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LANGUAGE AND LANGUAGE TEACHING JOURNAL (LLT Journal), to appear twice a year (in February and October) for teachers and students, is published by the English Education Study Program, Faculty of Teachers Training and Education, Sanata Dharma University. This journal welcomes articles on language and language teaching.

Editorial

LLT Journal this edition presents six selected articles covering various fields and topics related to language learning-teaching, and linguistic analysis. In the first article, Wulandari presents the Moodle features that were selected according to the suitability with the theory of paragraph writing as well as with the CALL principles and Gagne's nine events of instruction. Next, Nurhartanto discusses recast may be effective for students with certain dominance of learning strategies. In the third article, Isrokijah proposes problem-based learning (PBL) worksheets for the eighth grade students at junior high school. Afterwards, Veniranda's discussions on the acoustic properties of the oral and nasal vowels, in terms of the values of the formants, the fundamental frequencies, the anti-formants, the intensity, and the bandwidths show that there are changes of the average values of all the properties. Sihombing et all reveal the errors students make in writing and propose solution to the errors the students make for a better English language teaching and learning especially in teaching English for adults. Then, Ekaningrum and Prabandari's study discusses the varieties of pre-reading activities used by a particular teacher. They are brainstorming, pre-teaching vocabulary, pre-questioning, visual aids, and KWL strategy. The study further reveals the perception of the students on the strategies.

Oral and Nasal Vowels in Pontianak Teochew

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Abstract

The purpose of the study is to analyze the acoustic properties of the oral and nasal vowels, in terms of the values of the formants, the fundamental frequencies, the anti-formants, the intensity, and the bandwidths. The data were recorded and analyzed using the Praat program. The results show that there are changes of the average values of all the properties. The fundamental frequencies of the nasal vowels are all higher than their counterpart oral vowels. The hypothesis is correct for this acoustic property. However, by the test of significance t-test, only the nasal [ã] and diphthong [ũã] have significantly higher frequencies. The results of the average of intensity show that nasal vowels/ diphthongs may not always have higher intensity than their counterpart oral vowels/ diphthongs.

Keywords: *oral vowels, nasal vowels, formants, fundamental frequencies, anti-formants,intensity,bandwidths*

A. INTRODUCTION

In Teochew, one of the Min Chinese dialects, some nasal and oral vowels are phonemic. Some of them differ only on the nasality, and some on the nasality and tone. This study investigates two vowels, i.e. [i], [a], and a diphthong [ua] in the language. The purpose of the study is to analyze the acoustic properties of the oral and nasal vowels, in terms of the values of the formants, the fundamental frequencies, the anti-formants, the intensity, and the bandwidths. Due to damping effects of nasality, a preliminary hypothesis is that the bandwidth and fundamental frequency values are higher for nasal vowels than oral vowels. Since the air flows from both the oral and nasal cavity, there is a need of more energy, and thus the intensity is hypothesized to be higher in the nasal than the oral vowels. For high vowels, it is hypothesized that in the nasal vowels, there is a tongue lowering, so it will be shown by the increase of F1 values, while for the low vowel, there is a tongue raising, so the F1 values will decrease. The data were recorded and analyzed using the Praat program. This study is interesting as there is not yet any analysis on the nasal vowels of this dialect.

B. THE METHODS

The following two sections describe the data and the analysis of the data in this study.

1. The Data

The sample speaker in this study is female, from West Kalimantan, Indonesia. The data consist of three sets of oral and nasal vowels: [i]'aunt' and [ĩ] 'round,' [ua] 'postpone,' and [ũa] 'snore,' [a]'debate' and [ã]'take control over.' The first two sets have the same tone in the pairs. The third set has a different tone. There are 20 tokens of each vowel, and spoken in a carrier sentence [ua to tiap …

tsai me]?'I am typing ...do you know?' The results are 120 tokens of sounds to analyze. The recordings were done using the sound recorder in the Praat program, recorded as mono sounds, and the sampling frequency is set at 22,050 Hz, and then re-sampled at 20,000 Hz, to get the Nyquist frequency of 10,000 Hz. It is done by: Select the sound, select 'Convert,' and select 'Resample,' then change the frequency to 20,000. To reduce the noise and to have a better quality of sounds, the recording was done in the Phonology lab of Department of Linguistics and Cognitive Science. The sound files are saved as WAV files. Each file contains 10 tokens, so for each vowel, there are two files. To analyze the spectral slice to obtain the anti-formants, the sounds were re-sampled at 10,000 Hz, to obtain the Nyquist frequency of 5,000Hz.

2. The Analysis

The data were analyzed using the Praat program. To obtain the values of the fundamental frequencies, the intensities, the first three bandwidths and the first three formant values, for each token, the log setting is:

a. Extract the vowel from the carrier sentence
b. Select the sound, select 'Query,' select 'Log setting'
c. Type in the Log File 1: C:\Users\Veni\Desktop\oral and nasal vowels.txt
d. Type in Log 1 Format:
   Time 'time:2' seconds 'tab$' F0 'f0:2''tab$' amplitude 'intensity:2''tab$' bandwidth1 'b1:2''tab$' bandwidth2 'b2:2''tab$' bandwidth3 'b3:2''tab$' formant1 'f1:2''tab$' format2 'f2:2''tab$' formant3 'f3:2''tab$'

e. Place the cursor at the mid-point of the vowel/diphthong
f. Press Fn + F12, and check if all the values are recorded in the log file.

The numbers after the colon show the number of decimals for the values. The 'tab$' sets the numbers in different columns and so it can be directly paste in the Excel sheets. The diphthongs are considered as one unit, so the measurements are also obtained from the mid-points of the whole diphthongs.

After all the values of the 120 tokens were obtained, a check on the extreme outliers was done. These outliers were deleted. Then the average of each of the acoustic properties for each vowel was calculated. A t-test was performed for each pair of nasal-oral acoustic properties, e.g. the F0 values of oral [i] were compared to those of the nasal [ĩ], the b1 values of the oral [i] were compared to those of the nasal [ĩ], etc.

The results of these calculations are shown in tables, and in the discussion, the spectrograms, the LPC Smoothed spectra, and Cepstrally Smoothed spectra are shown to illustrate the difference between the nasal and oral vowels.

C. PREVIOUS STUDIES ON NASALIZED OR NASAL VOWELS

The term nasal vowel rather than nasalized vowel is used to indicate that the nasal vowel is phonemic (Reetz and Jongman 2009, p.47). Examples of nasalized vowels that are not phonemic are in American English, such in the words like ban and bad, or pink and pig. These are instances of anticipatory co-articulation. Carignan et.al. (2011) hypothesized that for the nasalized vowels in American English, the speaker will adjust the tongue height in order to compensate for the acoustic effect of nasalization. For the change of the height of the tongue, it is the values of F1 that are affected. They hypothesized that the evidence of enhancement might include lowering tongue position during nasalized [ĩ] and so raising F1, and higher tongue position during nasalized [ã], which means lowering F1.

Beddor et.al. (1986, p.3) stated that there are cross-language patterns of nasal vowels raising and lowering:

a. High (contextual and non-contextual) nasal vowels are lowered (e.g. nasalization lowers [i] and [u] in Bengali, Ewe, Gadsup, Inuit, and Swahili).
b. Low (contextual and non-contextual) nasal vowels are raised (e.g. nasalization raises [a] in Breton, Haida, Nama, Seneca, and Zapotec).

Manyah (2011) studied a Twi Language and stated that acoustic evidence shows that the F2 values are generally lower for the nasal vowels than the oral vowels, particularly for the high front vowels [i] and [ɪ]. They found that this does not apply to the low vowel [a] and high back vowels [u] and [ʊ]. They concluded that the degree of nasality,and for that matter nasal-oral contrast, depends on thevowel type. Acoustic investigations further revealthat nasal vowels are more widely dispersed than theoral vowels in phonological space.

Kelm (1989) studied the phonemic [a] and [ã] in Brazilian Portuguese and found that the average formant frequencies of the oral tokens are similarto those from previous studies of the same language (Nobre&Ingemann 1987). Their findings show that the difference between the oral and nasalized averages is found in the decreased first formant frequencies of the nasalized vowels. Kelm said that the lower F1 averages confirm that the vowel raising is brought on by nasalization, similar to that of phonemic nasality. In addition to the vowel raising, the second formant frequencies of the nasalized vowels are somewhat higher than the oral vowels, suggesting a more fronted pronunciation.

Reetz and Jongman (2009, p. 185) describe the difference between oral and nasal vowels as follows: “Compared to an oral vowel, a nasal vowel typically shows greater formant bandwidths, lower overall amplitude, a low-frequency nasal formant, and one or more anti-formants.”

There are different authors stating that in the articulation of a nasal vowel, there is a lowering of a high vowel and a raising of a low vowel. The findings are similar in different languages, as the acoustic correlate F1 in a nasal vowel increase for a high vowel and decrease for a low vowel. In the following section, the results of the analysis will show if Teochew nasal vowels are similar those of previous studied languages.

D. THE RESULTS AND DISCUSSIONS

The raw data of the values of F0, intensity, bandwidths 1-3, and formants 1-3 are edited by deleting the outliers, i.e. the values that are too much higher or lower than the average. The data can be seen in the Appendix (Appendix 1 and 2). The average of the values is listed in the table 1. The symbols ‘<’ means lower, and ‘>’ means higher, which indicate the relation between the oral and the nasal vowels. The different shades of grey will be explained later in the following paragraph.

The results show that there are changes of the average values of all the properties. The fundamental frequencies of the nasal vowels are all higher than their counterpart oral vowels. The hypothesis is correct for this acoustic property. However, by the test of significance t-test, only the nasal [ã] and diphthong [ũã] have significantly higher frequencies. The results of the t-test are discussed in more details later, but for now, the results of the test that shows significant difference are indicated by darker grey shading in table 1.

The results of the average of intensity show that nasal vowels/ diphthongs may not always have higher intensity than their counterpart oral vowels/ diphthongs. The intensity between the [i] and [ĩ] is only slightly different, and as indicated by lighter grey shading, the difference is not significant. The intensity of the nasal [ã] is significantly higher than [a], but the intensity of [ũã] is significantly lower than [ua]. The hypothesis that nasal intensity is higher is correct only for the low vowel [ã].

A preliminary hypothesis is that the bandwidths values are hypothesized as higher for nasal vowels than oral vowels.This hypothesis is not all correct. Of the nine bandwidth values, six of them show that the nasal vowels/ diphthong have higher, but only three of them are significantly higher. All the bandwidths of nasal [ĩ] are higher than oral [i], but only the first one is significantly higher. To be significantly different, the difference has to be more than 200 Hz. The first and second bandwidths of [ã] are lower, even the second bandwidth is significantly lower, which is the opposite of the hypothesis. The third bandwidth of [ã] is insignificantly higher than [a]. The first and third bandwidths of [ũã] are significantly higher than the oral [ua]. The second bandwidth of [ũã] is lower than [ua].

The hypothesis of the first formant (F1) values is correct for the high front vowel [i], and the low vowel [a]. In the nasal high vowel, there is a tongue lowering that results in the increase of average F1 values, while for the low vowel, there is a tongue raising that results in decrease of the average F1 values. The results show that it is not only the F1 that increase for [ĩ] and decrease for [ã], but F2 and F3 pattern the same for these high front and back low vowel. It means that nasality also affects the backness and roundness of the vowels. The table shows the increase of all F1, F2, and F3 of the nasal [ĩ] and the decrease of the nasal [ã], although not all of them are significantly different. These results show that in Teochew, the phenomenon of tongue lowering and raising that affect the F1 also apply and they are both significantly different for the two vowel [ĩ] and [ã].

Vowels	ACOUSTIC PROPERTIES							
	F0 in Hz	Intensity in dB	b1 in Hz	b2 in Hz	b3 in Hz	F1 in Hz	F2 in Hz	F3 in Hz
Oral [i]	225.40f	65.54	110.23	192.35	451.55	384.47	2783.45	3412.09
Nasal [ĩ]	229.04	66.91	358.65	303.58	610.16	529.08	2852.67	3954.08
Oral to Nasal	<	<	<	<	<	<	<	<
Oral [a]	150.75	68.36	324.85	325.80	602.51	1014.33	1619.28	3022.72
Nasal [ã]	231.17	72.89	302.40	96.40	786.23	883.82	1612.89	2999.58
Oral to Nasal	<	<	>	>	<	>	>	>
Oral [ua]	233.26	77.71	158.32	178.03	414.41	903.57	1402.234	2483.21
Nasal [ũã]	239.36	73.67	615.04	165.63	1219.32	866.87	1245.39	3121.52
Oral to Nasal	<	>	<	>	<	>	>	<

Table 1 The results of the average of the F0, intensity, bandwidths, and the formants.

A preliminary hypothesis is that the bandwidths values are hypothesized as higher for nasal vowels than oral vowels. This hypothesis is not all correct. Of the nine bandwidth values, six of them show that the nasal vowels/ diphthong have higher, but only three of them are significantly higher. All the bandwidths of nasal [ĩ] are higher than oral [i], but only the first one is significantly higher. To be significantly different, the difference has to be more than 200 Hz. The first and second bandwidths of [ã] are lower, even the second bandwidth is significantly lower, which is the opposite of the hypothesis. The third bandwidth of [ã] is insignificantly higher than [a]. The first and third bandwidths of [ũã] are significantly higher than the oral [ua]. The second bandwidth of [ũã] is lower than [ua].

The hypothesis of the first formant (F1) values is correct for the high front vowel [i], and the low vowel [a]. In the nasal high vowel, there is a tongue lowering that results in the increase of average F1 values, while for the low vowel, there is a tongue raising that results in decrease of the average F1 values. The results show that it is not only the F1 that increase for [ĩ] and decrease for [ã], but F2 and F3 pattern the same for these high front and back low vowel. It means that nasality also affects the backness and roundness of the vowels. The table shows the increase of all F1, F2, and F3 of the nasal [ĩ] and the decrease of the nasal [ã], although not all of them are significantly different. These results show that in Teochew, the phenomenon of tongue lowering and raising that affect the F1 also apply and they are both significantly different for the two vowel [ĩ] and [ã].

The results of the nasal diphthong [ũã] for the F1 and F2 are similar to the low vowel [a], i.e. the average values decrease. A possible explanation for this is that in the articulation of the diphthongs, the onset [ũ] is shorter than the second element [ã] of the diphthongs. The first consideration to choose this diphthong was intended to look at it as representing [u] rather than [a]. The results show that the mid points of the diphthongs carry the features of the [ã] rather than [u]. There is a slight tongue raising (thus F1 decrease) and a slight backing (thus F2 decrease). However, the diphthong [ũã] is different from [ã] for the F3 values, as there is an increase of F3 average of [ũã], which means the articulation is more spread or less round for the nasal diphthong.[1]

The results of the t-test is in the following table, with the significant values printed bold. It is two-tailed and type 2, at $p<0.05$.

[1]I wonder if the measurement has to be on the 10% -25% of the beginning part of the diphthong, rather than the mid-point to obtain the features of [u].

	F0	Intensity	b1	b2	b3	F1	F2	F3
[i] - [ĩ]	0.17	0.054	**6.50E-10**	0.39	0.32	**1.61E-07**	0.119	**2.46-08**
[a] - [ã]	**2.01E-25**	**0.0017**	0.70	**2.55E-07**	0.23	**0.002**	0.89	0.90
[ua] - [ũã]	**4.50E-05**	**2.69E-07**	**0.0002**	0.78	**0.0057**	0.18	**7.41E-05**	**1.74E-05**

Table 2 The t-test of values to show the significance at p<0.05

The following are the conclusions from the significance test:

a. For all the acoustic properties, the nasal [ĩ] has all higher values than the oral [i]. It is the b1, F1, and F3 that are significantly higher.
b. The f0 and intensity of nasal [ã] are significantly higher than [a], but b2 and F1 of [ã] are significantly lower than [a].
c. The nasal [ũã] has significantly higher f0, b1, b3, F2, and F3 than [ua], but [ũã] has significantly lower intensity and F2. The F1 of the nasal diphthong [ũã] is insignificantly lower than [ua].

By using the log system in the Praat program, the precise values of these acoustic correlates of the vowels can be obtained. One way to visualize the difference between the pairs of vowels in the formant values is by the spectrograms. The following is a comparison of sample tokens of the oral [i], which has lower formant values than the nasal [ĩ].

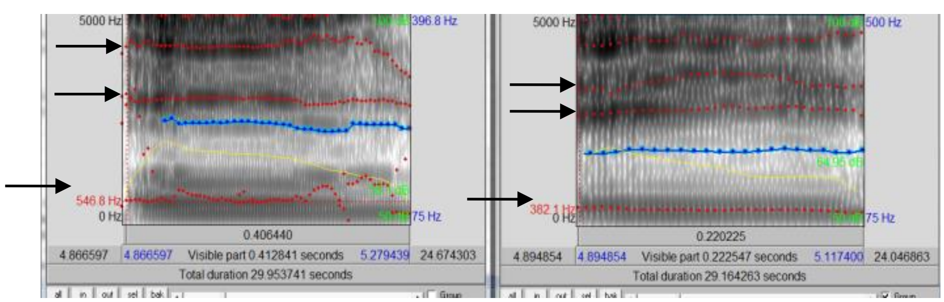


Figure 1 The formants F1, F2, F3 of nasal [ĩ](left) higher than and oral [i] (right)

To compare the formants, LPC Smoothing is better, as it can specify how many formants needed.The LPC smoothing of the pair of nasal and oral vowels are as follows, showing the nasal [ĩ] has higher formant frequencies. The following are the LPC Smoothing of the sample tokens of the oral-nasal vowels that represent the comparison of the formant values:

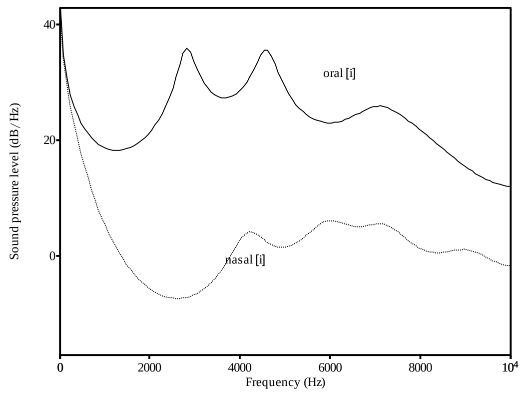


Figure 2: LPC Smoothed spectra of nasal [ĩ] and oral [i]: F1, F2, F3 of nasal [ĩ] > oral [i].

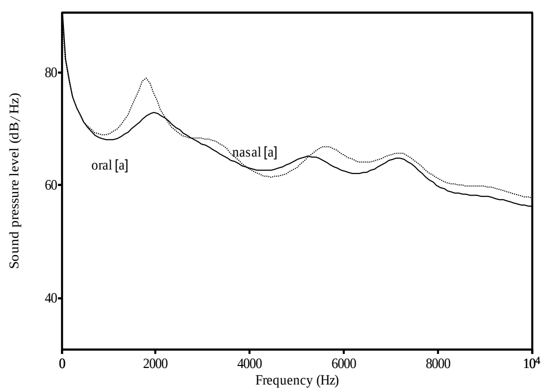


Figure 3 LPC Smoothing of nasal [ã] and oral [a]: F1, F2, F3 of nasal [ã] < oral [a].

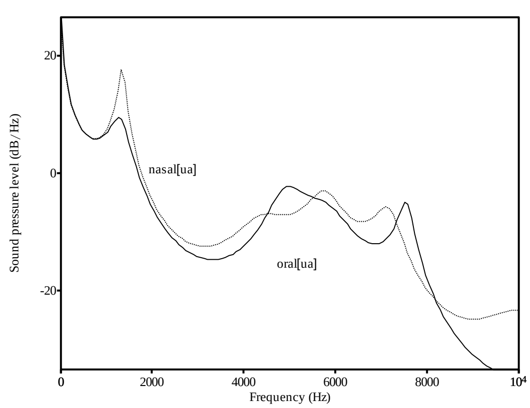


Figure 4: LPC Smoothed spectra of nasal [ũã] and oral [ua]: F1, F2 of [ũã]>[ua], F3 of [ũã] < [ua]

There are different techniques to measure the anti-formants, or nasal zero frequencies. Using Praat, Boersma (2005) said that it has to be done by hand. His instruction is as follows:

> 'In the sound window, you select the nasal time stretch, then choose "View spectral slice". In the spectrum window that pops up, you position the cursor at the location where you judge the zero to be. The cross hair will show both the frequency and the intensity (if you report the intensity, you first compare it with that of the neighboring peaks).'

In this study, the procedure to obtain the anti-formants or the zeroes was done by combining the instruction above with a previous study on nasals by Qi (1989), who applied the Cepstral Smoothing, but not by Praat program. The difference between LPC smoothing and Cepstral Smoothing is that with the Cepstral Smoothing, there is a sharper dip than the LPC Smoothing. Therefore, to obtain the anti-formant/ zero, this type of smoothing is better.

The steps are as follows:

a. Select the sound, then 'Convert,' then 'resample' at 10,000 Hz. The Nyquist frequency is 5,000 Hz. As the anti-formants are between F1 and F2 or F2 and F3 (Johnson 2012, p.194-195), the highest three first formant frequencies of all vowels are not more than 4,000, so this sample size is sufficient.
b. Select the new sound, then 'view and edit,' then on the top of the window that pops up, select 'spectrum,' and there appear different options, select 'view spectral slice.' Make sure the cursor is at the mid-point before clicking 'view spectral slice.'
c. On the Praat objects, there is a new file of the spectrum.
d. Select the spectrum file, then select the 'Cepstral Smoothing.' The new file is the result.
e. Select this file, then 'view and edit,' put the cursor at the dip to get the frequency. Take notes of this frequency manually as this is the anti-formant frequency.
f. Repeat steps b, c, d, and e for all other tokens of vowels.

The following is the result of a sample token of the Cepstral Smoothing. The left is the spectral slice, and the right the result of the Cepstral Smoothing.

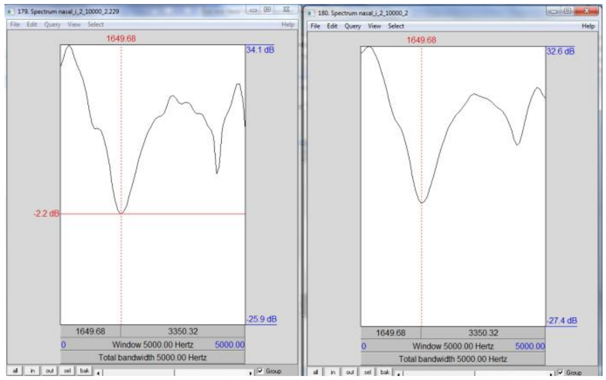


Figure 5 The spectral slice (left) and the Cepstrally smoothed spectra (right) of nasal [ĩ]

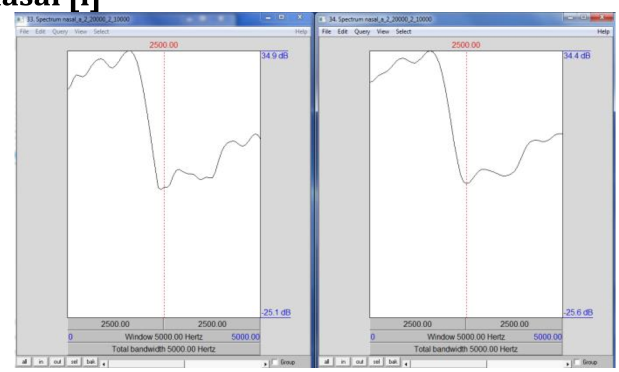


Figure 6The spectral slice (left) and the Cepstrally smoothed spectra (right) of nasal [ã]

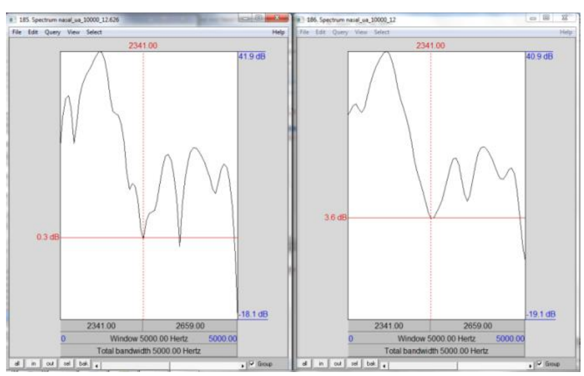


Figure 7 The spectral slice (left) and the Cepstrally smoothed spectra (right) of nasal [ũã]

The results of the average of the dips in the Cepstrally Smoothed spectra of the three nasal vowels/ diphthong are as in table 3.

AVERAGE		
AF nasal [ĩ]	AF nasal [ã]	AF nasal [ũã]
1669.93	**2604.80**	**2721.14**

Table 3 The Average of the Anti-formant Values

The average of the anti-formant of the nasal [ĩ] is between F1 and F2, and for nasal [ã] and [ũã], the anti-formants are between the F2 and F3 of the vowels. Like the previous measurements of the diphthongs, the average of it is also similar to the one of [ã]. The mid-points of the diphthongs are so much of the [ã] features. In this measurement, the tokens that were deleted in the calculations of the previous acoustic properties (f0, bandwidths, and formants) were not included in the measurements of the anti-formants either. The skipped tokens are represented as blank in the table in Appendix 3.

E. CONCLUSIONS

The results of this study show that there are acoustic differences between the oral and the nasal vowels/ diphthong. The generalization of the different acoustic properties between nasal and oral vowel/diphthong has to be formulated differently for different vowels/ diphthongs. Similar to previous studies, Teochew also has the F1 of the nasal high front [ĩ] that is significantly higher than the oral [i]. The F1 of the nasal low vowel [ã] and diphthong [ũã] are significantly lower than the oral [a] and [ua] respectively.

LPC Smoothing was used to show the formants, and Cepstral Smoothing was used to show the anti-formants.

This study does not consider the effect of different tones on the acoustic properties of the vowels. The assumption is that tones affect the pitch. Further study can investigate oral and nasal [i] and [ua] of different tones to see if the results are consistent with the results found in this study, which investigates the pairs of the vowels of the same tones.

REFERENCES

Beddor, Patrice Speeter., Krakow, Rena Arens.,Goldstein, Louis M.. 1986. “Perceptual Constraints and Phonological Change: A Study of Nasal Vowel Height.” *Phonology Year Book Vol 3.*

Carignan, Christopher.,Shosted, Ryan., Shih, Chilin., Rong, Panying. 2011. “Compensatory 0-articulation in American English nasalized vowels.” *Journal of Phonetics* 39 (2011) 668–682.

Chang, Yung-hsiang Shawn. 2008. “An Acoustic and Perceptual Study of Vowel Nasality in Taiwanese.“*USTWPL4*: 17-26.Urbana-Champaign: Department of Linguistics University of Illinois.

Glass, James Robert. 1984. *Nasal Consonants and Nasalized Vowels: An Acoustic Study and Recognition Experiment.* A Master of Science and Electrical Engineering Thesis. Cambridge: MIT.

Heinz, Jeffrey. 2012. *Acoustic and Auditory Phonetics*. Lecture Notes. University of Delaware.

Johnson, Keith. 2012. *Acoustic and Auditory Phonetics*. 3rd Edition. Malden: Wiley-Blackwell.

Kelm, Orlando R. 1989. "Acoustic Characteristics of Oral vs. Nasalized /a/ in Brazilian Portuguese: Variation in Vowel Timbre and Duration." *Hispania*, Vol. 72, No. 4 (Dec., 1989), pp. 853-861. American Association of Teachers of Spanish and Portuguese (URL: http://www.jstor.org/stable/343563 (Accessed: 10/03/2012).

Manyah, Kofi Adu. 2011. "Oral-nasal vowel contrasts: new perspectives ona debated question." ICPhS XVII Regular Session. Hong Kong, 17-21 August.

Qi, Yingyong. 1989. *Acoustic Features of Nasal Consonants*. A Dissertation. Ohio State University.

Reetz, Henning., and Jongman, Allard. 2009. *Phonetics: Transcription, Production, Acoustics, and Perception.* Malden: Wiley Blackwell.

Spears, Abby. 2006. *Nasal Coarticulation in French Vowel /i/: A Phonetic and Phonological Study.* An MA Thesis. Chapel Hill: Department of Linguistics University of North Carolina.

Websites:

Boersma, Paul. 2005. http://uk.groups.yahoo.com/group/praat-users/message/1922 Nasal zero frequency measure.

APPENDIX 1: The Log Data (The shaded tokens are to be deleted as they are outliers)

ORAL [i]	F0	Intensity	b1	b2	b3	F1	F2	F3
Time 2.28 seconds	224.68	64.66	72.22	96.26	301.32	411.08	2744.06	3415.56
Time 5.17 seconds	230.81	64.7	105.34	83.45	225.27	387.25	2727.89	3468.56
Time 8.09 seconds	230.96	64.31	101.75	49.79	178.95	385.5	2766.8	3436.89
Time 10.62 seconds	215.76	63.34	69.84	61.57	489.95	362.28	2779.66	3509.03
Time 13.59 seconds	215.34	65.68	57.07	188.04	522.03	390.6	2770.22	3400.95
Time 16.26 seconds	208.77	63.18	292.5	417.4	567.69	386.09	2858.3	3437.59
Time 19.59 seconds	222.02	69.4	80.46	125.79	212.73	394.27	2683.01	3264.37
Time 22.24 seconds	217.66	62.31	92.83	446.14	1128.89	371.8	2826.12	3396.72
Time 25.41 seconds	218.57	65.89	**51**	322.94	401.67	417.42	2691.49	3281.49
Time 28.61 seconds	220.96	65.35	93.13	139.43	357.11	391.74	2797.19	3338.91
Time 2.48 seconds	242.52	70.68	120.28	174.98	145.92	453.12	2798.49	3415.56
Time 5.01 seconds	224.62	63.66	106.14	161.64	208.63	369.54	2815.36	3604.64
Time 7.60 seconds	232.83	66.35	111.47	67.29	335.94	350.98	2788.75	3433
Time 10.18 seconds	231.06	67.01	105.1	93.15	236.79	407.28	2794.49	3419.73
Time 12.88 seconds	221.56	65.69	84.63	1108.2	**73.26**	338.52	2584.3	2869.41
Time 15.50 seconds	218.55	64.39	87.67	83.77	475.9	377.5	2831.82	3637.53
Time 17.94 seconds	242.32	69.39	132.2	105.65	302.94	383.97	2871.51	3376.23
Time 20.99 seconds	219.28	62.29	83.64	263.36	444.04	362.09	2756.94	3324.25
Time 23.61 seconds	227.42	66.77	184.25	147.43	1506.45	338.4	2824.47	3129.01
Time 26.29 seconds	231.58	66.23	88.19	757.19	487.29	397	2666.93	3409.08
AVERAGE	**224.8635**	**65.564**	**105.9855**	**244.6735**	**430.1385**	**383.8215**	**2768.89**	**3378.426**

NASAL [ĩ]	F0	Intensity	b1	b2	b3	F1	F2	F3
Time 2.23 seconds	231.48	70.88	279.42	504.78	2665.43	434.78	2844.39	3119.26
Time 5.09 seconds	221.48	67.12	377.55	148.62	555.47	545.77	2831.7	4020.03
Time 7.89 seconds	230.3	68.61	418.48	161.91	668.61	530.16	2935.71	3793.59
Time 10.65 seconds	230.14	67.77	358.13	253.71	466.93	667.66	2980.62	3721.9
Time 13.48 seconds	228.98	66.33	539.05	143.18	687.53	528.44	2948.3	3831
Time 16.26 seconds	227.03	65.88	543.6	137.03	395.91	619.02	2910.49	3973.89
Time 19.34 seconds	227.83	66.17	346.17	148.22	201.51	493.18	2815.21	4028.57
Time 22.33 seconds	239.41	66.39	277.74	139.21	479.49	521.81	2915.79	3814.78
Time 25.37 seconds	230.29	67.06	490.16	116.21	479.41	577.62	2772.39	4012.72
Time 27.95 seconds	216.73	68.91	468.56	162.28	433.73	343.2	2825.87	3946.96
Time 2.23 seconds	228.32	65.09	173.37	108.01	216.48	480.85	2965.4	4193.93
Time 5.07 seconds	229.11	66.31	340.66	**59.82**	207.36	556.81	2977.08	4208.48
Time 7.98 seconds	229.1	65.25	227.08	177.67	812.13	519.42	2947.28	4250.14
Time 10.54 seconds	222.66	65.43	291.7	170.61	483.34	483.89	2950.92	4212.4
Time 13.27 seconds	227.11	66.99	271.3	192.81	1241.88	563.45	2904.89	4191.78
Time 15.94 seconds	239.69	69.37	237.65	202.05	176.53	549.54	2887.32	4289.92
Time 18.80 seconds	240.47	66.11	278.57	136.93	366.19	553.24	2889.4	4256.96
Time 21.87 seconds	237.69	65.56	270.75	**2616.68**	790.04	528.86	2238.19	3605.86
Time 24.81 seconds	226.29	65.63	477.13	217.89	374.2	629.9	2830.58	4020.5
Time 27.83 seconds	225.35	65.44	400.03	2343.23	278.03	481.52	2191.83	3495.18
AVERAGE	**229.473**	**66.815**	**353.355**	**407.0425**	**599.01**	**530.456**	**2828.168**	**3949.393**

ORAL [a]	F0	Intensity	b1	b2	b3	F1	F2	F3
Time 2.09 seconds	172.42	71.01	370.13	263.41	377.8	913.39	1517.51	2497.7
Time 4.75 seconds	156.13	72.5	192.69	**841.63**	**2214.48**	1109.43	1782.56	2372.55
Time 7.40 seconds	159.41	69.56	435.37	229.02	329.52	1112.81	1553.58	2464.64
Time 9.95 seconds	147.19	69.19	201.85	183.51	270.52	1039.59	1564.49	2406.75
Time 12.46 seconds	157.74	62.05	487.54	422.73	118.73	926.06	1443.45	2445.59
Time 14.90 seconds	138.18	68.51	259.02	185.09	190.75	1063.38	1494.44	2383.21
Time 17.49 seconds	146.1	64.34	129.46	258.88	227.27	853.37	1767.09	2357.43
Time 20.04 seconds	147.51	64.13	343.2	250.89	544.11	908.3	1503.84	2398.65
Time 22.52 seconds	164.58	65.23	255.04	178.51	1013.86	858.28	1423.07	3135.79
Time 25.27 seconds	141.92	57.29	299.66	237.75	211.39	932.68	2099.64	4192.05
Time 2.23 seconds	144.6	67.79	352.69	966.7	450.31	1080.45	1264.82	2301.25
Time 5.01 seconds	162.83	61.91	851.53	440.84	505.36	1023.17	1545.01	2291.91
Time 7.58 seconds	137.93	71.06	176.55	253.43	435.94	1116.81	1843.96	**4080.62**
Time 10.21 seconds	147.12	68.04	249.2	552.34	178.9	1193.54	1693.6	4134.25
Time 12.89 seconds	139.85	76.47	375.89	556.27	878.82	1063.08	1916.37	3196.99
Time 15.76 seconds	140.2	72.44	220.49	456.97	475.03	1031.95	1635.2	3762.75
Time 18.96 seconds	155.17	74.06	209.62	184.53	1125.78	982.14	1431.7	3746.1
Time 21.56 seconds	150.01	72.95	282.57	364.38	2111.96	1094.31	1564.57	3415.02
Time 24.32 seconds	146.71	66.95	90.66	162.08	411.28	846	1343.15	2299.75
Time 26.91 seconds	154.66	73.79	375.32	520.07	1246.88	1130.72	1530.31	2476.75
AVERAGE	**150.513**	**68.4635**	**307.924**	**375.4515**	**665.9345**	**1013.973**	**1595.918**	**2917.988**

NASAL [ã]	F0	Intensity	b1	b2	b3	F1	F2	F3
Time 2.22 seconds	235.71	73.68	376.82	106.62	1164.4	902.85	1596.83	3052.55
Time 4.90 seconds	232.55	74.9	163.11	35.17	292.74	876.63	1622.2	2993.73
Time 7.48 seconds	230.27	77.04	286.34	41.7	630.08	864.23	1599.01	2850.17
Time 10.12 seconds	237.41	76.56	340.18	145.2	298.22	1352.25	1722.49	3261.13
Time 12.62 seconds	231.3	74.35	244.22	50.47	2875.97	820.46	1614.79	3436.9
Time 15.09 seconds	224.91	71.57	424.41	115.98	750.26	845.56	1588.11	3491.6
Time 17.61 seconds	239.33	76.68	413.41	48.73	688.74	887.85	1637.26	2793.98
Time 20.21 seconds	230.99	75.07	303.9	19.09	1058.39	807.52	1611.26	2920.31
Time 22.67 seconds	225.49	72.31	724.6	90.93	413.64	1033.72	1593.46	3378.05
Time 25.23 seconds	226.3	74.88	186.78	42.3	776.75	841.28	1583.55	2962.75
Time 1.87 seconds	233.44	71.11	246.31	210.57	1043.99	893.4	1716.42	3066.09
Time 4.72 seconds	240.16	72.62	365.55	274.34	965.66	973.33	1605.6	2579.42
Time 7.56 seconds	230.33	69.03	681.14	76.48	711.46	690.72	1638.48	3194.63
Time 10.15 seconds	226.51	71.25	116.94	64.52	1525.5	865	1601.86	2165.81
Time 12.81 seconds	226.3	70.61	116.61	73.36	115.66	841.71	1583.37	3212.97
Time 15.44 seconds	230.25	71.61	142.72	20.15	433.68	760.95	1605.18	2943.29
Time 18.23 seconds	229.65	70.93	178.68	162.47	787.38	819.25	1547.95	3001.43
Time 20.79 seconds	218.43	70.11	116.05	62.19	1266.23	791.61	1534.35	2766.78
Time 23.41 seconds	228.53	74.67	214.92	52.81	1159.55	830.51	1591.42	3024.46
Time 26.05 seconds	245.66	70.26	347.2	189.03	856.1	914.23	1666.18	3332.92
AVERAGE	**231.176**	**72.962**	**299.4945**	**94.1055**	**890.72**	**880.653**	**1612.989**	**3021.449**

ORAL [ua]	F0	Intensity	b1	b2	b3	F1	F2	F3
Time 1.91 seconds	236.38	77.68	179.14	149.81	185.74	940.98	1478.77	2556.75
Time 4.52 seconds	237.07	77.91	94.95	94.15	128.82	912.92	1459.53	2557.53
Time 7.09 seconds	231.31	77.95	179.59	178.67	496.78	902.14	1476.65	2444.59
Time 9.76 seconds	231.92	79.65	151.44	142.17	165.46	943.72	1402.88	2488.49
Time 12.43 seconds	227.68	80.09	120.23	140.45	456.27	906.92	1328.78	2514.17
Time 15.06 seconds	224.68	74.65	135.71	231.69	229.32	844.35	1303.17	2466.38
Time 17.71 seconds	235.55	76.55	104.62	180.01	190.28	880.52	1453.63	2489.1
Time 20.44 seconds	231.34	77.21	174.74	191.07	906.17	913.33	1390.57	2412.75
Time 23.34 seconds	220.79	76.69	**356.7**	**370.37**	614.96	919.21	1225.93	2399.59
Time 25.95 seconds	225.23	76.18	282.16	261.44	**1365.46**	897.42	1320.57	2702.49
Time 1.84 seconds	229.29	76.35	236.32	264.92	230.41	923.04	1315.74	2471.61
Time 4.57 seconds	235.68	77.53	120.22	84.49	263.37	875.41	1394.79	2506.79
Time 7.35 seconds	233.12	76.94	233.43	220.57	329.21	880.33	1354.83	2397.33
Time 9.97 seconds	239.15	77.59	132.75	116.54	466.52	864.62	1371.79	2559.56
Time 12.59 seconds	240.18	79.04	96.84	129.33	215.28	913.45	1439.51	2523.9
Time 15.16 seconds	232.9	80	105.62	94.05	275.6	930.3	1561.99	2397.59
Time 17.84 seconds	234.71	77.93	212.08	298.34	925.66	915.81	1393.25	2368.66
Time 20.31 seconds	230.08	78.81	136.83	164.87	887.71	915.39	1392.97	2501.46
Time 22.95 seconds	234.04	77.09	186.3	281.14	672.35	897.7	1394.66	2439.74
Time 25.70 seconds	233.68	75.74	248.98	242.29	434.48	903.24	1326.79	2601.4
AVERAGE	**232.239**	**77.579**	**174.4325**	**191.8185**	**471.9925**	**904.04**	**1389.34**	**2489.994**

NASAL [ũã]	F0	Intensity	b1	b2	b3	F1	F2	F3
Time 2.18 seconds	244.59	73.51	608.99	101.99	2242.48	929.63	957.62	3271.98
Time 4.70 seconds	240.55	74.03	843.67	86.6	299.66	908.56	1216.1	3837.78
Time 7.27 seconds	240.5	73.79	776.7	71.53	84.6	963.2	1215.99	3822.9
Time 9.79 seconds	235.35	70.11	340.98	86.45	1790.55	719.79	1178.81	2768.52
Time 12.20 seconds	231.78	70.94	456.59	70.5	888.23	711.3	1163.4	3580.52
Time 14.75 seconds	239.2	72.72	948.35	55.65	2763.14	803.97	1202.97	2735.63
Time 17.38 seconds	246.21	75.84	494.65	64.77	140.17	863.67	1248.59	3412.65
Time 19.86 seconds	239.93	72.06	319.25	156.41	664.84	761.45	1216.88	2481.81
Time 22.37 seconds	242.32	73.82	202.36	73.56	149.91	764.59	1221.05	3393.02
Time 24.73 seconds	241.64	72.08	419.23	74.96	243.74	782.11	1227.88	3456.68
Time 2.14 seconds	241.22	72.81	534.3	183.15	1257	1007.37	1326.93	2939.48
Time 4.86 seconds	241.99	73.7	102.04	**1346.32**	749.27	1214.73	1404.97	3415.83
Time 7.61 seconds	236.85	75.27	2297.37	696.33	1284.51	842.27	1185.69	1819.38
Time 10.10 seconds	234.53	71.29	368.45	207.92	4352.92	962.62	1600.93	3059.37
Time 12.61 seconds	234	77.14	764.31	**62**	1112.15	913.86	1180.65	2804.03
Time 15.16 seconds	242.51	74.77	607.12	524.15	2019.51	1135.27	1236.36	2468.78

Time 17.78 seconds	232.33	71.53	275.93	267.32	1041.79	805.16	1450.64	3072.33
Time 20.42 seconds	240.56	75.84	401.92	176.94	1682.01	916.62	1358.81	2914.14
Time 22.91 seconds	238.66	78.56	663.49	48.42	134.75	924.44	1200.09	3817.08
Time 25.57 seconds	239.77	77.13	511.28	34.69	908.01	801.57	1208.36	3335.22
AVERAGE	**239.2245**	**73.847**	**596.849**	**219.483**	**1190.462**	**886.609**	**1250.136**	**3120.357**

APPENDIX 2: THE DATA WITH DELETED OUTLIERS AND NEW AVERAGES

ORAL [i]	F0	Intensity	b1	b2	b3	F1	F2	F3
Time 2.28 seconds	224.68	64.66	72.22	96.26	301.32	411.08	2744.06	3415.56
Time 5.17 seconds	230.81	64.7	105.34	83.45	225.27	387.25	2727.89	3468.56
Time 8.09 seconds	230.96	64.31	101.75	49.79	178.95	385.5	2766.8	3436.89
Time 10.62 seconds	215.76	63.34	69.84	61.57	489.95	362.28	2779.66	3509.03
Time 13.59 seconds	215.34	65.68	57.07	188.04	522.03	390.6	2770.22	3400.95
Time 16.26 seconds	208.77	63.18	292.5	417.4	567.69	386.09	2858.3	3437.59
Time 19.59 seconds	222.02	69.4	80.46	125.79	212.73	394.27	2683.01	3264.37
Time 22.24 seconds	217.66	62.31	92.83	446.14	1128.89	371.8	2826.12	3396.72
Time 28.61 seconds	220.96	65.35	93.13	139.43	357.11	391.74	2797.19	3338.91
Time 2.48 seconds	242.52	70.68	120.28	174.98	145.92	453.12	2798.49	3415.56
Time 5.01 seconds	224.62	63.66	106.14	161.64	208.63	369.54	2815.36	3604.64
Time 7.60 seconds	232.83	66.35	111.47	67.29	335.94	350.98	2788.75	3433
Time 10.18 seconds	231.06	67.01	105.1	93.15	236.79	407.28	2794.49	3419.73
Time 15.50 seconds	218.55	64.39	87.67	83.77	475.9	377.5	2831.82	3637.53
Time 17.94 seconds	242.32	69.39	132.2	105.65	302.94	383.97	2871.51	3376.23
Time 20.99 seconds	219.28	62.29	83.64	263.36	444.04	362.09	2756.94	3324.25
Time 23.61 seconds	227.42	66.77	184.25	147.43	1506.45	338.4	2824.47	3129.01
Time 26.29 seconds	231.58	66.23	88.19	757.19	487.29	397	2666.93	3409.08
AVERAGE	**225.3967**	**65.53889**	**110.2267**	**192.3517**	**451.5467**	**384.4717**	**2783.445**	**3412.089**

NASAL [ĩ]	F0	Intensity	b1	b2	b3	F1	F2	F3
Time 2.23 seconds	231.48	70.88	279.42	504.78	2665.43	434.78	2844.39	3119.26
Time 5.09 seconds	221.48	67.12	377.55	148.62	555.47	545.77	2831.7	4020.03
Time 7.89 seconds	230.3	68.61	418.48	161.91	668.61	530.16	2935.71	3793.59
Time 10.65 seconds	230.14	67.77	358.13	253.71	466.93	667.66	2980.62	3721.9
Time 13.48 seconds	228.98	66.33	539.05	143.18	687.53	528.44	2948.3	3831
Time 16.26 seconds	227.03	65.88	543.6	137.03	395.91	619.02	2910.49	3973.89
Time 19.34 seconds	227.83	66.17	346.17	148.22	201.51	493.18	2815.21	4028.57
Time 22.33 seconds	239.41	66.39	277.74	139.21	479.49	521.81	2915.79	3814.78
Time 25.37 seconds	230.29	67.06	490.16	116.21	479.41	577.62	2772.39	4012.72
Time 27.95 seconds	216.73	68.91	468.56	162.28	433.73	343.2	2825.87	3946.96
Time 2.23 seconds	228.32	65.09	173.37	108.01	216.48	480.85	2965.4	4193.93
Time 7.98 seconds	229.1	65.25	227.08	177.67	812.13	519.42	2947.28	4250.14
Time 10.54 seconds	222.66	65.43	291.7	170.61	483.34	483.89	2950.92	4212.4
Time 13.27 seconds	227.11	66.99	271.3	192.81	1241.88	563.45	2904.89	4191.78
Time 15.94 seconds	239.69	69.37	237.65	202.05	176.53	549.54	2887.32	4289.92
Time 18.80 seconds	240.47	66.11	278.57	136.93	366.19	553.24	2889.4	4256.96
Time 24.81 seconds	226.29	65.63	477.13	217.89	374.2	629.9	2830.58	4020.5
Time 27.83 seconds	225.35	65.44	400.03	2343.23	278.03	481.52	2191.83	3495.18
AVERAGE	**229.0367**	**66.91278**	**358.6494**	**303.575**	**610.1556**	**529.0806**	**2852.672**	**3954.084**

ORAL [a]	F0	Intensity	b1	b2	b3	F1	F2	F3
Time 2.09 seconds	172.42	71.01	370.13	263.41	377.8	913.39	1517.51	2497.7
Time 7.40 seconds	159.41	69.56	435.37	229.02	329.52	1112.81	1553.58	2464.64

Time 9.95 seconds	147.19	69.19	201.85	183.51	270.52	1039.59	1564.49	2406.75
Time 12.46 seconds	157.74	62.05	487.54	422.73	118.73	926.06	1443.45	2445.59
Time 14.90 seconds	138.18	68.51	259.02	185.09	190.75	1063.38	1494.44	2383.21
Time 17.49 seconds	146.1	64.34	129.46	258.88	227.27	853.37	1767.09	2357.43
Time 20.04 seconds	147.51	64.13	343.2	250.89	544.11	908.3	1503.84	2398.65
Time 22.52 seconds	164.58	65.23	255.04	178.51	1013.86	858.28	1423.07	3135.79
Time 25.27 seconds	141.92	57.29	299.66	237.75	211.39	932.68	2099.64	4192.05
Time 5.01 seconds	162.83	61.91	851.53	440.84	505.36	1023.17	1545.01	2291.91
Time 7.58 seconds	137.93	71.06	176.55	253.43	435.94	1116.81	1843.96	4080.62
Time 10.21 seconds	147.12	68.04	249.2	552.34	178.9	1193.54	1693.6	4134.25
Time 12.89 seconds	139.85	76.47	375.89	556.27	878.82	1063.08	1916.37	3196.99
Time 15.76 seconds	140.2	72.44	220.49	456.97	475.03	1031.95	1635.2	3762.75
Time 18.96 seconds	155.17	74.06	209.62	184.53	1125.78	982.14	1431.7	3746.1
Time 21.56 seconds	150.01	72.95	282.57	364.38	2111.96	1094.31	1564.57	3415.02
Time 26.91 seconds	154.66	73.79	375.32	520.07	1246.88	1130.72	1530.31	2476.75
AVERAGE	**150.7541**	**68.35471**	**324.8494**	**325.8012**	**602.5071**	**1014.328**	**1619.284**	**3022.718**

NASAL [ã]	**F0**	**Intensity**	**b1**	**b2**	**b3**	**F1**	**F2**	**F3**
Time 2.22 seconds	235.71	73.68	376.82	106.62	1164.4	902.85	1596.83	3052.55
Time 4.90 seconds	232.55	74.9	163.11	35.17	292.74	876.63	1622.2	2993.73
Time 7.48 seconds	230.27	77.04	286.34	41.7	630.08	864.23	1599.01	2850.17
Time 10.12 seconds	237.41	76.56	340.18	145.2	298.22	1352.25	1722.49	3261.13
Time 15.09 seconds	224.91	71.57	424.41	115.98	750.26	845.56	1588.11	3491.6
Time 17.61 seconds	239.33	76.68	413.41	48.73	688.74	887.85	1637.26	2793.98
Time 20.21 seconds	230.99	75.07	303.9	19.09	1058.39	807.52	1611.26	2920.31
Time 22.67 seconds	225.49	72.31	724.6	90.93	413.64	1033.72	1593.46	3378.05
Time 25.23 seconds	226.3	74.88	186.78	42.3	776.75	841.28	1583.55	2962.75
Time 1.87 seconds	233.44	71.11	246.31	210.57	1043.99	893.4	1716.42	3066.09
Time 4.72 seconds	240.16	72.62	365.55	274.34	965.66	973.33	1605.6	2579.42
Time 7.56 seconds	230.33	69.03	681.14	76.48	711.46	690.72	1638.48	3194.63
Time 10.15 seconds	226.51	71.25	116.94	64.52	1525.5	865	1601.86	2165.81
Time 12.81 seconds	226.3	70.61	116.61	73.36	115.66	841.71	1583.37	3212.97
Time 15.44 seconds	230.25	71.61	142.72	20.15	433.68	760.95	1605.18	2943.29
Time 18.23 seconds	229.65	70.93	178.68	162.47	787.38	819.25	1547.95	3001.43
Time 20.79 seconds	218.43	70.11	116.05	62.19	1266.23	791.61	1534.35	2766.78
Time 23.41 seconds	228.53	74.67	214.92	52.81	1159.55	830.51	1591.42	3024.46
Time 26.05 seconds	245.66	70.26	347.2	189.03	856.1	914.23	1666.18	3332.92
AVERAGE	**231.1695**	**72.88895**	**302.4037**	**96.40211**	**786.2332**	**883.8211**	**1612.894**	**2999.583**

ORAL [ua]	**F0**	**Intensity**	**b1**	**b2**	**b3**	**F1**	**F2**	**F3**
Time 1.91 seconds	236.38	77.68	179.14	149.81	185.74	940.98	1478.77	2556.75
Time 4.52 seconds	237.07	77.91	94.95	94.15	128.82	912.92	1459.53	2557.53
Time 7.09 seconds	231.31	77.95	179.59	178.67	496.78	902.14	1476.65	2444.59
Time 9.76 seconds	231.92	79.65	151.44	142.17	165.46	943.72	1402.88	2488.49
Time 12.43 seconds	227.68	80.09	120.23	140.45	456.27	906.92	1328.78	2514.17
Time 15.06 seconds	224.68	74.65	135.71	231.69	229.32	844.35	1303.17	2466.38
Time 17.71 seconds	235.55	76.55	104.62	180.01	190.28	880.52	1453.63	2489.1
Time 20.44 seconds	231.34	77.21	174.74	191.07	906.17	913.33	1390.57	2412.75
Time 1.84 seconds	229.29	76.35	236.32	264.92	230.41	923.04	1315.74	2471.61
Time 4.57 seconds	235.68	77.53	120.22	84.49	263.37	875.41	1394.79	2506.79
Time 7.35 seconds	233.12	76.94	233.43	220.57	329.21	880.33	1354.83	2397.33
Time 9.97 seconds	239.15	77.59	132.75	116.54	466.52	864.62	1371.79	2559.56
Time 12.59 seconds	240.18	79.04	96.84	129.33	215.28	913.45	1439.51	2523.9
Time 15.16 seconds	232.9	80	105.62	94.05	275.6	930.3	1561.99	2397.59
Time 17.84 seconds	234.71	77.93	212.08	298.34	925.66	915.81	1393.25	2368.66
Time 20.31 seconds	230.08	78.81	136.83	164.87	887.71	915.39	1392.97	2501.46
Time 22.95 seconds	234.04	77.09	186.3	281.14	672.35	897.7	1394.66	2439.74
Time 25.70 seconds	233.68	75.74	248.98	242.29	434.48	903.24	1326.79	2601.4
AVERAGE	**233.2644**	**77.70611**	**158.3217**	**178.0311**	**414.4128**	**903.565**	**1402.239**	**2483.211**

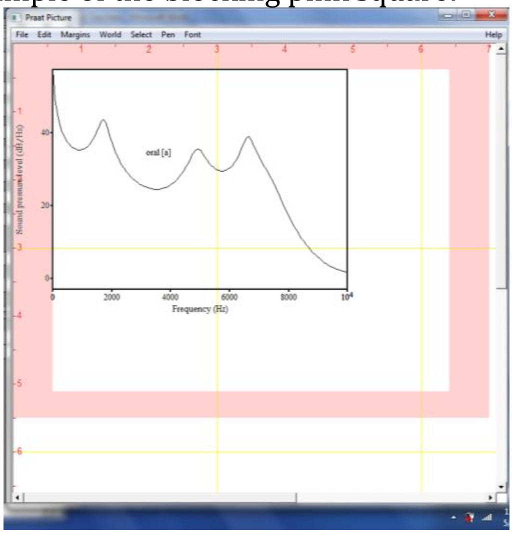
NASAL [ũã]	F0	Intensity	b1	b2	b3	F1	F2	F3
Time 2.18 seconds	244.59	73.51	608.99	101.99	2242.48	929.63	957.62	3271.98
Time 4.70 seconds	240.55	74.03	843.67	86.6	299.66	908.56	1216.1	3837.78
Time 7.27 seconds	240.5	73.79	776.7	71.53	84.6	963.2	1215.99	3822.9
Time 9.79 seconds	235.35	70.11	340.98	86.45	1790.55	719.79	1178.81	2768.52
Time 12.20 seconds	231.78	70.94	456.59	70.5	888.23	711.3	1163.4	3580.52
Time 14.75 seconds	239.2	72.72	948.35	55.65	2763.14	803.97	1202.97	2735.63
Time 17.38 seconds	246.21	75.84	494.65	64.77	140.17	863.67	1248.59	3412.65
Time 19.86 seconds	239.93	72.06	319.25	156.41	664.84	761.45	1216.88	2481.81
Time 22.37 seconds	242.32	73.82	202.36	73.56	149.91	764.59	1221.05	3393.02
Time 24.73 seconds	241.64	72.08	419.23	74.96	243.74	782.11	1227.88	3456.68
Time 2.14 seconds	241.22	72.81	534.3	183.15	1257	1007.37	1326.93	2939.48
Time 7.61 seconds	236.85	75.27	2297.37	696.33	1284.51	842.27	1185.69	1819.38
Time 10.10 seconds	234.53	71.29	368.45	207.92	4352.92	962.62	1600.93	3059.37
Time 15.16 seconds	242.51	74.77	607.12	524.15	2019.51	1135.27	1236.36	2468.78
Time 17.78 seconds	232.33	71.53	275.93	267.32	1041.79	805.16	1450.64	3072.33
Time 20.42 seconds	240.56	75.84	401.92	176.94	1682.01	916.62	1358.81	2914.14
Time 22.91 seconds	238.66	78.56	663.49	48.42	134.75	924.44	1200.09	3817.08
Time 25.57 seconds	239.77	77.13	511.28	34.69	908.01	801.57	1208.36	3335.22
AVERAGE	**239.3611**	**73.67222**	**615.035**	**165.63**	**1219.323**	**866.8661**	**1245.394**	**3121.515**

APPENDIX 3: The Anti-formant Values of the nasal vowels (Blank spaces are of deleted tokens, outliers of previous acoustic property analysis)

AF nasal [i]	AF nasal [a]	AF nasal [ua]
1650.23	2500	2880.49
1574.13	2449.27	3626.83
1840.48	2715.61	2690.25
1739.01	3121.47	2791.71
1586.82		2702.93
1624.87	2550.73	2740.98
1574.13	2474.63	2715.61
1624.87	2411.22	2779.03
1650.23	3108.79	2487.32
1726.33	2436.58	2842.44
1612.18	2715.61	2538.05
1903.89	2284.39	
	2576.1	2550.73
1865.84	2918.54	2664.88
1536.08	2550.73	
1561.45	2411.22	2500
1650.23	2639.51	2804.39
1650.23	2398.54	2436.58
	2398.55	2626.83
1688.28	2829.76	2601.46
1669.96	**2604.80**	**2721.139**

APPENDIX 4: Notes of the drawing using Praat

1. It turns out that there were difficulties to save the drawings in the available picture formants in Praat. The pictures were cut by half.To overcome the difficulty, the results of drawing at the Praat Picture were blocked and copied (Ctrl C) and then paste (Ctrl V). Another problem occurred. Blocking the drawing by its size (if the pink square is exactly the size of the square of the spectra), will still result in an incomplete picture when pasted on the Word document. The trick to solve this problem is by blocking the picture at a much bigger window, much to the right and to the bottom, so the picture will be intact when pasted. Only by blocking it much longer and wider, the picture will not be cut half. The example of the blocking pink square:



2. To label the spectra, block a little square where we want the symbol of phrase to appear, select 'World,' 'Text' or Text special,' then type in the long space available at the pop up window. Then click 'apply' or 'OK.'To label it with a IPA symbols which are not available in the Praat, we can go to the word document, type the IPA symbol, copy it, then go this Praat 'Text' or 'Text special' space, then paste it, then click 'apply' or 'OK.'
3. To label the frequency, click 'Margin,' select 'Mark' then select 'Mark bottom.' A pop-up window will show how the format of label. The default is checked 'write numbers,' 'draw ticks,' and 'draw dotted line.' If the dotted line is not needed, uncheck it.