An Acoustic Analysis of Vowel Duration in Wolaytta Doonaa

Firew Elias

A Thesis Submitted to

The Department of Linguistics and Philology

Presented in Partial Fulfillment of the Requirements for the Degree of Master of Arts (Theoretical and Descriptive Linguistics)

Advisor: Dr. Derib Ado

Addis Ababa University

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School of Graduate Studies

This is to certify that the thesis prepared by Firew Elias, entitled: *An Acoustic Analysis of Vowel Duration in Wolaytta Doonaa* and submitted in partial fulfillment of the requirements for the Degree of Master of Arts (Theoretical and Descriptive Linguistics), complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Approved by the Board of Examiners:

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Examiner _____ Signature _____ Date _____

Advisor Derib Ado Signature _____ Date August 28, 2017

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Chairperson, Department of Linguistics and Philology

ABSTRACT

An Acoustic Analysis of Vowels' Duration in Wolaytta Doonaa

This acoustic study investigates the vowels' duration of Wolaytta Doonaa, a language spoken in the south west part of Ethiopia, by the Wolaytta people. The vowels set for the analysis were delimited by the alveolar obstruent consonants' CVC frame. Each vowel comprising of short and long acoustic representations with both accented and unaccented equivalents were taken for the analysis. The duration of the vowels within the recorded sound files were separated and were measured with Praat script in milliseconds and analysis was made depending on the tongue height, gender, accent status and the adjacent consonants so as to determine their mean scores and degree of variations due to these impacts on their intrinsic and extrinsic durations. The results showed that the durations of the vowels of Wolaytta Doonaa have significant variation due to the tongue height and the tongue advancement, thus, as a vowel in Wolaytta Doonaa is lower, its acoustic duration is longer. In addition to that, women utter longer vowels than men do; plus, the accented vowels portray longer duration than their unaccented counterparts. Besides, the effect of pre-fortis clipping on duration of the short vowels was not attested in the finding, thus, the impact of post-vocalic voiceless obstruents on the duration of the preceding vowel was not significant.

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From the very beginning of my schooling days to the final stage of this thesis, The Mighty God kept me healthy, and made me accomplish the task peacefully; behold, may His Holy Name be glorified forever. And I believe that the speech organs with their sophisticated traits of speech production and perception are the formation of the Divine Hands.

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List of Acronyms/Abbreviations

Acronym/Abbreviation	Description
CVC	A vowel between two consonants
dVd	A short vowel between two voiced alveolar obstruents
dVt	A short vowel preceded by a voiceless alveolar obstruent and followed by a voiced alveolar obstruent
dVVd	A long vowel between two voiced alveolar obstruents
dVVt	A long vowel preceded by a voiceless alveolar obstruent and followed by a voiced alveolar obstruent
PFC	Pre-fortis clipping
STDEV	Standard deviation
tVd	A short vowel preceded by a voiced alveolar obstruent and followed by a voiceless alveolar obstruent
tVt	A short vowel between two voiceless alveolar obstruents
tVVd	A long vowel preceded by a voiced alveolar obstruent and followed by a voiceless alveolar obstruent

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CHAPTER ONE
INTRODUCTION

1.1. Background of the Study

The Language and Its Nomenclature

Wolaytta Doonaa is a language spoken in the south west part of Ethiopia, by the Wolaytta people. It is clustered under the North Ometo languages within Omotic proto family of Afro Asiatic phylum (Fleming, 1976).

There have been ambiguities in addressing the language of Wolaytta in the previous works. Formerly it is addressed as 'Welamo' or 'Wolaamo' (as in Cerulli (1929) and others; Ohman & Hailu (1976), etc.), but this term is widely known for its derogatoriness and is not the actual name of the people (Degefu, 2012). Aside from that, various equivocal nomenclatures were used interchangeably even in the later works. Just to mention, 'Wolaitta,' 'Wolaittattuwa,' 'Wolaita,' 'Wolaitta Doona,' 'Wolaitta K'aala' and the likes are the repeatedly cited ones (as in Adams, 1983; Azeb, 2007; Wakasa, 2008; Aklilu, 2010; Degefu, 2012; etc.). Hitherto, if we address so, the terms evoke a kind of ambiguity for it is difficult to distinguish the name of the people from the language they speak.

Forthrightly, the name 'Wolaytta,' or 'Wolaitta,' or 'Wolaita' alone doesn't signify the language; nor does it depict any other folk property of the ethnicity. It rather stands for either the ethnic group's name (Adams, 1983; Hirut, 1999; Wakasa, 2008), or for the area the Wolayttas occupy (Degefu, 2012). Again the name Wolaittattuwa is also a generic term that implies the overall folkloric values of Wolaytta (say, 'Wolayttattuwa durawusu' means 'she dances the Wolaytta's dance' (Here 'Wolaittattuwa' is supposed to mean 'Dance of Wolaytta')). To end with, the name 'Wolaytta K'aala' (lit. the word of Wolaytta) also sounds ambiguous for it sometimes stands for a single word and/or token of the language.

So as to explicate the aforementioned indistinctness when addressing the language of *the Wolayttas,* the researcher here prefers to use the term *Wolaytta Doonaa* (lit. the mouth of Wolaytta) for this terminology clearly depicts the language and distinguishes the speakers from the language they speak. Passingly, the symbol '**y**' within 'Wolaytta' is considered preferable for the surface representation of the existing glide (and in turn, to pay his respects to both Gordon (2005) and Wakasa (2008) who have, convincingly, addressed it as 'Wolaytta' in their respective works). Henceforth, the language of Wolaytta is to be addressed as 'Wolaytta Doonaa' throughout this work.

The Linguistic Classification

According to Moreno (as cited in Adams, 1983), Wolaytta Doonaa was previously included in the Cushitic family with a sub classification of the Western Cushitic branch. But, due to the vast diversity within this group and the significant morpho-syntactic dissimilarity with that of the Highland East Cushitic, Fleming (1976) excluded this sub-class from that of Cushitic family; and, by naming it 'the Omotic family,' he described it as an independent sub proto family of Afro Asiatic phylum.

Then Fleming (1976) has further divided the Omotic family into two major subgroups, the Eastern and the Western subdivisions. Based on this classification, the Western subdivision in turn divided into two subgroups namely the Maji Languages and the Kafa-Gimojan languages. While the former of this subfamily consists of Nao, Sheko and Maji Languages, the later one, the Kafa-Gimojan, is further divided into two sub-clusters namely the Kafa Languages and the Gimojan languages. The Gimojan division includes Yemsa, Benchnon and the Ometo-cluster languages.

The Ometo languages, in which Wolaytta Doonaa is included, encompass the majority of speakers than the rest languages of the Omotic family and hence it is the main group of closely related languages (Degefu, 2012). Fleming has further divided this sub-cluster into South (Maale), West (Basketo and Doko-Dollo), East (Harro, Kachama, Koorete and Zayse), and North (Dawro, Gamo-Gofa, Kontta, Wolaytta Doonaa). So, Wolaytta Doonaa, as mentioned above,

clustered under the North Ometo sub group within the Omotic superfamily. Hence, even the later classifications of its superfamily (by Bender, 1976; 1986; 2000) haven't brought any remarkable change towards the Ometo cluster, it would be better to recognize the place of Wolaytta Doonaa according to this classification. The following diagram summarizes this classification.

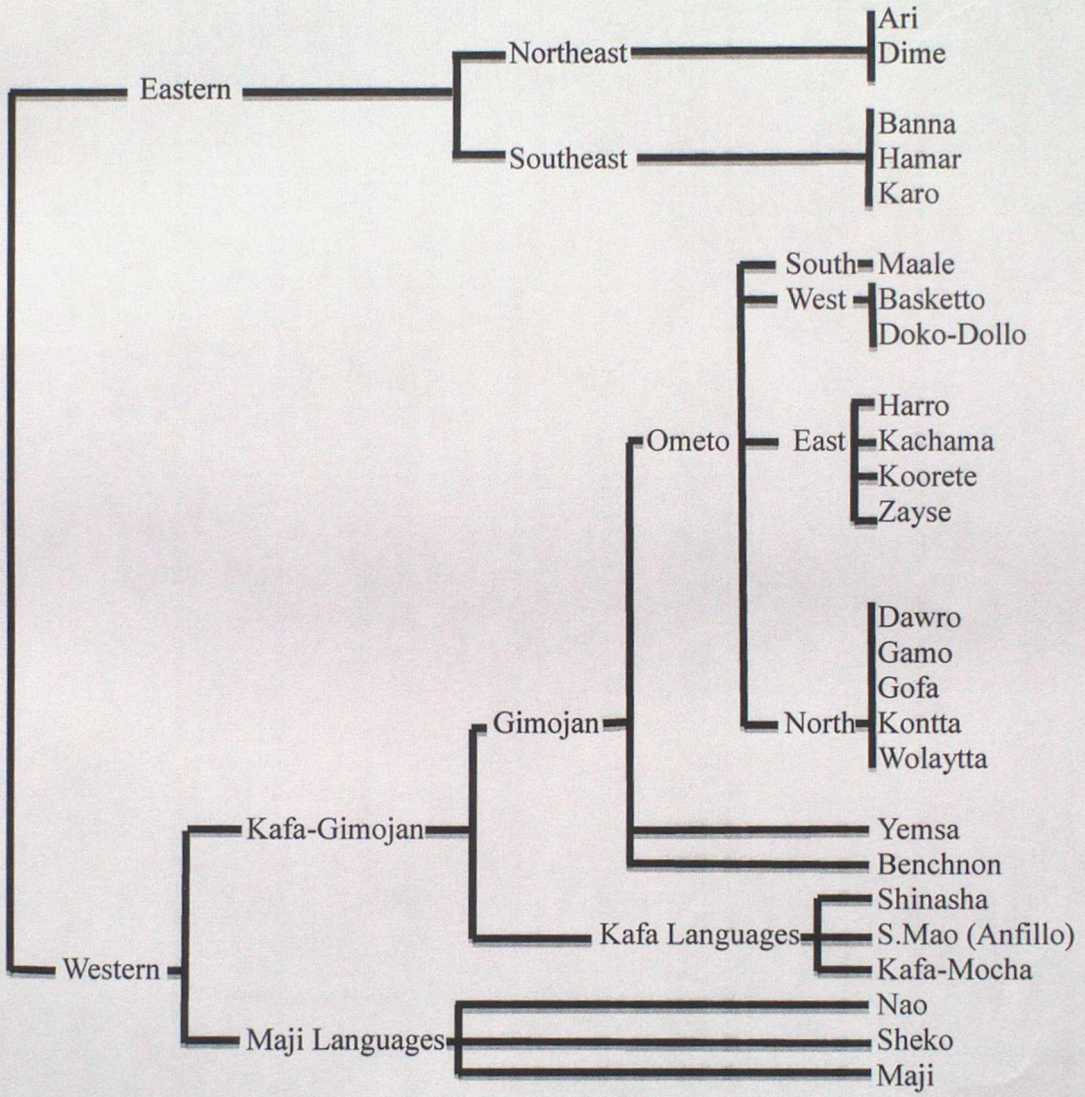

Figure 1: A Family Tree of the Omotic Languages as summarized by Fleming (1976) (Adapted with a slight modification from Azeb (1996)).

The Demography

The speakers of Wolaytta Doonaa inhabit in the south west part of Ethiopia within the Southern Nations, Nationalities and Peoples Regional State. They predominantly cover the entire area of Wolaytta Zone plus some areas from Gamo Gofa and Dawro zones which are bordering Wolaytta. Areas which border Wolaytta include: Hadiyya and Kambata Tambaro (KT) Zones to north, Oromia Region, Sidama Zone and Bilate River to east, Lake Abaya to south east, Gamo Gofa Zone to south, and Omo River to west. Wolaytta Soddo, the zonal capital of Wolaytta, is 380km from Addis Ababa. The location of Wolaytta Zone, where Wolaytta Doonaa is predominantly spoken, is shown in the following maps.

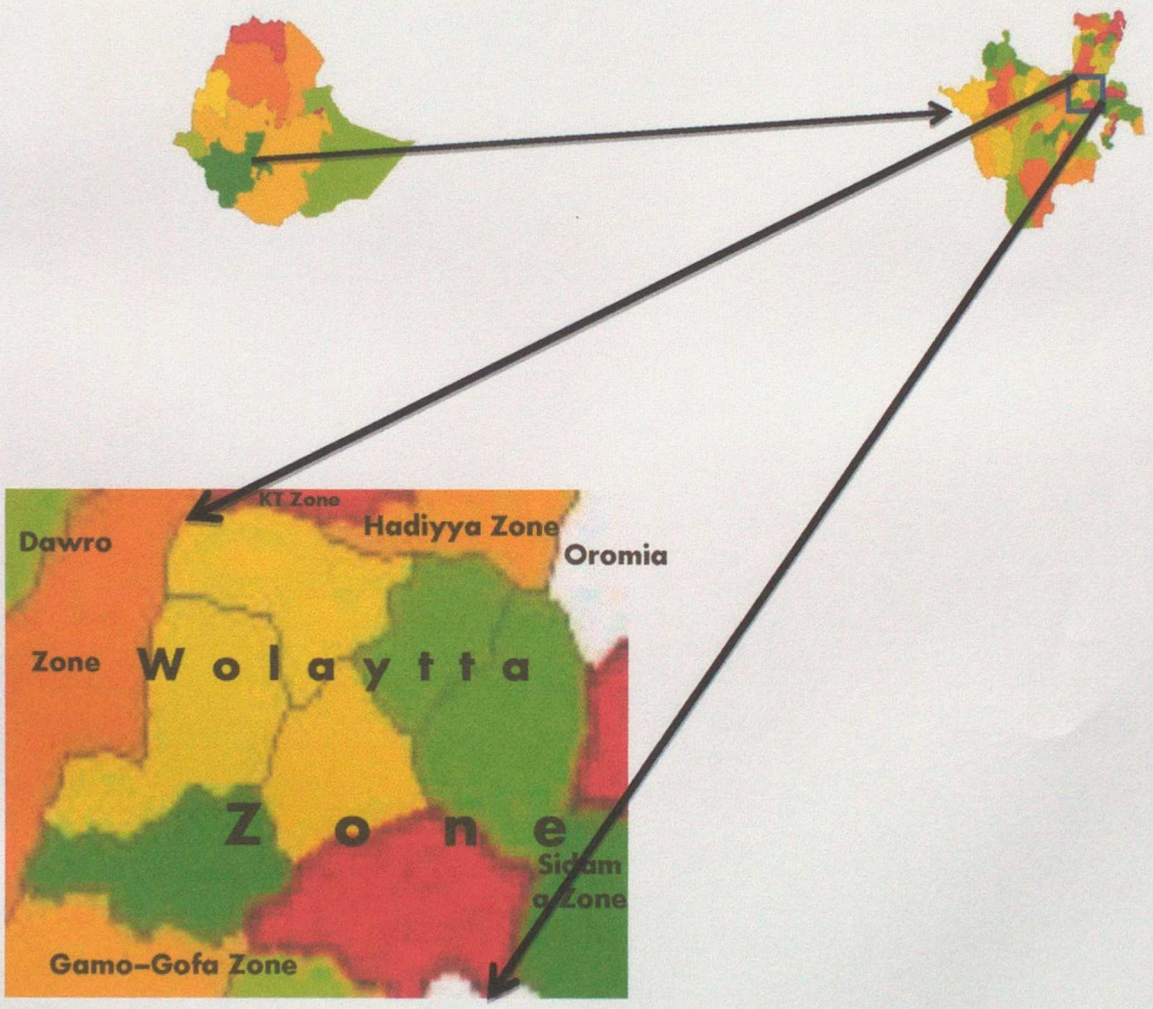

Fig 1.1: The map of Wolaytta (GRASS GIS© 2012)

According to the data of Population and Housing Census of Ethiopia (2007), the number of Wolaytta people is 1, 707, 079. However, regarding the exact number of Wolaytta Doonaa speakers, the approximations of the number of speakers may diverge significantly hence the language's boundary is not precisely known. Regarding the trend of orthography in the language, since the 1940's (when the Sudan Interior Mission (SIM) formulated a writing system for Wolaytta Doonaa in the Saba Script), it has been existed in written form. Currently the language is the medium of instruction in all primary schools in Wolaytta Zone, and is given as a single subject in secondary schools. In addition to that, the language is studied as an area of qualification in higher educations both at diploma and degree level (in Arba Minch College of Teachers' Education and Wolaytta Soddo University respectively).

The Phonology of Wolaytta Doonaa

i. The Inventory of Consonant Phonemes

Exclusive of the bilabial fricative /Φ/, the velar nasal [ŋ] (i.e. the allophone of the alveolar nasal /n/) and the glottal nasal /h̃/, the entire remaining consonant phonemes of the language have considerably both geminate and singleton forms. These consonant phonemes are listed in the table as follows:

Manner of Articulation	Airstream Mechanism	Place of Articulation											
		Bilabial		Alveolar		Post-alveolar		Palatal		Velar		Glottal	
		vl	vd	vl	vd	vl	vd	vl	vd	vl	vd	vl	vd
Plosive	Pulmonic	/p/	/b/	/t/	/d/	/ʧ/	/ʤ/			/k/	/g/	/ʔ/	
	Glottallic Egressive	/p'/		/t'/		/ʧ'/				/k'/			
	Glottallic Ingressive				/ɗ/								
Fricative	Pulmonic	/Φ/		/s/	/z/	/ʃ/	/ʒ/					/h/	
	Glottalic Egressive			/s'/									
Nasal	Pulmonic		/m/		/n/				/ɲ/		[ŋ]		/h̃/
Trill	Pulmonic				/r/								
Approximant	Pulmonic		/w/		/l/				/j/				

Table 1.1: The consonant phonemes of Wolaytta Doonaa (adapted from Wakasa, 2008)

ii. The Inventory of Vowel Phonemes

Regarding the vowels of Wolaytta Doonaa, according to Wakasa (2008), five vowels, /i/, /e/, /a/, /o/, and /u/ are recognized as vowel phonemes. As vowels of Wolaytta Doonaa are phonemically distinctive due to their length, there are five short and five long vowel phonemes in Wolaytta

Doonaa. Wakasa (2008) has classified the vowel phoneme inventory of Wolaytta Doonaa as follows:

Tongue Height	Tongue Advancement					
	Front		Central		Back	
	Short	Long	Short	Long	Short	Long
High	/i/	/i:/			/u/	/u:/
Mid	/e/	/e:/			/o/	/o:/
Low			/a/	/a:/		

Table 1.2: The vowel phonemes of Wolaytta Doonaa (adapted from Wakasa, 2008)

1.2. Statement of the Problem

Initiation to examine vowel duration is an attribute to the prevalence of phonological, morpho-syntactic and semantic variation due to the variance of vocalic length. According to Ladefoged (2001), vowels of every language differ from one another; and such a difference between and/or within them is a basis for the existence of meaning difference in the words where the vowels occur. If the difference in length were not a cause for any other morpho-semantic discrepancy, being much concerned in such a variation would never give a sense. So, it is the existence of vowel length based variation in meaning that paves the way for investigation of vowel duration. To do so, having a grasp regarding the existing vowel phonemes within the language would be the basic issue.

There are lots of phonological, morphological and syntactic works done in Wolaytta Doonaa. To mention some of them, the tagmemic analysis on its grammar by Adams (1983) and the description of its modern grammar by Wakasa (2008) are the intensively described works on the phonological and morpho-syntactic values on the grammar of the language. The work on the supra-segmental structures, which shows its supra-segmental features (treating Wolaytta Doonaa different from the tonal and stress languages) by Azeb (1996), is also a rigorous description of

the prosody of the language. In addition to that, the descriptions on the phonology, non-verbal predications, negation, tense, aspect and mood (TAM) of the language (by Yitbarek, 1984; Azeb, 2007; Aklilu, 2010; and Degefu, 2012 respectively) are also worth mentioning works on describing the language's phonological, morphological and syntactic aspects. Despite these all works on the phonology, morphology and syntax, there is almost nothing done on the experimental phonetics in the language.

The prevailing feature of vowel length (i.e. the fact that vowel length is phonemic in the language) was described in some of the aforementioned works (Adams, 1983; Yitbarek, 1984; and Wakasa, 2008). The case of pitch accents of the language was also raised and was found that there are contrasting accented and unaccented syllabic nuclei within its phonotactics (Azeb, 1996).

These two areas (that is, the findings on phonological vowel length and the pitch accent) in which previous studies were concerned are the two interesting features of the language which are treated together in this research. In this regard, the phonological vowel length has a lot to deal with acoustic vowel duration as it distinguishes the short vowels from their long counterparts. This is to mean that the claims on the phonological vowel duration by previous studies (Adams, 1983; Yitbarek, 1984; and Wakasa, 2008) have correlation with a concept "How much long are the 'long vowels' and how much short are the 'short vowels,'" and hence it is the concern of the investigation of vowel duration. In the case of the prevailing pitch accent variation within the syllables of the language, as it is demonstrated by Azeb (1996), there might be a correlation with accented versus unaccented (i.e. the contrast between syllables with accented versus unaccented moraic nuclei, according to the description by Azeb (1996)) vowels with their phonological length and phonetic duration. Nevertheless, the claims on phonemic contrast on vowel length and the durational contrast with regard to accent status were not based on experimental data.

So, there is a gap of acoustic durational information regarding the correlation between phonological vowel length, the prevailing accent status and the phonetic vowel duration. This has brought uncertainty and inadequacy of acoustic evidence regarding the durational information of vowels of the language, and in turn this does hinder the progression of any other phonetic study

in the language. As this language lacks synchronic data on acoustic features of its sounds, vowel duration in this circumstance, then it would be impossible to investigate any diachronic study on it.

This study was set out to fill this research gap with regard to acoustic durational evidence of vowels of Wolaytta Doonaa. So, it investigates the durational variation between phonologically perceived long vowels and their short counterparts, plus the accented nuclei and their unaccented counterparts depending on the statistical data.

1.3. Objectives of the Study

1.3.1. General Objective

The general objective of the study is to clearly investigate the intrinsic and extrinsic vowel phonemes' actual duration in Wolaytta Doonaa acoustically.

1.3.2. The Specific Objectives

Then the study is planned specifically to:

1. investigate intrinsic vowel duration in Wolaytta Doonaa
2. investigate extrinsic vowel duration due to voicing differences of the adjacent consonants
3. investigate the durational differences between the vowels which are uttered by female and male subjects

1.4. Significance of the Study

As this research gives objective data which is based on the statistic description, it is essentially intended to benefit the researchers who are interested in investigating the phonetic, phonological and the related linguistic aspects in Wolaytta Doonaa. Researchers who have intension to describe the complete acoustic features of the vowels in terms of their formant structures, and the acoustic characteristics of consonants in terms of their degrees of gemination, lenition and the duration of voice onset time (VOT) can use this study so as to have an initial insight on the vocalic length of the language. Additionally, this work has a lot to do with the investigation of vocalic characteristics of some other languages within the Ometo Cluster in particular and the

Omotic languages with the same pitch and accent features in general since it deals with the vowel of a pitch accent language. Of all, the issues raised in the finding of this study, which are with acoustic and statistic data, have brought a new grasp regarding the vowel duration of the language.

1.5. Scope of the Study

The study is firstly limited in the investigation of the phonemic vowels' duration than that of the phonetic ones. Due to the fact that some phonologically conditioned vowels (the nasalized vowels, for example) are out of the domain of this study. To do so, the experiment is limited to the carrier words which are entirely tri-syllabic. Secondly the constraint of duration due to age variation is also out of the scope of this analysis. This is because, for the time being, it is a bit difficult to determine the exact age of the informants which are from the countryside. And this gap is left for future investigation. Thirdly, the phonetic environment of the adjacent consonants is limited to alveolar obstruents, so as to keep consistency, adjacent consonants from other places and manners of articulation (like bilabials and nasal consonants) are not taken as the tokens' phonetic environment. Putting the above delimitations in mind, the planned study is to cover the investigation of phonemic vowels' length among the male and female speakers of Wolaytta Doonaa. The areas which are out of the scope of this research are left for future study.

1.6. Hypothesis of the Study

1. The high vowels of Wolaytta Doonaa might have shorter duration than those of low vowels.
2. The back vowels of Wolaytta Doonaa might have a longer duration than the front vowels.
3. Vowels which are adjacent to voiced consonants might have longer duration than their equivalents which are adjacent to the voiceless consonants.
4. Females might produce longer vowels than males both in short and long vowel phonemes.
5. There would be a durational discrepancy between accented and unaccented vowels; the accented vowels might have a longer duration than their unaccented counterparts.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1. The Nature of Vowels in Terms of Articulation

As the attribute of their articulatory natures, the vowel phonemes within many languages of the world have some correlations. Ladefoged (2001) states: "Every language has a number of vowels that contrast with one another so that they make different word. Many languages use just the five vowels that can be represented by the letters 'a, e, i, o, u'" (p. 25). Indeed the variation within these vowels brings the variation in meaning, and the vowel phonemes have also discrete symbols which are depicted in various forms of representations.

Vowel sounds are not uttered through the interaction between the vocal organs; rather they are depicted via the commonly known attributes which demarcate the identity of one vowel from the other. According to Lodge (2009), these attributes comprise of the placement of our tongue's main body, that is, both its horizontal (front-back) and vertical (high-low) movements, and the shape of our lips.

The same is true in the former literatures that characterize vowels with the abovementioned three qualities. Ladefoged & Madieson (1996) clearly put this as: "The basic parameters of most vowel systems are the three scales whose endpoints are traditionally called high and low, front and back, and rounded and unrounded" (p. 282). They further address the attributes of high-low and back-front vowels as height and back-ness respectively. In fact, those words were the means to address the articulatory nature of vocoids and traditionally and were not necessarily thought to precisely depict the shape of the vocal tract. Besides the three parameters in which vowels are differed from one another, there are further criteria which demarcate the boundaries between vowels uttered in the same tongue lip positions. Among these criteria, the durational and/or perceptual variations are the first ones, to mention.

So, apart from quality, vowel phonemes contrast from one another in their duration which could be intrinsic or extrinsic. Intrinsic duration refers to the natural duration of vowels which is not affected by any factor such as stress, adjacent sound or intonation. Vowel duration that is influenced by those factors mentioned is referred to as extrinsic duration. Since the scope of this study merely targets at duration than the entire acoustic and articulatory characteristics, it would be better to proceed to survey the literatures focusing on vowels' duration.

Vowel Duration versus Vowel Length

The terms duration and length are used and addressed interchangeably in various works which deal with experimental phonetics in general and vowel duration in particular. Nevertheless, for the notations have discrete indications, precisely addressing of these two terms is necessary.

Paul et.al, (2005) have precisely addressed how duration differs from length as; "Duration and length both refer to the span of time during which a sound is sustained. The term duration is usually restricted to phonetics, and is used for the absolute or actual time taken in the articulation of a sound." This is to mean that the two terms stand for the time length of certain utterance. Duration is a measurable portion of length in which the perceived duration (or the length) is changed to the phonetic or the surface representation. Paul et.al, (2005) have also justified the term length as; "The term **length** is usually restricted to phonology. It refers to the relative time a sound is sustained as perceived by the listener." (p. 10-11) in easier words, length is the perceived version of duration in which our mental language faculty encodes. In this circumstance duration belongs to phonetics, whereas length belongs to phonology.

Lehiste (1970) refers to duration 'the time dimension of the acoustic signal' and gives further justification as, "The physical correlate of the timing of articulatory sequences is the time dimension of the acoustic signal. From a physical standpoint, speech constitutes variations in acoustic patterns as a function of time. The time dimension enters any description of speech –that of segmental sounds as well as their organization in the time domain." (p. 9-10)

Silvia (2005) agrees with her addressing '... a temporal variable that could affect vowel classification...' (p. 214) Summing up, the former works have precisely differentiated the terms

duration and length. In that, they put length is more of an attribute perception, whereas duration is an attribute of articulation.

2.2. Intrinsic Vowel Duration

Vowels have an intrinsic duration that is consistent with their individual characteristics. Each vowel has its own identity that makes it peculiar from the rest vowels. Lehiste, (1970), has described an intrinsic duration as, "... The duration of a segment may be determined by the nature of the segment itself, that is, by its point and manner of articulation. The term 'intrinsic duration' may be used to refer the duration of a segment as determined by its phonetic quality." (p. 18). Gonet and Stadnicka (2005) also relate the intrinsic duration of vowels to the physiology of speech organs where the vowels are uttered. The authors call it a "weaker conditioning of vowel duration" hence it is related to the vowels' degree of openness –the vowel's duration increases proportionally as the degree of openness increases (p. 77-78).

Lehiste (1970) also justifies that because of the tongue position and height, the roundness or flatness of our lips, the vowels we utter do differ from one another. And this difference is not phonologically or segmentally conditioned, but is an intrinsic attribute of a vowel's nature. The shape of our oral cavity determines the vowel we utter intrinsically. According to her (Lehiste), the main cause to the intrinsic durational variation of vowels is the height of our tongue. Hence she clearly puts it, "As far as the vowels are concerned, their duration appears to be correlated with tongue height: other factors being equal, a high vowel is shorter than a low vowel" (p. 18).

The acquainted explanation for intrinsic duration: 'The other things being equal, higher vowels are shorter than lower vowels' has its own basis. This is a claim that is dependent on the traditional measurement of vocalic durations like any other segments, and the measurement is based on selecting the segments in their respective acoustic boundaries (Hardcastle and Laver, 1999, para. 4).

Aside from the height of the tongue, there is also a case that determines the intrinsic duration of vowels, namely the up-down movement of the jaw, hence the movement of jaw to utter low vowels might take longer time than those of the high vowels (Lehiste, 1970).

Carol & Buder (2002) also prove that the intrinsic vowel duration is related to the time dimension of the vowels uttered in the same phonetic environment. Yet the extent of durational difference is not that far remarkable as the long vowels, there is a durational difference between the tense and lax vowels (p. 2485). This implies that vowels within the same phonetic environment and/or neighboring consonants might show durational difference due to the position of our tongue and the jaw movement as well.

Some works describe that the time dimension quantity is not that far worth as expected from the movement of certain speech organs (as in Lindblom, 1967), yet, the physiological emanation towards the vowel's articulation process is high. However, there might be some other hindrances which limit the durational differences (like devoicing in certain phonetic environments as in Jaeger, (1978).

Generally, the intrinsic duration of a vowel is directly related to the physiological structure of the speech organ during its utterance process. The above works portray that the tongue movements of both to horizontal and vertical directions plus the lip position make vowels differ from one another in their duration.

2.3. Extrinsic Vowel Duration

The length of vowels can extrinsically be affected due to the impacts of adjacent consonants (Padgett, 2008); the syllable structure (open versus closed syllables), the position of the vowel (word-medially versus word finally); stress (stressed versus unstressed vowels, and moraic vowels (Stevens, 2001)) and the variation of gender (Ericsdotter & Ericsson, 2001).

Van Santen (as cited in Hardcastle and Laver, 1999) had mainly used a corpus set of 13, 048 tokens so as to examine the quantitative effects on vowel duration. He observed about seven factors which were thought to influence the duration of a vowel. These factors include, the nature of a vowel, the nature of the adjacent segments, the vowel's location in the syllable (left/right, or open/closed position of the syllable), the amount and weight of either previous or following syllables of the target vowel, the manner of stress of the syllable, the place of the carrier word in

the sentence, and the accent status of the word (where the target vowel found). The author finally excluded stress intervals and put that the remaining factors have a substantial impact on vowel duration. However, among the above, the nature of the vowel, and the nature of the adjacent segments is more of intrinsic. And an inquiry whether vowel durations are acoustic correlates of a stress or not is discussed later in this section.

Gonet (2001) also classified the extrinsic factors which have a phonological impact on durations of vowels and gives the further justifications. Accordingly, the factors are classified as the force of articulation (which is considered as the known factor for extrinsic conditioning), manner of articulation (implies to the collection of consonants with plosive, affricative, fricative, nasal and lateral manners of articulation), and place of articulation (implies the three categories: labial, apical and velar). This study specifically examines the vowels between the alveolar obstruents and hence the some of the above extrinsic factors are out of the scope of this research.

Nevertheless, it is tried to portray the reverse somewhere that duration effects are allophonic than having a direct correlation with syllable weight, at least for Scottish English (Bob, 2005). In effect, this argument can be taken as applicable for any other variety of English; the same is true according to Gonet and Stadnicka (2005).

Due to neighboring voiceless obstruents, vowels are considered to have a shorter duration according to various experimental works on duration. The works mainly addressed the effect of postvocalic fortis obstruents or PFC (Pre-Fortis Clipping). Gonet and Stadnicka (2005) depict that the shortening of a vowel or 'clipping' mainly takes place in the pre-fortis position. They even explained that any other sonorant or vowel-like segment in this position lacks its original duration while vowels and sonorants in pre-lenis obstruents preserve their original duration. Gonet and Stadnicka (ibid) move forward by justifying the extrinsic influences on duration by pointing out that the duration of the vowel preceding a voiced obstruent is longer than that of a vowel preceding a voiceless obstruent (p. 79).

An adjacent consonant's degree of vibration during its articulation process (i.e. the state of being voiced or voiceless) is seen with a great attention by various phoneticians and phonologists.

After an intensive experiment on the vowels of Scottish English, Scobbie, et.al, (1999) have concluded this situation as, "The typical English pattern of extrinsic vowel duration is that phonetically much shorter allophones of vowels are found before voiceless consonants as opposed to voiced ones. In Scottish varieties voiced stops condition short duration vowels, as indeed to nasals and /l/. Only voiced fricatives (/v ð z ʒ/) and /r/ condition long duration" (p. 231).

Wells (as cited in Gonet & Lidia (2005) puts the denotation of extrinsic durational changeability firstly to a commonly known term vowel shortening, or "clipping" as the influence exercised on the vocalic segments and any other sonorants due to the succeeding consonants. Given that the influence of post-vocalic obstruents onto any other vocalic, sonorant, and lenis segments is attestable, pre-fortis clipping and vowel shortening are clearly noticeable. Though Gonet & Lidia further explain that the force of the succeeding consonant extends up to the third syllable and bring a supra segmental conditioning. This concept is left for the time being as it is beyond the scope of this analysis.

Carol & Buder (2002) have also described the impact of post-vocalic voicing towards vowel duration, in the case of English, that the voicing of ultimate consonant signals the length of the preceding vowel. They also restated that in adult speech the vowels in a pre-voiced obstruent position are doubly longer than those preceding voiceless obstruents.

However, the striking durational gap which is attested in English vowels in pre-voiced versus voiceless obstruent positions might not be found for an Ethiopian language. Nevertheless there is the durational gap in Amharic vowels in which pre-voiced vowels are longer than those vowels in pre-voiceless obstruent position (Derib, 2011). This issue will be discussed in later sections.

2.4. The Role of Accent Status on Vowel Duration

For Wolaytta Doonaa is a pitch accent language, in which the role of supra segments is beyond the stress and a bit slighter than the tonal languages, and where the accents are recognized as high tone (Azeb, 1996), the supra segmental impact raised in this section is the accent status.

Since the majority of previous studies have extensively seen the impact of stress in vocalic length, it is preferred to investigate the correlation between stress and accent with that of vowel duration. To do so, at least, the experimental investigations which were probed before two couples of decades claim that low tone vowels have a longer duration than those of high tones whereas vowels on rising tones are longer than those on falling tones (Gandour (as cited in Lee, 1990). Such claims have a lot to do with current studies on vowels of pitch accent languages, though they were more concerned with the auditory view point.

Beckman et al. (1992) have justified the accented versus unaccented vowels' durational trait in terms of physio-articulatory aspect. That is, they distinguished that the motion of the jaw (or what they called "jaw kinematics") have observable interface with the accent status of the vowel uttered. They justified that the situation where consonantal position leaves its shape as the jaw is lowered so as to utter certain lower vowel is correlated with the so called "truncation" effects (p. 150).

Apart from that, according to Sole´ et al (2007) further explain, based on the study by Edwards et al. (1991), that during the utterance process of short unaccented vowel, the jaw moves little distance, and, during the utterance process of the accented long vowels, it moves longer distance. Nevertheless they did not cover that the kinematics movements have an advanced correlation with those of unaccented vowels.

Ericsdotter and Ericsson (2001) have also reconsidered Lindblom's data, along with theirs, and concluded that the articulatory and acoustical vowel space created in the stressed vowels is greater than their shorter equivalents. They proved that when the articulatory spaces are wider in certain vowel area, this does make the accented vowels longer.

Ericsdotter and Ericsson (2001) have further explained that men and women used divergent strategies of treating the stress pattern of certain phrase. Here the men's tendency to focus on the stressed word is in terms of duration, loudness, and a small pitch, whereas, the women's tendency to focus on the word to be stressed is in terms of duration, loudness, a great pitch

change, and starting from the previous word so as to have a maximum stress level on the word they focus (p. 3-4).

Ericsdotter and Ericsson (2001) have investigated the data from Swedish speakers and found that women utter longer vowels than men do. In addition to that, according to this data, the women also produced the vowels' duration which was shorter or approaching to its citation form duration in non-stressed vowels, and longer durations of the stressed vowels (p. 3).

Nevertheless, the recent works, at least to some languages disprove that stress and accent related supra segmental impacts have no that far correlation with vowel duration. Ciszewski (2012) has explained the accent-duration correlation as, "The results indicate that stressed vowels *may* be longer than unstressed ones. Their durational superiority, however, is not stress-related, but follows mainly from vowel intrinsic durational characteristics and, to some extent, from the prosodic context (i.e. the number of following unstressed vowels) in which it is placed." (p. 215)

Regarding the pitch-accent languages' nature, the correlation between accent status and vowel length is investigated in Korean by Lee (1990) where the prominence of pitch (which is the phonetic characteristics of stress and length) is related to what he says an increased duration and loudness of a syllable as compared with the norm. Lee, in this study, has revealed that there is a difference between the perceptual length of rising and falling tones. Regarding the impact of accent on perception, he says, "The fact that an accented syllable leads a new pitch (tone) pattern may also influence the perception of pitch prominence" (p. 17). Still this is more of an attribute of auditory length than that of the acoustic duration; and it would be intentionally left for the future hence this work merely targets at the acoustic traits of durations.

2.5. The Impact of Gender Difference on Vowel Duration

Gender difference is one of the causes for difference in vowel duration, the observable discrepancies in vowel durations between male and female speakers is summarized by Ericsdotter and Ericsson (2001) as, "...women use greater vowel duration contrasts than men do, the women producing shorter or similar vowel durations in non-stressed positions, and longer vowel durations in stressed positions" (p. 3). This finding has also a consistence with the

investigation result of Amharic vowels in which Derib (2011) found that the durational variation on Amharic vowels due to the difference of gender brought a significant difference. Due to that, women utter longer vowels than men do.

2.5.1. Sociophonetics and Gender Difference

The durational difference due to gender is not language specific according to Simpson (2009) since the vast majority of languages whose vowel durations are investigated so far show that women utter longer vowels than men. Simpson's (1998) study on German vowels within spontaneous and read speeches depict that females' vowel duration is 11% longer than males on average. Though this data depict the findings of the spontaneous speech, it has a clear indication of the durational difference due to gender difference.

Then again, Samuelsson (2006) has gone through various literatures portraying the sociophonetic variation of duration and concluded that while some literature describe women produce longer duration on vowels than men do, the others depict that men consonantal duration is quiet longer than women's utterance. In addition to that, according to his conclusion, women may produce even longer sentences while reading or speaking than men do. He also referred to some experimental works which portray even women are supposed to pause their speech more frequently and repeatedly than men do.

Regarding sociophonetics, Simpson and Ericsdotter (2003) put further explanation as it is the emanation of one kind of vowels' durational facet. Due to the fact that their studies associate this variation to the impact of sociophonetics, which looks the slow speaking rate as a feature of women.

2.5.2. Physiological Aspect and Gender Difference

Despite relating vowel duration variance with sociophonetic aspect, it is also conceived as the prevalence of difference in the physiological aspect in both genders affects the vowel duration. There are many other works which associate the durational variance with gender difference as an occurrence of anatomy. Simpson (2000) describes that, as the articulatory organ of men travels

the longer distance (in comparison to that of women's), it is supposed to mean that shorter vowel durations and the raise in the overall tempo of utterance were maintained by women.

According to Simpson and Ericsdotter (2003), the gender-specific variation in anatomy (i.e. the contrast in the makeup of articulatory organs of male and female) had put a durational demarcation between males and females. Here the articulatory organ of males, as mentioned above, passes through a longer distance with a faster speed and in turn this makes the vowels uttered by male become temporally shorter in contrast to the females'. According to Samuelsson's report, because of the prevalence of various segmental aspects within one sentence, the variance in certain phonetic environment may be compensated somewhere else in that sentence. That is why they complement that there is no sole reason that can alone demarcate the durational variation of one gender from the other.

Summing up, nearly all the languages acoustically studied show that the durational contrasts occur due to gender difference in certain degrees. Among the reasons put by the scholars for this difference are the physiological aspect differences among males and females. The other reason described was the sociophonetic aspect difference between the two genders. Whatsoever the reason is, the clearly known point is that women utter longer vowels than men.

2.6. Previous Works on Vowels of Wolaytta Doonaa

Though not acoustic data based, the phonology of Wolaytta Doonaa is explained in the tagmemic analysis of the language in which the five short and five long vowels (which are acceptable so far) were documented (Adams, 1983). However, as mentioned earlier, the work depicts the general grammatical value of the vowels than experiment based acoustic explanation on them.

A work by Yitbarek (1984) tried to depict the language's segmental features (both vowels and consonants) initially, although it is not experimental again. In this work, regarding the length of vowels and the prevailing accent status, Yitbarek explained that the vowel length is phonemic and there are lots of lexical minimal pairs. Even though this is convincing, he simply described the syllabic area of the stressed/unstressed vowels. But, apart from being a mere description, this

work doesn't have a clearly demarcated gap between the long and the short vowels of the language. Within vowel harmony (p. 61), he put some vowels as long, but which are actually short. To mention,

a) Orthography: ya, Gloss: 'you come'
   Wrong transcription *[ya:]
   Actual transcription: /ya/

b) Orthography: ma, Gloss: 'you eat'
   Wrong transcription *[ma:]
   Actual transcription: /ma/

So, this work clearly shows that there is no clear demarcation between the long and the short vowels.

Recently, Wakasa (2008) has documented the five short and five long vowel phonemes in Wolaytta Doonaa. Based on his establishment, the five short vowel phonemes in the language are: /i/, /e/, /a/, /o/, and /u/. (Since the researcher of this thesis himself is also the speaker of the language and he observed that there is no other syllabic nucleus attested in the language than the above phonemes so far, the documentation of the short vowels by Wakasa is approvable.)

Based on the documentation by Wakasa (2008), the tongue position of the vowels during their utterance process is mentioned. The advancement and the height of our tongue when uttering the vowels in Wolaytta Doonaa, according to Wakasa, are listed as follows:

[i] The high-front flat vowel
[e] The mid-front flat vowel
[a] The low flat vowel
[o] The mid-back round vowel
[u] The high back round vowel

So, this classification of short vowels' nature based on the height and advancement of the tongue has a lot to do with differentiating vowels so as to measure their intrinsic duration in this research.

Wakasa (2008) has also explained the long counterparts which are phonemically contrasting as the minimal pairs with the aforementioned short vowels as they are the only five long vowels (i.e. the lengthened equivalents of the short vowels) in the language. The long vowel phonemes, according to him, are: /ii/, /ee/, /aa/, /oo/, and /uu/. He further describes that, approving the previous claim by Adams (ibid), the vowel is phonemic in the language. Nevertheless he notified that, raising the query evoked by Lamberti and sottile (as mentioned in Wakasa) regarding the phonological relevance of the vowels' quantity in the language, the issue related to the vowel quantity needs to be put aside until the adequate acoustic recording and documentation of the vowels is done (p. 72).

Even though, Wakasa (2008) doubts on the adequate occurrence of the contrasting minimal pairs with regard to vowel duration by the reference on the previous works along with his study in which he says that the minimal pairs due to the vowel length are "relatively rare." He reasons out that the duration was somehow showing a variation even between the native speakers (p. 73). This doubt, to some extent, depicts that there is a bit disagreement regarding the clear demarcation absolute vocalic length of short and long vowels of the language. But the impact of either idiolect or sociophonetics on vowel length and/or duration is mentioned by the researchers such as Simpson and Ericsdotter (2003). Whether this is also the case for the vowels of Wolaytta Doonaa needs, as he already suggested there, an experimental study.

With regard to the supra segmental features in Wolaytta Doonaa, Azeb (1996) has described the prevailing prosodic features in the language that the long accented syllables may have a contour tone in which the rising tone is included. These accented long vowels in certain syllabic environment may contrast with its unaccented equivalents where the long vowels do not show any trait that belongs significantly to an accented long syllable.

Nevertheless, the contrast between the two syllables is not only due to the long vowels variation because of merely accent status variation, but also the syllables in which the accent status variation is observed can be minimally paired. The tokens listed in the appendices section of this research can be a good example for the accentual minimal pairs both in long and short nuclei.

CHAPTER THREE

METHODOLOGY

In this section, the methods how the data were gathered and analyzed are presented. First, the method in which the subjects were selected for recording data is explained. Then the method of data gathering from those subjects is put briefly. And finally data analysis methodology is described.

3.1. Selection of the Language

Wolaytta Doonaa is among the Ethiopian languages which are relatively well researched in terms of morphological, syntactic and semantic features. Its grammatical structures are well investigated by various Ethiopian and foreign linguists. However, since the acoustic analysis in this language is not yet described, it is difficult to promote the language into technology-aided activities like speech synthesis. So, the researcher has purposively selected the language as it is one of the vernacular languages of Ethiopia serving a sizable community.

3.2. Selection of Participants

3.2.1 Population

The target population of the study comprises Wolaytta Doonaa speaking community. Since there is no dialectal variation attested within Wolaytta zone (for there's no dialectology based isogloss in which its varieties are demarcated), a speaker of the language that comes from any part of the countryside Wolaytta does represent the population.

3.2.2 Sample Selection

The researcher selected the participants who were studying Ethiopian Languages, majoring Wolaytta Language and Literature, for their first degree at Wolaytta Soddo University. The sample of this study encompassed 10 female and 10 male informants who were third year students. The participants were purposively selected to make sure that no participant with any speech and/or language disorder is included.

3.3 Data Collection Method

3.3.1 The Speech Material

The speech material comprised of 4,800 vowel tokens from which 2,400 were accented and 2,400 are unaccented. The token selection was based on five vowels * two contrasting lengths (short and long vowels) * four phonetic environments for each vowel (i.e. [t _ t], [t _ d], [d _ t] & [d _ d]) * two accentual minimal pairs for each phonetic environment (accented and unaccented nuclei) * 10 female and 10 male subjects * three random repetitions (i.e. 5*2*4*2*20*3= 4800). In order to measure both the intrinsic and extrinsic vowel durations, the selected tokens included the intended short and long vowels within the *CVC* frames. Intrinsic durations were measured with only short vowels while the entire remaining variation is tested with both short and long vowels. The exhaustive word list of the 80 tokens was framed as follows:

a. [tVt] and [tVVt]: The list of post- and pre-voiceless vowel tokens all are meaningful

b. [tVd] and [tVVd]: The list of post-voiceless and pre-voiced tokens from which very few are loan words and one nonce word

c. [dVt] and [dVVt]: The list of post-voiced and pre-voiceless tokens from which only one word is a loan scientific term

d. [dVd] and [dVVd]: The list of post- and pre-voiced vowel tokens all are meaningful

Hence any vowel adjacent to voiced consonants is considered to have its citation form duration, as it is already mentioned in the literature survey section, the minimal pairs were selected according to voiced versus voiceless pairs. In addition to that, the pairs were also set depending on their accent status, in easier words, the accented short and long vowels are analyzed by being compared with their respective unaccented equivalents.

To measure the extrinsic durational variation between the vowels, the minimal pairs were set for analysis as follows:

a. [tVt] versus [dVd] / [tVVt] versus [dVVd]: To measure the impact of voicing of both preceding and succeeding consonants within CVC

b. [tVd] versus [dVd] / [tVVd] versus [dVVd]: To measure the effect of post-voiceless obstruent

c. [dVt] versus [dVd] / [dVVt] versus [dVVd]: To measure the impact of pre-fortis clipping

3.3.2 Recordings

The recording process took place in the Audio Visual Room at the School of Veterinary Medicine in Wolaytta Soddo University. A Marantz Professional® voice recorder, accompanied by a pre-prepared PowerPoint slide of the tokens, was used for recording. The recorded sounds, in which a Marantz recorded in 44100 Hz by default format, were further saved as *.wav* file.

3.3.3 Parameters for Segmenting Vowels' Durations

In order to consistently segment the measurable vowels from the saved sound files, the spectrograms and waveforms were used as a standard criterion. Based on these criteria, the beginning of the target vowel's time dimension was determined. The general criterion which is used to determine the start point is the point where the higher formants show a stable line and the start of the waveform's amplitude and the end where: i) a change in amplitude in the waveform (i.e. consistent with the loss of energy in the higher formants) occurs; ii) aperiodicity's onset is placed. Putting this in mind, the target vowels' durations within the tokens were manually segmented and recorded in milliseconds. Some of the extractions from the annotated target vowels are shown below.

The sample waveform of the short /i/ within its *tVd* frame which was uttered by a female subject:

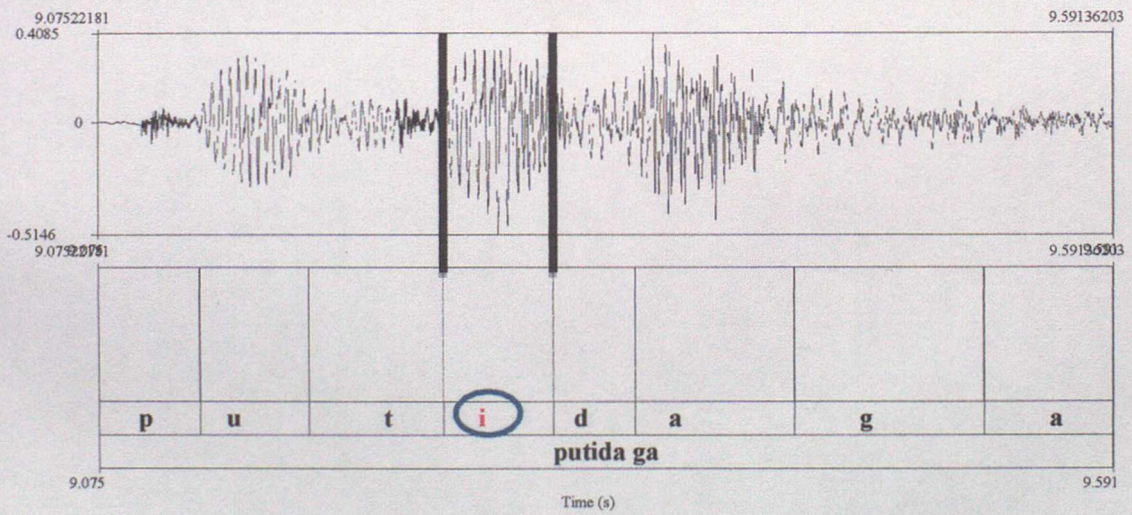

*Figure 3.1: The sample extraction of the durational waveform of /i/ in a **tVd** frame*

The sample waveform of /e:/ within its *tVVt* frame which was uttered by a male subject:

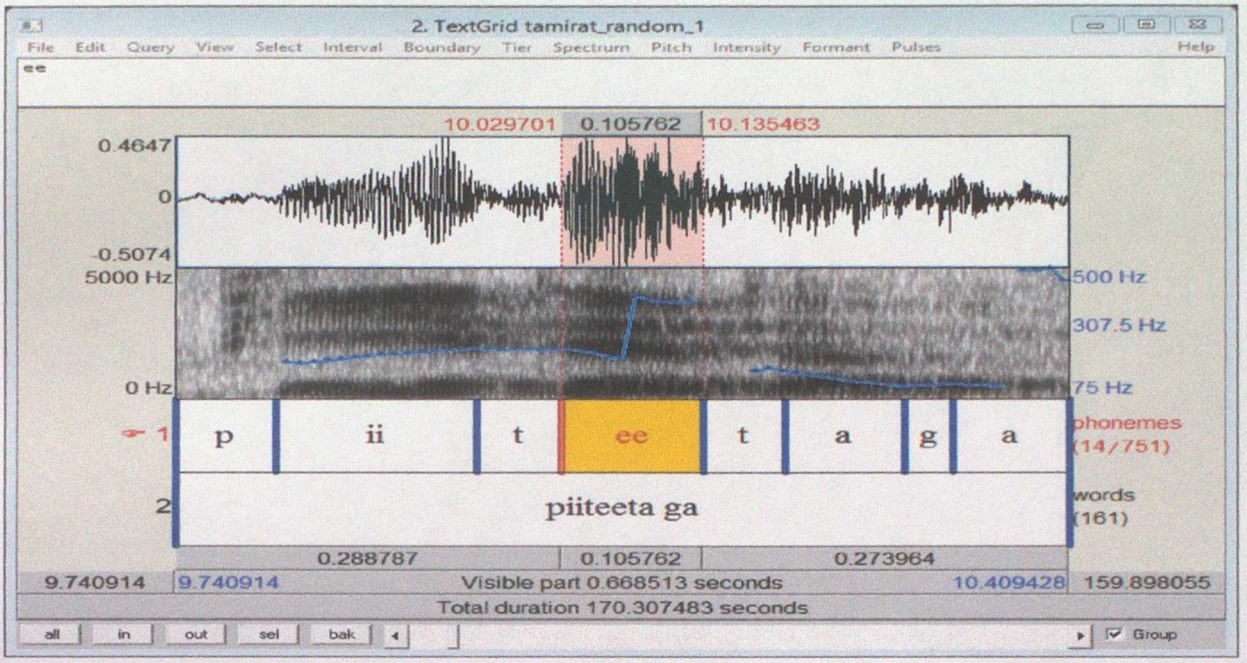

*Figure 3.2: The sample extraction of the durational waveform of /e:/ in a **tVVt** frame (which is 106ms)*

The sample waveform of the short /o/ within its *tVt* frame which was uttered by a male subject:

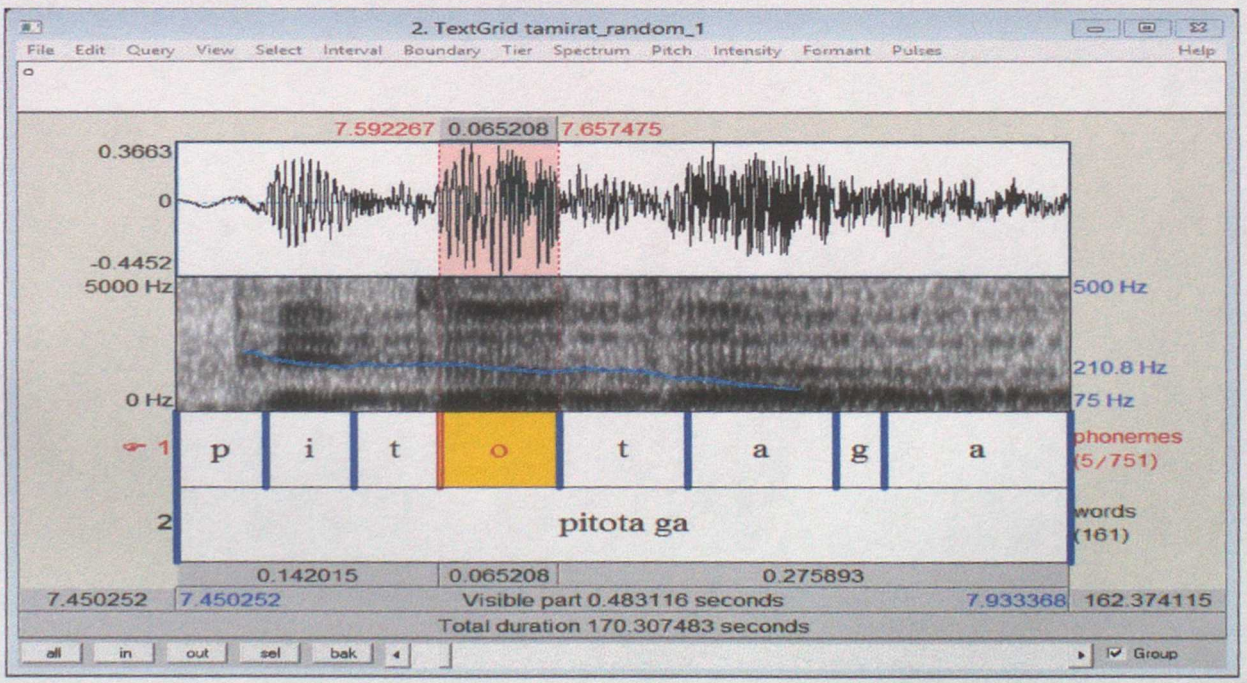

*Fig. 3.3: The sample extraction of the durational waveform of unaccented /o/ in a **tVt** frame (which is 65ms)*

The segmented target vowels were then annotated to textgrid of PRAAT version 6.0.21 (Paul Boersma and David Weenink, 2016) and then selected with PRAAT script of segmenting sounds in durations. The final result was exported to Microsoft Excel, took final shape and classified into various analyzable datasets which make it suitable for repeated measures (i.e. blocks, vowel lengths, accent statuses, genders, targeted CVC frames, etc.).

3.3.4 Data Analysis

The organized data in the Excel Dataset folders were further imported into SPSS Software, and their values were analyzed. Repeated measures ANOVA was made with IBM-SPSS version 20. In doing so, the statistical levels of significances of the three repetitions for Within-Subjects Variables were described. The significant differences of the repeated measures ANOVA tests were further rechecked with both Bonferroni Post Hoc tests within SPSS and Tukey Post Hoc of HSD in R. Apart from this, the normality of residuals by the three repetitions was checked with histograms/Shapiro-Wilk tests in order to determine whether they are approximately normally distributed or not. Then the final results were discussed in accordance with the issues raised in the section of literature review.

CHAPTER FOUR

RESULTS

4.1. Introduction on the Results

80 tokens within try syllabic words were recorded from 20 subjects in three rounds depict that there is a clear-cut durational gap between male and female subjects. Regarding the average duration of short vowels, for both male and female subjects, /a/ was the longest vowel followed by /o/ and /e/ respectively. The following plot demonstrates the estimated marginal means of three repeated measures of the short vowels:

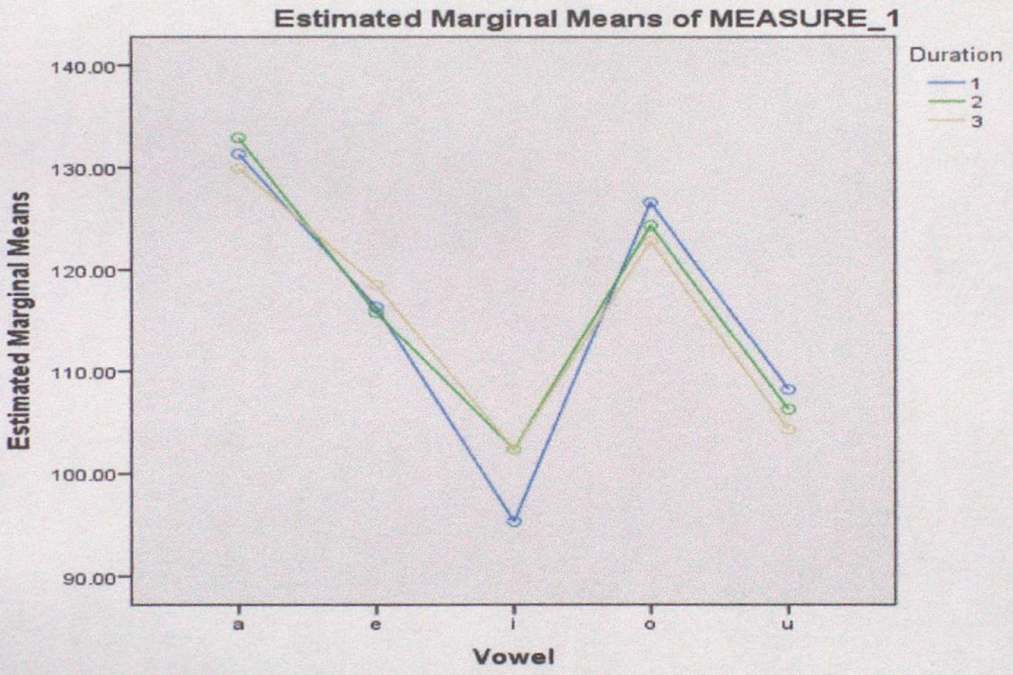

Fig. 4.1: The estimated marginal means of short vowels in three repetitions

The durational differences between the genders were attested in individual vowels (and its level of statistical significance is discussed in the later sections). The mean values of both short and long vowels demonstrate that the low vowels are affected by the jaw movement lengthening and have longer durations. This effect is to be presented in the intrinsic duration section and its match with the former literatures will be described in the discussion chapter.

The mean values of the short vowels within a *tVt* frame demonstrate that the low vowels are affected by the jaw movement lengthening and have longer durations. This effect is to be presented in the intrinsic duration section and its consistency with the former literatures will be described in the discussion chapter.

The following plot describes the extraction of mean durational values of the short and long vowels within tVt frame.

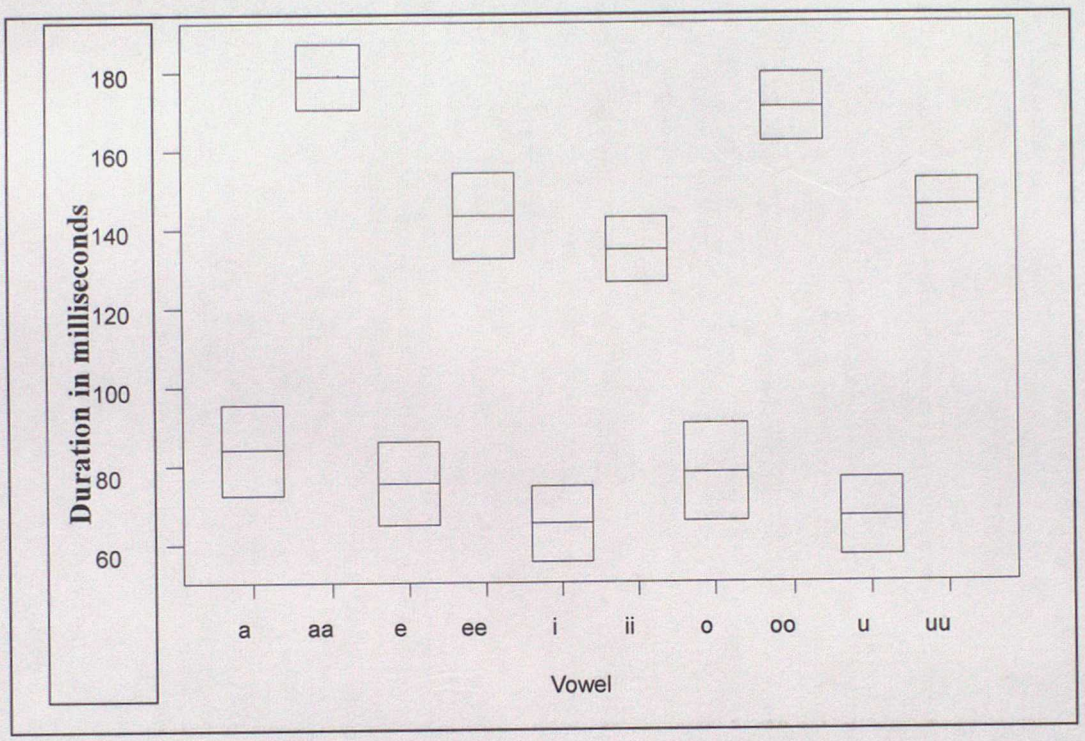

Fig. 4.2: The mean durational values of short and long vowels within a tVt frame

4.2. Results of SPSS Repeated Measure ANOVA on the Intrinsic Duration

4.2.1. Tongue Advancement (and Lip Rounding)

In order to investigate the intrinsic duration of short vowels, first the lip rounding, the backward and frontward movement of the tongue during the articulation of the five vowels was measured. Here the contrast between plain (round) and flat (unround) vowels was also seen together.

Vowel	Tongue Position	Males		Females	
		Mean	STDEV	Mean	STDEV
/i/	Front	56ms	5.147157387	75ms	10.68934222
/e/	Front	65ms	8.138728904	86ms	11.74279806
/a/	Central	73ms	10.0670821	95ms	12.3430611
/o/	Back (Round)	66ms	6.697411744	91ms	10.66722365
/u/	Back (Round)	57ms	3.113370335	77ms	9.907158724

Table 4.1: The mean values of short vowels in terms of tongue advancement

Tongue Position	Males		Females	
	Mean	STDEV	Mean	STDEV
Front	60ms	5.843635	67ms	26.04217
Central	73ms	10.06708	79ms	31.06167
Back (Round)	61ms	4.501955	69ms	27.2989

Table 4.2: The intrinsic mean values of short vowels

The vowel tokens within *tVt* frames were measured in three repetitions so as to determine the statistical level of significance based on the vowels' intrinsic durational difference over the three repetitions. Based on the durational value of the short vowels which are measured within tri-syllabic words, the mean duration of the three phase recordings were calculated. Forty tokens, among which twenty accented and twenty unaccented phonetic environments were included and only a voiceless neighboring alveolar obstruent consonant *tVt* frame was selected for this measurement. So as to measure merely the physio-articulatory impact on their duration, everything regarding the phonetic environment and accent status are kept the same. Then the intrinsic aspects, as mentioned below, are put accordingly.

Descriptive Statistics				
Repetitions	TA	Mean	Std. Deviation	N
Duration1	Back	70.88	23.815	80
	Central	84.00	22.304	40
	Front	59.81	19.234	80
	Total	69.07	23.454	200
Duration2	Back	70.45	21.515	80
	Central	87.17	23.340	40
	Front	62.50	18.155	80
	Total	70.61	22.427	200
Duration3	Back	68.38	19.616	80
	Central	81.60	16.923	40
	Front	57.86	16.434	80
	Total	66.82	19.830	200

Table 4.3: The descriptive statistics of tongue advancement

Mauchly's test indicated that the assumption of sphericity had been violated, **$X^2(3) = 13.000$, p=.047.** Thus the degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity. So, a repeated measures ANOVA with a Greenhouse-Geisser correction which was applied to the degrees of freedom showed that the mean intrinsic durational values of the short vowels within a tVt frame differed significantly between the three repetitions, **[F(1.879, 370.240)=4.338, p=.016].**

Pairwise Post Hoc tests of Dunn-Bonferroni were conducted in order to determine the specific areas the significant difference was emanated from. The following table summarizes the pairwise test results of Between-Subject variables where the durational difference between the specific tongue positions occurred. Accordingly, back versus central (p=.000), back versus front (p=.000) and front versus back (p=.001) thus they were all statistically highly significant.

Pairwise Comparisons						
Measure: MEASURE_1						
(I) TA	(J) TA	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
Back	Central	-14.358*	3.297	.000	-22.320	-6.397
	Front	9.842*	2.692	.001	3.341	16.342
Central	Back	14.358*	3.297	.000	6.397	22.320
	Front	24.200*	3.297	.000	16.239	32.161
Front	Back	-9.842*	2.692	.001	-16.342	-3.341
	Central	-24.200*	3.297	.000	-32.161	-16.239
Based on estimated marginal means: *. The mean difference is significant at the .05 level. b. Adjustment for multiple comparisons: Bonferroni.						

Table 4.4: The pairwise results of tongue advancement

4.2.2. Tongue Height

Apart from the durational difference between vowels due to the front-back movement of our tongue, their mean values in terms of the up-down movement of the tongue due to jaw kinematics were also calculated. The following table shows the mean values and their standard deviations of vowels in each tongue position in three repetitions.

Descriptive Statistics				
Repetition	Tongue Height	Mean	Std. Deviation	N
Duration1	High	61.06	21.183	80
	Low	84.00	22.304	40
	Mid	69.63	22.655	80
	Total	69.07	23.454	200
Duration 2	High	60.79	16.521	80
	Low	87.17	23.340	40
	Mid	72.16	22.046	80
	Total	70.61	22.427	200
Duration 3	High	56.26	15.800	80
	Low	81.60	16.923	40
	Mid	69.98	19.130	80
	Total	66.82	19.830	200

Table 4.5: The descriptive statistics of tongue height

Mauchly's test indicated that the assumption of sphericity had been violated, **$X^2(3) = 12.285$, p=.002.** Thus the degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity. So, a repeated measures ANOVA with a Greenhouse-Geisser correction which was applied to the degrees of freedom showed that the mean intrinsic durational values of the short vowels within a tVt frame based on the tongue height differed significantly between the three repetitions, **[F(1516.477, 68553.375)=4.358, p=.015].**

Pairwise Post Hoc tests of Dunn-Bonferroni were conducted in order to determine the specific areas the significant difference was emanated from. The following table summarizes the pairwise test results of Between-Subject variables where the durational difference between the specific tongue positions occurred. Accordingly, high versus mid (p=.000), high versus low (p=.000) and mid versus low (p=.000) thus they were all statistically highly significant.

Pairwise Comparisons

Measure: MEASURE_1

(I) TH	(J) TH	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
High	Low	-24.888*	3.264	.000	-32.768	-17.007
	Mid	-11.217*	2.665	.000	-17.651	-4.783
Low	High	24.888*	3.264	.000	17.007	32.768
	Mid	13.671*	3.264	.000	5.791	21.551
Mid	High	11.217*	2.665	.000	4.783	17.651
	Low	-13.671*	3.264	.000	-21.551	-5.791

Based on estimated marginal means:
*. The mean difference is significant at the .05 level.
b. Adjustment for multiple comparisons: Bonferroni.

Table 4.6: The pairwise results of tongue height

Accordingly, the intrinsic durational values of Wolaytta Doonaa vowels in this regard also showed statistically high significance durational difference due to tongue height in three discreet positions. As a vowel is lower, its duration is longer hence this is commonly attested in any language.

4.3. Results of SPSS Repeated Measure ANOVA on the Extrinsic Duration

All the tokens selected for this study are in a CVC frame of voiced and voiceless neighboring consonants and hence this made it possible to investigate their durational variation pertaining to the convinced phonetic conditioning. So, the experimental results of Wolaytta Doonaa are measured in accordance with this selection (of the tokens).

To determine the statistical levels of significance of vowels' extrinsic duration, the vowel tokens were set in two different data sets in which the short and the long vowels put separately and were measured in repeated measures ANOVA.

Short Vowels

Based on the durational value of the short vowels which were measured within tri-syllabic words, the mean duration of the three phase recordings were calculated. Each CVC frame, among which accented and unaccented phonetic environments were included, are shown with their mean values and their standard deviations in the following table. As the four frames (i.e. *dVd*, *dVt*, *tVd* and *tVt*) were taken as between-the variances, the tokens selected for this measurement for each participant comprise of 200 vowel tokens neighboring the aforementioned alveolar obstruent consonants. The number of durations implies the repetition of the measures.

Descriptive Statistics				
Repetition	Frame	Mean	Std. Deviation	N
Duration1	dVd	78.97	21.879	200
	dVt	78.90	21.981	200
	tVd	68.38	19.951	200
	tVt	69.07	23.454	200
	Total	73.83	22.402	800
Duration2	dVd	76.45	19.069	200
	dVt	80.54	22.382	200
	tVd	70.19	20.424	200
	tVt	70.61	22.427	200
	Total	74.45	21.518	800
Duration3	dVd	79.57	20.253	200
	dVt	78.92	20.631	200
	tVd	68.97	18.448	200
	tVt	66.82	19.830	200
	Total	73.57	20.586	800

Table 4.7: The descriptive statistics of short vowels' CVC frame

Mauchly's test indicated that the assumption of sphericity had been violated, **$X^2(2) = 8.783$, p=.012.** Thus the degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity. So, a repeated measures ANOVA with a Greenhouse-Geisser correction which was applied to the degrees of freedom showed that the mean extrinsic durational values of the short vowels within *dVd, dVt, tVd* and *tVt* frames differed significantly between the three repetitions, **[F(1.978, 1574.698) = .910, p=.001].**

Pairwise Post Hoc tests of Dunn-Bonferroni were conducted in order to determine the specific areas the significant difference was emanated from. The following table summarizes the pairwise test results of Between-Subject variables where the durational difference between the frames occurred. Based on this, dVd versus dVt and tVt versus tVd were both not significant (p=1.0), while there were significant durational differences between the frames dVd versus tVd (p=.000), dVt versus tVt (p=.000) and dVd versus tVt (p=.000). Among these pairwise comparisons, the frames dVd versus dVt, tVt versus tVd, dVd versus tVd, and dVt versus tVt have a lot to do with our discussion in the later section. This result generally shows that prevocalic voicing has a remarkable impact on the succeeding vowel's lengthening.

Pairwise Comparisons

Measure: MEASURE_1

(I) Frame	(J) Frame	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
dVd	*dVt*	-1.127	1.788	1.000	-5.857	3.603
	tVd	9.147*	1.788	.000	4.417	13.877
	tVt	9.495*	1.788	.000	4.765	14.225
dVt	*dVd*	1.127	1.788	1.000	-3.603	5.857
	tVd	10.273*	1.788	.000	5.543	15.003
	tVt	10.622*	1.788	.000	5.892	15.352
tVd	*dVd*	-9.147*	1.788	.000	-13.877	-4.417
	dVt	-10.273*	1.788	.000	-15.003	-5.543
	tVt	.348	1.788	1.000	-4.382	5.078
tVt	*dVd*	-9.495*	1.788	.000	-14.225	-4.765
	dVt	-10.622*	1.788	.000	-15.352	-5.892
	tVd	-.348	1.788	1.000	-5.078	4.382

Based on estimated marginal means:
*. The mean difference is significant at the .05 level.
[b]. Adjustment for multiple comparisons: Bonferroni.

Table 4.8: The pairwise results of short vowels' CVC

4.3.1. Long Vowels

The mean durations of the tokens in the three repeated recordings depending on the durational values of the long vowels within tri-syllabic words were measured. Each CVC frame, among which accented and unaccented phonetic environments were included, are shown with their mean values and their standard deviations in the following table. As the four frames (i.e. *dVVd, dVVt, tVVd* and *tVVt*) were taken as between-the variances, the tokens selected for this measurement for each participant comprise of 200 vowel tokens neighboring the aforementioned alveolar obstruent consonants. The number of durations implies the repetition of the measures.

Descriptive Statistics				
Repetition	Frame	Mean	Std. Deviation	N
Duration1	dVVd	163.92	29.278	200
	dVVt	172.80	31.871	200
	tVVd	152.53	29.341	200
	tVVt	154.61	35.399	200
	Total	160.96	32.529	800
Duration2	dVVd	160.36	28.865	200
	dVVt	168.20	29.246	200
	tVVd	150.02	30.485	200
	tVVt	154.35	34.419	200
	Total	158.23	31.523	800
Duration3	dVVd	159.85	24.904	200
	dVVt	167.27	28.891	200
	tVVd	150.75	26.983	200
	tVVt	152.46	36.417	200
	Total	157.58	30.282	800

Table 4.9: The descriptive statistics of long vowels' CVC frame

Mauchly's test indicated that the assumption of sphericity had been violated, $\mathbf{X^2(2) = 24.180}$, **p=.000.** Thus the degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity. So, a repeated measures ANOVA with a Greenhouse-Geisser correction which was applied to the degrees of freedom showed that the mean extrinsic durational values of the long vowels within *dVVd, dV Vt, tVVd* and *tVVt* frames differed significantly between the three repetitions, **[F(1.942, 1545.695) = 9.162, p=.000].**

In order to determine the specific areas the significant difference was emanated from, the pairwise Post Hoc tests of Dunn-Bonferroni were conducted. The following table summarizes the pairwise test results of Between-Subject variables where the durational difference between the frames *tVVd* versus *tVVt* was not significant (p=1.0), while there were significant durational differences between the frames *dVVd* versus *tVVd* (p=.001), *dVVd* versus *dVVt* (p=.021) and *dVVd* versus *tVVt* (p=.036).

Pairwise Comparisons						
Measure: MEASURE_1						
(I) Frame	(J) Frame	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
dVVd	dVVt	-8.045*	2.747	.021	-15.309	-.781
	tVVd	10.277*	2.747	.001	3.012	17.541
	tVVt	7.567*	2.747	.036	.302	14.831
dVVt	dVVd	8.045*	2.747	.021	.781	15.309
	tVVd	18.322*	2.747	.000	11.057	25.586
	tVVt	15.612*	2.747	.000	8.347	22.876
tVVd	dVVd	-10.277*	2.747	.001	-17.541	-3.012
	dVVt	-18.322*	2.747	.000	-25.586	-11.057
	tVVt	-2.710	2.747	1.000	-9.974	4.554
tVVt	dVVd	-7.567*	2.747	.036	-14.831	-.302
	dVVt	-15.612*	2.747	.000	-22.876	-8.347
	tVVd	2.710	2.747	1.000	-4.554	9.974
Based on estimated marginal means *. The mean difference is significant at the .05 level. b. Adjustment for multiple comparisons: Bonferroni.						

Table 4.10: The pairwise results of long vowels' CVC frame

The normality of residuals by the three repeated measures was checked by using the histograms/Shapiro-Wilk tests in order to determine whether they are approximately normally distributed or not. Then the p-values show that the distribution of the data which was sampled from shows a relatively normal distribution except in few areas.

Tests of Normality							
Repetition	Frame	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Duration1	dVVd	.052	200	.200*	.984	200	.025
	dVVt	.075	200	.008	.980	200	.005
	tVVd	.064	200	.043	.984	200	.021
	tVVt	.037	200	.200*	.994	200	.604
Duration2	dVVd	.060	200	.075	.990	200	.160
	dVVt	.051	200	.200*	.987	200	.061
	tVVd	.064	200	.043	.986	200	.042
	tVVt	.048	200	.200*	.992	200	.361
Duration3	dVVd	.061	200	.072	.986	200	.053
	dVVt	.084	200	.002	.976	200	.002
	tVVd	.058	200	.200*	.985	200	.035
	tVVt	.037	200	.200*	.992	200	.386
*. This is a lower bound of the true significance. a. Lilliefors Significance Correction							

Table 4.11: The results of long vowels' CVC frame normality distribution

4.4. Results of SPSS Repeated Measure on the Impact of Gender

The mean durations of the tokens in the three repeated recordings depending on the durational values within tri-syllabic words were measured for both females and males. The mean values of each gender were measured in a repeated way measure. Without any missing value, the mean values and their standard deviations in the three repeated recordings are described in the table as follows:

Descriptive Statistics				
Repetitions	Gender	Mean	Std. Deviation	N
Duration1	Female	126.1817	47.89228	200
	Male	104.9611	47.46292	200
	Total	115.5714	48.78896	400
Duration2	Female	126.8612	46.27623	200
	Male	105.8225	46.46849	200
	Total	116.3419	47.49684	400
Duration3	Female	123.6513	45.43893	200
	Male	107.5000	47.07448	200
	Total	115.5756	46.90806	400

Table 4.12: The descriptive statistics of durations per genders

Mauchly's test indicated that the assumption of sphericity had been violated, $X^2(2) = 101.438$, **p=.000.** Thus the degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity. So, a repeated measures ANOVA with a Greenhouse-Geisser correction which was applied to the degrees of freedom showed that the mean extrinsic durational values of females differed significantly from males between the three repetitions, **[F(1.632, 649.542) = .835, p=.002].** In order to determine the specific areas the significant difference was emanated from, the pairwise Post Hoc tests of Dunn-Bonferroni were conducted. The following table summarizes the pairwise test results of Between-Subject variables where the durational difference between the females versus males was statistically highly significant (p=.000). Based on this observation, we can confidently conclude that women's vowels have longer duration than men's vowels.

Pairwise Comparisons						
Measure: MEASURE_1						
(I) Gender	(J) Gender	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
Female	Male	19.470*	4.610	.000	10.407	28.533
Male	Female	-19.470*	4.610	.000	-28.533	-10.407
Based on estimated marginal means *. The mean difference is significant at the .05 level. b. Adjustment for multiple comparisons: Bonferroni.						

Table 4.13: The pairwise results of durations per genders

When we see the differences within each group of the long vowels (i.e. the group of accented and unaccented), the accented vowel /i:/ by Boy5 which is 129ms is the shortest long vowel among the accented vowels while the unaccented long vowel /a:/ by Girl3 which is 227ms is the longest long vowel among the accented groups. On the other hand, while the unaccented long vowel /i:/ by Boy5 which is 95ms is the shortest long vowel among the unaccented group, the unaccented long vowel /a:/ which is 224ms is the longest short vowel among the unaccented group. Both within accented and unaccented groups of long vowels, the long high vowel /i:/ (with the shortest duration) and the long low vowel /a:/ (with the longest duration) were attested contrastingly in the respective groups.

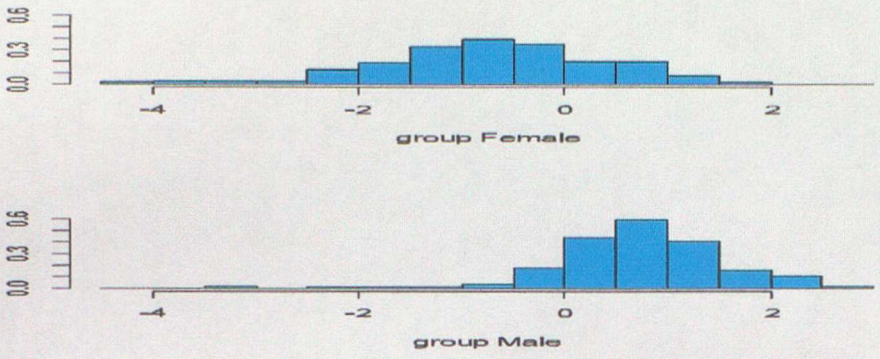

Fig. 4.3: The histograms showing female and male groups

4.5. Results on the Effect of Accent Status

Another aspect of phonological conditioning on duration is the accent status between the vowels. The tokens selected for this measurement are entirely identical in their segments. What makes them unlike from one another is the variation in the prevailing suprasegment, the accent status. As it is formerly discussed in the literature survey, Wolaytta Doonaa is a pitch accent language. Due to the fact that the minimal pairs within the tokens' frames of **/t_t/, /t_d/, /d_t/** and **/d_d/** selected in terms of accent status. So, among the whole 80 tokens selected for this analysis, 40 are accented while the rest 40 are unaccented.

The mean durations of the tokens in the three repeated recordings depending on the durational values of accented and unaccented vowels within tri-syllabic words were measured. The mean values of accented and unaccented vowels in the three repeated recordings are listed with their standard deviations in the following table:

Descriptive Statistics				
Repetition	Accent.Status	Mean	Std. Deviation	N
Duration1	Accented	121.9950	50.83652	200
	Unaccented	109.1477	45.88454	200
	Total	115.5714	48.78894	400
Duration2	Accented	121.0525	49.17045	200
	Unaccented	111.6312	45.39714	200
	Total	116.3419	47.49684	400
Duration3	Accented	120.8200	48.55507	200
	Unaccented	110.3312	44.70919	200
	Total	115.5756	46.90806	400

Table 4.14: The descriptive statistics of durations per accent

Mauchly's test indicated that the assumption of sphericity had been violated, $\mathbf{X^2(2) = 94.618}$, **p=.000.** Thus the degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity. So, a repeated measures ANOVA with a Greenhouse-Geisser correction which was applied to the degrees of freedom showed that the mean extrinsic durational values of accented vowels differed significantly from their unaccented counterparts between the three repetitions, **[F(1.650, 656.733) = .824, p=.002].** In order to determine the specific areas the significant difference was emanated from, the pairwise Post Hoc tests of Dunn-Bonferroni were conducted. The following table summarizes the pairwise test results of Between-Subject variables where the durational difference between the accented versus unaccented vowels was statistically significant (p=.02). We can generalize that accented vowels have longer duration than their unaccented counterparts based on this repeated way measure.

Pairwise Comparisons						
Measure: MEASURE_1						
(I) Accent Status	(J) Accent Status	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
Accented	Unaccented	10.919*	4.680	.020	1.718	20.120
Unaccented	Accented	-10.919*	4.680	.020	-20.120	-1.718
Based on estimated marginal means *. The mean difference is significant at the .05 level. b. Adjustment for multiple comparisons: Bonferroni.						

Table 4.15: The pairwise results of durations per accent statuses

The Results of Discriminant Analysis

In order to determine whether the genders were predictable depending on their vowels' score or not, the linear discriminant analysis on the mean values of both accented and unaccented vowels was conducted. The following table summarizes this discussion (the vowels with insignificant degree of prediction are excluded).

Gender	Vowel	Degree of Prediction (%)
Male	/i/	40
	/i/	50
	/i/	40
	/a/	60
	/u/	70
	/e/	40
	/e/	40
	/a/	40
	/a:/	40
	/a:/	50
	/i:/	90
	/e:/	60
	/e:/	50
	/u:/	70
Female	/a/	50
	/i/	40
	/i/	40
	/e/	40
	/u/	40
	/a:/	50
	/e:/	60
	/i:/	70
	/o:/	40
	/u:/	50

Table 4.16: The results of discriminant analysis

Based on this result, the overall discrimination rate is observably very low. Besides, few vowels, which are the high vowels, had more than 70% or so discrimination. The above table depicts that the highest tendency to be identified among the vowels of male subjects was the long high front vowel /i:/ which is 90% and the long high back vowel /u:/ which is 70%. On the other side, among the vowels of female subjects, the highest identifiable tendency reflected on the long high front vowel /i:/ again which is 70%.

4.6. Summary of the Findings

Summing up our discussion on the results, the short and long vowels of Wolaytta Doonaa have been measured in terms of their intrinsic nature and phonological conditioning. Their results have been analyzed using the repeated measure ANOVA within SPSS software. The results show that the durational differences due to the variation of tongue height and tongue advancement

have shown a remarkable level of statistical significance in many contrasting pairs. Apart from this, there have also been significant differences in duration between the vowels uttered by female subjects and male subjects. Also the results of vowels durational difference due to accent status difference showed that accented vowels are significantly longer than their unaccented equivalents. Here the accent status has also more significant impact on durational difference among the long vowels in comparison to the short ones. While the CVC conditioning brought a significant difference in duration in certain phonetic environments, some other phonetic environments remain with no significant difference.

CHAPTER FIVE

DISCUSSION

5.1. Discussion on the Intrinsic Duration

The finding on the intrinsic duration of Wolaytta Doonaa vowels within *tVt* frame was seen in terms of the tongue advancement and tongue height. A repeated measure analysis of variance test was conducted to compare the front, the central and the back short and long vowels separately. The results of both observations show that the central vowel /a/ has the longest duration than the back vowel followed by the front vowel. There is a highly significant difference in duration between the scores of high, mid and low short vowels. The post hoc results have also shown that their scores do significantly differ from one another. The central vowel is the longest one in the language while the front vowels are the shortest ones in duration among the short vowels of Wolaytta Doonaa. This finding does fully confirm the claim of Lehiste (1970) which is said to be the vowels differ from one another due to the distinction in the height of the tongue. The central vowel is, apart from being the only central vowel in the language, also the low vowel and its long duration from the rest is not solely an attribute of the tongue's front-back movement, but also the up-down movement. As Wolaytta Doonaa lacks plain central vowels, it would rather be a good alternative to investigate the intrinsic duration merely in terms of the tongue's up-down movement.

When we see the findings on intrinsic durations in terms of tongue height (i.e. the up-down movement of our tongue), it shows that the high vowels of Wolaytta Doonaa are the shortest vowels in the language. Then the mid vowels are a longer than the high vowels and shorter than the low vowels. Thus, the low vowels are the longest vowels in the language. So, there is a significant difference in the scores for the three distinctive tongue positions; and this finding has clearly confirmed the claim of Lehiste (1970): "... other factors being equal, a high vowel is shorter than a low vowel."

In conclusion, this finding portrays the intrinsic values of Wolaytta Doonaa vowels have a consistent score with that of the Amharic vowels' duration which was examined by Derib (2011). Of the intrinsic duration, the tongue's front-back movement demarcates Wolaytta vowels' intrinsic duration with the central vowel long duration followed by the back and the front vowels

in their respective order. Though, as repeatedly explained, due to the lack of central plain vowel, this finding calls for some else yardsticks of deciding the intrinsic duration. So, the next criterion of measuring intrinsic duration, the up-down movement of our tongue, is needed.

Based on the tongue height, the high vowels are intrinsically shortest than the mid vowels followed by the low vowels. Summing up, showing nothing strange result, as in many languages whose vowel duration is researched so far, the low vowels of Wolaytta Doonaa have the longest duration than any other vowels. And this finding in turn has confirmed the already discussed claim by (Lehiste, 1970) stating that due to the up-down movement of the jaw, it might take longer time to utter low vowels than those of the high vowels.

5.2. Discussion on the Extrinsic Duration

The durational variation due to phonological conditioning implies the mean durational results of both short and long vowels separately in terms of the adjacent consonants. Consequently, the mean values show that the short vowels follow the voiced consonants have longer duration than those follow the voiceless consonants. The same is true for the long vowels that the long vowels follow the voiced consonants are longer in duration than those vowels follow the voiceless consonants. This means that the voicing or voicelessness of preceding consonant has a significant impact on the succeeding vowel in Wolaytta Doonaa. This finding confirms one of the phonological conditioning impacts mentioned in Hardcastle and Laver, (1999) which attests that the duration of a vowel can be affected by the voicing of the preceding consonant.

There are also results of extrinsic durations for vowels coming before the voiceless versus voiced consonants. This measurement is conceived in order to confirm whether there is a significant PFC effect in the language. The finding does unpredictably portray that the average duration of the short vowels before the voiceless was rather greater than those vowels preceding the voiced consonants. Regarding the long vowels preceding the voiceless versus voiced consonants result, the mean values indicate that they are nearly equal in approximate values (that there is an insignificant dissimilarity in decimals). Here the hypothesis of durational variance due to PFC becomes not significant in the case of Wolaytta Doonaa vowels. And in turn this result needs extra study in the language (including some other consonants besides the alveolar obstruents) so as to confirm whether there are languages in which PFC is not attested.

Summing up the impact of adjacent consonants on the vowels' duration of Wolaytta Doonaa, the universal characteristics of vocalic duration with regard to the adjacent consonants is predictable. Despite that, some aspects like pre-fortis clipping lacks predictability hence the post-vocalic obstruents could not clip the preceding vowels' duration according to the result. This finding on Wolaytta Doonaa vowels does exclude the former claims in some other languages (which are stated by Gonet and Stadnicka (2005) and many others).

5.3. Discussion on the Impact of Accent Variation on Vowels' Duration

The findings on the durations of accented versus unaccented vowels portray that there is a highly significant difference in durations between the scores of accented and unaccented vowels. Consequently, this durational difference between accented and unaccented vowels disproves the claim by Ciszewski's (2012) saying that there is no correlation between stress/accent and vowel duration. So, as the effect of accent on Wolaytta Doonaa vowels according to the finding is highly observable and significant, it fits the claims by both Beckman et al. (1992), and Ericsdotter and Ericsson (2001). Summing up the impact of accent status on vowels' duration, in Wolaytta Doonaa, the accented vowels between two alveolar obstruents had longer duration than their unaccented counterparts.

5.4. Discussion on the Impact of Gender Variation on Vowels' Duration

As formerly discussed in the literature survey section, almost all the languages with the investigated data so far show that gender variation has correlation with vowel duration. In order to examine whether this variation on Wolaytta Doonaa vowels, the tokens recorded from ten male and ten female subjects are analyzed. Based on the scores, the average short vowel duration for females is remarkably longer than males with an average range of 21ms.

The results on long vowels also indicate that there is a significant difference between the genders in terms of vowel duration. Therefore, Wolaytta Doonaa long vowels uttered by female speakers were longer than the vowels uttered by the male speakers in average range of 17ms. This finding has a great correlation with the formerly examined works such as Simpson and Ericsdotter (2003); and also consistent enough with the finding on Amharic vowels' durational variance due to gender difference Derib (2011).

Summing up our discussion, the intrinsic and extrinsic duration of vowels between the voiced and voiceless alveolar obstruents are examined. Concerning the intrinsic duration, there is a durational variance both in terms of tongue height and tongue advancement; hence the result shows that the central vowel is longer than the back vowels which, in turn, have the longer duration than the front ones. The result of tongue height also shows there is a durational variation between the high, mid and low vowels. Accordingly the low vowel is longer than the mid vowels which, in turn, have the longer duration than the high vowels.

Regarding the extrinsic duration, the expectation of the hypothesis met regarding the post-fortis vocalic shortening, but pre-fortis clipping is not attested depending on the result, hence the hypothesis failed. About the CVC the results on the voicing effect and the effect of accent status with the hypothesis, again the results match the expectation of the hypothesis. As in many languages acoustically analyzed so far, the findings have also shown that the difference in gender affects the duration of the vowel, thus, Wolaytta Doonaa vowels uttered by females is longer than those of males'. And this result also matches the expectation put in the hypothesis part of this study regarding gender difference and vowel duration.

CHAPTER SIX

CONCLUSION AND FUTURE DIRECTIONS

6.1. Conclusion

The duration of short and long vowels within the phonetic environment of two adjacent alveolar obstruent consonants has been measured by recording the tokens from ten male and ten female subjects. The measurement process targeted the intrinsic and extrinsic durations of the vowels. The intrinsic duration measurements were based on the tongue advancement (i.e. the front-back movement of our tongue) and the tongue height (i.e. the up-down movement of our tongue) while the extrinsic measurements were based on the voicing/voicelessness status of the adjacent consonant and the prevailing accent/supra segmental status within the vowel. In addition to that, the durational variation due to gender difference and accent variation have also been measured.

The results of intrinsic duration show that the durational variation of the vowels due to the tongue advancement and height are significantly varied. Due to the fact that Wolaytta Doonaa vowels intrinsic duration depicts that the low vowels are longer than the mid vowels followed by the high vowels. Even the tongue advancement result depicts this; hence the only central vowel of the language is a low vowel by its tongue height trait.

The extrinsic duration measurement results demonstrate that the duration of vowels can be highly affected when they are between voiced or voiceless CVC environments. In addition to that, the vowels following voiceless obstruents vary in their duration from their equivalents following the voiced obstruents (due to that the post-voiceless vowels have longer duration). Though the durational difference between accented and unaccented short vowels is not attested, the effect of accent becomes visible among the long vowels. Because of this, the accented long vowels have longer duration than their unaccented equivalents in both genders.

The durational measurement result of gender variation shows that women utter longer vowels than men in each and every phonetic environment. The gap between the maximum score of males in short vowels (i.e. 68ms) and the minimum score of females in short vowels (i.e. 62ms) does also portray this. In addition to that, accented vowels attested to have a longer duration than their unaccented counterparts.

6.2. Future Directions

For this research is extremely time and resource-bounded, raising the entire acoustic durational issues within this short time was found to be difficult. Though the intrinsic duration of vowels are adequately seen in terms of their physiological traits, the extrinsic durational traits need experimenting vowels from various phonetic environments apart from the alveolar obstruents. So, in order to raise every phonological impact on vowel duration, it needs to see the impact of the place of articulation on duration in depth.

As it is the first study on experimental phonetics in the language, it is conceived to disclose initial evidence regarding the durational feature of vowels of Wolaytta Doonaa, there are many issues kept unseen. The impact of age and some other physiological variations in terms of vowel duration and the likes are some of the issues which need a rigorous investigation within experimental phonetics in general and acoustic phonetics in particular.

In addition to the duration measurement, analyzing the duration of consonants (so as to know the degree of gemination and lenition), the formant values and the VOT duration of the segments needs a rigorous study.

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APPENDICES

APPENDIX 1: Individual scores, mean values and their standard deviations of accented /a:/

Block/Random	Subject	Duration in Milliseconds					
		aaH/vd_vd	aaH/vd_vl	aaH/vl_vd	aaH/vl_vl	Mean	STDEV
1	Boy1	166	160	146	138	152.5	12.79323
1	Boy2	187	164	169	173	173.25	9.878428
1	Boy3	141	193	155	199	172	28.40188
1	Boy4	176	183	135	168	165.5	21.23676
1	Boy5	159	166	139	158	155.5	11.56143
1	Boy6	221	221	212	240	223.5	11.78983
1	Boy7	192	210	145	164	177.75	28.89492
1	Boy8	213	197	130	159	174.75	37.45553
1	Boy9	175	188	169	174	176.5	8.103497
1	Boy10	135	153	147	153	147	8.485281
1	Girl1	191	212	174	185	190.5	15.96872
1	Girl2	202	175	183	242	200.5	29.89426
1	Girl3	279	243	194	235	237.75	34.88433
1	Girl4	146	204	134	165	162.25	30.61998
1	Girl5	216	225	186	191	204.5	18.9473
1	Girl6	179	179	143	173	168.5	17.23369
1	Girl7	217	172	164	189	185.5	23.44497
1	Girl8	203	194	163	188	187	17.14643
1	Girl9	164	221	171	219	193.75	30.45625
1	Girl10	164	215	173	157	177.25	26.00481
2	Boy1	156	173	146	149	156	12.08305
2	Boy2	144	184	150	151	157.25	18.09926
2	Boy3	132	171	186	211	175	33.07567
2	Boy4	159	189	174	172	173.5	12.28821
2	Boy5	129	175	120	159	145.75	25.65638
2	Boy6	206	230	220	234	222.5	12.47664
2	Boy7	177	161	189	154	170.25	15.77709
2	Boy8	208	195	150	178	182.75	25.05161
2	Boy9	189	175	159	151	168.5	16.92139
2	Boy10	154	180	139	164	159.25	17.23127
2	Girl1	192	195	156	197	185	19.44222
2	Girl2	173	180	189	210	188	16.06238
2	Girl3	202	244	241	226	228.25	19.18984
2	Girl4	162	188	146	188	171	20.68816
2	Girl5	215	221	179	175	197.5	23.85372

2	Girl6	150	201	152	181	171	24.5085
2	Girl7	178	208	178	191	188.75	14.22146
2	Girl8	199	195	168	165	181.75	17.7271
2	Girl9	179	215	194	208	199	15.93738
2	Girl10	145	196	161	156	164.5	22.03785
3	Boy1	149	144	164	163	155	10.03328
3	Boy2	168	211	156	167	175.5	24.28305
3	Boy3	159	205	193	186	185.75	19.4829
3	Boy4	187	212	170	183	188	17.56891
3	Boy5	162	164	153	134	153.25	13.69611
3	Boy6	195	259	202	251	226.75	32.9077
3	Boy7	174	171	158	161	166	7.702813
3	Boy8	172	199	146	139	164	27.313
3	Boy9	205	174	161	177	179.25	18.51801
3	Boy10	149	178	157	183	166.75	16.33758
3	Girl1	223	213	158	205	199.75	28.79091
3	Girl2	205	197	159	194	188.75	20.3695
3	Girl3	208	204	222	225	214.75	10.30776
3	Girl4	176	188	131	165	165	24.53569
3	Girl5	194	233	172	173	193	28.53069
3	Girl6	185	201	163	200	187.25	17.74589
3	Girl7	144	199	132	174	162.25	30.20348
3	Girl8	167	196	175	183	180.25	12.36595
3	Girl9	212	209	198	204	205.75	6.130525
3	Girl10	179	150	154	168	162.75	13.301
	Subject	Duration in Milliseconds					

APPENDIX 2: Individual scores, mean values and their standard deviations of unaccented /a:/

m		aaL/vd_vd	aaL/vd_vl	aaL/vl_vd	aaL/vl_vl	Mean	STDEV
1	Boy1	153	180	138	149	155	17.83255
1	Boy2	157	195	124	148	156	29.49576
1	Boy3	173	139	184	155	162.75	19.83893
1	Boy4	181	141	119	175	154	29.23468
1	Boy5	159	152	150	169	157.5	8.582929
1	Boy6	177	223	160	209	192.25	28.8603
1	Boy7	204	167	150	170	172.75	22.61821
1	Boy8	174	213	195	160	185.5	23.30236
1	Boy9	182	174	142	175	168.25	17.85824
1	Boy10	138	155	174	169	159	16.14517
1	Girl1	164	236	191	162	188.25	34.471
1	Girl2	208	245	200	214	216.75	19.68714
1	Girl3	212	245	241	217	228.75	16.66083
1	Girl4	156	176	126	156	153.5	20.61553
1	Girl5	227	207	192	175	200.25	22.11146
1	Girl6	149	177	172	170	167	12.35584
1	Girl7	225	186	179	184	193.5	21.20535
1	Girl8	145	223	173	175	179	32.37283
1	Girl9	161	220	226	193	200	29.69848
1	Girl10	156	192	173	161	170.5	16.01041
2	Boy1	159	141	153	168	155.25	11.32475
2	Boy2	132	174	146	154	151.5	17.54043
2	Boy3	210	230	164	178	195.5	29.99444
2	Boy4	173	171	163	196	175.75	14.17451
2	Boy5	147	166	145	141	149.75	11.1168
2	Boy6	210	221	202	226	214.75	10.8128
2	Boy7	174	207	167	166	178.5	19.33046
2	Boy8	184	193	196	182	188.75	6.800735
2	Boy9	162	138	167	155	155.5	12.66228
2	Boy10	146	156	151	155	152	4.546061
2	Girl1	194	186	197	193	192.5	4.654747
2	Girl2	190	180	187	180	184.25	5.057997
2	Girl3	194	249	225	232	225	22.99275
2	Girl4	196	185	160	199	185	17.72005
2	Girl5	199	220	184	199	200.5	14.79865
2	Girl6	157	173	183	175	172	10.89342
2	Girl7	175	167	159	169	167.5	6.608076
2	Girl8	159	189	196	193	184.25	17.07581
2	Girl9	232	224	182	205	210.75	22.2617
2	Girl10	170	166	173	185	173.5	8.185353

3	Boy1	162	163	141	165	157.75	11.2361
3	Boy2	128	182	171	182	165.75	25.69533
3	Boy3	158	158	124	173	153.25	20.74247
3	Boy4	184	192	175	165	179	11.63329
3	Boy5	177	166	117	121	145.25	30.68523
3	Boy6	174	227	183	235	204.75	30.70695
3	Boy7	186	174	170	179	177.25	6.898067
3	Boy8	176	175	142	147	160	18.01851
3	Boy9	144	166	186	151	161.75	18.58987
3	Boy10	151	166	125	172	153.5	20.95233
3	Girl1	192	214	166	171	185.75	21.94501
3	Girl2	191	171	157	199	179.5	19.07005
3	Girl3	204	227	202	245	219.5	20.43689
3	Girl4	176	178	151	191	174	16.71327
3	Girl5	194	224	153	178	187.25	29.74755
3	Girl6	154	183	157	171	166.25	13.40087
3	Girl7	172	145	142	183	160.5	20.17424
3	Girl8	156	205	148	164	168.25	25.3558
3	Girl9	178	199	179	231	196.75	24.79751
3	Girl10	170	148	150	149	154.25	10.5317

APPENDIX 3: Individual scores, mean values and their standard deviations of accented /a/

Block/Random	Subject	Duration in Milliseconds					
		aH/vd_vd	aH/vd_vl	aH/vl_vd	aH/vl_vl	Mean	STDEV
1	Boy1	87	77	68	96	82	12.13809
1	Boy2	100	91	79	91	90.25	8.616844
1	Boy3	65	73	56	53	61.75	9.069179
1	Boy4	53	56	53	56	54.5	1.732051
1	Boy5	93	69	80	78	80	9.899495
1	Boy6	78	91	83	77	82.25	6.396614
1	Boy7	69	92	66	80	76.75	11.81454
1	Boy8	73	66	80	56	68.75	10.24288
1	Boy9	83	93	70	68	78.5	11.73314
1	Boy10	53	46	61	54	53.5	6.137318
1	Girl1	100	147	108	107	115.5	21.29945
1	Girl2	96	135	128	125	121	17.18527
1	Girl3	102	122	109	129	115.5	12.23383
1	Girl4	104	106	88	88	96.5	9.848858
1	Girl5	97	119	78	101	98.75	16.82013
1	Girl6	129	100	65	87	95.25	26.73793
1	Girl7	78	106	103	91	94.5	12.76715
1	Girl8	79	96	68	86	82.25	11.78629

1	Girl9	109	96	103	125	108.25	12.36595
1	Girl10	90	73	49	70	70.5	16.8226
2	Boy1	58	102	76	67	75.75	18.98025
2	Boy2	83	98	77	74	83	10.67708
2	Boy3	78	66	65	61	67.5	7.325754
2	Boy4	63	86	51	56	64	15.4704
2	Boy5	73	90	80	103	86.5	13.02562
2	Boy6	95	79	83	88	86.25	6.898067
2	Boy7	85	81	71	71	77	7.118052
2	Boy8	85	70	52	74	70.25	13.72042
2	Boy9	85	76	75	100	84	11.57584
2	Boy10	36	45	57	69	51.75	14.36141
2	Girl1	140	121	108	118	121.75	13.37597
2	Girl2	99	122	111	121	113.25	10.71992
2	Girl3	115	113	122	114	116	4.082483
2	Girl4	91	98	93	103	96.25	5.377422
2	Girl5	105	159	128	114	126.5	23.64318
2	Girl6	82	118	90	108	99.5	16.44182
2	Girl7	91	116	79	79	91.25	17.44276
2	Girl8	84	104	105	86	94.75	11.29528
2	Girl9	104	104	123	134	116.25	14.84082
2	Girl10	71	87	90	71	79.75	10.17759
3	Boy1	87	84	76	67	78.5	8.962886
3	Boy2	96	112	67	80	88.75	19.51709
3	Boy3	64	65	56	62	61.75	4.031129
3	Boy4	77	67	54	83	70.25	12.68529
3	Boy5	83	84	75	65	76.75	8.80814
3	Boy6	80	96	96	80	88	9.237604
3	Boy7	76	82	76	62	74	8.485281
3	Boy8	86	97	72	88	85.75	10.34005
3	Boy9	83	80	74	93	82.5	7.937254
3	Boy10	49	58	68	42	54.25	11.26573
3	Girl1	124	124	79	109	109	21.2132
3	Girl2	110	91	117	115	108.25	11.87083
3	Girl3	94	120	96	112	105.5	12.58306
3	Girl4	71	87	67	79	76	8.869423
3	Girl5	100	103	113	102	104.5	5.802298
3	Girl6	75	134	101	94	101	24.58997
3	Girl7	109	67	74	89	84.75	18.58987
3	Girl8	87	94	58	81	80	15.59915
3	Girl9	96	122	109	92	104.75	13.59841
3	Girl10	98	59	80	82	79.75	16.00781

APPENDIX 4: Individual scores, mean values and their standard deviations of unaccented /a/

Block/Random	Subject	Duration in Milliseconds					
		aL/vd_vd	aL/vd_vl	aL/vl_vd	aL/vl_vl	Mean	STDEV
1	Boy1	84	71	73	79	76.75	5.909033
1	Boy2	87	82	77	78	81	4.546061
1	Boy3	81	64	55	73	68.25	11.2361
1	Boy4	47	76	51	75	62.25	15.3921
1	Boy5	71	84	52	67	68.5	13.17826
1	Boy6	79	83	78	66	76.5	7.325754
1	Boy7	96	77	77	89	84.75	9.394147
1	Boy8	90	70	40	54	63.5	21.50194
1	Boy9	80	63	70	57	67.5	9.882645
1	Boy10	38	39	48	71	49	15.34058
1	Girl1	123	118	87	101	107.25	16.45955
1	Girl2	109	87	114	102	103	11.74734
1	Girl3	82	104	73	105	91	16.02082
1	Girl4	78	98	73	62	77.75	15.06375
1	Girl5	101	84	62	77	81	16.18641
1	Girl6	110	110	63	100	95.75	22.33644
1	Girl7	89	85	76	93	85.75	7.274384
1	Girl8	109	94	82	117	100.5	15.58846
1	Girl9	112	70	89	128	99.75	25.48692
1	Girl10	53	73	43	48	54.25	13.14978
2	Boy1	72	86	66	76	75	8.406347
2	Boy2	88	128	71	56	85.75	31.05238
2	Boy3	79	77	61	73	72.5	8.062258
2	Boy4	63	76	56	56	62.75	9.429563
2	Boy5	75	77	115	62	82.25	22.8236
2	Boy6	86	74	84	78	80.5	5.507571
2	Boy7	66	77	60	70	68.25	7.135592
2	Boy8	57	56	57	63	58.25	3.201562
2	Boy9	73	56	98	67	73.5	17.78576
2	Boy10	45	50	41	54	47.5	5.686241
2	Girl1	94	115	84	89	95.5	13.62596
2	Girl2	103	114	105	125	111.75	10.04573
2	Girl3	103	101	76	119	99.75	17.76467
2	Girl4	87	102	64	93	86.5	16.21727
2	Girl5	106	101	64	90	90.25	18.73277
2	Girl6	84	92	71	114	90.25	18.04393
2	Girl7	76	93	81	92	85.5	8.346656
2	Girl8	68	93	85	104	87.5	15.15476

2	Girl9	92	127	95	129	110.75	19.9729
2	Girl10	83	66	66	66	70.25	8.5
3	Boy1	88	63	74	81	76.5	10.66146
3	Boy2	89	71	71	68	74.75	9.604686
3	Boy3	75	73	62	67	69.25	5.909033
3	Boy4	56	74	68	64	65.5	7.549834
3	Boy5	88	64	75	70	74.25	10.21029
3	Boy6	91	79	72	88	82.5	8.660254
3	Boy7	74	85	74	79	78	5.228129
3	Boy8	79	59	69	53	65	11.43095
3	Boy9	86	77	86	78	81.75	4.924429
3	Boy10	56	46	60	48	52.5	6.608076
3	Girl1	116	118	80	98	103	17.77639
3	Girl2	94	88	96	108	96.5	8.386497
3	Girl3	84	93	76	86	84.75	6.994045
3	Girl4	83	84	81	80	82	1.825742
3	Girl5	131	114	88	98	107.75	18.83923
3	Girl6	66	80	79	90	78.75	9.844626
3	Girl7	79	83	78	71	77.75	4.99166
3	Girl8	93	108	82	79	90.5	13.12758
3	Girl9	94	107	92	100	98.25	6.751543
3	Girl10	78	61	64	81	71	9.966611

APPENDIX 5: Individual scores, mean values and their standard deviations of accented /e:/

Block/Random	Subject	Duration in Milliseconds					
		eeH/vd_vd	eeH/vd_vl	eeH/vl_vd	eeH/vl_vl	Mean	STDEV
1	Boy1	166	164	143	130	150.75	17.30848
1	Boy2	151	139	137	116	135.75	14.5459
1	Boy3	150	189	156	161	164	17.26268
1	Boy4	152	166	155	189	165.5	16.78293
1	Boy5	172	165	125	162	156	21.08712
1	Boy6	183	221	203	158	191.25	27.06012
1	Boy7	150	151	144	166	152.75	9.358597
1	Boy8	146	184	128	168	156.5	24.56963
1	Boy9	174	185	146	174	169.75	16.66083
1	Boy10	131	118	130	169	137	22.13594
1	Girl1	159	223	170	205	189.25	29.84823
1	Girl2	174	177	175	205	182.75	14.88568
1	Girl3	209	266	199	209	220.75	30.53277
1	Girl4	150	152	133	125	140	13.14027

1	Girl5	176	147	159	179	165.25	15.01943
1	Girl6	163	139	176	161	159.75	15.34872
1	Girl7	140	205	142	183	167.5	31.90089
1	Girl8	220	210	159	185	193.5	27.3069
1	Girl9	178	158	183	208	181.75	20.56494
1	Girl10	193	210	184	167	188.5	17.93507
2	Boy1	164	141	129	149	145.75	14.68276
2	Boy2	120	162	142	110	133.5	23.23073
2	Boy3	175	165	137	149	156.5	16.84241
2	Boy4	178	165	147	167	164.25	12.84199
2	Boy5	129	130	136	155	137.5	12.06924
2	Boy6	200	237	194	199	207.5	19.84103
2	Boy7	143	162	151	139	148.75	10.14479
2	Boy8	178	164	140	141	155.75	18.51801
2	Boy9	137	167	145	153	150.5	12.79323
2	Boy10	117	161	107	164	137.25	29.46608
2	Girl1	160	188	184	163	173.75	14.29161
2	Girl2	193	153	156	207	177.25	26.91189
2	Girl3	242	240	218	204	226	18.25742
2	Girl4	176	145	166	149	159	14.53731
2	Girl5	187	169	137	182	168.75	22.48518
2	Girl6	179	166	144	192	170.25	20.46745
2	Girl7	202	145	159	195	175.25	27.5968
2	Girl8	169	187	155	163	168.5	13.60147
2	Girl9	197	167	195	201	190	15.53491
2	Girl10	208	193	135	149	171.25	34.79823
3	Boy1	149	180	159	149	159.25	14.61449
3	Boy2	135	150	146	185	154	21.61789
3	Boy3	166	153	146	170	158.75	11.17661
3	Boy4	196	179	164	198	184.25	15.96611
3	Boy5	155	144	134	154	146.75	9.844626
3	Boy6	229	237	201	231	224.5	16.03122
3	Boy7	155	163	161	175	163.5	8.386497
3	Boy8	146	153	152	143	148.5	4.795832
3	Boy9	176	169	193	149	171.75	18.20943
3	Boy10	118	140	128	184	142.5	29.09181
3	Girl1	156	181	172	195	176	16.35033
3	Girl2	140	185	153	202	170	28.50731
3	Girl3	196	226	201	239	215.5	20.43689
3	Girl4	145	206	170	128	162.25	33.88584
3	Girl5	184	177	192	182	183.75	6.238322

3	Girl6	164	162	174	199	174.75	16.99755
3	Girl7	163	184	132	196	168.75	28.04015
3	Girl8	183	165	169	167	171	8.164966
3	Girl9	199	196	193	186	193.5	5.567764
3	Girl10	183	145	171	141	160	20.29778

APPENDIX 6: Individual scores, mean values and their standard deviations of unaccented /e:/

Block/Random	Subject	Duration in Milliseconds					
		eeL/vd_vd	eeL/vd_vl	eeL/vl_vd	eeL/vl_vl	Mean	STDEV
1	Boy1	137	140	79	102	114.5	29.28595
1	Boy2	137	134	151	80	125.5	31.22499
1	Boy3	149	142	105	153	137.25	21.97537
1	Boy4	145	142	141	100	132	21.40093
1	Boy5	153	163	127	119	140.5	20.87263
1	Boy6	164	170	140	144	154.5	14.73092
1	Boy7	153	138	134	106	132.75	19.61929
1	Boy8	161	151	160	126	149.5	16.29928
1	Boy9	183	167	175	108	158.25	34.13088
1	Boy10	116	116	137	90	114.75	19.24188
1	Girl1	160	169	168	134	157.75	16.33758
1	Girl2	168	143	166	163	160	11.5181
1	Girl3	184	236	198	138	189	40.48045
1	Girl4	131	128	150	93	125.5	23.7557
1	Girl5	142	194	148	140	156	25.56039
1	Girl6	175	160	166	158	164.75	7.632169
1	Girl7	110	152	138	133	133.25	17.46186
1	Girl8	149	197	179	152	169.25	22.89651
1	Girl9	202	170	183	144	174.75	24.34988
1	Girl10	146	183	153	151	158.25	16.76057
2	Boy1	154	132	141	129	139	11.22497
2	Boy2	154	127	139	103	130.75	21.54646
2	Boy3	141	125	129	93	122	20.4939
2	Boy4	149	140	145	109	135.75	18.20943
2	Boy5	139	156	85	99	119.75	33.28037
2	Boy6	180	123	155	153	152.75	23.32917
2	Boy7	111	126	124	103	116	10.92398
2	Boy8	148	149	142	116	138.75	15.47848
2	Boy9	145	132	139	100	129	20.04994
2	Boy10	139	150	131	101	130.25	20.99802
2	Girl1	191	177	133	154	163.75	25.55223

2	Girl2	154	152	193	188	171.75	21.76197
2	Girl3	204	172	201	171	187	17.94436
2	Girl4	174	132	124	107	134.25	28.4766
2	Girl5	180	196	172	159	176.75	15.47848
2	Girl6	161	165	148	149	155.75	8.539126
2	Girl7	143	141	140	137	140.25	2.5
2	Girl8	150	189	151	145	158.75	20.33675
2	Girl9	199	197	175	171	185.5	14.54877
2	Girl10	159	167	143	138	151.75	13.54929
3	Boy1	140	130	138	111	129.75	13.22561
3	Boy2	154	143	119	137	138.25	14.63728
3	Boy3	148	110	131	128	129.25	15.56438
3	Boy4	160	147	126	125	139.5	17.0196
3	Boy5	137	128	132	106	125.75	13.67175
3	Boy6	169	185	194	161	177.25	14.97498
3	Boy7	146	147	125	93	127.75	25.28998
3	Boy8	150	170	132	139	147.75	16.58061
3	Boy9	166	145	154	113	144.5	22.69361
3	Boy10	101	133	140	98	118	21.58703
3	Girl1	182	162	194	137	168.75	24.94494
3	Girl2	170	158	156	130	153.5	16.84241
3	Girl3	166	203	260	193	205.5	39.55165
3	Girl4	121	147	120	129	129.25	12.5
3	Girl5	177	171	152	133	158.25	19.92277
3	Girl6	145	144	166	153	152	10.1653
3	Girl7	151	154	171	135	152.75	14.75071
3	Girl8	173	169	165	137	161	16.32993
3	Girl9	191	192	184	168	183.75	11.08678
3	Girl10	148	176	152	140	154	15.49193

APPENDIX 7: Individual scores, mean values and their standard deviations of accented /e/

Block	Subject	Duration in Milliseconds					
		eH/vd_vd	eH/vd_vl	eH/vl_vd	eH/vl_vl	Mean	STDEV
1	Boy1	70	73	91	78	78	9.273618
1	Boy2	77	107	70	41	73.75	27.09705
1	Boy3	64	50	76	43	58.25	14.70544
1	Boy4	44	56	51	59	52.5	6.557439
1	Boy5	71	73	64	62	67.5	5.322906
1	Boy6	76	77	59	52	66	12.46328
1	Boy7	60	107	70	55	73	23.50886

1	Boy8	66	64	46	36	53	14.46836
1	Boy9	88	56	76	32	63	24.5221
1	Boy10	41	58	67	27	48.25	17.80215
1	Girl1	111	95	65	47	79.5	28.86174
1	Girl2	115	130	104	108	114.25	11.44188
1	Girl3	130	102	126	77	108.75	24.5136
1	Girl4	98	70	84	61	78.25	16.21471
1	Girl5	105	73	68	53	74.75	21.88416
1	Girl6	83	103	86	85	89.25	9.251126
1	Girl7	105	113	85	80	95.75	15.77709
1	Girl8	106	91	99	69	91.25	16.0494
1	Girl9	52	89	92	78	77.75	18.19112
1	Girl10	67	81	50	38	59	18.88562
2	Boy1	94	83	74	57	77	15.64182
2	Boy2	70	78	55	26	57.25	22.91106
2	Boy3	63	52	68	45	57	10.42433
2	Boy4	64	68	62	51	61.25	7.274384
2	Boy5	68	83	56	50	64.25	14.5688
2	Boy6	88	82	85	61	79	12.24745
2	Boy7	75	67	61	65	67	5.887841
2	Boy8	76	63	66	50	63.75	10.71992
2	Boy9	79	105	78	57	79.75	19.65324
2	Boy10	54	55	52	52	53.25	1.5
2	Girl1	85	106	118	121	107.5	16.34013
2	Girl2	91	90	83	96	90	5.354126
2	Girl3	79	106	69	89	85.75	15.77709
2	Girl4	79	79	100	97	88.75	11.32475
2	Girl5	92	107	99	68	91.5	16.8226
2	Girl6	98	97	89	50	83.5	22.69361
2	Girl7	76	105	67	73	80.25	16.91892
2	Girl8	83	100	85	95	90.75	8.098354
2	Girl9	65	101	113	78	89.25	21.73131
2	Girl10	63	60	60	42	56.25	9.604686
3	Boy1	93	69	59	51	68	18.22087
3	Boy2	80	87	64	45	69	18.67262
3	Boy3	126	77	58	42	75.75	36.42687
3	Boy4	72	76	62	55	66.25	9.535023
3	Boy5	77	68	65	50	65	11.22497
3	Boy6	79	85	76	72	78	5.477226
3	Boy7	71	76	59	54	65	10.23067
3	Boy8	99	62	69	73	75.75	16.15292

3	Boy9	83	82	79	64	77	8.831761
3	Boy10	45	65	42	35	46.75	12.86792
3	Girl1	121	127	98	107	113.25	13.1751
3	Girl2	110	77	79	48	78.5	25.33114
3	Girl3	87	85	93	66	82.75	11.67262
3	Girl4	138	84	69	79	92.5	30.96773
3	Girl5	90	107	84	65	86.5	17.33013
3	Girl6	129	109	95	71	101	24.38579
3	Girl7	85	63	70	48	66.5	15.37314
3	Girl8	63	85	83	57	72	14.09492
3	Girl9	146	110	92	85	108.25	27.28095
3	Girl10	77	95	63	47	70.5	20.42058

APPENDIX 8: Individual scores, mean values and their standard deviations of unaccented /e/

Block/Random	Subject	Duration in Milliseconds					
		eL/vd_vd	eL/vd_vl	eL/vl_vd	eL/vl_vl	Mean	STDEV
1	Boy1	69	90	73	70	75.5	9.814955
1	Boy2	76	78	73	35	65.5	20.43689
1	Boy3	66	55	61	47	57.25	8.180261
1	Boy4	56	58	51	23	47	16.26858
1	Boy5	67	91	65	68	72.75	12.23043
1	Boy6	71	67	66	74	69.5	3.696846
1	Boy7	99	71	64	67	75.25	16.09089
1	Boy8	58	72	66	37	58.25	15.28343
1	Boy9	93	85	73	77	82	8.869423
1	Boy10	41	59	44	53	49.25	8.261356
1	Girl1	84	98	101	87	92.5	8.266398
1	Girl2	115	113	115	87	107.5	13.69915
1	Girl3	87	88	101	51	81.75	21.46897
1	Girl4	78	71	69	50	67	11.97219
1	Girl5	98	89	63	45	73.75	24.24012
1	Girl6	70	74	60	85	72.25	10.34005
1	Girl7	91	108	92	94	96.25	7.932003
1	Girl8	83	124	82	82	92.75	20.83867
1	Girl9	79	106	106	99	97.5	12.76715
1	Girl10	58	39	68	70	58.75	14.17451
2	Boy1	93	90	59	68	77.5	16.62328
2	Boy2	70	62	64	32	57	17.0098
2	Boy3	53	47	44	56	50	5.477226
2	Boy4	61	57	53	47	54.5	5.972158

2	Boy5	72	50	73	74	67.25	11.52895
2	Boy6	98	71	82	60	77.75	16.21471
2	Boy7	72	80	56	55	65.75	12.28481
2	Boy8	45	78	54	55	58	14.07125
2	Boy9	88	76	75	42	70.25	19.73787
2	Boy10	45	66	63	37	52.75	14.00893
2	Girl1	138	77	85	88	97	27.72484
2	Girl2	91	82	117	92	95.5	15.02221
2	Girl3	99	104	79	66	87	17.68238
2	Girl4	59	64	66	65	63.5	3.109126
2	Girl5	114	104	95	55	92	25.85859
2	Girl6	94	96	74	57	80.25	18.40969
2	Girl7	106	97	81	89	93.25	10.71992
2	Girl8	109	110	65	67	87.75	25.13132
2	Girl9	106	129	98	83	104	19.20069
2	Girl10	80	54	39	43	54	18.45716
3	Boy1	68	90	78	65	75.25	11.29528
3	Boy2	67	77	67	42	63.25	14.93039
3	Boy3	64	57	46	46	53.25	8.845903
3	Boy4	46	58	69	53	56.5	9.678154
3	Boy5	63	89	62	80	73.5	13.22876
3	Boy6	51	73	62	54	60	9.831921
3	Boy7	81	79	58	47	66.25	16.52019
3	Boy8	63	56	50	52	55.25	5.737305
3	Boy9	85	62	75	66	72	10.23067
3	Boy10	58	62	48	47	53.75	7.410578
3	Girl1	130	134	110	110	121	12.80625
3	Girl2	104	95	134	86	104.75	20.83867
3	Girl3	82	72	81	53	72	13.44123
3	Girl4	66	73	90	62	72.75	12.36595
3	Girl5	100	84	101	77	90.5	11.90238
3	Girl6	92	80	75	56	75.75	14.97498
3	Girl7	83	83	104	52	80.5	21.42429
3	Girl8	94	98	85	65	85.5	14.70827
3	Girl9	102	101	98	97	99.5	2.380476
3	Girl10	55	72	74	57	64.5	9.882645

APPENDIX 9: Individual scores, mean values and their standard deviations of accented /i/

Block/Random	Subject	Duration in Milliseconds					
		iH/vd_vd	iH/vd_vl	iH/vl_vd	iH/vl_vl	Mean	STDEV
1	Boy1	67	56	44	63	57.5	10.08299
1	Boy2	57	63	45	37	50.5	11.7047
1	Boy3	61	74	63	47	61.25	11.08678
1	Boy4	45	47	57	32	45.25	10.27538
1	Boy5	91	79	63	96	82.25	14.68276
1	Boy6	74	63	50	49	59	11.8603
1	Boy7	63	50	35	59	51.75	12.41974
1	Boy8	80	78	49	40	61.75	20.27108
1	Boy9	95	75	74	74	79.5	10.34408
1	Boy10	60	61	62	47	57.5	7.047458
1	Girl1	96	74	90	88	87	9.309493
1	Girl2	113	89	75	90	91.75	15.73478
1	Girl3	105	56	97	70	82	22.9056
1	Girl4	83	75	79	52	72.25	13.88944
1	Girl5	85	90	62	65	75.5	14.0594
1	Girl6	81	80	59	50	67.5	15.45962
1	Girl7	86	73	62	64	71.25	10.93542
1	Girl8	95	69	77	40	70.25	22.91106
1	Girl9	99	86	79	60	81	16.26858
1	Girl10	43	59	60	56	54.5	7.852813
2	Boy1	60	66	67	73	66.5	5.322906
2	Boy2	51	66	39	41	49.25	12.33896
2	Boy3	59	74	58	45	59	11.8603
2	Boy4	66	46	52	44	52	9.93311
2	Boy5	59	58	39	45	50.25	9.844626
2	Boy6	74	60	66	52	63	9.309493
2	Boy7	52	61	43	44	50	8.3666
2	Boy8	74	83	65	40	65.5	18.52026
2	Boy9	55	72	67	74	67	8.524475
2	Boy10	49	53	66	77	61.25	12.76388
2	Girl1	95	105	99	76	93.75	12.52664
2	Girl2	84	103	97	87	92.75	8.80814
2	Girl3	98	96	89	67	87.5	14.20094
2	Girl4	54	63	54	77	62	10.86278
2	Girl5	73	107	72	71	80.75	17.51904
2	Girl6	109	92	77	69	86.75	17.63283
2	Girl7	78	65	63	54	65	9.899495
2	Girl8	58	84	72	80	73.5	11.47461

2	Girl9	79	115	102	59	88.75	24.79751
2	Girl10	67	56	56	41	55	10.67708
3	Boy1	64	55	55	43	54.25	8.616844
3	Boy2	62	76	48	41	56.75	15.52149
3	Boy3	68	56	57	37	54.5	12.87116
3	Boy4	77	48	55	39	54.75	16.21471
3	Boy5	72	72	63	49	64	10.86278
3	Boy6	84	75	52	53	66	16.02082
3	Boy7	54	57	46	51	52	4.690416
3	Boy8	71	66	47	47	57.75	12.57975
3	Boy9	67	59	80	55	65.25	11.02648
3	Boy10	53	70	50	43	54	11.46008
3	Girl1	126	111	80	74	97.75	24.85122
3	Girl2	92	84	56	72	76	15.66312
3	Girl3	77	80	98	68	80.75	12.57975
3	Girl4	71	88	62	72	73.25	10.8128
3	Girl5	110	82	77	56	81.25	22.23173
3	Girl6	83	69	95	57	76	16.5328
3	Girl7	82	79	58	52	67.75	14.97498
3	Girl8	75	59	52	52	59.5	10.84743
3	Girl9	111	89	69	63	83	21.72556
3	Girl10	67	75	40	58	60	15.0333

APPENDIX 10: Individual scores, mean values and their standard deviations of accented /i:/

Block/Random	Subject	Duration in Milliseconds					
		iiH/vd_vd	iiH/vd_vl	iiH/vl_vd	iiH/vl_vl	Mean	STDEV
1	Boy1	130	156	116	140	135.5	16.84241
1	Boy2	102	156	117	135	127.5	23.30236
1	Boy3	124	183	179	174	165	27.58019
1	Boy4	132	149	119	147	136.75	14.05643
1	Boy5	128	154	144	136	140.5	11.12055
1	Boy6	126	150	112	119	126.75	16.52019
1	Boy7	146	145	114	124	132.25	15.84035
1	Boy8	150	132	113	145	135	16.51262
1	Boy9	139	175	158	146	154.5	15.7586
1	Boy10	127	142	98	130	124.25	18.66146
1	Girl1	155	191	135	133	153.5	26.90105
1	Girl2	174	207	182	165	182	18.05547
1	Girl3	184	247	168	204	200.75	34.16992
1	Girl4	153	153	122	126	138.5	16.8226

1	Girl5	141	185	157	192	168.75	23.89386
1	Girl6	149	136	125	122	133	12.24745
1	Girl7	177	163	103	124	141.75	34.20892
1	Girl8	193	200	154	181	182	20.24846
1	Girl9	168	200	149	153	167.5	23.15887
1	Girl10	174	147	147	186	163.5	19.67232
2	Boy1	132	148	128	120	132	11.77568
2	Boy2	150	136	111	152	137.25	18.89224
2	Boy3	99	144	141	159	135.75	25.73422
2	Boy4	138	167	123	137	141.25	18.48197
2	Boy5	143	134	111	102	122.5	19.19201
2	Boy6	132	134	100	138	126	17.5119
2	Boy7	128	173	127	131	139.75	22.23173
2	Boy8	155	121	111	128	128.75	18.83923
2	Boy9	134	152	156	121	140.75	16.27626
2	Boy10	142	133	123	119	129.25	10.34005
2	Girl1	181	160	146	139	156.5	18.52026
2	Girl2	131	153	136	147	141.75	10.04573
2	Girl3	194	217	163	184	189.5	22.42766
2	Girl4	137	143	124	143	136.75	8.958236
2	Girl5	164	142	173	171	162.5	14.20094
2	Girl6	121	148	158	118	136.25	19.8053
2	Girl7	172	131	122	117	135.5	25.01333
2	Girl8	180	185	161	153	169.75	15.21786
2	Girl9	185	182	167	165	174.75	10.21029
2	Girl10	118	125	160	109	128	22.31591
3	Boy1	130	134	123	131	129.5	4.654747
3	Boy2	119	149	158	133	139.75	17.26992
3	Boy3	117	177	133	57	121	49.63869
3	Boy4	143	166	149	144	150.5	10.66146
3	Boy5	128	137	110	122	124.25	11.32475
3	Boy6	157	170	148	125	150	18.95609
3	Boy7	140	170	124	115	137.25	24.15747
3	Boy8	143	124	130	103	125	16.67333
3	Boy9	125	159	147	155	146.5	15.17674
3	Boy10	149	139	158	123	142.25	14.99722
3	Girl1	154	146	154	159	153.25	5.377422
3	Girl2	157	141	138	129	141.25	11.67262
3	Girl3	185	190	182	177	183.5	5.446712
3	Girl4	148	128	141	133	137.5	8.812869
3	Girl5	157	195	178	179	177.25	15.58578

3	Girl6	131	139	133	116	129.75	9.776673
3	Girl7	155	130	130	127	135.5	13.0767
3	Girl8	161	157	136	134	147	13.97617
3	Girl9	155	154	175	158	160.5	9.814955
3	Girl10	147	155	138	127	141.75	12.03813

APPENDIX 11: Individual scores, mean values and their standard deviations of unaccented /i:/

Block/Random	Subject	Duration in Milliseconds					
		iiL/vd_vd	iiL/vd_vl	iiL/vl_vd	iiL/vl_vl	Mean	STDEV
1	Boy1	133	135	106	125	124.75	13.22561
1	Boy2	110	176	141	107	86.13842	32.23352
1	Boy3	152	109	123	96	90.43233	24.01388
1	Boy4	126	149	130	121	83.18918	12.23383
1	Boy5	112	134	117	119	91.90545	9.469248
1	Boy6	111	117	153	109	93.49174	20.61553
1	Boy7	133	158	116	124	89.88975	18.20943
1	Boy8	116	136	129	122	87.46573	8.655441
1	Boy9	132	162	125	146	99.15559	16.35797
1	Boy10	129	128	130	101	75.54867	14.02379
1	Girl1	160	159	107	144	109.7877	24.7723
1	Girl2	152	140	122	162	117.3244	17.20465
1	Girl3	185	166	176	207	125.5246	17.48333
1	Girl4	142	141	94	135	89.61032	22.87648
1	Girl5	167	158	139	168	102.7808	13.44123
1	Girl6	115	128	121	129	98.35377	6.551081
1	Girl7	145	111	99	117	99.12514	19.49359
1	Girl8	153	163	126	149	113.8542	15.64981
1	Girl9	147	146	176	145	112.1047	15.02221
1	Girl10	169	130	133	138	94.62043	17.9722
2	Boy1	117	131	120	136	126	8.981462
2	Boy2	129	126	126	156	134.25	14.5688
2	Boy3	127	158	88	105	119.5	30.22692
2	Boy4	121	158	122	133	133.5	17.21434
2	Boy5	78	142	81	130	107.75	33.00884
2	Boy6	133	110	156	179	144.5	29.69287
2	Boy7	147	166	120	112	136.25	24.85122
2	Boy8	130	150	144	112	134	16.89181
2	Boy9	124	121	111	149	126.25	16.15292
2	Boy10	109	133	107	109	114.5	12.36932
2	Girl1	150	136	118	140	136	13.36663

2	Girl2	159	144	90	150	135.75	31.11672
2	Girl3	191	169	174	173	176.75	9.742518
2	Girl4	132	145	92	136	126.25	23.47161
2	Girl5	188	186	135	154	165.75	25.74717
2	Girl6	120	159	143	122	136	18.52926
2	Girl7	140	108	117	129	123.5	13.96424
2	Girl8	145	163	125	129	140.5	17.31088
2	Girl9	154	173	168	153	162	10.03328
2	Girl10	137	112	108	160	129.25	24.18505
3	Boy1	132	153	107	128	130	18.85029
3	Boy2	170	115	157	115	139.25	28.5
3	Boy3	146	182	115	110	138.25	33.23026
3	Boy4	134	167	132	116	137.25	21.40677
3	Boy5	71	118	83	70	85.5	22.45737
3	Boy6	117	172	148	127	141	24.37212
3	Boy7	152	149	130	161	148	13.0384
3	Boy8	146	130	143	130	137.25	8.460693
3	Boy9	140	139	125	122	131.5	9.327379
3	Boy10	136	120	93	132	120.25	19.39716
3	Girl1	157	161	153	130	150.25	13.88944
3	Girl2	127	116	104	134	120.25	13.1244
3	Girl3	176	166	177	158	169.25	8.995369
3	Girl4	139	180	92	130	135.25	36.12363
3	Girl5	143	163	137	178	155.25	18.80381
3	Girl6	146	152	144	110	138	18.97367
3	Girl7	140	134	140	113	131.75	12.81601
3	Girl8	148	161	141	138	147	10.23067
3	Girl9	141	149	181	136	151.75	20.22169
3	Girl10	104	139	116	135	123.5	16.42153

APPENDIX 12: Individual scores, mean values and their standard deviations of unaccented /i/

Block/Random	Subject	Duration in Milliseconds					
		iL/vd_vd	iL/vd_vl	iL/vl_vd	iL/vl_vl	Mean	STDEV
1	Boy1	80	64	55	45	61	14.85485
1	Boy2	76	52	48	32	52	18.18424
1	Boy3	48	54	48	39	47.25	6.184658
1	Boy4	43	40	34	43	40	4.242641
1	Boy5	60	44	44	42	47.5	8.386497
1	Boy6	67	54	43	40	51	12.24745
1	Boy7	64	55	51	56	56.5	5.446712

1	Boy8	52	53	52	64	55.25	5.85235
1	Boy9	65	65	48	63	60.25	8.220908
1	Boy10	54	49	48	44	48.75	4.112988
1	Girl1	88	98	86	68	85	12.49
1	Girl2	98	117	95	81	97.75	14.81834
1	Girl3	90	99	95	87	92.75	5.315073
1	Girl4	60	61	51	46	54.5	7.234178
1	Girl5	62	102	54	77	73.75	21.10884
1	Girl6	82	95	49	51	69.25	22.86737
1	Girl7	96	72	76	58	75.5	15.69501
1	Girl8	82	93	81	84	85	5.477226
1	Girl9	66	86	75	67	73.5	9.255629
1	Girl10	41	59	48	37	46.25	9.639329
2	Boy1	68	55	51	55	57.25	7.410578
2	Boy2	63	41	69	45	54.5	13.60147
2	Boy3	55	59	41	51	51.5	7.72442
2	Boy4	42	43	37	51	43.25	5.795113
2	Boy5	31	49	37	41	39.5	7.549834
2	Boy6	58	51	57	56	55.5	3.109126
2	Boy7	62	46	54	59	55.25	6.994045
2	Boy8	78	76	66	62	70.5	7.72442
2	Boy9	38	56	32	61	46.75	13.93736
2	Boy10	52	70	35	53	52.5	14.29452
2	Girl1	101	83	67	59	77.5	18.57418
2	Girl2	108	105	54	83	87.5	24.95997
2	Girl3	85	80	61	55	70.25	14.5
2	Girl4	37	64	67	96	66	24.12468
2	Girl5	62	109	61	101	83.25	25.3295
2	Girl6	77	92	54	58	70.25	17.63283
2	Girl7	68	85	73	58	71	11.22497
2	Girl8	51	92	62	78	70.75	17.98842
2	Girl9	79	70	75	59	70.75	8.655441
2	Girl10	65	46	51	49	52.75	8.421203
3	Boy1	61	61	68	43	58.25	10.68878
3	Boy2	68	76	58	29	57.75	20.53249
3	Boy3	52	54	37	49	48	7.615773
3	Boy4	40	45	41	32	39.5	5.446712
3	Boy5	51	31	56	27	41.25	14.3846
3	Boy6	36	69	51	44	50	14.07125
3	Boy7	48	66	47	40	50.25	11.08678
3	Boy8	67	70	55	39	57.75	14.08013

3	Boy9	37	78	66	82	65.75	20.33675
3	Boy10	65	51	47	51	53.5	7.895146
3	Girl1	82	153	87	79	100.25	35.32115
3	Girl2	69	69	90	80	77	10.0995
3	Girl3	77	63	69	63	68	6.63325
3	Girl4	59	77	59	67	65.5	8.544004
3	Girl5	94	64	66	52	69	17.77639
3	Girl6	105	90	73	78	86.5	14.24781
3	Girl7	79	96	67	51	73.25	19.01534
3	Girl8	76	66	60	45	61.75	12.97112
3	Girl9	87	85	58	66	74	14.2595
3	Girl10	52	69	34	49	51	14.3527

APPENDIX 13: Individual scores, mean values and their standard deviations of accented /o/

Block/Random	Subject	Duration in Milliseconds					
		oH/vd_vd	oH/vd_vl	oH/vl_vd	oH/vl_vl	Mean	STDEV
1	Boy1	94	97	83	68	85.5	13.12758
1	Boy2	92	89	76	76	83.25	8.460693
1	Boy3	58	74	56	46	58.5	11.59023
1	Boy4	52	53	62	62	57.25	5.5
1	Boy5	69	66	64	68	66.75	2.217356
1	Boy6	52	84	67	70	68.25	13.1244
1	Boy7	67	72	76	78	73.25	4.856267
1	Boy8	50	60	70	89	67.25	16.64081
1	Boy9	61	50	64	56	57.75	6.130525
1	Boy10	47	48	56	52	50.75	4.112988
1	Girl1	100	75	76	112	90.75	18.28251
1	Girl2	145	103	95	76	104.75	29.12473
1	Girl3	92	105	94	87	94.5	7.593857
1	Girl4	93	73	89	85	85	8.640988
1	Girl5	76	80	68	116	85	21.26029
1	Girl6	81	83	73	79	79	4.320494
1	Girl7	102	84	94	79	89.75	10.27538
1	Girl8	124	139	86	93	110.5	25.17274
1	Girl9	110	116	111	90	106.75	11.47098
1	Girl10	88	73	71	72	76	8.041559
2	Boy1	73	73	62	66	68.5	5.446712
2	Boy2	85	87	66	78	79	9.486833
2	Boy3	66	54	61	63	61	5.09902
2	Boy4	53	64	65	75	64.25	8.995369

2	Boy5	66	71	66	58	65.25	5.377422
2	Boy6	64	73	83	89	77.25	11.02648
2	Boy7	69	75	63	61	67	6.324555
2	Boy8	73	59	78	63	68.25	8.770215
2	Boy9	62	59	58	79	64.5	9.814955
2	Boy10	45	56	61	59	55.25	7.135592
2	Girl1	96	94	108	129	106.75	16.07016
2	Girl2	112	100	112	119	110.75	7.889867
2	Girl3	89	67	91	100	86.75	14.00893
2	Girl4	75	60	91	90	79	14.62874
2	Girl5	94	85	80	76	83.75	7.762087
2	Girl6	93	106	86	83	92	10.23067
2	Girl7	79	131	96	108	103.5	21.85559
2	Girl8	83	91	93	94	90.25	4.99166
2	Girl9	62	120	122	103	101.75	27.83733
2	Girl10	84	93	58	96	82.75	17.26992
3	Boy1	77	83	70	60	72.5	9.882645
3	Boy2	83	79	80	81	80.75	1.707825
3	Boy3	85	58	61	60	66	12.72792
3	Boy4	51	69	65	62	61.75	7.719024
3	Boy5	58	48	68	67	60.25	9.322911
3	Boy6	68	70	76	69	70.75	3.593976
3	Boy7	57	74	65	81	69.25	10.46821
3	Boy8	73	62	54	77	66.5	10.47219
3	Boy9	72	69	90	71	75.5	9.746794
3	Boy10	59	54	60	69	60.5	6.244998
3	Girl1	112	113	87	89	100.25	14.17451
3	Girl2	112	61	80	102	88.75	22.8236
3	Girl3	101	54	76	86	79.25	19.72097
3	Girl4	95	94	103	84	94	7.788881
3	Girl5	112	80	112	100	101	15.09967
3	Girl6	107	105	82	101	98.75	11.44188
3	Girl7	88	117	62	76	85.75	23.38625
3	Girl8	72	92	81	95	85	10.55146
3	Girl9	105	115	114	108	110.5	4.795832
3	Girl10	84	59	76	67	71.5	10.84743

APPENDIX 14: Individual scores, mean values and their standard deviations of unaccented /o/

Block/Random	Subject	Duration in Milliseconds					
		oL/vd_vd	oL/vd_vl	oL/vl_vd	oL/vl_vl	Mean	STDEV
1	Boy1	72	78	71	73	73.5	3.109126
1	Boy2	74	71	70	59	68.5	6.557439
1	Boy3	70	48	46	60	56	11.19524
1	Boy4	52	61	38	37	47	11.57584
1	Boy5	53	63	98	54	67	21.15026
1	Boy6	71	59	60	75	66.25	7.973916
1	Boy7	71	68	56	65	65	6.480741
1	Boy8	47	60	37	42	46.5	9.882645
1	Boy9	81	87	74	49	72.75	16.7008
1	Boy10	57	57	50	48	53	4.690416
1	Girl1	89	83	82	104	89.5	10.14889
1	Girl2	124	124	114	119	120.25	4.787136
1	Girl3	98	53	87	87	81.25	19.53416
1	Girl4	72	85	74	99	82.5	12.39624
1	Girl5	104	92	89	113	99.5	11.09054
1	Girl6	67	101	91	96	88.75	15.06375
1	Girl7	68	116	58	106	87	28.30783
1	Girl8	76	114	98	111	99.75	17.28921
1	Girl9	110	122	88	75	98.75	21.18765
1	Girl10	72	68	55	62	64.25	7.410578
2	Boy1	67	71	69	68	68.75	1.707825
2	Boy2	81	71	47	65	66	14.28286
2	Boy3	76	69	75	48	67	13.0384
2	Boy4	61	62	48	65	59	7.527727
2	Boy5	93	58	47	61	64.75	19.77161
2	Boy6	63	81	53	61	64.5	11.81807
2	Boy7	85	70	46	62	65.75	16.25577
2	Boy8	68	64	40	68	60	13.46601
2	Boy9	80	89	59	75	75.75	12.57975
2	Boy10	61	51	47	59	54.5	6.608076
2	Girl1	88	140	106	115	112.25	21.63909
2	Girl2	109	112	104	111	109	3.559026
2	Girl3	61	106	84	67	79.5	20.17424
2	Girl4	86	59	93	71	77.25	15.23975
2	Girl5	129	101	75	76	95.25	25.51307
2	Girl6	88	87	89	105	92.25	8.539126
2	Girl7	103	119	67	79	92	23.4094
2	Girl8	95	94	65	83	84.25	13.93736

2	Girl9	110	102	97	121	107.5	10.47219
2	Girl10	64	71	52	70	64.25	8.732125
3	Boy1	76	84	61	64	71.25	10.68878
3	Boy2	75	92	77	74	79.5	8.42615
3	Boy3	60	57	49	58	56	4.830459
3	Boy4	72	55	47	75	62.25	13.45053
3	Boy5	61	65	67	65	64.5	2.516611
3	Boy6	58	71	41	61	57.75	12.4733
3	Boy7	86	80	56	67	72.25	13.42572
3	Boy8	58	67	60	49	58.5	7.416198
3	Boy9	67	73	76	72	72	3.741657
3	Boy10	65	59	56	48	57	7.071068
3	Girl1	116	137	112	125	122.5	11.09054
3	Girl2	62	88	69	96	78.75	15.90335
3	Girl3	72	77	59	85	73.25	10.90489
3	Girl4	77	93	65	93	82	13.61372
3	Girl5	93	95	86	79	88.25	7.274384
3	Girl6	92	114	40	74	80	31.28365
3	Girl7	59	78	78	63	69.5	9.949874
3	Girl8	90	78	80	86	83.5	5.507571
3	Girl9	81	130	82	114	101.75	24.28134
3	Girl10	72	80	48	64	66	13.6626

APPENDIX 15: Individual scores, mean values and their standard deviations of accented /o:/

Block/Random	Subject	Duration in Milliseconds					
		ooH/vd_vd	ooH/vd_vl	ooH/vl_vd	ooH/vl_vl	Mean	STDEV
1	Boy1	182	167	148	166	165.75	13.91342
1	Boy2	187	186	153	122	162	30.99462
1	Boy3	153	206	169	164	173	22.99275
1	Boy4	167	174	163	175	169.75	5.737305
1	Boy5	175	147	185	140	161.75	21.65448
1	Boy6	186	201	211	216	203.5	13.22876
1	Boy7	157	151	139	173	155	14.14214
1	Boy8	205	193	192	181	192.75	9.810708
1	Boy9	171	185	149	170	168.75	14.84082
1	Boy10	170	185	162	157	168.5	12.23383
1	Girl1	199	112	157	186	163.5	38.56164
1	Girl2	216	199	180	206	200.25	15.19594
1	Girl3	236	220	265	224	236.25	20.33675
1	Girl4	177	169	157	180	170.75	10.27538

1	Girl5	195	218	180	173	191.5	19.90812
1	Girl6	182	193	229	140	186	36.65151
1	Girl7	161	220	198	188	191.75	24.47277
1	Girl8	220	203	199	186	202	14.02379
1	Girl9	197	200	185	197	194.75	6.652067
1	Girl10	194	204	181	187	191.5	9.882645
2	Boy1	166	187	153	152	164.5	16.29928
2	Boy2	172	179	170	148	167.25	13.40087
2	Boy3	154	215	196	200	191.25	26.14543
2	Boy4	188	185	145	185	175.75	20.54872
2	Boy5	154	154	125	116	137.25	19.68714
2	Boy6	162	198	199	217	194	23.05067
2	Boy7	161	178	142	137	154.5	18.77054
2	Boy8	193	201	191	176	190.25	10.43631
2	Boy9	178	121	159	145	150.75	24.00521
2	Boy10	166	156	143	168	158.25	11.44188
2	Girl1	208	191	180	168	186.75	16.99755
2	Girl2	183	205	184	228	200	21.24461
2	Girl3	222	210	251	225	227	17.26268
2	Girl4	175	156	163	157	162.75	8.732125
2	Girl5	192	204	183	172	187.75	13.57387
2	Girl6	172	195	190	196	188.25	11.14675
2	Girl7	166	189	178	168	175.25	10.5633
2	Girl8	202	186	152	189	182.25	21.32878
2	Girl9	207	227	235	192	215.25	19.46578
2	Girl10	147	181	176	172	169	15.12173
3	Boy1	173	160	175	155	165.75	9.776673
3	Boy2	162	155	157	159	158.25	2.986079
3	Boy3	156	178	199	181	178.5	17.63519
3	Boy4	183	169	187	166	176.25	10.30776
3	Boy5	155	135	168	121	144.75	20.85466
3	Boy6	177	233	181	209	200	26.20433
3	Boy7	170	146	148	169	158.25	13.02242
3	Boy8	167	216	151	179	178.25	27.65713
3	Boy9	166	155	173	168	165.5	7.593857
3	Boy10	171	142	188	155	164	19.91649
3	Girl1	174	213	154	195	184	25.57342
3	Girl2	157	190	196	181	181	17.14643
3	Girl3	194	237	204	194	207.25	20.38586
3	Girl4	161	155	165	181	165.5	11.12055
3	Girl5	204	204	189	157	188.5	22.15852

3	Girl6	157	178	187	180	175.5	12.92285
3	Girl7	160	184	156	189	172.25	16.66083
3	Girl8	214	191	181	183	192.25	15.12999
3	Girl9	192	229	203	230	213.5	19.01754
3	Girl10	155	171	142	163	157.75	12.36595

APPENDIX 16: Individual scores, mean values and their standard deviations of unaccented /o:/

Block/Random	Subject	Duration in Milliseconds					
		ooL/vd_vd	ooL/vd_vl	ooL/vl_vd	ooL/vl_vl	Mean	STDEV
1	Boy1	194	167	168	137	166.5	23.30236
1	Boy2	148	161	205	144	164.5	27.9583
1	Boy3	176	164	132	149	155.25	19.03287
1	Boy4	159	161	138	160	154.5	11.03026
1	Boy5	150	170	137	145	150.5	14.0594
1	Boy6	163	217	124	181	171.25	38.68139
1	Boy7	172	213	129	192	176.5	35.81899
1	Boy8	162	181	148	152	160.75	14.72809
1	Boy9	151	178	117	132	144.5	26.31223
1	Boy10	157	183	131	150	155.25	21.5155
1	Girl1	163	232	162	172	182.25	33.47014
1	Girl2	167	189	177	191	181	11.19524
1	Girl3	257	218	154	244	218.25	45.79938
1	Girl4	140	169	156	136	150.25	15.19594
1	Girl5	195	162	131	166	163.5	26.18524
1	Girl6	139	195	153	156	160.75	24.00521
1	Girl7	154	212	149	138	163.25	33.18006
1	Girl8	179	235	133	181	182	41.71331
1	Girl9	215	203	183	196	199.25	13.37597
1	Girl10	183	188	110	167	162	35.80503
2	Boy1	183	163	135	139	155	22.39047
2	Boy2	166	184	178	147	168.75	16.31717
2	Boy3	134	208	110	144	149	41.84097
2	Boy4	162	176	136	162	159	16.69331
2	Boy5	134	182	115	109	135	33.09582
2	Boy6	149	208	128	186	167.75	35.98495
2	Boy7	155	175	111	159	150	27.3983
2	Boy8	154	168	114	180	154	28.7054
2	Boy9	133	147	96	126	125.5	21.51743
2	Boy10	127	170	124	163	146	23.87467
2	Girl1	173	208	129	161	167.75	32.63306

2	Girl2	147	198	126	190	165.25	34.44198
2	Girl3	216	216	159	209	200	27.5318
2	Girl4	143	195	132	165	158.75	27.78939
2	Girl5	202	180	132	184	174.5	29.90541
2	Girl6	164	187	160	164	168.75	12.31192
2	Girl7	136	175	154	170	158.75	17.61391
2	Girl8	178	197	144	162	170.25	22.60347
2	Girl9	185	225	182	207	199.75	20.18869
2	Girl10	128	159	111	120	129.5	20.85665
3	Boy1	176	172	125	173	161.5	24.39262
3	Boy2	173	150	145	157	156.25	12.20314
3	Boy3	114	201	121	159	148.75	40.05309
3	Boy4	159	187	126	186	164.5	28.75761
3	Boy5	135	156	110	118	129.75	20.3695
3	Boy6	153	175	140	178	161.5	18.15673
3	Boy7	155	157	111	152	143.75	21.92981
3	Boy8	156	185	134	183	164.5	24.25558
3	Boy9	140	153	127	153	143.25	12.44655
3	Boy10	140	167	132	197	159	29.42788
3	Girl1	154	204	164	167	172.25	21.88416
3	Girl2	157	188	117	173	158.75	30.57641
3	Girl3	253	245	152	200	212.5	46.59399
3	Girl4	156	199	168	181	176	18.421
3	Girl5	192	164	138	157	162.75	22.38117
3	Girl6	145	168	138	152	150.75	12.84199
3	Girl7	128	161	149	169	151.75	17.83956
3	Girl8	129	209	117	186	160.25	44.29729
3	Girl9	201	199	186	197	195.75	6.70199
3	Girl10	115	151	118	137	130.25	16.91892

APPENDIX 17: Individual scores, mean values and their standard deviations of accented /u/

Block/Random	Subject	Duration in Milliseconds					
		uH/vd_vd	uH/vd_vl	uH/vl_vd	uH/vl_vl	Mean	STDEV
1	Boy1	83	95	37	29	61	32.86335
1	Boy2	75	59	47	54	58.75	11.89888
1	Boy3	64	86	50	40	60	19.93322
1	Boy4	95	69	51	58	68.25	19.31105
1	Boy5	48	66	40	45	49.75	11.32475
1	Boy6	64	66	60	39	57.25	12.41974
1	Boy7	69	73	41	59	60.5	14.27118

1	Boy8	69	59	38	50	54	13.19091
1	Boy9	79	50	57	75	65.25	13.96126
1	Boy10	59	59	43	39	50	10.51982
1	Girl1	100	81	65	123	92.25	24.99833
1	Girl2	74	107	80	118	94.75	21.12463
1	Girl3	124	111	92	95	105.5	14.88847
1	Girl4	83	96	77	73	82.25	10.04573
1	Girl5	96	73	53	50	68	21.27596
1	Girl6	92	91	33	51	66.75	29.5113
1	Girl7	100	96	65	59	80	20.99206
1	Girl8	84	106	72	98	90	15.05545
1	Girl9	115	69	70	75	82.25	21.99053
1	Girl10	68	73	49	50	60	12.30176
2	Boy1	73	82	51	48	63.5	16.62328
2	Boy2	62	60	54	46	55.5	7.187953
2	Boy3	67	44	72	45	57	14.5831
2	Boy4	56	63	52	52	55.75	5.188127
2	Boy5	84	72	55	47	64.5	16.66333
2	Boy6	66	63	47	44	55	11.10555
2	Boy7	81	79	45	59	66	17.16586
2	Boy8	90	69	73	47	69.75	17.68945
2	Boy9	69	65	60	62	64	3.91578
2	Boy10	54	74	36	51	53.75	15.6285
2	Girl1	105	108	58	71	85.5	24.8529
2	Girl2	71	108	68	83	82.5	18.19341
2	Girl3	74	129	67	101	92.75	28.26511
2	Girl4	52	94	57	58	65.25	19.34554
2	Girl5	98	83	79	75	83.75	10.04573
2	Girl6	84	83	61	59	71.75	13.59841
2	Girl7	82	108	47	67	76	25.70344
2	Girl8	83	86	69	51	72.25	15.98697
2	Girl9	103	95	79	97	93.5	10.24695
2	Girl10	71	70	49	49	59.75	12.41974
3	Boy1	82	82	59	73	74	10.86278
3	Boy2	67	86	59	59	67.75	12.73774
3	Boy3	72	116	57	49	73.5	29.89426
3	Boy4	83	74	53	50	65	16.06238
3	Boy5	63	65	35	52	53.75	13.7447
3	Boy6	78	81	62	73	73.5	8.346656
3	Boy7	77	80	38	68	65.75	19.18984
3	Boy8	68	66	53	44	57.75	11.32475

3	Boy9	78	63	53	46	60	13.88044
3	Boy10	61	60	43	74	59.5	12.71482
3	Girl1	102	120	77	53	88	29.24608
3	Girl2	85	88	82	92	86.75	4.272002
3	Girl3	109	81	61	54	76.25	24.64921
3	Girl4	84	71	49	42	61.5	19.43365
3	Girl5	97	82	77	75	82.75	9.945686
3	Girl6	98	80	66	95	84.75	14.77329
3	Girl7	108	81	61	49	74.75	25.7989
3	Girl8	83	115	90	72	90	18.23915
3	Girl9	79	81	78	92	82.5	6.454972
3	Girl10	69	79	55	38	60.25	17.80215

APPENDIX 18: Individual scores, mean values and their standard deviations of unaccented /u/

Block/Random	Subject	Duration in Milliseconds					
		uL/vd_vd	uL/vd_vl	uL/vl_vd	uL/vl_vl	Mean	STDEV
1	Boy1	70	65	46	49	57.5	11.78983
1	Boy2	55	59	53	51	54.5	3.41565
1	Boy3	66	63	24	44	49.25	19.44865
1	Boy4	52	48	35	33	42	9.416298
1	Boy5	41	53	48	62	51	8.831761
1	Boy6	75	43	54	64	59	13.68698
1	Boy7	64	110	48	53	68.75	28.30047
1	Boy8	48	49	50	76	55.75	13.52467
1	Boy9	61	55	38	50	51	9.763879
1	Boy10	44	45	37	46	43	4.082483
1	Girl1	122	67	76	77	85.5	24.74537
1	Girl2	108	75	91	114	97	17.60682
1	Girl3	56	98	91	85	82.5	18.44813
1	Girl4	105	80	49	45	69.75	28.22971
1	Girl5	70	42	49	85	61.5	19.67232
1	Girl6	9	71	65	73	54.5	30.52322
1	Girl7	81	76	90	72	79.75	7.762087
1	Girl8	91	105	52	112	90	26.79552
1	Girl9	107	110	76	74	91.75	19.39716
1	Girl10	69	49	55	37	52.5	13.30413
2	Boy1	74	73	62	39	62	16.26858
2	Boy2	55	58	30	45	47	12.62273
2	Boy3	69	39	33	50	47.75	15.81929
2	Boy4	53	56	35	42	46.5	9.746794

2	Boy5	61	52	67	53	58.25	7.088723
2	Boy6	53	60	47	43	50.75	7.410578
2	Boy7	60	59	47	55	55.25	5.909033
2	Boy8	54	61	56	51	55.5	4.203173
2	Boy9	54	54	79	54	60.25	12.5
2	Boy10	41	57	61	58	54.25	8.995369
2	Girl1	67	80	70	82	74.75	7.36546
2	Girl2	102	70	103	85	90	15.68439
2	Girl3	84	83	64	67	74.5	10.47219
2	Girl4	62	85	73	85	76.25	11.05667
2	Girl5	82	74	69	33	64.5	21.67179
2	Girl6	70	55	60	91	69	15.93738
2	Girl7	87	90	72	62	77.75	13.1244
2	Girl8	71	75	84	90	80	8.602325
2	Girl9	84	73	91	77	81.25	7.932003
2	Girl10	59	50	48	43	50	6.683313
3	Boy1	48	107	41	32	57	33.97058
3	Boy2	71	52	38	38	49.75	15.6285
3	Boy3	64	56	36	26	45.5	17.54043
3	Boy4	64	51	49	48	53	7.438638
3	Boy5	65	47	57	53	55.5	7.549834
3	Boy6	46	57	49	37	47.25	8.261356
3	Boy7	59	64	40	59	55.5	10.59874
3	Boy8	70	36	38	43	46.75	15.77709
3	Boy9	62	55	46	53	54	6.582806
3	Boy10	55	52	54	64	56.25	5.315073
3	Girl1	121	75	67	62	81.25	27.03547
3	Girl2	72	79	56	66	68.25	9.742518
3	Girl3	74	62	59	72	66.75	7.36546
3	Girl4	76	67	55	67	66.25	8.616844
3	Girl5	74	85	50	53	65.5	16.8226
3	Girl6	81	50	69	77	69.25	13.76893
3	Girl7	59	46	73	73	62.75	12.97112
3	Girl8	87	80	110	65	85.5	18.73499
3	Girl9	74	85	80	79	79.5	4.50925
3	Girl10	45	79	59	36	54.75	18.73277

APPENDIX 19: Individual scores, mean values and their standard deviations of accented /u:/

Block/Random	Subject	Duration in Milliseconds					
		uuH/vd_vd	uuH/vd_vl	uuH/vl_vd	uuH/vl_vl	Mean	STDEV
1	Boy1	150	168	117	177	153	26.49528
1	Boy2	172	157	171	153	163.25	9.673848
1	Boy3	152	123	113	158	136.5	21.88607
1	Boy4	149	146	126	134	138.75	10.68878
1	Boy5	139	186	136	170	157.75	24.30878
1	Boy6	145	147	177	180	162.25	18.82153
1	Boy7	154	181	139	154	157	17.49286
1	Boy8	168	160	138	154	155	12.70171
1	Boy9	161	157	133	133	146	15.09967
1	Boy10	168	155	126	146	148.75	17.65172
1	Girl1	113	134	155	181	145.75	29.09038
1	Girl2	120	188	151	179	159.5	30.68659
1	Girl3	194	219	214	231	214.5	15.41644
1	Girl4	152	140	148	141	145.25	5.737305
1	Girl5	171	168	163	200	175.5	16.66333
1	Girl6	151	141	190	177	164.75	22.66238
1	Girl7	174	159	137	144	153.5	16.46208
1	Girl8	185	184	122	199	172.5	34.35598
1	Girl9	184	183	154	146	166.75	19.61929
1	Girl10	141	149	146	149	146.25	3.774917
2	Boy1	179	175	131	172	164.25	22.35136
2	Boy2	149	165	132	167	153.25	16.29673
2	Boy3	173	191	148	144	164	22.10581
2	Boy4	161	151	126	181	154.75	22.86737
2	Boy5	130	142	97	133	125.5	19.67232
2	Boy6	146	159	195	199	174.75	26.28529
2	Boy7	128	144	134	129	133.75	7.320064
2	Boy8	185	154	147	171	164.25	17.11481
2	Boy9	143	150	143	159	148.75	7.588368
2	Boy10	145	147	155	147	148.5	4.434712
2	Girl1	185	186	160	204	183.75	18.08084
2	Girl2	157	165	179	149	162.5	12.79323
2	Girl3	243	214	210	215	220.5	15.15476
2	Girl4	153	151	139	135	144.5	8.850612
2	Girl5	162	198	185	158	175.75	19.01534
2	Girl6	142	160	129	159	147.5	14.84363
2	Girl7	162	138	139	142	145.25	11.29528

2	Girl8	188	159	143	173	165.75	19.24188
2	Girl9	159	166	163	157	161.25	4.031129
2	Girl10	129	132	140	150	137.75	9.394147
3	Boy1	161	171	122	168	155.5	22.72297
3	Boy2	174	151	129	150	151	18.38478
3	Boy3	131	160	112	145	137	20.44505
3	Boy4	158	153	131	140	145.5	12.28821
3	Boy5	138	159	113	131	135.25	19.01534
3	Boy6	166	162	169	190	171.75	12.5
3	Boy7	164	132	167	129	148	20.28135
3	Boy8	170	164	149	128	152.75	18.71497
3	Boy9	143	168	113	149	143.25	22.80899
3	Boy10	155	168	144	140	151.75	12.55322
3	Girl1	194	180	153	156	170.75	19.65324
3	Girl2	158	166	158	154	159	5.033223
3	Girl3	211	199	181	195	196.5	12.36932
3	Girl4	159	138	133	141	142.75	11.32475
3	Girl5	170	163	175	161	167.25	6.448514
3	Girl6	171	124	137	151	145.75	20.12254
3	Girl7	156	148	134	129	141.75	12.44655
3	Girl8	174	141	153	164	158	14.21267
3	Girl9	165	170	178	145	164.5	14.0594
3	Girl10	155	129	119	131	133.5	15.26434

APPENDIX 20: Individual scores, mean values and their standard deviations of unaccented /u:/

Block/Random	Subject	Duration in Milliseconds					
		uuL/vd_vd	uuL/vd_vl	uuL/vl_vd	uuL/vl_vl	Mean	STDEV
1	Boy1	157	127	156	71	127.75	40.31026
1	Boy2	81	142	204	80	126.75	59.1009
1	Boy3	196	132	110	91	132.25	45.68278
1	Boy4	136	133	123	73	116.25	29.36409
1	Boy5	156	140	157	98	137.75	27.62095
1	Boy6	175	146	171	100	148	34.47705
1	Boy7	153	125	147	124	137.25	14.93039
1	Boy8	158	139	154	70	130.25	40.99085
1	Boy9	156	162	131	89	134.5	33.17127
1	Boy10	116	134	102	68	105	27.92848
1	Girl1	171	178	155	124	157	24.01388
1	Girl2	181	176	144	130	157.75	24.71673
1	Girl3	188	239	192	142	190.25	39.63479

1	Girl4	121	153	129	108	127.75	18.92749
1	Girl5	202	150	164	88	151	47.39902
1	Girl6	103	158	109	148	129.5	27.54995
1	Girl7	180	134	155	120	147.25	26.14543
1	Girl8	163	165	150	113	147.75	24.10221
1	Girl9	171	160	153	114	149.5	24.79919
1	Girl10	132	188	143	89	138	40.6694
2	Boy1	140	154	150	103	136.75	23.25762
2	Boy2	105	126	184	94	127.25	40.09468
2	Boy3	134	143	150	67	123.5	38.23175
2	Boy4	134	141	140	86	125.25	26.34862
2	Boy5	117	124	106	96	110.75	12.31192
2	Boy6	134	157	161	130	145.5	15.7586
2	Boy7	121	110	148	111	122.5	17.71064
2	Boy8	148	124	131	87	122.5	25.72288
2	Boy9	126	139	98	94	114.25	21.79258
2	Boy10	135	128	107	72	110.5	28.29016
2	Girl1	170	180	145	146	160.25	17.51904
2	Girl2	165	173	145	85	142	39.78274
2	Girl3	186	181	159	173	174.75	11.78629
2	Girl4	97	154	147	118	129	26.41969
2	Girl5	186	164	158	138	161.5	19.75686
2	Girl6	130	140	112	127	127.25	11.58663
2	Girl7	128	158	102	97	121.25	28.01636
2	Girl8	142	152	148	101	135.75	23.52835
2	Girl9	177	151	150	100	144.5	32.19213
2	Girl10	134	170	107	97	127	32.64966
3	Boy1	160	137	141	94	133	27.86874
3	Boy2	129	142	133	96	125	20.08316
3	Boy3	135	123	127	92	119.25	18.83923
3	Boy4	133	131	132	85	120.25	23.51418
3	Boy5	140	129	130	88	121.75	23.04163
3	Boy6	137	167	164	112	145	25.80698
3	Boy7	158	136	131	125	137.5	14.38749
3	Boy8	158	118	124	92	123	27.15388
3	Boy9	130	155	119	87	122.75	28.19427
3	Boy10	148	123	106	68	111.25	33.59936
3	Girl1	175	146	159	151	157.75	12.68529
3	Girl2	167	131	139	90	131.75	31.82635
3	Girl3	189	197	170	106	165.5	41.25126
3	Girl4	144	135	125	94	124.5	21.76388

3	Girl5	162	166	150	78	139	41.23106
3	Girl6	121	157	105	111	123.5	23.28805
3	Girl7	152	121	110	93	119	24.83277
3	Girl8	137	153	133	73	124	35.08086
3	Girl9	177	161	157	130	156.25	19.51709
3	Girl10	126	142	115	74	114.25	29.03303

Appendix 21: The List of Tokens Selected for the Analysis

Long Vowel Tokens

Vowel	Frame	Accent Status	Carrier Word	Gloss
[i]	-voiced _t	Accented	/tí:todan/	Like Tito (name)
		Unaccented	/ti:tídan/	Like Titi (name)
	+voiced _t	Accented	/dí:tidan/	Like Dity (name)
		Unaccented	/di:tádan/	Like Dita (name)
	-voiced _d	Accented	/tí:dedan/	Like Tiide (name)
		Unaccented	/essti:de/	STD-*Indef.* (a loan word 'STD')
	+voiced _d	Accented	/dí:dínné/	Though he/it lives
		Unaccented	/di:dí:te/	DDT-*Indef.* (dichlorodiphenyltrichloroethane)
[e]	-voiced _t	Accented	/ʔité:tó/	From Amharic 'እቴቴ'
		Unaccented	/pí:te:ta/	You peel
	+voiced _t	Accented	/ʔodé:ta/	You tell
		Unaccented	/páde:ta/	You portion out
	-voiced _d	Accented	/goté:dan/	Like a storm
		Unaccented	/bite:dan/	Like a witchcraft
	+voiced _d	Accented	/godé:dan/	Like a wall
		Unaccented	/góde:dan/	Like the goddess
[a]	-voiced _t	Accented	/kata:to/	A continuous pressing-*Indef.*
		Unaccented	/kata:tó/	Let him press continuously
	+voiced _t	Accented	/godá:too/	Your greatness
		Unaccented	/goda:tá/	Their greatness-ACC

	-voiced _d	Accented	/matá:dan/	As (if) approaching
		Unaccented	/máta:dan/	Like a nearby
	+voiced _d	Accented	/dá:dasa/	You lived
		Unaccented	/da:dísá/	Daadisa-ACC (men's name)
[o]	-voiced _t	Accented	/metó:to/	troubling-*Indef.*
		Unaccented	/meto:tó/	Let him be in trouble
	+voiced _t	Accented	/hidó:ta/	hope-*indef.*
		Unaccented	/hido:tá/	Be hopeful, be optimistic
	-voiced _d	Accented	/metó:de/	Trouble time
		Unaccented	/ʔí:to:de/	Difficulty time
	+voiced _d	Accented	/dó:dadan/	Like Dooda
		Unaccented	/do:dádan/	Like Dooda
[u]	-voiced _t	Accented	/tú:teta/	Handles
		Unaccented	/wá:tu:te:/	What would you do (2Sg)
	+voiced _t	Accented	/dú:todan/	Like detaching
		Unaccented	/pádu:te:/	May you portion out?
	-voiced _d	Accented	/matú:de:/	A nonce word
		Unaccented	/tu:dáre:/	Tudare (name)
	+voiced _d	Accented	/dú:deta/	Dumbs
		Unaccented	/du:dané/	Duudane (the name of a place (found in Gammo Gofa, South of Wolaytta))

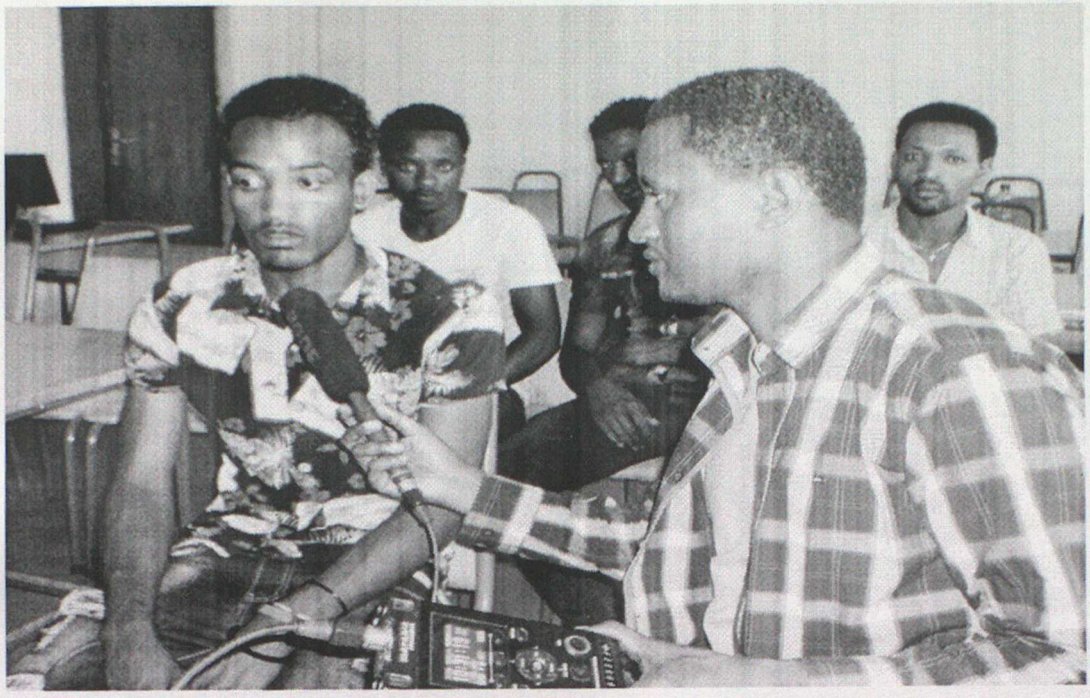
Short Vowel Tokens

Vowel	**Frame**	**Accent Status**	**Carrier Word**	**Gloss**
[i]	-voiced _t	Accented	/pí:tító/	Peel (Old polite usage)
		Unaccented	/pí:tite/	Peel-*Imp.*
	+voiced _t	Accented	/pádító/	Portion (Old polite usage)
		Unaccented	/pádite/	Portion

	-voiced _d	Accented	/qatída/	We inhabited
		Unaccented	/pútida/	We shitted
	+voiced _d	Accented	/ʔodída/	We told
		Unaccented	/pádida/	Portioned out
[e]	-voiced _t	Accented	/gá:tétó/	Be an illegitimate child (3Sg IMP)
		Unaccented	/gá:teta/	Be an illegitimate child (2Sg IMP)
	+voiced _t	Accented	/yedéta/	Chasing (*Indef.*)
		Unaccented	/codetta/	Dormant seeds (of cocoyam, potato, etc.)
	-voiced _d	Accented	/gatédan/	As price
		Unaccented	/bétedan/	Like a migrant
	+voiced _d	Accented	/wodédan/	Like a time
		Unaccented	/gádedan/	like a garden
[a]	-voiced _t	Accented	/gitáto/	Greatness (*Indef.*)
		Unaccented	/gitató/	Let him be great
	+voiced _t	Accented	/godáto/	Anger (*Indef.*)
		Unaccented	/godató/	Let him be angry against
	-voiced _d	Accented	/ʔetádan/	Like them
		Unaccented	/mátadan/	Like a nearby
	+voiced _d	Accented	/godádan/	Like a wall
		Unaccented	/gódadan/	Like a lord
[o]	-voiced _t	Accented	/pítótó/	Let it be dusty
		Unaccented	/pítota/	Dusts
	+voiced _t	Accented	/ma:dóta/	Backings, supports
		Unaccented	/kádota/	Ploughs
	-voiced _d	Accented	/metódan/	Like a difficulty
		Unaccented	/wótodan/	Like a patched up garment; like a fault
	+voiced _d	Accented	/ʔadódan/	As salty mineral used for feeding cattle
		Unaccented	/ʔódodan/	Like news
[u]	-voiced _t	Accented	/pútútó/	Let him/it shit
		Unaccented	/pútuta/	Shit (2Sg-IMP)

	+voiced _t	Accented	/dútíírá/	With Dutee (flattering name for Dutare (woman))
		Unaccented	/dutáró/	Dutaro –ACC (women's name)
	-voiced _d	Accented	/na:túdan/	Like the children
		Unaccented	/ʔátudan/	Like Atu (men's name)
	+voiced _d	Accented	/dúdidan/	Like Dudee
		Unaccented	/ʔádudan/	Like Adu

Appendix 22: Sample Snapshots of Prerecording Sessions (with Male Subjects)



APPENDIX 24: Sample Snapshots of Recording Sessions (with Female Subjects)