An Acoustic Analysis of Amharic Vowels[*]

Shinya IWATSUKI
(Nagoya University)
iwatsukishinya@gmail.com

1. Introduction

Ethiopia is a multilingual state, which approximately 80 ethnic groups inhabit and each group has their own language. According to the present Constitution, established in 1994, 'all Ethiopian languages shall enjoy equal state recognition and each Federation may have their respective working language' (article 5). These languages are Amharic, Afar, Harai, Oromo, Somali and Tigrinya.

Amharic, the native language of the Amharas, has been the governing language of the government since 13th century for historical reasons. Today, Amharic is provided by The Constitution as 'the working language of the Federal Government' (article 5) and could be regarded as the official language *de facto* of the country. This language is used nationwide by diverse ethnics as a common language or lingua franca in inter-ethnic communication.

Considering the above stated situation, it can be said that Amharic might be changing rapidly because of language contact. There are many studies devoting to the language and the description is trustworthy (for example Armbruster1909, Cohen1936, Leslau1995). However, it must be said that some of these studies are out of date and must be re-investigated. Especially in the phonetic domain, with the rapid development of technology, many possibilities for analysis have been proposed, but attempts are not fully made at this kind of study.

Iwatsuki (2011) analyzed the vowel quality acoustically and showed that, comparing the formant frequency, they are differentiated by their quality. However this study has a crucial weakness in methodology. The surrounding environments of the target vowels in the lists are not coherent and it might have affected the formant frequency. A closer investigation is needed to support the conclusion of my previous study.

Another important acoustic characteristic of the vowel other than the quality is its quantity or duration. In many languages, duration of the vowel is one of the cues for distinction of segments. In Amharic, there is no phonological distinction in length. It does not mean, however, that all vowels are realized with equal duration. For a better understanding of the phonological system of the language, it is indispensable to describe the duration of the vowels.

The present article aims to describe the acoustic characteristics of Amharic and focuses especially on the quantity of the vowels. In section 2, the description of the problem will be given with brief information about the vowel system of the language. Section 3 explains the methodology, and the following section presents the data. Discussion on the data will be given in the section 5. Section 6 is the conclusion.

2. Vowel System of Amharic

Amharic has a seven-term vowel system as shown in Table 1.

Table 1. Vowel Chart of Amharic

	front	center	back
close	i	ə	u
mid	e	ä	o
open		a	

/i/, /e/, /o/ and /u/ have approximately the same value of the IPA. /a/ is normally realized as a back vowel i.e. [ɑ].

/ə/ is realized as [ə]or [ɨ]. /ä/ is a central mid vowel and its most typical realization is said to be [ɐ], though it has many allophonic realizations

20

according to the surrounding environment. /ä/ and /a/ sometimes have very close realizations and could be difficult to distinguish for non-native speakers. Although lexical minimal pairs are not common[1], minimal pairs in the verbal inflectional system are found productively. Here are some examples.

(1)　　　　tän**ä**ggärä　　　v.s.　　　tän**a**ggärä
　　　　　　"it is informed"　　　　　　"he spoke"
　　　　　yənn**ä**kkäsal　　v.s.　　　yənn**a**kkäsal
　　　　　　"he is bitten"　　　　　　"he always bites"
　　　　　täg**ä**ddälu　　　v.s.　　　täg**a**ddälu
　　　　　　"they are killed"　　　　　"they killed each other"

The latter words of each pair are so-called tä+C derived stem and the typical meaning of this derivation is *habitual* (it may be rendered in English as *one is apt to do something*, *one is always doing something, one has the habit of doing something* etc.) or *reciprocal*. Although not all verbs will be derived to these patterns because of restriction of meaning, there are lots of minimal pairs and it is clear that /ä/ and /a/ are distinctive.

"Different phonemes have different realizations." This is one of the basic concepts of phonetics and phonology. This suggests that /ä/ and /a/ have different realization in quality. The actual pronunciation, however, is difficult to distinguish, especially in a natural enunciation.

As is mentioned in the previous section, this article aims to describe acoustic characteristics of the vowels. This study will contribute to find cues for distinction of the vowels, other than its quality.

2. Collecting Data

To investigate vowel quality and the vowel length of the language, I conducted a research in Addis Abeba, the capital of Ethiopia.

The informant Mr. M is a 23-year old man, born in Addis Abeba. Although his parents are Gurage speakers, they all speak in Amharic in the family. He attended university in Jimma, which indicates that he is highly educated. As Jimma is located in the Oromoia Region, he might have had considerable contact with Oromo, but he doesn't speak the Oromo language. Amharic is his

---

[1] For example, /bäl/ *"say, well, then"* and /bal/ *"husband"*.

first language, and English is his second language and the medium language of higher education.

The experiment was held in October 2011, in a quiet room in the Siddist Kilo Campus of Addis Abeba University. The devices with which I recorded the sounds were:

Recorder: Sony, Linear PCM Recorder PCM-10,

Microphone: Audio-Technica, Condenser Microphone AT9941.

Sampling rate: 44.1 kHz

Quantization rate: 24 bits

File format: WAVE file

I asked the informant to read 4 lists I had prepared which contained nonsense words in carrier sentences. I instructed the informant to assume that the nonsense words were the name of a village newly found in South America or the name of a recently released washing powder. The target vowels are surrounded by the consonant /d/ for several reasons. First, plosive consonants have a silent period that makes it easier to identify the vowels. Second, /b/ and /g/ are almost always realized as fricative when they are surrounded by vowels, which means there would be difficulties in distinguishing consonant and vowel. Third, I considered restriction of time and physical and mental burden for the informant. These are the reasons why I chose /d/ as a surrounding consonant. Below is represented the lists which are transliterated into phonological representation.

List 1: d_d

1. yəh däd yəbbalal   *It is called "d_d".*
2. yəh dud yəbbalal
3. yəh did yəbbalal
4. yəh dad yəbbalal
5. yəh ded yəbbalal
6. yəh dəd yəbbalal
7. yəh dod yəbbalal

List 2: d_d

1. yəh ə-däd wəst'näw   *It is in the "d_d".*
2. yəh ə-dud wəst'näw

3. yəh ə-did wəst' näw
4. yəh ə-dad wəst' näw
5. yəh ə-ded wəst' näw
6. yəh ə-dəd wəst' näw
7. yəh ə-dod wəst' näw

List 3: d_d

1. yəh kä-däd yəššalal   *It is better than "d_d".*
2. yəh kä-dud yəššalal
3. yəh kä-did yəššalal
4. yəh kä-dad yəššalal
5. yəh kä-ded yəššalal
6. yəh kä-dəd yəššalal
7. yəh kä-dod yəššalal

List 4: ad_d

1. yəh adäd yəbbalal   *It is called "ad_d".*
2. yəh adud yəbbalal
3. yəh adid yəbbalal
4. yəh adad yəbbalal
5. yəh aded yəbbalal
6. yəh adəd yəbbalal
7. yəh adod yəbbalal

3. Data

3.1. IPA Transcriptions

Tables 2 to 5 are narrow IPA transcriptions of recordings.

Table 2. Transcription of list 1

target				
ä	[dɜḓ]	[dɜḓ]	[dɛ̣ḓ]	[dɛḓ]
u	[duḓ]	[duḓ]	[du̥ḓ]	[duḓ]
i	[diḓ]	[diḓ]	[diḓ]	[diḓ]
a	[daḓ]	[daḓ]	[dɑḓ]	[dɑḓ]
e	[deḓ]	[deḓˋ]	[de̥ḓ]	[deḓ]
ə	[dɨḓ]	[dɨḓ]	[dɨḓ]	[dɨ̥ḓ]
o	[do̥ḓ]	[do̥ḓ]	[dʊḓ]	[do̥ḓ]

23

Table 3. Transcription of list 2

target				
ä	[ʃdɜd̥]	[ʃdɜd̥]	[ʃdɛd̥]	[ʃdəd̥]
u	[ðdud̥]	[ʃdud̥]	[ʃdud̥]	[ʔɾud̥]
i	[ĭdid̥]	[ĭdid̥]	[ĭd̥id̥]	[ĭd̥id̥]
a	[ʃdad̥]	[ʃdad̥]	[ʔd̥ad̥]	[ʃd̥ad̥]
e	[ʃded̥]	[ʃɾed̥]	[ʃded̥]	[ʃɾed̥]
ə	[ĭdid̥]	[ĭdid̥]	[ĭdid̥]	[ĭdid̥]
o	[ðdod̥]	[ʃd̥od̥]	[ðdʊd̥]	[ʃdod̥]

Table 4. Transcription of list 3

target				
ä	[kɜdɜd]	[kɜɾɜd̥]	[kɜd̥ɛd̥]	[kɜdɜd̥]
u	[kədud̥]	[kɜdud̥]	[kɜd̥ud̥]	[kɜd̥ud̥]
i	[kədid̥]	[kədid̥]	[kədid̥]	[kədid̥]
a	[kɜdad̥]	[kɜdad̥]	[kɜdad̥]	[kɜd̥ad̥]
e	[kɜded̥]	[kəded̥]	[kəded̥]	[kəred̥]
ə	[kədid̥]	[kədid̥]	[kədid̥]	[kədid̥]
o	[kɜd̥od̥]	[kəd̥od̥]	[kəd̥od̥]	[kəd̥od̥]

Table 5. Transcription of list 4

target				
ä	[ɑdəd̥]	[ɑdɜd̥]	[ɑdɜd̥]	[ɑdɜd̥]
u	[ɑd̥ud̥]	[ɑd̥ud̥]	[ɑd̥ud̥]	[ɑd̥ud̥]
i	[ɑd̥id̥]	[ɑdid̥]	[ɑd̥id̥]	[ɑɾid̥]
a	[ɑd̥ad̥]	[ɑdad̥]	[ɑdad̥]	[ɑðad̥]
e	[ɑd̥ed̥]	[ɑd̥ed̥]	[ɑd̥ed̥]	[ɑded̥]
ə	[ɑdid̥]	[ɑdid̥]	[ɑdid̥]	[ɑdəd̥]
o	[ɑd̥od̥]	[ɑd̥od̥]	[ɑd̥od̥]	[ɑdod̥]

Let us examine the tables shown above. Realizations of /ä/ and /a/ are as follows.

/ä/: [ə], [ɜ] and [ɛ]

/a/: [ɑ]

24

/ä/ is realized as a central vowel, as for /a/ is always pronounced with the low back vowel. Although these lists might have been pronounced slower than natural enunciation, these vowels are distinguished aurally.

3.2. Formant Frequency

Recorded sets of words are shown in a spectrogram and I measured their 1st and 2nd formant by the eye. In case it is difficult to judge where the formants are, I made use of the algorithm of the software. Figure 1 below is the scatter graph of the 1st and 2nd formant of all the vowels which I made using JPlotFormants v.1.4

Figure 1.
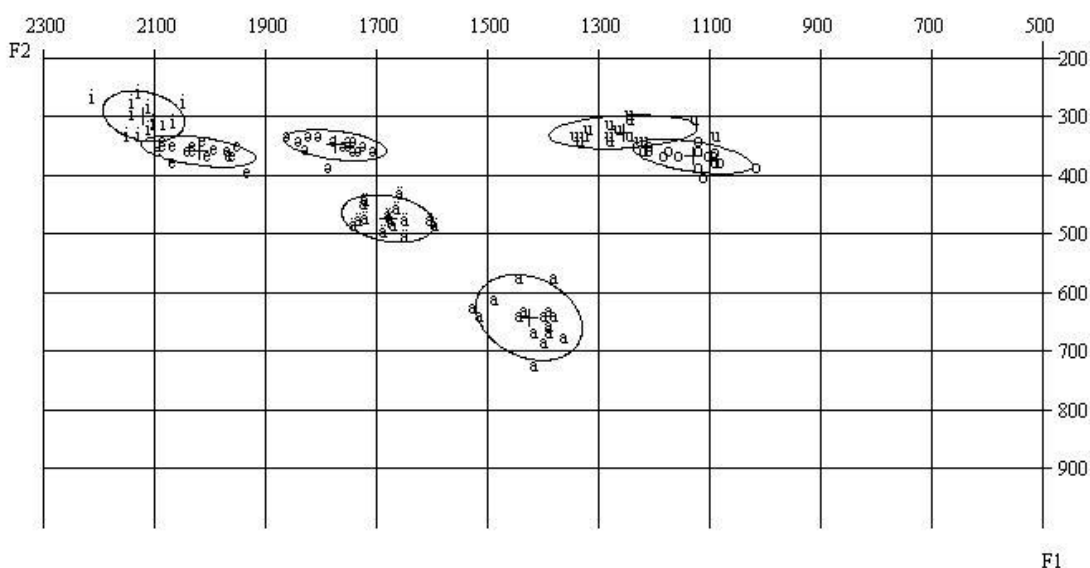
Figure 1 shows that each vowel has its own frequency and no pairs of vowels are overlapped in the scatter graph. As for the pairs, /i/-/e/ and /u/-/o/, they are scattered very closely and this reflects the fact that /e/ and /o/ are realized as close-mid vowels, rather than open-mid ones([ɛ] and [ɔ]).
The result here can be regarded as a strong support for my previous study (Iwatsuki 2011).

3.3. Duration

I measured the duration of the target vowels and of the silent period of following consonant. Duration is presented in percentage. The criteria for

deciding the vowels are burst of the preceding /d/ and disappearing of formants. Voice bars of following /d/ are treated as silent period.
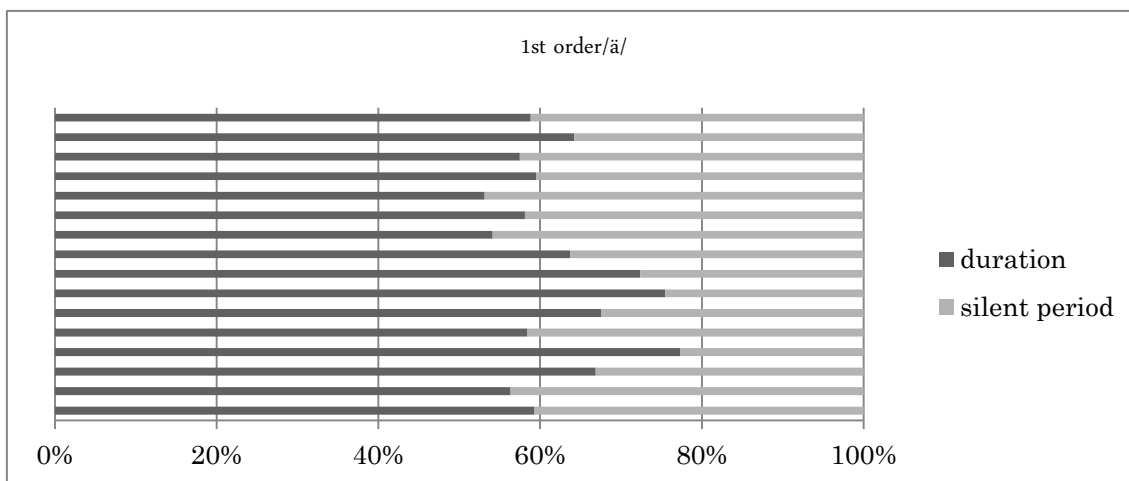
Figure 2. Duration in Percentage of /ä/
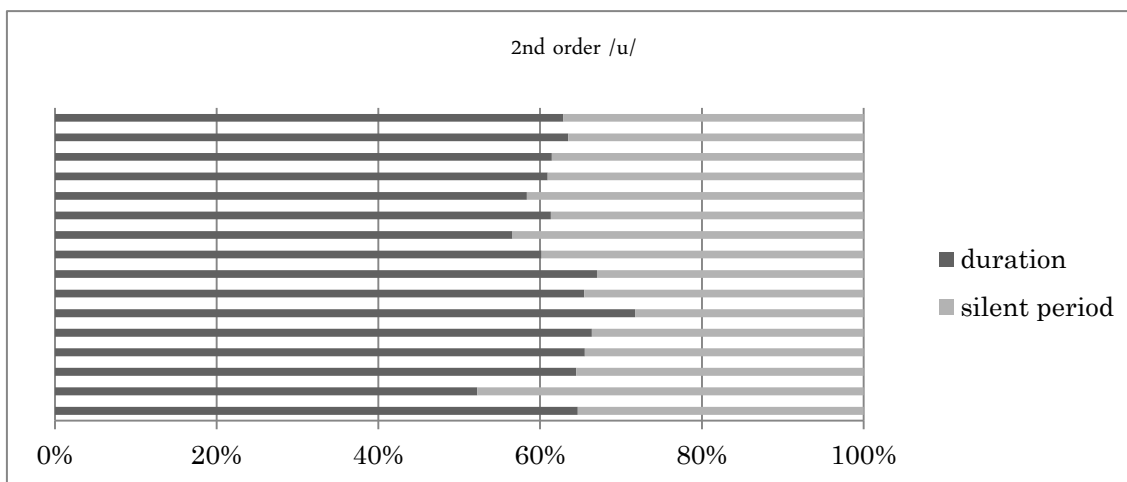

Figure 3. Duration in Percentage of /u/

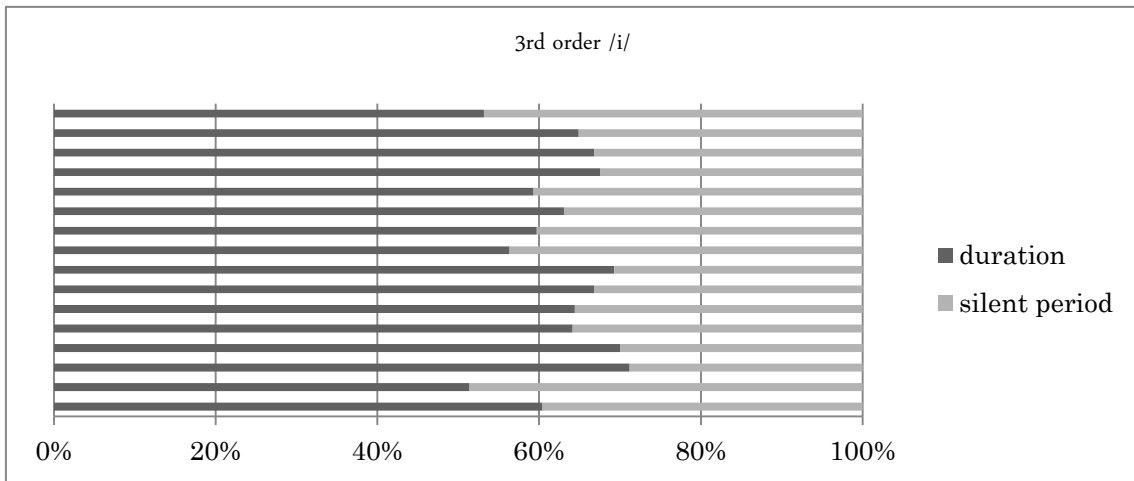Figure 4. Duration in Percentage of /i/

Figure 5. Duration in Percentage of /a/

Figure 6. Duration in Percentage of /e/
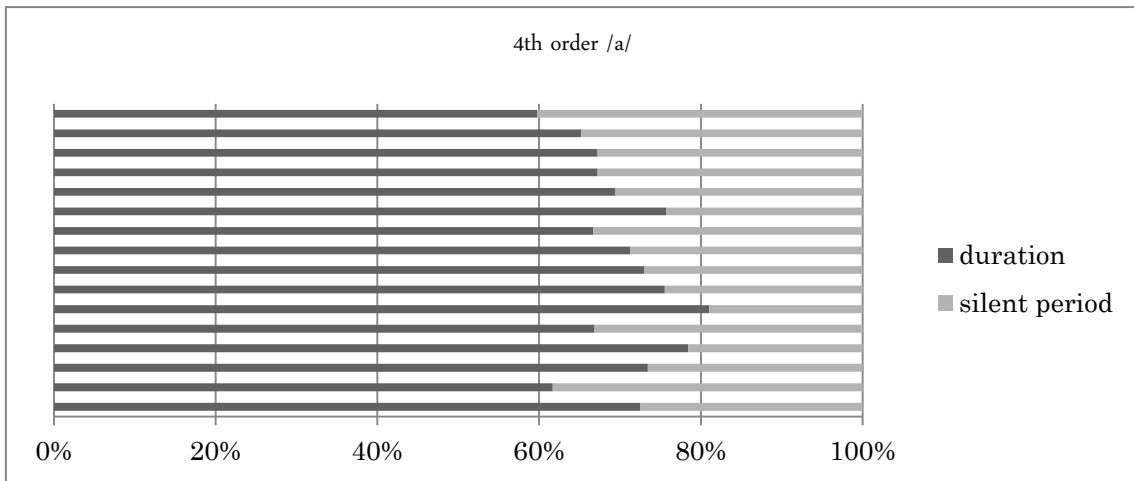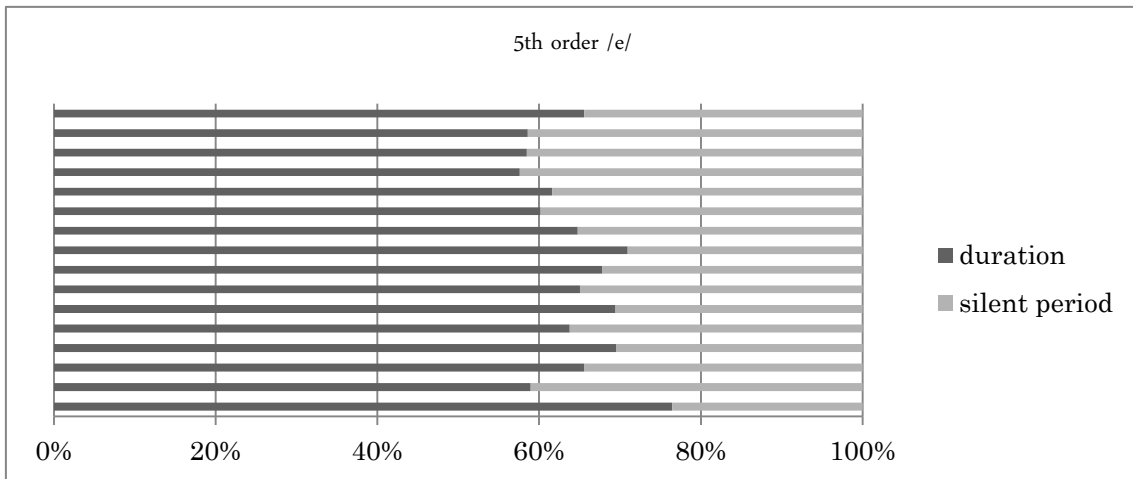

Figure 7. Duration in Percentage of /ə/

Figure 8. Duration in Percentage of /o/

Table 6 below shows mean and median of the duration and silent period. We must keep in mind that the number of samples is so limited that statistical values represented here are not necessarily significant.

Table 6. Mean and Median

	Mean (%)	Median (%)
ä	62.8	59.5
u	62.6	63
i	62.9	64
a	69.8	70
e	64.6	65
ə	45.6	46
o	69.0	70

I arrange the vowels according to their median in (2)

(2)　　ə　　　　ä　uie　　a,o

　　————————————————————————→ long
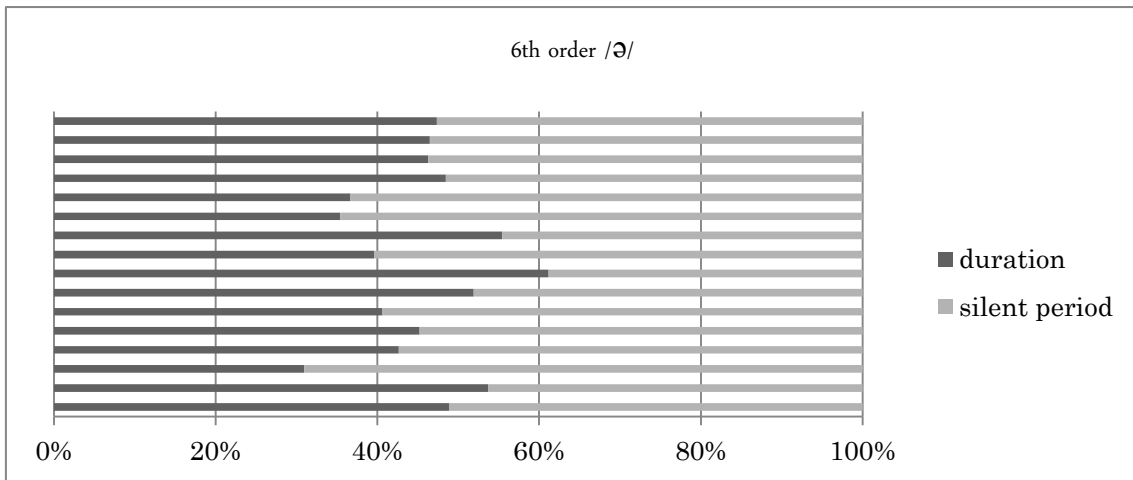
4. Discussion

We can see from the data that the durations of /a/ and /o/ are long.

That /a/ has long duration can be accounted by the fact that /a/ is realized as a low vowel. Lehiste&Peterson(1961) showed that low and tense vowels have long duration and it is reasonable to suppose so from the view point of articulatory phonetics. Low vowels require a big movement of the tongue and necessarily the duration becomes long in order to articulate the target vowel.

This standpoint doesn't give a plausible explanation why /o/ has long duration.

/ə/, to the contrary, has short duration and following silent period is relatively long, which may be regarded as a compensatory lengthening. Here, we must take the problem of gemination into account. Geminate consonants are phonologically distinctive in Amharic and we can find many minimal pairs. Ethiopian syllabary, however, has no way to indicate gemination and minimal pairs are written identically, as in (3).

(3)   አለ   alä *"he said"* or   allä *"he is present"*
       ገና   gäna *"yet"*   or   gänna *"Christmas"*

In this research, the word lists are written in Ethiopic script and the infprmant is simply asked to pronunce it. It is therefore possible that he read some words in the lists with gemination[2].

Hayward suggests that there is a tendancy in syllable structure, where cenral vowels /ə/, /ä/ and /a/[3] commonly occur in syllables closed with two consonants and the front and back vowels are common enough in syllables closed in a single consonant (Hayward 1986: 305). This tendancy may have led the informant to pronunce the words whose nucleus is a central vowel with a geminated coda, /dädd/ and /dədd/ rather than /däd/ and /dəd/.

---

[2] Native speakers sometimes tell me that such pairs are homonyms or they are different in "accent", a term which is used without precise definition. It is possible that they explained that fact with simplicity so as not to confuse foreign speakers who are not familiar with the language. Considering other facts, whether native speakers are aware of gemination or not is left to be examined in further study.

[3] Hayward classifies /a/ into central vowel group, which seems to me strange. He gives some examples for /CaCC/ structure but the number of words with this syllable structure is limited. Moreover, within these examples first consonant of the coda is mostly nasal or glide. I believe, therefore, that /a/ must be treated as a back vowel and this assumption does not conflict with phonological behavior of the segment.

5. Conclusion

In this paper, some tendancy in duration is observed. I suggested in section 4 that duration may be relevant to syllable structure of the language. However, the data is so limited that I cannot mention the feature of vowels with certainty. In future work, it will be necessary to collect recordings of other people from diverse ethnic groups and each sex. Word lists should also contain various environments to investigate the nature of vowels. Then, description of suprasegmentals such as stress, intonation and prosody is needed since these factors are cues for distincition of segments in many cases. In the final step, I will discover the cues for distinction other than quality. I believe that this study would contribute to reinterpretation of the phonological system of Amharic.

References

Armbruster, C. H. (1908) *Initia Amharica; an introduction to spoken Amharic*, Cambridge University Press

Cohen, M. (1936) *Traité de langue amharique (Abyssinie)*, Institut d'éthnologie, Paris

Hayward, D. (1986), 'The High Central Vowel in Amharic: New Approach to an Old Problem', in *The Fergusonian Impact vol.1.From Phonology toSociety*, Fishman. et al.ed., Mouton de Gruyter

Iwatsuki, S. (2011) 'An acoustic Observation on 1st and 4th Order Vowels of Amharic', in *Cushitic-Omotic Studies 2010*, Yoichi TSUGE and Hideyuki INUI ed.

Lehiste & Peterson (1961) 'Transitions, Glides and Dipthongs', in *Journal of the Acoustical Society of America 33*

Leslau, W. (1995) *Reference Grammar of Amharic*, Otto Harrassowitz, Wiesbaden

Ray, D. K. and Read, C. (1992) *The Acoustic Analysis of Speech*, Singular Publishing California