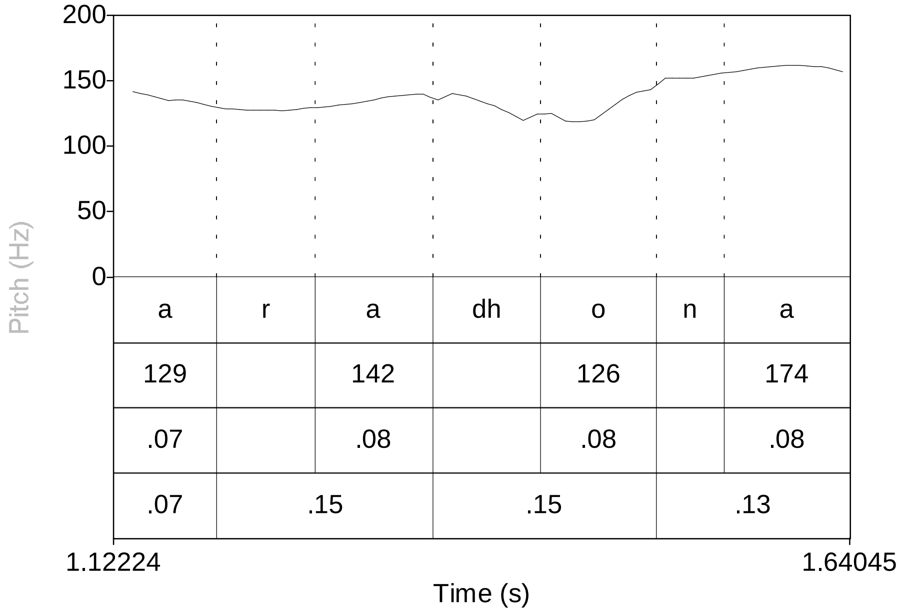
217 225 237 250
.10 .08 .07 .10
.10 .17 .15 .18
5.64544
6.25512
Time (s)


200
150
100
50
0
Pitch (Hz)
a r a dh o n a
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.07 .08 .08 .08
.07 .15 .15 .13
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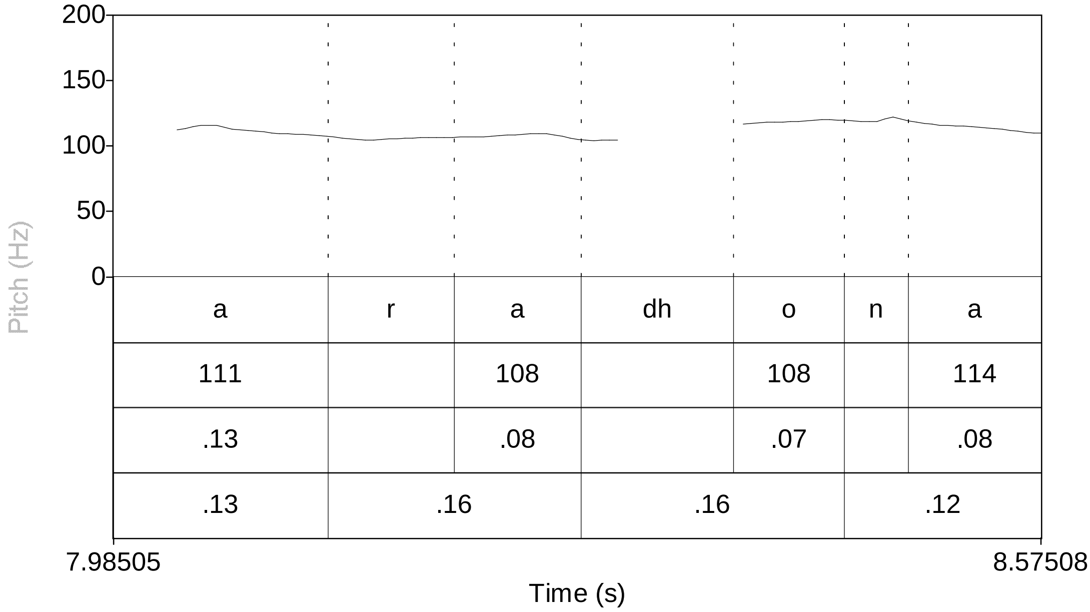
1.64045
Time (s)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100
50
0
Pitch (Hz)
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.13 .08 .07 .08
.13 .16 .16 .12
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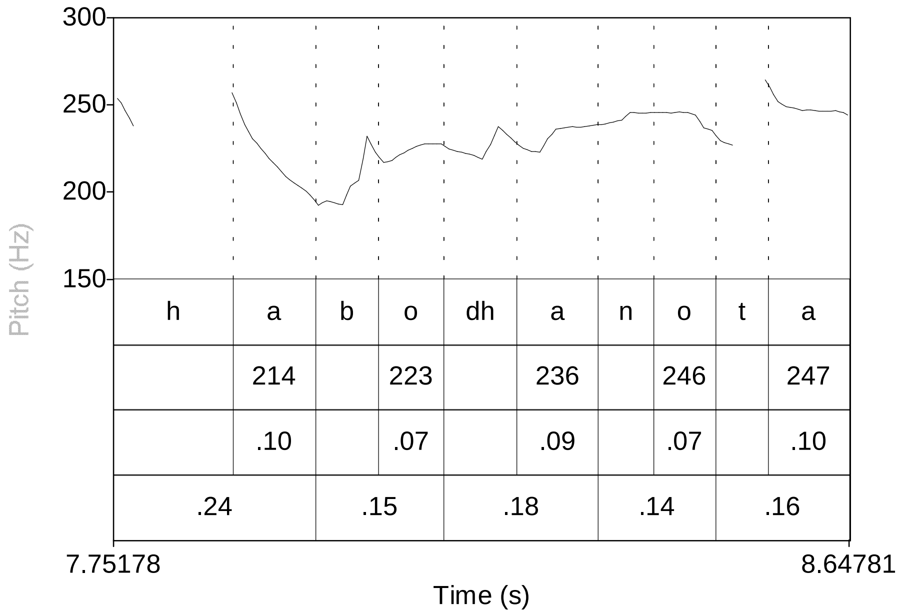
8.57508
Time (s)


300
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200
150
Pitch (Hz)
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.24 .15 .18 .14 .16
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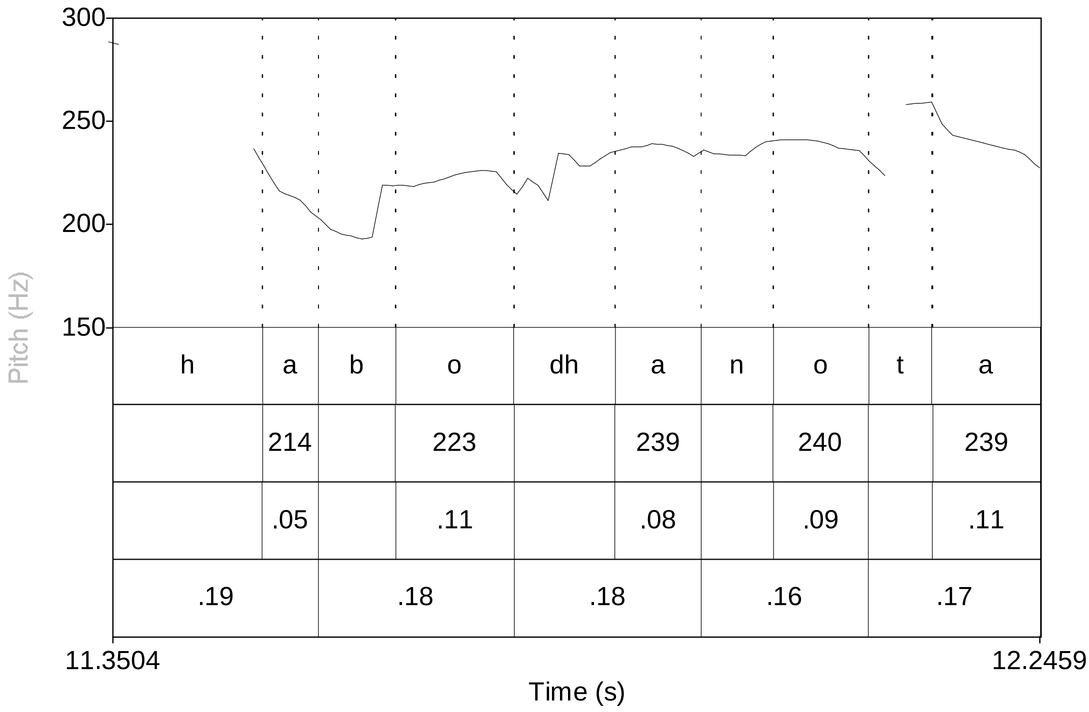
8.64781
Time (s)


300
250
200
150
Pitch (Hz)
h
a
b
o
dh
a
n
o
t
a
214
223
239
240
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.08
.09
.11
.19
.18
.18
.16
.17
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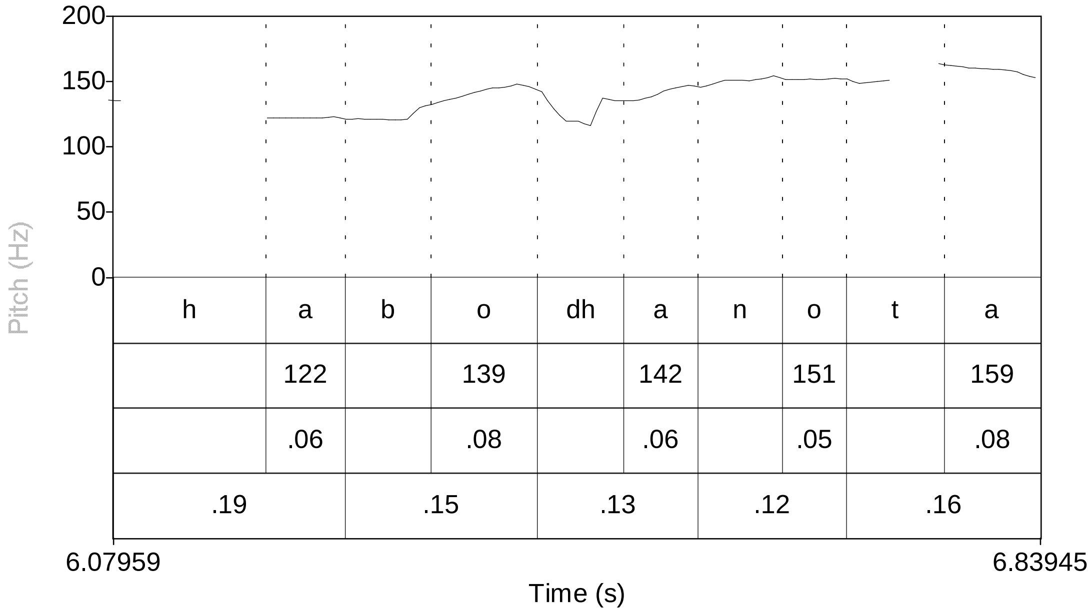
12.2459
Time (s)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Pitch (Hz)
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b
o
dh
a
n
o
t
a
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142
151
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.05
.08
.19
.15
.13
.12
.16
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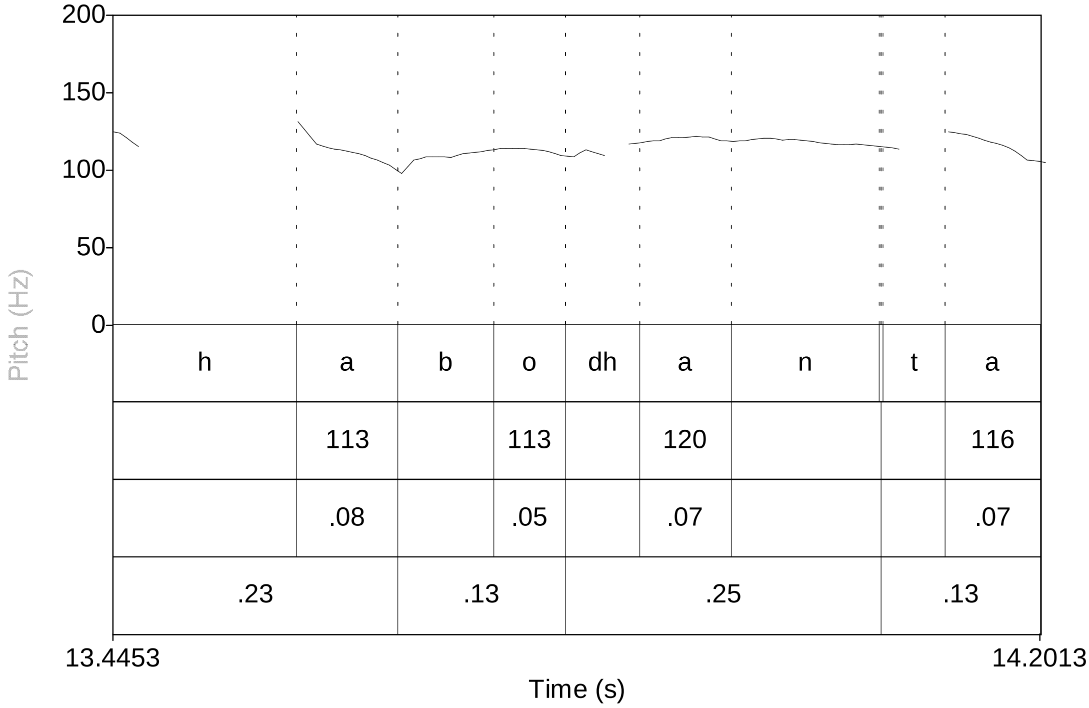
Time (s)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Pitch (Hz)
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b
o
dh
a
n
t
a
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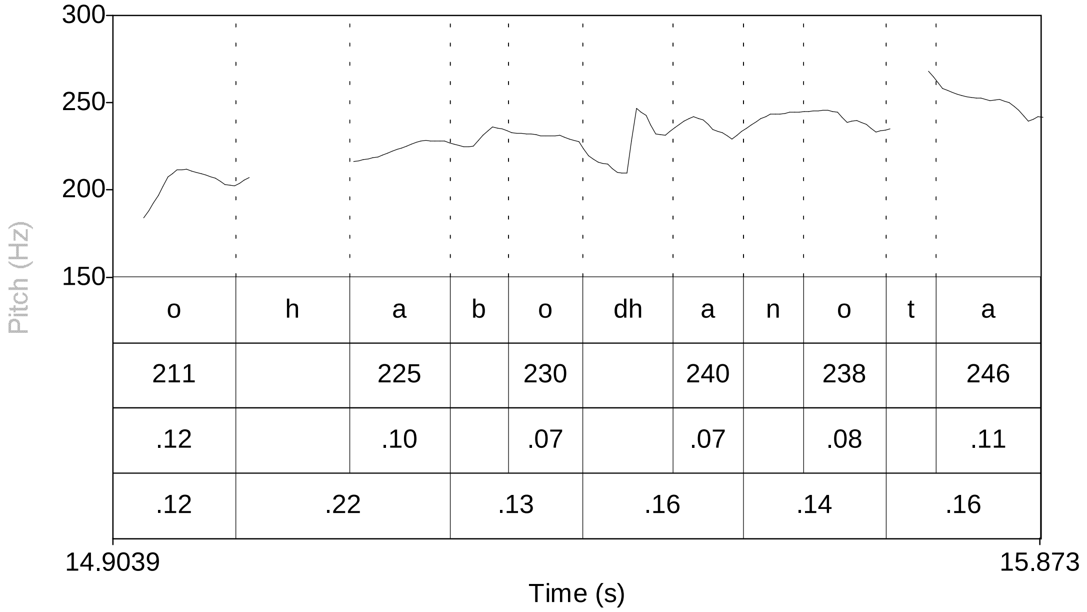
.07
.23
.13
.25
.13
13.4453
14.2013
Time (s)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250
200
150
Pitch (Hz)
o
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a
b
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dh
a
n
o
t
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225
230
240
238
246
.12
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.08
.11
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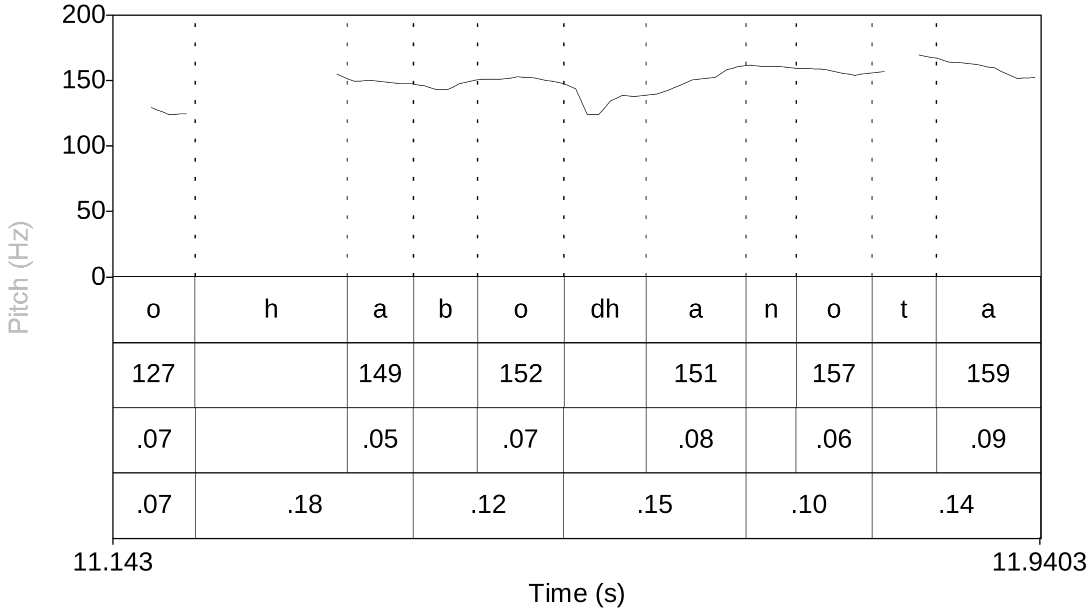
.22
.13
.16
.14
.16
14.9039
15.873
Time (s)


Pitch (Hz)
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100
50
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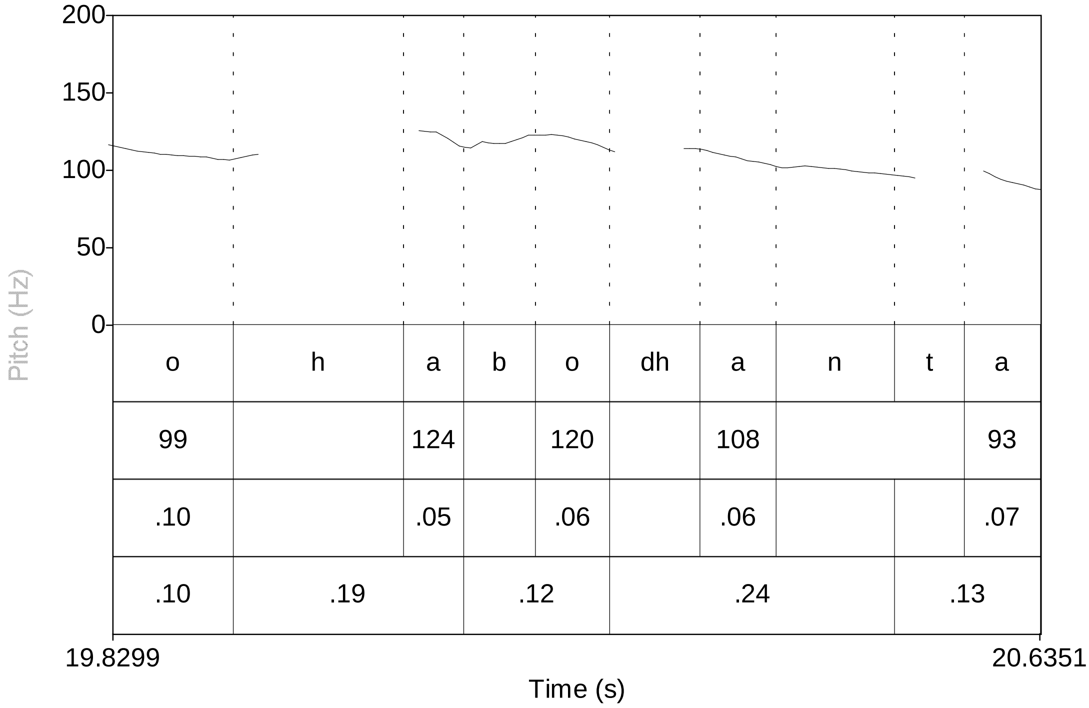
.07 .18 .12 .15 .10 .14
11.143
11.9403
Time (s)


Pitch (Hz)
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150
100
50
0
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.10 .05 .06 .06 .07
.10 .19 .12 .24 .13
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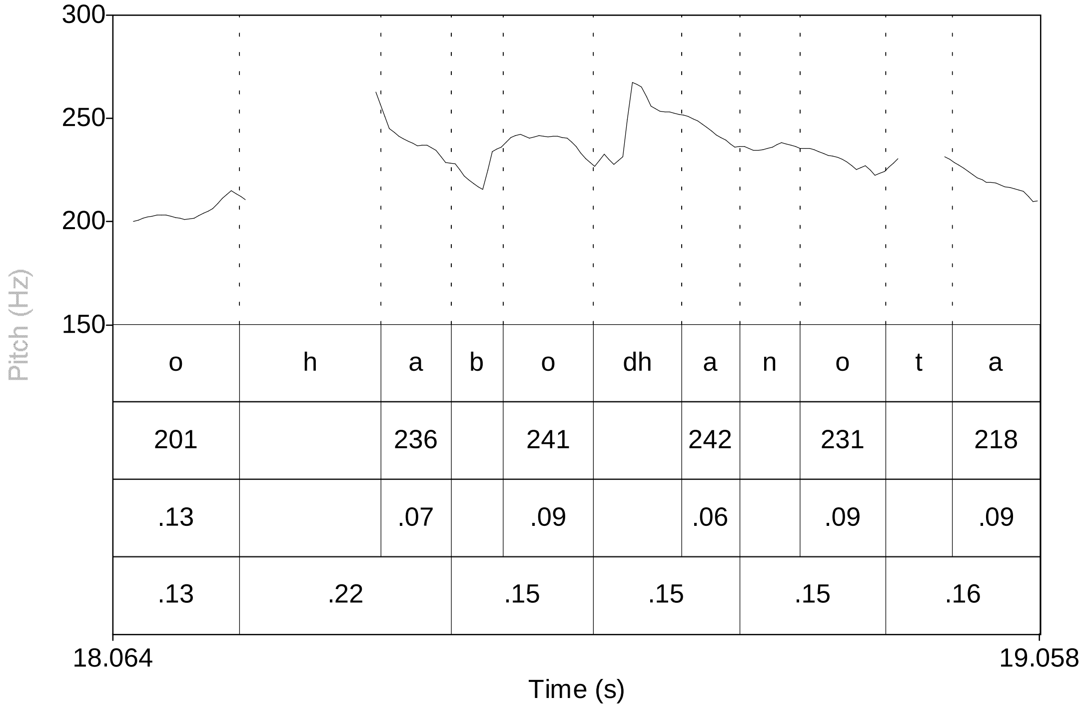
20.6351
Time (s)


300
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150
Pitch (Hz)
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.13 .22 .15 .15 .15 .16
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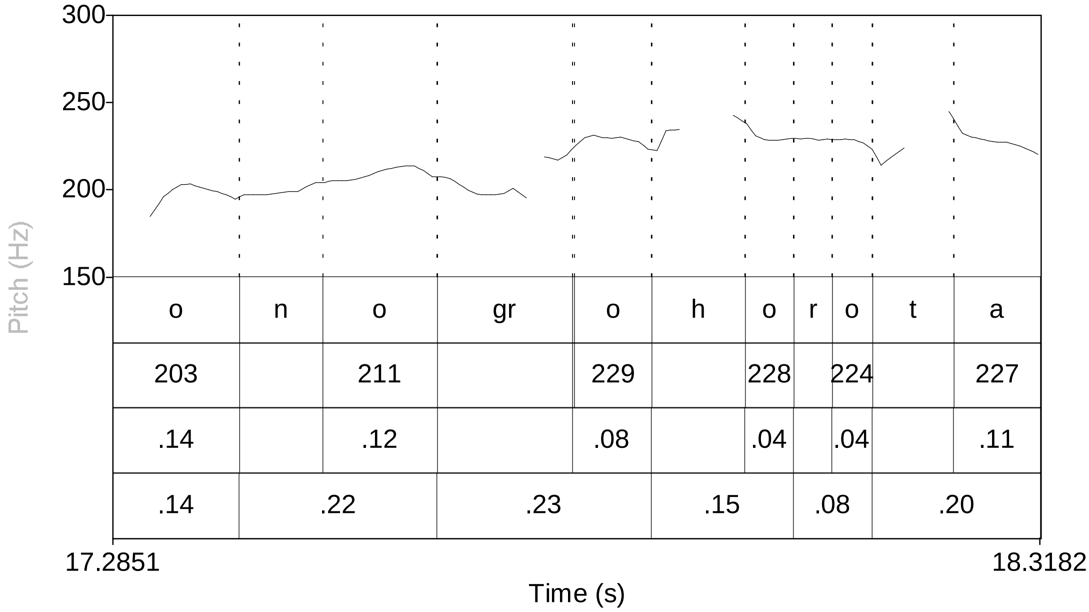
19.058
Time (s)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250
200
150
Pitch (Hz)
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.14 .12 .08 .04 .04 .11
.14 .22 .23 .15 .08 .20
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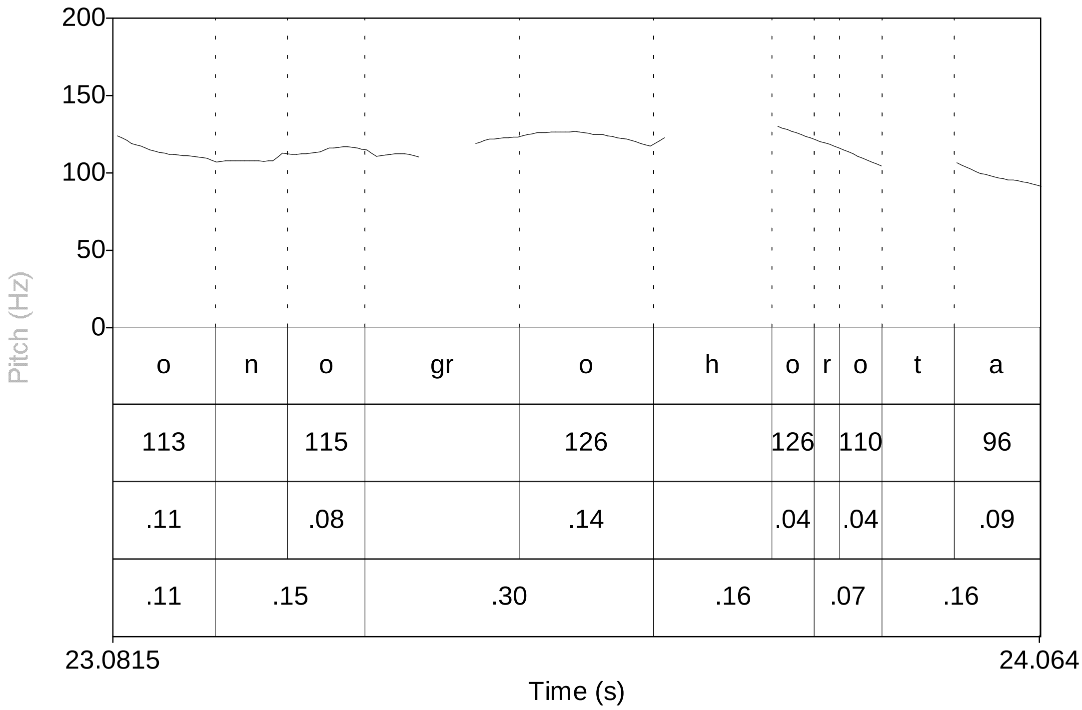
18.3182
Time (s)


200
150
100
50
0
Pitch (Hz)
o n o gr o h o r o t a
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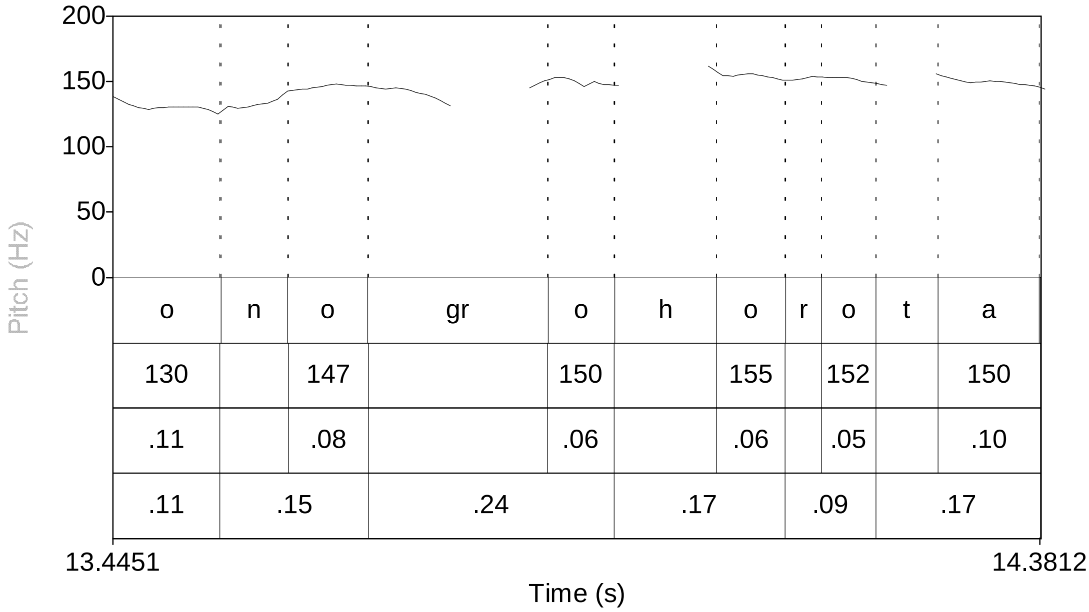
.11 .08 .14 .04 .04 .09
.11 .15 .30 .16 .07 .16
23.0815
24.064
Time (s)


200
150
100
50
0
Pitch (Hz)
o n o gr o h o r o t a
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.11 .08 .06 .06 .05 .10
.11 .15 .24 .17 .09 .17
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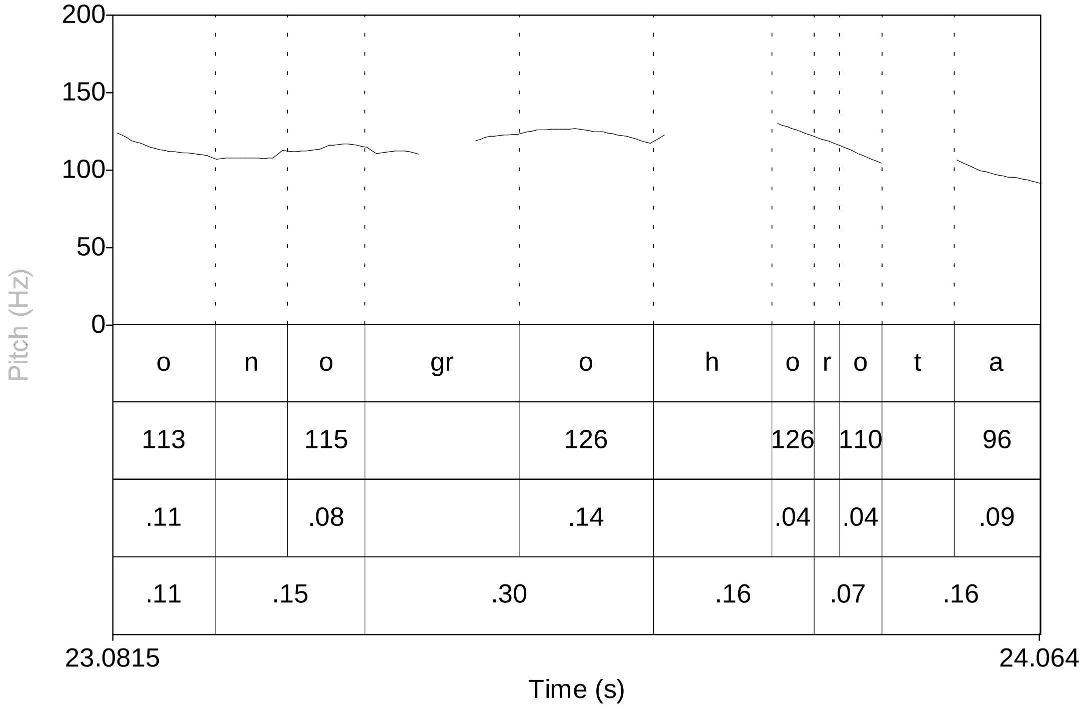
14.3812
Time (s)


200
150
100
50
0
Pitch (Hz)
o n o gr o h o r o t a
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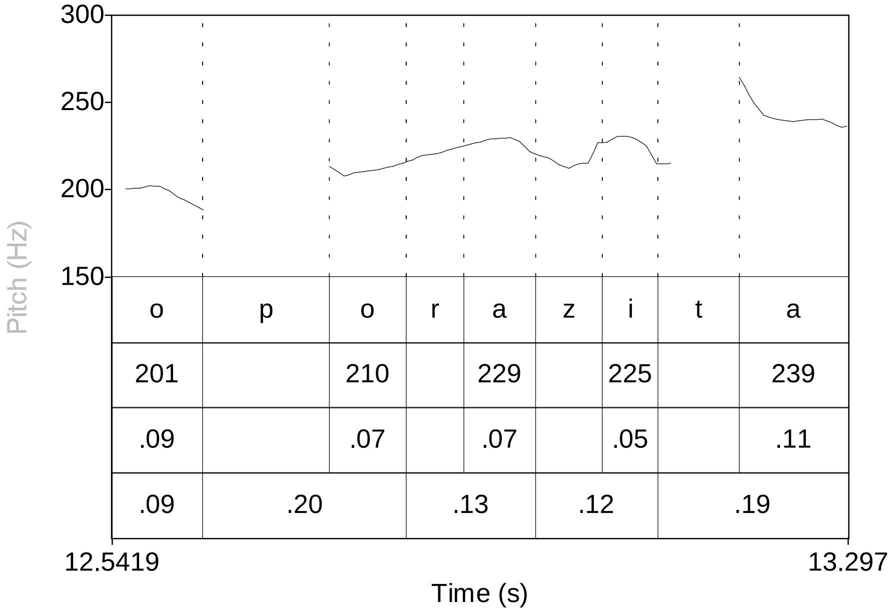
.11 .08 .14 .04 .04 .09
.11 .15 .30 .16 .07 .16
23.0815
24.064
Time (s)


300
250
200
150
Pitch (Hz)
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.09 .07 .07 .05 .11
.09 .20 .13 .12 .19
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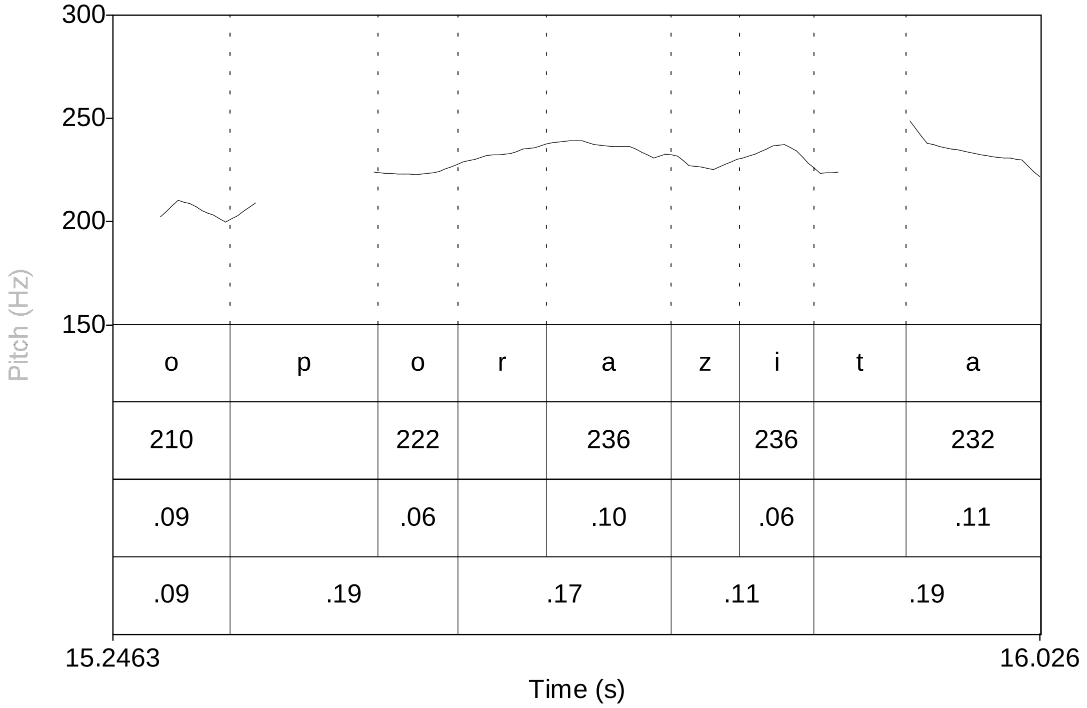
13.297
Time (s)


300
250
200
150
Pitch (Hz)
o p o r a z i t a
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.09 .06 .10 .06 .11
.09 .19 .17 .11 .19
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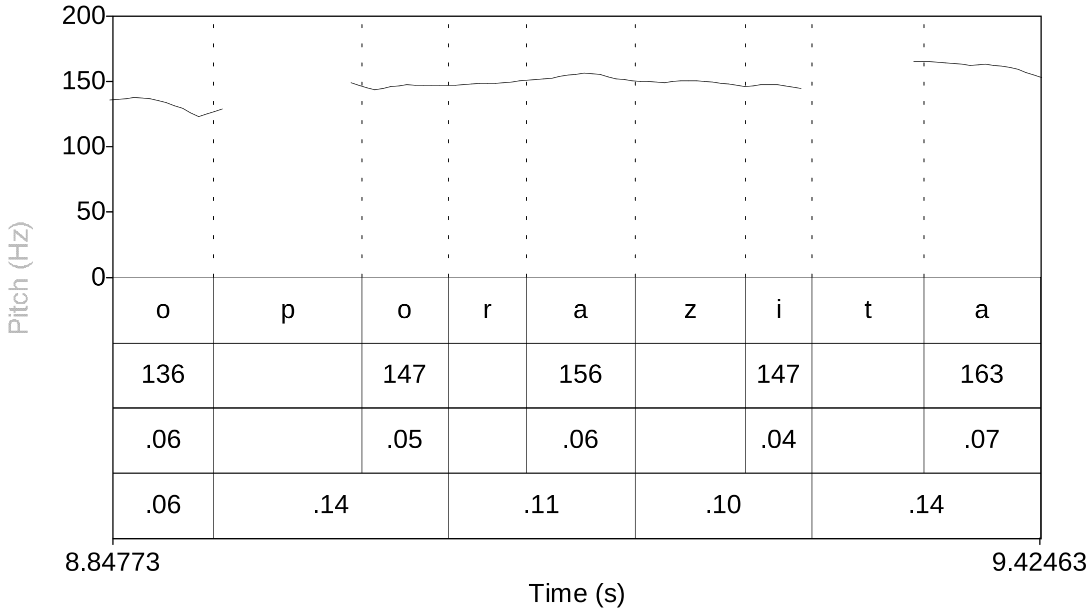
16.026
Time (s)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100
50
0
Pitch (Hz)
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.06 .14 .11 .10 .14
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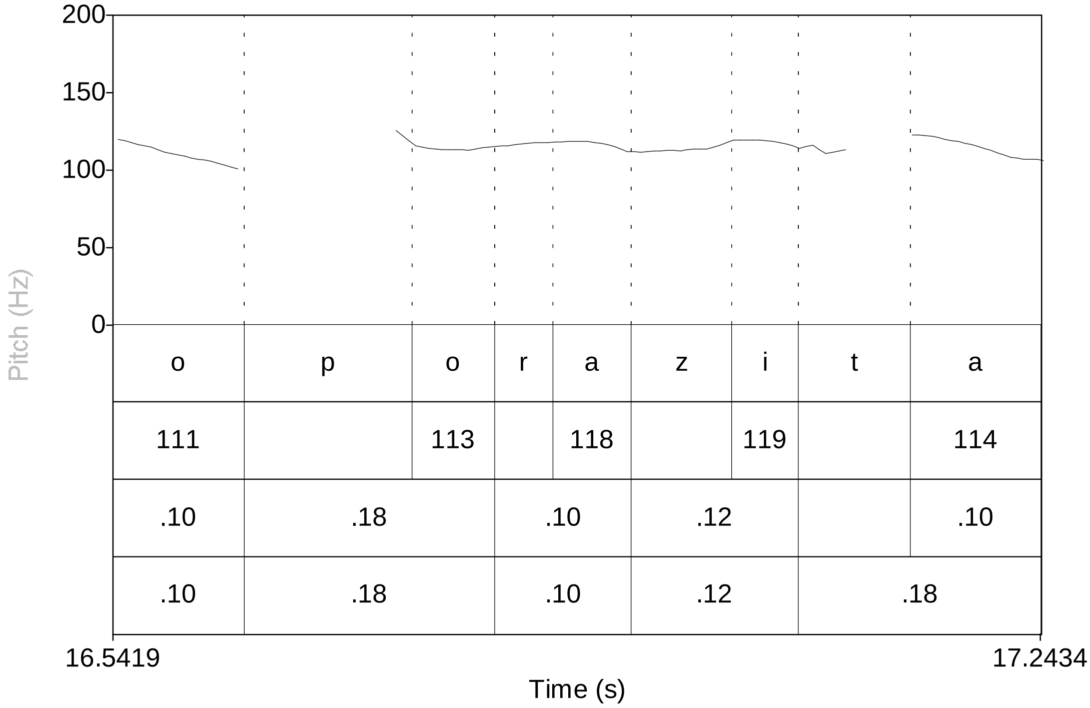
9.42463
Time (s)


200
150
100
50
0
Pitch (Hz)
o
p
o
r
a
z
i
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