ACOUSTIC ANALYSIS OF VOWELS IN TWO SOUTHERN ANGAMI DIALECTS

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ABSTRACT

This paper describes the acoustic analysis of vowels in two southern Angami dialects and the creation of the database. While, attention has been given to the standard variety of Angami, studies on its varieties are few in number. The goal of the paper is to study the segmental features of the dialects and account for the variations that exist. Kigwema and Viswema are considered to be the oldest villages of the Angamis to have established in the Kohima district. Numerous villages have branched out from these two ancestral villages and there are varying degrees of mutual intelligibility among the villages. This paper explores the variation that exists among two dialects originating from the Kigwema and Viswema villages. The findings of the study show that dialectal variation is well represented by vowel variations in the two dialects.

Index Terms— Angami, Kigwema, Viswema, tone, vowels, consonants, dialects.

1. INTRODUCTION

Angamis are one of the major communities of the Nagas who live primarily in the Kohima district of Southern Nagaland, India. According to the Census of India, 2001, Angami (also referred to as Tenyidie, ISO 639 – 3: njm) is spoken by 130,000 people in Nagaland and is considered to be a language at a vulnerable stage by UNESCO. Angami is a tonal language and it falls under the Tibeto-Burman language family [1, 2]. Burling states that there are eight related languages under the Eastern Branch of Tibeto-Burman namely, Rengma Northern, Pochuri, Rengma, Simi, Angami, Chokri, Kheza, and Mao [1]. In the past studies of Angami, the description of the Angami was solely based on the standard Kohima dialect. [3, 4, 5, 6]. While resource are scarce for the language, there are two online sources where Angami language have been documented, namely, the World Atlas of Language Structure (WALS) containing a collection of descriptive works on the language and the UCLA Phonetic lab archives containing some speech data recorded in the Khonoma dialect of Angami[5, 4, 7]. The available information and speech samples are limited to Northern Angami and Khonoma dialects.

1.1. Motivation

Each Angami village is believed to have its own variety of the language. While the northern variety, spoken around the Kohima village, is considered to be the standard variety, there are numerous varieties of the language, within the same Kohima district. Previous studies have claimed that there are nine varieties, distinguished by salient linguistic properties, of the Southern Angami dialect itself [8, 9]. In order to investigate the possible phonetic and phonological variations among the Southern Angami varieties, only two varieties, as spoken in the Kigwema and the Viswema villages are considered in the present study.

The database collected in this study is aimed towards capturing dialectal differences in the two varieties of Southern Angami dialects. Hence, the acoustic characteristics of vowels produced in Southern Angami dialects namely, Kigwema and Viswema are studied in this study as potential dialectal cues. Except for the study on the Khonoma dialect, a western variety of Angami, studies on Angami vowels have been impressionistic and without any acoustic description [8, 6, 10, 5]. Such studies have also resulted in disagreements regarding the phonemic inventory of the Angami language. For example, in previous studies, the vowel inventory size proposed for Angami ranges from six to seven phonemic vowels [11, 10, 5, 6, 12]. This inconsistency stems out of the fact that the central vowel schwa in Angami are not characterized acoustically and often a single vowel may be categorized into two separate phonemic categories. Hence, with the aim of conclusively describing the Angami vowel inventory, a database is constructed, as reported in this study, and some acoustic analysis of vowels and tones are undertaken.

2. DESIGN OF THE CORPUS

As the primary objective of the study to be undertaken is discovering the phonetic correlates of dialectal variation in
Angami, a prepared list of words and sentences along with impromptu interviews were collected from Angami speakers. The prepared sentence list contained about 650 unique words. Speech data of 72 native speakers of Kigwema and Viswema dialect, reading prepared lists and answering questions, resulting in about 30 hours of speech data.

The following subsection gives a detailed description of the development of the Angami speech database, detailing data preparation, recording procedures, the area of the data collection, speaker information and the annotation procedures.

2.1. Preparation of the data

In order to capture the dialectal differences, two sets of data were prepared - a) speech data and b) sociolinguistic data. The sociolinguistic data was collected from the octogenarian and septuagenarian speakers of the dialects about their community, the history of the village and information related to migration and settlement. This information was gathered in order to crosscheck and relate to the existing studies on migration and pattern of settlement of the Angamis. In investigating dialectal variations, such information provide valuable background information.

In this work, we only describe the speech data that was collected to capture the dialectal differences in Angami. Two kinds of speech data was captured in this work: a) controlled sentential text data and b) spontaneous speech data. For eliciting the spontaneous speech data, the story of Noah and David from the Bible was used by showing pictures of the story as prompts. In order to ascertain the phonemic, vocalic and tonal inventories of the dialects, the designed text corpus consisted of more than 400 words as listed below:

- Swadesh list consisting of 208 basic words[13].
- 70 commonly used lexical items including vegetables and agricultural items.
- 72 monosyllables of the CV structure where C is one of the 36 consonants and V is either a high vowel /i/ or a low vowel /a/.
- Another 72 Monosyllables of the CV structure where C is either /p/, /n/, /l/ and V is one of the 6 vowels with the combination of possible tones was explored.

2.2. Recording of data

Data for the dialectal study of Angami has been collected from the two villages namely, Kigwema and Viswema of Nagaland (see Figure 1). These two villages were chosen because the Angamis consider these villages to be the oldest villages of the Southern Angami. The distance between the two villages is 10.5 km. Over a period of time, eleven villages were formed out of these two ancestral villages. All the villages of the Southern Angami are on a geographic continuum with well-defined boundaries. The data was recorded in five field visits from March 2016 to October 2017.

The recordings were made using TASCAM DR–100 MKII portable digital solid state recorder, with a sampling rate of 44.1 KHz, attached to a head-mounted Shure SM10A microphone. Recordings were made in the homes of the subjects and at times the village community halls. For the recording the text-corpus data, subjects were given sheets containing target words to be read. The word list was made in consultation with the native speakers and was cross-checked during the elicitation process too. The target words from the text-corpus were repeated in three environments: in isolation, in a fixed phrase, and in a sentence. For recording the data each speaker took from 30 to 50 minutes, depending on the speech rate and reading proficiency of the speakers. In case of the spontaneous speech, speech duration varied from from 5 to 10 minutes depending on the way the stories were recollected and elaborated. Apart from that, the time taken for sociolinguistic interviews of the elders of the village ranged from 30 minutes to an hour.

2.3. Speaker information

A total of seventy two speakers’ speech and sociolinguistic data were collected. The sentential speech data was collected from 21 male and 16 female speakers of Kigwema dialect and 11 male and 7 female speakers of Viswema dialect. The spontaneous speech data, involving storytelling, was collected from 3 male and 4 female speakers of Kigwema dialect and 2 male and 2 female speakers of Viswema dialect. The speakers’ age range was 20 to 50 years and all speakers resided in the village. All speakers have high school as the minimum education and thus could read the text provided for them to read.

As for the sociolinguistic interview, data was collected from 6 male and 1 female speaker from Kigwema village;
3. PRELIMINARY OBSERVATIONS

While extensive acoustic analysis of the large database is in progress, in the following subsections, we report the preliminary results of segmental and supra-segmental characteristics of Southern Angami. Specifically, two sets of files containing the 208 Swadesh words and seventy commonly used lexical items including vegetables and agricultural items were chosen for reporting in this work. Again, acoustic analysis reported here is only from two male and two female speakers of the Kigwema dialect and two male and one female speaker of the Viswema dialect. A total of 278 target words in three sentential environments, from two dialects yielded 1,248 tokens. The tentative observations from speech data of seven speakers from the two dialect is reported in the following subsections.

3.1. Consonant inventory

The number of consonants in the speech of the two dialects is 32 in total, however, the consonants are not equally distributed. Kigwema dialect has 31 consonants whereas Viswema has 32 consonants. Aspirated alveolar lateral /lʰ/ and aspirated alveolar affricate /tsʰ/ are consonants found only in the Kigwema dialect. There are eight stop consonants, five affricates, six fricatives and six nasals in the two dialects. One noticeable feature of the Angami consonants is the presence of aspiration in nasals and laterals. Like the lateral aspirate, nasals /m/ and /n/ also have aspirated counterparts. On the other hand, there are two consonants appearing in the the two dialects whose phonological classification is not yet confirmed. Hence, the sounds have been termed as /XG/ and /XK/. The sound /XG/ is yet to be determined as it overlaps with voiced velar /g/ and uvular stops /G/ in both the dialects whereas the sound /XK/ overlaps with voiceless velar /k/ and voiceless uvular /q/ in Viswema dialect. The frequency distribution of the consonants belonging to the two dialects are shown in Figure 4. In our database, the most frequently occurring consonant is the alveolar nasal /n/ in Kigwema dialect whereas in Viswema dialect voiceless bilabial plosive /p/ is most frequently occurring.

3.2. Vowel inventory

From the database, we ascertained that there are 6 vowels occurring in both the dialects. In addition to that, there are few diphthongs in both the dialects but it is not discussed in this paper and only monophthongs are reported here. The frequency distribution of the vowels belonging to the two dialects is shown in Figure 5. The most frequent vowel is open front-low vowel /a/ in Kigwema dialect and close front high vowel /i/ in Viswema dialect. In fact, this contrast is a common knowledge among southern Angami speakers. In practice, this knowledge utilized by southern Angami speakers to identify the dialects of native speakers.

Table 1. Distribution of speakers based on dialects

<table>
<thead>
<tr>
<th>Dialects</th>
<th>No. of Males</th>
<th>No of Females</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kigwema</td>
<td>30</td>
<td>15</td>
<td>45</td>
</tr>
<tr>
<td>Viswema</td>
<td>16</td>
<td>11</td>
<td>27</td>
</tr>
</tbody>
</table>

2.4. Annotation of data

Speech data collected for this database was annotated manually, using Praat. An example of an annotation is shown in Figure 3. Annotation consisted of four tiers, namely, phoneme, word, tone and sentence tiers.
In order to examine the distinctive characteristics of the vowels, an acoustic study has been conducted. For this purpose, first two formant frequencies for each vowel were measured. While the first formant (F1) frequency gives information about vowel height, the second formant (F2) frequency provides information on vowel backness [15]. Both F1 and F2 frequencies of the vowels are calculated at vowel midpoint. After extracting the vowel formants, vowel plots are generated using average formant frequencies of all the vowels. Figure 6 shows the vowel plots generated by taking the average formant frequencies of all the vowels.

The vowel plot in Figure 6 shows that Kigwema dialect has larger vowel space than Viswema dialect. Sex differences in the vowel space is also captured in the vowel plots. In both the dialects, the male speakers tend to have smaller vowel space than the female speakers. Similar observations for vowel space have also been attested cross-linguistically [16].

From Figure 6 it is clear that there is a marked difference between the vowel spaces of the two varieties, namely Kigwema and Viswema. This difference in vowel space may also be a result of rate of speaking or stress differences between the two dialects. However, more analysis is required to come to a definitive conclusion regarding this.

In order to see the individual vowel token distribution in the F1–F2 space, we also plotted the formant values normalized for speaker effects using the Lobanov normalization method [17]. The normalized vowel plot is shown in Figure 7, where, the central tendency of the vowel along with ellipses showing one standard deviation of the formant values is repre-
sented. Generally, the figure shows that in both varieties, the six vowels have distinct formant frequencies as ascertained by non-overlapping ellipses. However, a close examination of the Viswema vowel plot shows overlapping of the ellipses for /a/ and /u/. This may be because of a dialect specific vowel change that must have occurred in one of the two varieties under investigation in this study. This suspicion is further confirmed by the statistics of vowel frequency distribution as seen in Figure 5. The figure clearly shows inverse distribution of the vowels /a/ and /u/ in Kigwema and Viswema. While, Kigwema has about 16.15% /u/ vowels, Viswema has only about 4.01% /u/ vowels. On the other hand, while Kigwema has about 7.33% /a/ vowels, Viswema has about 16.07% /a/ vowels. From the analysis of the formants and from the descriptive statistics available for the distribution of the vowels for the two varieties of Southern Angami, it can be assumed that there there are potential vowel differences between the two varieties.

Fig. 7. Normalized vowel plots of the two dialects

3.3. Tone inventories

Angami language is a tonal language and it is described to have five tones [11, 10, 5, 6]. However, there are reports from Kohima village and Khonoma variety that there are only four tones [12, 18]. In order to ascertain the distribution of distinct tones in Southern Angami, tone data was also collected and analyzed. The finding shows that there are four distinct tones Southern Angami. Four distinct F0 tracks for tones as produced by one speaker each from Kigwema and Viswema varieties are shown in Figure 8 and Figure 9. As the types and distribution of tones in the two southern Angami dialects is not confirmed as of now, the annotators have marked the four distinct tones heard by them while annotating as T1, T2, T3, T4. T1 and T4 are high and low tones respectively. Figure 8 and Figure 9 confirm that the two varieties, namely, Kigwema and Viswema, do not differ in terms of the number and types of tones. Though the inventories of tones are similar, the frequencies of tone vary from dialect to dialect as shown in Figure 10. T3 has the highest occurrence (53.3% in Kigwema dialect and 56.78% in Viswema dialect) in both the dialects and T1 has the lowest occurrence (2.71% in Kigwema dialect and 0.24% in Viswema dialect). Hence, we assume that there may be dialectal variations in the emergence of tones in Southern Angami varieties, which will need further in-depth analysis.

Fig. 8. F0 tracks of four tones as produced by one speaker of Kigwema variety

Fig. 9. F0 tracks of four tones as produced by one speaker of Viswema variety

4. SUMMARY

This study reported the creation of a speech database for two Angami varieties to understand the dialectal differences. Data was collected from two Southern Angami villages namely, Kigwema and Viswema, in order to study the acoustic correlates of dialectal differences in terms of consonants, vowels and tones. Our initial analysis did show a difference in the types and distribution of consonants in the two varieties. Similarly, in case of vowels, the vowel spaces of the two varieties did show some differences, indicating possible differences in vowel realization due to stress or rate of speaking differences distinct to each variety. While tones need more cross dialectal analysis, we have reported our initial findings regarding the acoustics of tones in the Southern Angami varieties. Acoustic characterization has contributed in making decisions regarding dialect specific phonetic features in this study. However,
the descriptive statistical analyses obtained for the distribution of phonetic features have considerably aided in pinpointing the phonetic features potentially responsible for dialectal differences.

5. ACKNOWLEDGEMENTS

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6. REFERENCES


