UNVERSITY OF EDUCATION, WINNEBA

AN ACOUSTIC ANALYSIS OF EWE NASAL CONSONANT SOUNDS

CELESTINE ADZOA SEWORNAM KORSI-AGORDO

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CELESTINE ADZOA SEWORNAM KORSI-AGORDO

(8120080007)

A THESIS IN THE DEPARTMENT OF APPLIED LINGUISTICS, FACULTY OF FOREGIN LANGUAGES AND COMMUNICATION, SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES, UNIVERSITY OF EDUCATION, WINNEBA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR AWARD OF THE MASTER OF PHILOSOPHY (APPLIED LINGUISTICS) DEGREE

OCTOBER, 2015

DECLARATION

Candidate's Declaration

I, Celestine Adzoa Sewornam Korsi-Agordo, declare that this thesis, with exception of quotations and references contained in published works which have all been identified and dully acknowledged, is entirely my own original work, and has not been submitted, either in part or whole, for another degree elsewhere.

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I hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of Thesis as laid down by the University of Education, Winneba.

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TABLE OF CONTENT

Content **Page**

CHAPTER TW0: LITERATURE REVIEW OF RELATED STUDIES

CHAPTER THREE: RESEARCH METHODOLOGY

CHAPTER FOUR: THE RESULTS

LIST OF TABLES

ABSTRACT

This study was conducted on the acoustic analysis of nasal consonant sounds in the Ewe language spoken in Ghana. Three major dialects were selected; Tɔŋu, Aŋlɔ and Eʋedome, with the purposes of investigating the acoustic properties of the Ewe nasal consonants, how the nasal consonants occurred at word positions in these dialects and identify similarities and differences existing at the dialectal levels. The analysis was made with the structure NV, VNV, NVN, CVN and NCV using mono and disyllabic words within the formula: N=[m, n, ɲ and ŋ]. V=[a, ə, i, or ɔ]. C=[k or g]. The average F1 and F2 value measurements calculated in Hertz for the speakers of each dialect were used to draw tables and charts.

The results confirmed the existing literature on the four nasal consonants [m, n, ɲ, ŋ] at word-initial and word-medial positions. However, at word-final position, only the bilabial nasal /m/ and the velar nasal /ŋ/ occurred. No records have been found on the alveolar nasal /n/ and the palatal nasal /ɲ/ occurring at word-final position in any of the three dialects. There were also similarities and differences in the nasal consonants at the dialectal and gender levels in terms of formant frequency values. Most of the highest formant frequency values measured were recorded for /n/, /ɲ/,/ɲ/ and the lowest were measured for /m/. There should also be a further research into the acoustic analysis of Ewe oral stops to contribute to the description of the Ewe sound systems.

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TABLE OF CONTENT

Content **Page**

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TABLE OF CONTENT

Content **Page**

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CHAPTER ONE

INTRODUCTION

3.0 Overview

This chapter discusses the background to the study, brief history about the Ewe people, the statement of the problem, purpose of the study and the research questions. It also talks about the significance of the study, articulatory description of Ewe nasal consonant sounds, delimitations and limitations.

1.7 Background to the Study

Although language-systems are, to a considerable extent, independent of the medium in which they manifest, the natural or primary medium of human language is sound. For this reason, the study of sound is of more central importance in linguistics than is the study of writing, of gestures or of any other language-medium, whether actual or potential. But it is not sound as such, and not the full range of sounds, that is of concern to the linguist. He is interested in the sounds that are produced by the human speech-organs in so far as these sounds have a role in language, Lyons (2009). The study of sounds in Lyons' assertion is truly relevant to the study of language linguistically. The researcher therefore, desired to conduct a study and analyze the sounds of the Ewe nasal consonants acoustically to contribute to the description of the language.

Lyons opined that, there are, however, several facts that have been either discovered or confirmed by acoustic and auditory phonetics- and more especially the former, which has made great progress in the last twenty-five or thirty years of which no one with serious interest in language can afford to be ignorant. Most importantly of these perhaps is the fact that repetitions of what might be heard as the same utterance are only coincidental, if ever, physical (i.e. acoustically).

In his argument, no two utterances are the same but just coincidental, moreover, more discoveries have been made through the study of acoustics. His assertion augmented the fact that, the research on the acoustic analysis of the nasal consonant sounds in the Ewe language was very necessary. This unearthed such discoveries associated with the study of sounds, in bridging the gap between this study and the articulatory description of the language.

Ewe as one of the major languages widely spoken within the West Africa zone makes an extensive use of nasal sounds in both the vowels and consonants. Though there have been a lot of efforts by renowned linguists such as Duthie, A. S. (1996) and Ameka F. K. (1989) to give articulatory description to Ewe consonants, much need to be achieved in the acoustic investigations. As mentioned early on successes have been chalked in the areas of phonology, syntax, morphology and semantics. A few other linguists of the language have also documented a contrast between oral and nasal vowels in the Niger-Congo languages. One of such linguists is Capo (1981) who argued that nasality in Ewe language should be analyzed phonemically as a feature relevant to vowels but not consonants.

In Capo's analysis nasal vowels (ã, ŏ, ŭ, ĕ, ĭ) are distinct oral vowels while nasal and voiced oral stops are treated as predictable variants. Non-syllabic nasal consonants are always followed by a nasal vowel and syllabic nasal consonants are analyzed as reduced form of consonant vowel syllables. This analysis in his explanation conformed to the reconstruction of the Proto-Volta-Congo languages for which similar proposals have been made. Capo further asserted that the degree of nasality of nasal vowels is less when they occur after nasal consonants than non-nasal ones.

There have been quite a number of acoustic studies of nasals internationally the procedures and methods of which this study aimed at using to describe the Ewe nasal consonant sounds. However with particular reference to the Ewe language a lot need to be done to bridge the gap between the acoustic and the articulatory investigation. The present study therefore, examined the Ewe nasal consonants acoustically at different word positions.

1.2 Research on the Ewe Language

There are several dialects of the Ewe language. The dialectal differences according to Dotse (2011) are found in one or more of the following; speech sounds used, choice between synonyms, forms of words, pitch/tonal variations and mode of expressions. Some of these dialects are mutually intelligible to native speakers but with some level of difficulty.

Estimates of the total number of speakers of Ewe language asserted by linguists and many scholars vary considerably. Capo (1988) gives the modest estimate of four million people, while The Summer Institute of Linguistics' Ethnologue (15 Edition, 2005) gives eight million. It is widely spoken in Ghana, Togo, Benin, and Southeastern Nigeria. It is taught and used as a medium of instruction in formal education at the basic schools and as an elective subject at second cycle schools in the regions of the three countries where they are predominantly spoken. It is also one major language of study at some selected colleges and universities in Ghana as far as the teaching and learning of the language is concerned. Examples of such institutions are University of Education, Winneba, University of Cape Coast, University of Ghana, Legon and all Colleges of Education in the Volta Region. The rest are Ada College of Education and Mountain Mary

College of Education. It is also studied and examined at all the basic schools in the Volta Region as a core subject among the Ghanaian languages.

Several linguists and scholars of the Ewe language such as Gilbert Ansre (tone, syntax), Herbert Stahlke (morphology, tone), Nick Clement (tone, syntax), Felix K. Ameka (semantics, cognitive linguistic) Houkpati B. Capo (phonology, phonetics), Alan S. Duthie (semantics, phonetics) to mention but a few, have worked tirelessly on Ewe and closely related languages. Angela Kluge (2011) also in her contribution proposed that the Ewe (Gbe) language consists of dialect continuum that can be split into three large clusters: Western Gbe varieties, e.g. Ewe, Agoi, Anexo etc, Central Gbe varieties e.g. Adza, Dogbo, Tado etc. and Eastern Gbe varieties e.g. Fon, Agbome, Gbesi, Gbokpa, Ayizo etc.

The dialect continuum was proposed Ewe by Westermaan who was regarded as the most influential writer on the language cluster. The spelling 'Ewe' is the English spelling of Eʋe with the purpose of assisting the non-native speakers to pronounce it with a bit of ease. Likewise, the native speakers are also called Eʋeawo which translates into 'the Eʋe (Ewe) people'. He was asserted to be the linguist who used the term 'standard Ewe' to refer to the written form of the Ewe language. Since the establishment of a working group at the West Africa Language Congress at Cotonou in 1980, H.B Capo's suggestion of 'Gbe' was generally and officially accepted by the linguists at the conference as the name of the language. Gbe means language/dialect in each of the varieties.

In spite of this proposal and its acceptance, the natives still call it Eʋegbe as originally and historically known. Despite the variations and diverse views about the name all the clusters are mutually intelligible to the native speakers of the language. In the Volta region where the language is predominantly spoken, three major dialect clusters have been identified with sub-dialects. They are Tɔŋu (Mafi, Bator, Agave, Meƒe, Dɔfɔ etc), Aŋlɔ (Some, Aƒlao, Avenɔ, Dzodze, Aŋlɔ etc) and Eʋedome (Kpando, Ave, Ho, Peki, Aŋfɔe, Adaklu etc). All these dialects and sub-dialects make extensive use of nasal consonants which are common to all.

1.3 The Origin and Brief History of the People of Eʋeland

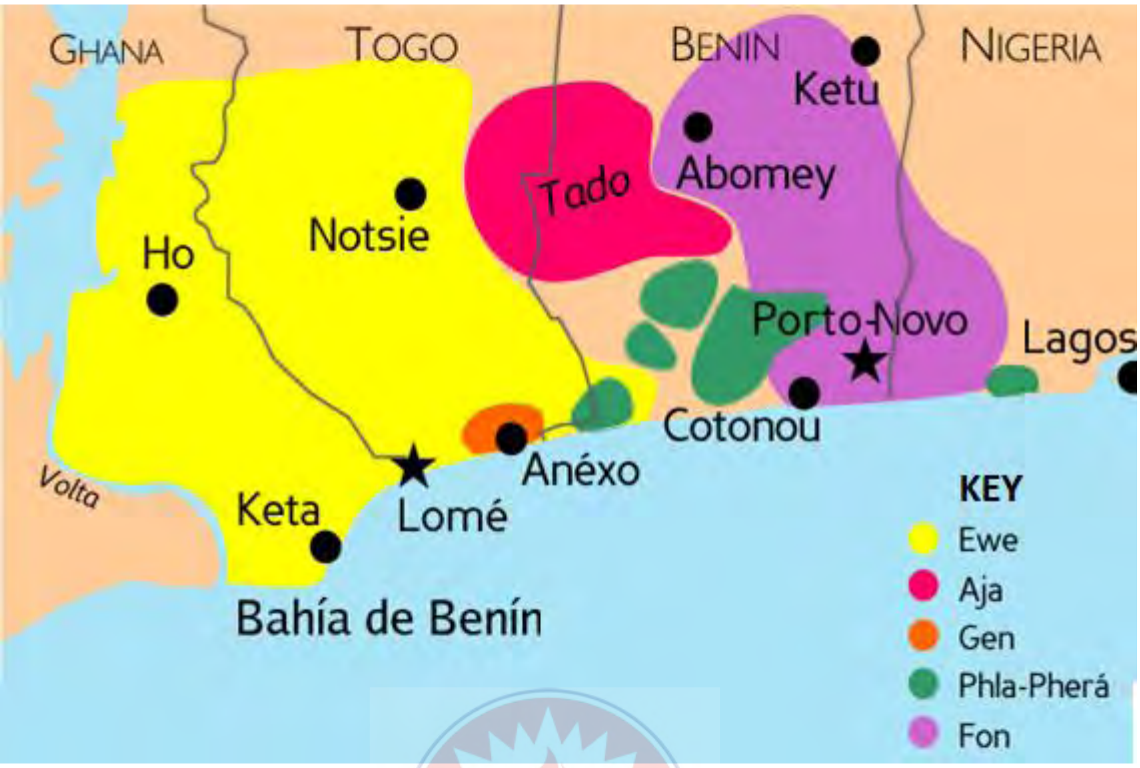
The boundaries of the Ewe people are essentially artificial in the sense that some of them do not correspond with any well marked ethnic divisions due to the political territories created by the colonial masters. As a result the Ewes like some other ethnic groups have remained fragmented under four flags. Those who were under the Germans were later handed over to the British. They are now the Ewes in South East Ghana (Volta region). Those under the French are in Southern Togo and Benin (Dahomey) respectively. The rest are located in South Western Nigeria which is traditionally, Yuroba dominated settlement within Ogun and Lagos states as asserted by Dotse (2011).

The town ŋɔtsie is significant and crucial in the history of the Ewe people of Ghana because they believe that is their root or ancestral home. Ketu-ŋɔtsie or ŋɔtsie in short, is a Yuroba town in present day Benin where it is asserted they migrated from to settle in the Volta Region of Ghana. This assertion is supported by Duthie (1996 pg1.) who said "The name 'Ewe' used to apply to cover all dialects spoken fairly between the Volta River in Ghana and Badagary in Nigeria''.

Factors which bind the Ewe people together are their cultural practices, social values and norms, religious activities, traditional beliefs, music and traditional dances. Religiously, they believe in a supreme being called Mawu (God); a male father and the sustainer of the entire universe. This Supreme Being is worshipped through intermediaries known as fetish priests. Respect is also given to ancestral spirits. Pouring of libation further strengthens the bond between the living and the dead. Traditional medicines are also strongly practiced. Economically the Ewe people are peasant farmers who keep some livestock and engage in the production of crops and vegetables. On the coast and other parts of their settlements where rivers and streams are found, fishing is important and local variations in economic activities permit a great deal of trade between one community and another, carried out chiefly by women.

Generally, Ewes like other people love music and dance. They have all kinds of music to suit every occasion such as work, religion, recreation, traditional ceremonies, rituals or special events.

The inserted map below indicates the locations and settlements of the Ewe people of West Africa. The yellow background indicates the varieties spoken in Ghana, parts of Togo and a few traditional and historical communities in Benin. Other varieties that are identified with pink and the orange colours settled in Togo, precisely, around Anexo, Abomey, Ketu and its environs in Benin. They speak varieties referred to as Aja and Gen. The rest have been identified with sea-green and purple colours spoken in Togo, Benin and Federal Republic of Nigeria around Badagery around Lagos city. They are also native speakers of Phla-pherà and Fon.



1.3.1 The West African map showing settlements/locations of the Ewe people as shown in world Atlas. (1998)

1.4 Statement of the Problem

Many seasoned linguists like Ansre (2000) and Duthie (1996) have worked tirelessly towards the development of the Ewe language and brought its study to the limelight. There has been a wide gap, however, in the acoustic study as compared to the investigation and the study of the articulatory sounds of the language. The acoustic description of the Ewe nasal sounds are necessary for the fact that, the results of the formant frequency value measurements in Tɔŋu, Aŋlɔ and Eʋedome dialects are not the same. This implies there are differences and similarities, hence the study to acoustically analyze and identify the similarities and differences that exist within these three dialects. Gbegble (2008) set the pace in this field by conducting a study on the acoustic analysis of Ewe vowel sounds. Nevertheless, much work need to be done in the acoustic investigation and description of the language. This researcher therefore, saw it as a challenge and set out to conduct a study of the acoustic analysis of the Ewe nasal consonants, to contribute to the efforts of linguists towards the description of the Ewe language.

1.5 Purpose of the Study

The purpose of the study was to give an acoustic description of Ewe nasal consonants within the scope of prevocalic, intervocalic and postvocalic nasals using NV, VNV, NVN, CVN, CCVN and NCV syllables. The purpose of this formula was to examine by means of spectrographic analysis the formant frequency and duration to define the acoustic properties of [m, n, ɲ,ŋ] as used in Ewe.

1.6 Research Questions

In view of the problem stated, the following questions have been formulated to guide the study on the nasal consonants;

1. What are the acoustic properties of Ewe nasal consonants?
2. What are the dialectal similarities and differences in the acoustic properties of the nasal consonants in Tɔŋu, Aŋlɔ and Evedome?
3. What are some of the acoustical characteristics in terms of gender?

1.7 Significance of the Study

The outcome of this study will be of immense benefit to all and sundry in the teaching and learning processes. It will be useful as far as the documentation of Ewe language in linguistics is concerned. In addition it would serve as a reference for further studies on issues related to acoustic study of Ewe nasal consonants and other speech work in the language. Thus it would serve as a source of written material for teachers, students and linguists in general.

1.8 Articulatory Description of Ewe Nasal Consonants

Many linguists have been concerned with nasality in the phonological theory and extreme claims have been made about nasality in a number of languages that exhibit, at the phonetic level, nasal consonants and nasal vowels. These claims according to the linguists can be grouped into three categories: (1) the language has both nasal consonants and nasalized vowels as autonomous/underlying phonemes; (2) the language has phonemic nasal consonants only and nasalized vowels are pure phonemic realizations; and (3) the language has phonemic nasalized vowels only, and nasal consonants are pure phonetic realizations. The language of course, has phonemic non-nasal consonants and non-nasal vowels in all three cases. The three positions have been held with regards to Ewe, the subject matter of this paper. Westermann (1930), Ansre (1961), and Stahlke (1971) respectively, cited by H.B Capo (1981).

According to Westermann (1930) the production of the four nasal consonants [m, n, ɲ, ŋ] that are identified in Ewe is not completely different but rather conform to the IPA production of nasal sounds. A nasal as asserted by many linguists is produced when the velum is lowered to allow air freely, to flow or escape through the nostril. According to Roach (2009), they have the same construction as plosives except that air is allowed through the nose but not through the mouth. This assertion is supported by Duthie (1996 p.15) 'that nasals are together, the blocking of the air not to escape through the mouth so that it must pass through the nose instead'.

He further claimed that all four consonant nasals in Ewe; [m, n, ɲ, ŋ] can be prolonged and all are voiced. Two of them /m/ and /ŋ/ may fill the syllable nucleus.

Westermann (1930), Stahlke (1971) and Ansre (1961) respectively also augmented this assertion in their study that 'Ewe has four nasals namely /m/, /n/, /ɲ/ and /ŋ/ and some nasalized vowels.'

1.8.1 The Bilabial Nasal Consonant /m/

In Ewe the phoneme /m/ occurs in all three dialects at syllable-initial, syllable-medial and syllable-final positions. Here are examples in the table:

Table 1.8.1: The Distribution of the Ewe Bilabial Nasal /m/ at Word-Initial, Medial and Final Positions

Word	IPA Transcriptions	English Gloss
Me	[mə]	roast/inside
Mi	[mí]	we/us
mɔ	[mɔ]	Road
Ma	[má]	Divide
ame	[amə]	human
ama	[amā]	herb
ami	[ami]	oil
mim	[mím]	swallowing
mem	[məm]	roasting
mam	[mám]	dividing

1.8.2 The Alveolar Nasal /n/

The alveolar nasal /n/ occurs at syllable-initial and syllable-medial only in Ewe (Duthie 1996). There are no records of the phoneme /n/ occurring at syllable-final in the language.

Table 1.8.2: The Distribution of the Ewe Alveolar /n/ at Word Initial, Medial and Final Positions

Word	IPA Transcription	English Gloss
nom	[nom]	drinking
Na	[na]	To give
Nu	[nu]	mouth
No	[no]	breast
ene	[ənə]	Four
ana	[anà]	witchcraft
ani	[anì]	African python

1.8.3 The Palatal Nasal /ɲ/

The palatal nasal /ɲ/ which is orthographically written as 'ny' is a phoneme in the Ewe language and occurs at syllable-initial and syllable-medial only in Tɔŋu, Aŋlɔ and Eʋedome dialects. Here is a table showing the distribution of a few examples of such words:

Table 1.8.3: The Distribution of the Palatal Nasal /ɲ/ at word-Initial and word-Medial Positions

Word	IPA Transcription	English Gloss
nya	[ɲa]	Word/wash
nyi	[ɲi]	Cow/to rear
nyɔ	[ɲɔ]	Wake up
nye	[ɲə]	me
nyateƒe	[ɲatəƒə]	truth
nyui	[ɲui]	good
anyɔnyɔ	[aɲɔɲɔ]	September
anyiehe	[aɲiəhə]	south
enyi	[əɲi]	eight
nyuri	[ɲuri]	uncle
anyeʋɔ	[aɲəʋɔ]	rainbow
Anyi	[aɲi]	Bee/ground
funya	[fuɲá]	maltreatment

1.8.4 **The Velar Nasal /ŋ/**

The velar nasal /ŋ/ is one of the Ewe phonemes that gives considerable difficulty to non-native speakers and foreign learners. Its place of articulation is the same as that of the plosives /k, g/. This assertion was supported by two renowned linguists; Peter Roach (2009) and Alan Duthie (1996). In the three main Ewe dialects spoken in Ghana, the phoneme /ŋ/ occurs at all three syllable positions, thus, initial, medial and final. Examples are illustrated in the following tables:

Table 1.8.4: The Distribution of the Velar Nasal /ŋ/ at Word-Initial, Word-Medial and Word-Final Positions

Word	IPA Transcription	English Gloss
Ŋe	[ŋə]	break
ŋku	[ŋku]	eye
ŋdi	[ŋdi]	morning
ŋɔti	[ŋɔti]	nose
ŋgɔ	[ŋgɔ]	front
aŋɔ	[aŋɔ]	Tar/paint
aŋe	[aŋə]	Catapult/rubber
aŋgba/aŋkpa)	[aŋgba]	leaf
akaŋga	[akaŋga]	vulture
keŋ	[kəŋ]	Entirely/completely
boŋ	[boŋ]	rather
sɔŋ	[sɔŋ]	A lot/plenty
koŋ	[koŋ]	In particular
toŋ	[toŋ]	Pitch/tone describing perfect silent

1.9 Delimitations

The Ewe language as mentioned early on is widely spoken in regions of four West African countries with varieties or sub-dialects, greatly influenced by dialect continuum on either sides of the political and regional boundaries. The research should have been done across at least one variety from each of the four countries but due to time and political barrier constraints, it was conducted in Ghana only. This was within the scope of the Ewe nasal consonants, analyzed acoustically in Tɔŋu, Aŋlɔ and Eʋedome dialects.

1.10 Limitation

Due to time constraints and the fact that this research had to be done within a limited time frame, the participants in this research were only sixty (60) people; twenty (20) representing each of the three dialects, selected from the respective communities proposed for the data collection. These selections were further considered in terms of gender balance where ten (10) males and ten (10) females were chosen for each dialect group.

Another hindrance to this study was the uncooperative attitude of respondents. They were not ready to participate in the exercise. Some had to be convinced beyond reasonable doubts that the data being collected is solely for an academic research before they complied. Others demanded to be given money whilst the rest also thought the researcher was a detective and therefore felt reluctant to participate in the recording exercise.

1.11 Conclusion

The researcher set out to identify the acoustic properties in the study of the nasal consonants at syllable positions in the three major dialects spoken in Ghana. This chapter discussed background to the study, research on the Ewe language, the origin and brief history of the Ewe people, statement of the problem, purpose of the study, research questions, significance of the study, articulatory description of Ewe nasal consonants, limitations and delimitations investigation was also conducted on similarities and differences that exist across these dialects.

The chapter two dealt with a review of previous literature that have been carried out on nasal consonants. This included nasal consonants in general, early studies on Ewe nasal consonants and related acoustic studies in other languages.

CHAPTER TW0

LITERATURE REVIEW OF RELATED STUDIES

2.0 Introduction

The second chapter of this research discusses the review of related Literature within the scope of language study and articulatory studies on nasal consonants in general. It also reviewed the acoustic studies on nasal consonants in Ewe and other languages specifically relevant to the present study.

2.1 Some Early Studies on Nasal Consonants in Ewe

Capo (1981) in his effort to review the works of Westermann (1930), Ansre (1961), Stahlke (1971) and Capo (1977) respectively, stated that 'in some West African languages, e.g. Akan, Yoruba and Gban, although phonemic nasalized vowels are recognized, Gban do not take for granted the existence of a "primary nasal consonant". This is also the case with Ewe for which at least three positions have been identified'. One of such positions according to him is that Ewe has four nasal consonants namely /m/, /n/, /ɲ/, /ŋ/ and some nasalized vowels. The second position according to Capo is the one taken by Stahlke (1971). Stahlke argued that nasalized vowels in Ewe should be analyzed as a sequence of oral vowels followed by nasal consonants and he also recognizes the four nasal consonants stated by the linguists mentioned early on. Working in the framework of generative phonology, Stahlke did not apparently agree that all vowels are automatically nasalized after a nasal consonant.

The third position is argued for in Capo (1977 b) that, no phonemic nasal consonant exists in Wací and Gen, two dialects of Gbe; only nasalized vowels exist and they assimilate a specific set of non-nasal voiced consonants to become nasals. In his further analysis he realized that nasal consonants do not occur after certain oral consonants. Since there is clearly a phonetic relationship between the nasal consonants and the oral consonants that are not followed by nasalized vowels, he was not in agreement with the fact that these restrictions were merely accidental but rather showed a phonological peculiarity of the dialect cluster. Working within the framework of taxonomic phonology, Capo recognized that the (created) nasal consonants are followed by slightly nasalized vowels. He therefore proposed to discuss some constraints in the distribution of nasal consonants and the nasalized vowels in all Gbe dialects in his paper.

Capo's assertion of nonexistence of the phonemic nasal consonants in Wací and Gen (varieties of Ewe spoken in Benin) has been overgeneralized from my point of view. It would be inappropriate to draw a conclusion on the nonexistence of nasal consonants on only two variants of the Ewe language since there are many dialects and sub-dialects within the Ewe language across countries within the West African zone. This researcher therefore, did not support the discoveries on the generalization of the linguist, hence, the study on the acoustic analysis of the nasal consonants in the selected dialects among the native speakers in the Volta Region of Ghana. These nasals were acoustically analyzed in the three major variants spoken in Ghana at different word positions, where it had been proven that they existed as distinct phonemes in Tɔŋu, Aŋlɔ and Eʋedome.

In another claim, Capo (1981) asserted that, although the Ewe language has been described as a single language group it has considerable dialectal variations. He argued that Ewe should be analyzed as having no nasal consonants and it must follow that the treatment of 'syllabic nasal' allophones of marginal nasal consonants is to be rejected. He however noticed and considered the fact that phonetic syllable nasals seemed restricted to two nasal consonants; [m] and [ŋ] and occasionally [n] where he gave examples as followed:

[ŋgbɛ] ‘I refused’ (Fon dialect)

[ekpɔm] ‘He saw me’ (Gen dialect)

[enusəm] ‘He is hearing’ (Aŋlɔ)

ŋkəkə] ‘Day’ (Wací)

[Keŋ] ‘Completely’ (Kpando)

These phonetic syllabic nasals exhibited in Capo’s examples thus, the use of [m,n,ŋ] clearly showed the existence of nasal consonants in Ewe whether restricted or not. The researcher therefore, did not support his line of argument of Ewe to be analyzed as not having nasal consonants hence, this study to examine the four nasal consonants of the language acoustically at different word positions. These analysis were done in the syllable-initial, syllable-medial and syllable-final positions; to identify and come out with the differences and similarities that exist among these dialects in terms of formant frequency values and duration.

2.2 General Studies on Nasal Consonants in Other Languages

According to Williams (1989), a nasal consonant is produced with a lowered velum allowing air to escape through the nose. Examples of nasals in English are /m/ and /n/ in words such as nose and mouth. Nasal occlusive are nearly universal in human languages. Williams asserted that ‘ nearly all nasal consonants are nasal occlusive where air escapes through the nose but not through the mouth, as it is blocked (occluded) by the lips or tongue and the oral cavity still acts as a resonance chamber for the sound’. Most nasals according to him are voiced and in fact the nasal sounds [n] and [m] are among the most common sounds cross-linguistically. Voiceless nasals do occur in a few languages such as Burmese, Welsh and Guarani spoken in Australia, South American-Indian and Wales respectively.

In terms of acoustics, nasals are sonorants, meaning that they do not significantly restrict the escape of air (as it can freely escape out the nose).

In his assertion, nasals however, are also obstruents in their articulation because the flow of air through the mouth is blocked. This duality where a sonorant air flows through the nose along with obstruction in the mouth means that nasal occlusives behave both like sonorants and like obstruents. Acoustically, nasals have bands of energy at around 200 and 2000 Hz. These assertions were made by Williams (1989). Here are examples of nasal consonants adopted from him:

Table 2.2.1: Distribution of Nasal Consonants Adopted from Willams (1989)

Voiced		Voiceless	
Description	**IPA**	**Description**	**IPA**
voiced bilabial nasal	[m]	voiceless bilabial nasal	[m̥]
voiced labiodental nasal	[ɱ]	voiceless labiodental nasal	[ɱ̊]
voiced dental nasal	[n̪]	voiceless dental nasal	[n̪̊]
voiced alveolar nasal	[n]	voiceless alveolar nasal	[n̥]
voiced retroflex nasal	[ɳ]	voiceless retroflex nasal	[ɳ̊]
voiced palatal nasal	[ɲ]	voiceless palatal nasal	[ɲ̥]
voiced velar nasal	[ŋ]	voiceless velar nasal	[ŋ̊]
voiced uvular nasal	[ɴ]	voiceless uvular nasal	[ɴ̥]

In his reconstruction of proto-Volta-Congo language clusters Steward (1976) postulates that nasal consonants have originated under the influences of nasal vowels. He claimed this hypothesis was supported by the fact that there were several Niger-Congo languages that had been analyzed as lacking nasal consonants altogether. He further asserted that languages like these have nasal vowels accompanied with complementary distribution between oral and nasal consonants before oral and nasal vowels. Subsequent loss of the oral/nasal contrast in the vowels according to him may result in nasal vowels becoming parts of the phoneme inventory and in all cases reported up to date, bilabial nasal consonant /m/ is the first nasal consonant sound to be phonologized.

Niger-Congo in his assertion, thus invalidated two common assumptions that, all languages have at least one primary nasal consonant and if a language has only one primary nasal consonant it is /m/.

The above debate on nasals by Steward (1976) confirmed the fact that a step has been taken in the study of Ewe nasal consonants, as it was classified among the Niger-Congo languages. This claim, however, did not include or cover the study of all the four nasal consonants known in Ewe. This research supported and built upon the views of Steward and acoustically analyzed the Ewe nasal consonants which have been documented to serve as the basis for further research in the language.

Odden (2005) asserted that during the production of nasal consonants, the velum is lowered so that the pathway from the pharynx to the nasal passage is open and air flows from the lungs out through the nostril. In nasal stops, the mouth cavity is closed off by a complete constriction in the vocal tract. This according to him means that nasal consonants that are made with an oral constriction add a side cavity onto the long pharyngeal-nasal tube.

The side cavity is a tube closed at one end, thus resonating frequency components of the side branch are not permitted out of the vocal tract but are ‘absorbed’ by the side cavity he further asserted. This gives rise to anti-formant. Nasals have several anti-formants which are determined by the size of the cavity. As /m/ has the longest side resonator, its anti-formants are low and narrowly spaced (first anti-formant around 800-

1000Hz). Anti-formants of /n/ are higher and wider spaced around 2000Hz and short oral branch produces the highest and widest anti-formants for /ŋ/ around 3000Hz.

His argument affirmed the analysis of the Ewe nasal consonants due to the fact that the frequency formant values calculated for the bilabial nasal consonant /m/ are lower than the others whilst that of the alveolar nasal /n/ and the velar nasal /ŋ/ are also among the high and highest values measured. This phenomena occurred as a result of the presence of anti-formant which is an energy trough rather than an energy peak produced in the nasal stops by the effect of the stoppage in the oral (side) chamber, which causes the acoustic energy to reduce the energy level in the larynx-to-nose (main) chamber.

Consonants such as [m, n, ŋ] are of course nasals but they are not nasalized since the term implies that part of the air goes through the nose and part through the mouth. Contrasts between nasalized and non-nasalized consonants probably do not occur in any language. Ladeforged (2006). His claimed is supported by Duthie (1996) who also asserted that Ewe has four nasal consonants. This classification is seen in his analysis on the Ewe orthography where he grouped [m, n, ɲ, ŋ] as nasal consonants attesting to their nasal qualities mentioned above. The four, [m, n, ɲ, ŋ] according to him, are distinct phonemes of the Ewe language.

Traditional education largely ignores spoken language; even in drama and foreign language learning, little attention is paid to the details of speech in an objective way. We, therefore, need a method of describing speech in objective, verifiable terms, as opposed to the lay approaches which typically describe sounds as ‘hard’, ‘soft’ ‘sharp’ and so on, which can only be properly understood by the person using such descriptions. Lodge (2009).

In his view, such an approach to any subject of study is totally subjective: since only the person carrying out the description can understand them, other people are expected to be 'on the same wavelength' and clever enough to follow them. So, if we are to observe and describe speech in any meaningful way, we need some kind of objectively verifiable way of doing so. In fact, there are three ways of approaching the task; articulatory phonetics, acoustics phonetics and auditory phonetics. The assertion of Lodge augmented the fact that, the study of every language if possible, should include all three branches of the phonetics. Thus, the study of all the branches, would help the development of that language in the linguistic investigations, hence, this acoustics study of the nasal consonants in the Ewe language.

2.3 **Related Acoustic Studies on Nasal Consonants**

Though there have been an extensive phonetic work on nasal consonants in the Ewe language, its acoustic equivalent is uncommon. Gbegble (2008) set the pace in this field by analyzing vowels acoustically. She assessed both the oral and nasal vowels and showed the distinction between the two in the Ewe language. Her work showed how the language makes use of the nasal vowels as distinct phonemes from the nasal consonants. She claimed vowels that are adjacent to nasal consonants are produced partially or fully through the nose.

The researcher supported her effort in the acoustic investigations. It served as the basis upon which the acoustic study of the Ewe nasal consonants was built. In spite of the short fall in the acoustic study of the Ewe language, many research works have been conducted in other languages on the acoustic properties of nasal consonants, which are equally relevant to the present study.

Bosiwah (2011) conducted a research in Akan nasals which had similar features of the topic under study. His aim was to give an acoustic description of Akan nasals using NV, VNV and CVN syllables, with C = [b], V = [a] or [o] and N = [m, n, ɲ,ŋ] by means of spectrographic analysis within the quantal theory framework. The result of his work proved that the bilabial /m/ and the alveolar nasal /n/ in Akan occur at word initial, medial and final. However, the palatal nasal /ɲ/ occurs at word- initial, and word- medial but not word- final. (Lawrence Bosiwah 2011; citing Dolphyne 1986 b). Here is an excerpt from Bosiwah's work indicating the Akan nasal /m/ at different word positions.

Table 2.3.1: The Distribution of Akan Bilabial Nasal /m/ at Word-Position adopted from Bosiwah (2011)

Akan Word	Ipa Translation	English Gloss
ma	[ma]	Give
mo	[mo]	Well done
ama	Ama	So that
ɔma	[ɔm:a]	(3rd per. Sing.) gives
nam	[nam]	Fish
Bam	[bam]	Embrace

Akan and Ewe are classified under the Kwa language branch which belongs to the Niger-Congo family spoken in West Africa. Greenberg (1976). Whilst Akan has [m, n and ɲ] as the nasal phonemes with allophones, Ewe language has [m, n, ɲ and ŋ] as distinct phonemes. These two languages have similar phonemes and belong to the same language group. However the positions of their nasal consonants differ in their distribution and number. Nevertheless, Bosiwah's work still served as a guide and reference in achieving the purpose of this research.

Glass (1982) stated that, "the basic production of nasal consonant have been studied extensively and are well understood". He challenged himself with the above statement to study the acoustic analysis of nasal consonants which was authenticated with scientific prove. He described nasal consonants as being voiced, since in their production, the vocal tract is excited by vocal vibration. Nasal consonants according to him are produced by lowering the velum so that air flows through the nasal tract and is radiated at the nostrils. According to Glass, the different between three nasal consonants in American English /m/, /n/, /ŋ/ is the location of the constriction formed with the tongue as in *simmer, sinner and singer*.

He further asserted that in many languages including American English nasal consonants can have a profound effect on neighboring vowels. Following the release of a nasal consonant the initial portion of a following vowel would be nasalized during time interval that the velum is closing. According to James, the same holds true for the final portion of a vowel preceding a nasal consonant. He further stated that the amount of contracted nasalization depends upon the particular language dialect. Since anticipatory nasalization is common in American English, a sequence of a vowel plus nasal consonant (VN) may, in many situations, be pronounced as a simple nasalized vowel or a nasalized vowel plus a short residual nasal murmur. This in his claim is especially true of vowel-nasal-consonant (VNC) sequence where the consonant is voiceless stop, as in words *camp, bent and bunk.* In these cases nasalization of the preceding vowel may provide the major acoustic difference between these words and the corresponding pair words *cap, bet and buck.*

In American English according to him the speakers have the freedom to nasalize vowels at will independent of the presence or absence of a nasal consonant. For this reason it is important not to assume that the presence of nasalized vowel will always indicate the presence of nasal consonant as well. He conducted an acoustic study on the three nasals using data base consisting of 1200words excised from continuous speech recorded from six speakers, three (3) males and three (3) females. All of the recorded words were digitized and their phonetic transcriptions were aligned with the speech waveform. In his final analysis of the formant frequency on the three nasal consonants in American English, Glass studied the acoustic characteristics of nasal consonants and realized that the nasal murmur spectra is characterized by the existence of a very low first formant, located at about 300Hz which is separated from the upper formant structure. James also noted in his own analysis that the formants were highly damped and there was the presence of anti-formants caused by the closure in the oral cavity which varied in frequency with the place of articulation. In his assertion the anti-formants could generally be found between 250 and 1250Hz for /m/, between 1450 and 2200Hz for /n/ and above 3000Hz for /ŋ/. He noted that although the anti-formant varies with the place of articulation, the overall spectral shape of nasal consonants are very similar in appearance.

Even though the American English nasal consonants are realized at the same place of articulation as the Ewe nasal consonants, their formant frequency measurements in Hertz were not the same acoustically as Ewe nasal consonants. More so, their syllabic nasals formation varied at word positions and also there could not be the presence of anti-formants caused by the closure in the oral cavity in the production of Ewe nasals. This could occur as a result of the English language not being any of the Kwa branch of the Niger-Congo language groups asserted by Dotse (2011). Glass's discovery of anti-formants in his theory might call for a study comparing American and Ewe nasal consonants to bring out the similarities and differences in them.

According to Flege's Speech Learning Model (SLM), which is based on similarities and equivalences between two languages- the mother tongue (L1) and the target language (L2) equivalent or similar sounds are difficult to produce because the learner perceives them as being the same sound in his/her L1 and not a new category. This was exactly the problem encountered by Brazilian students who used Portuguese as L1 and English as their L2. They had difficulty in the production of the phonemes /m/ and /n/. The Brazilian learners generally transfer to English the knowledge they have of the Portuguese language phonic system and its orthographic conventions, tending to produce nasalized vowels, without making the distinction between /m/ and /n/ at the end syllables. Becker (2007).

Identifying this problem, she set out to conduct a study in acoustic investigation, to come out with what is produced by the Brazilian pre-intermediate learners of English in codas of monosyllables which have the vowel sequence + nasal consonants ([m] and [n]). She used minimal pairs whose contrast lies precisely in the nasal sounds within two distinct environments preceding the vowel ([æ] and [I]).

In Becker's assertion acoustic analysis was preferred over auditory analysis because the contrast between final [m] and [n] is difficult to hear even for native speakers. Her analysis were mainly comparative, with the use of the production of two native speakers of English who composed the control group. In her assertion, there are three types of obstructions of the articulators in the oral cavity resulting in the three nasal consonants which occur in Brazilian Portuguese: [m] bilabial, [n] alveolar and [ɲ] palatal, all in the coda position (endings). However her research was conducted on the bilabial nasal [m] and the alveolar nasal [n] only.

She claimed the bilabial [m] occurs in the beginning of words ("mar" [sea]), and in the middle, following a consonant in another syllable ("norma" [norm]) or in a position between vowels ("homeopatia" [homeopathy]), thus, word-initial and word-medial positions. The environments of occurrence of the alveolars are similar. It is very important to mention that the graphemes "m" and "n" occur at the end of syllables (inside words –

"limpo" [clean], "santo" [saint] - and word-finally - "fim"[end]-), without corresponding to the phonetic articulation of the segments [m] and [n], she asserted.

For her experiment, the production of ten pairs of words (minimal pairs, Table below) was recorded. The informants were ten adolescents, students of English at pre-intermediate level; five boys and five girls. All words were monosyllabic, and the nasals were preceded by two vowels of distinct qualities:

Table 2.3.2: Minimal Pairs used in the Research adopted from Becker (2007)

	[m]	**[n]**
[I]	dim	din
	gym	gin
	Pim	pin
	skim	skin
	Tim	tin
[æ]	cam	can
	dam	Dan
	gram	gran
	jam	Jan
	Pam	pan

Data was analyzed using PRAAT

In her result Becker claimed for the lack of specific references about acoustic data of nasals in codas, the analysis of the data obtained with the control group was much more detailed, so that we could, based on the results of such analysis, define one or more parameters for the analysis of the production of the Brazilian learners.

Becker found out that the relative duration of the nasal consonants obtained by dividing the average value of the duration of the nasal murmur by the total duration of the target word, the three first formants of the vowel preceding the nasal, and the three first formants of the nasal (specifically the nasal murmur) of the data from the control group, the values of the second formant (F2) of the nasal proved to be the most consistent ones, she asserted. For all the words in the corpus, in each of the three repetitions, for both informants, the figures related to F2 were consistently higher for [n] than for [m], for the same pair. This was therefore the parameter used to distinguish between [m] and [n]. For a student to have produced an alveolar, his/her production should be similar to the production of a native speaker (the boy learners were compared to the boy native speaker, and the girl learners with the girl native speaker); that is, F2 of the nasal murmur of [n] should have been higher than F2 of [m] for the same pair, and the difference between these two formants should be greater than 100 Hz.

In her findings 40% of the target words produced by learners were acoustically similar to those produced by the native speakers, 27% of the words showed an F2 with opposite results to those of the native speaker while a third of the productions were acoustically (F2 of [m] and F2 of [n] showing very close frequencies, though F2 [n] was higher than F2 [m]. Based on these analysis it was revealed that, the failure to distinguish between final nasal consonants is a typical characteristic of Brazilian Portuguese-English inter-language learners of English as L2. In view of this peculiarity, they need to be given a greater attention in the classroom because of the large numbers of monosyllabic minimal pairs in English which are distinguishable solely by the place of the final nasal, she asserted.

The review of this literature on the analysis of [m] and [n] by this Brazilian student was of immense benefit to my study because Ewe also makes an extensive use of [m] and

[n] in the formation and production of monosyllables at word-initial and word-medial positions. In addition, it guided the researcher to handle with ease, the challenge she was confronted with involving the native speakers of Aŋlɔ dialect alternating [ŋ] and [n] at certain phonetic environments which was acoustically proven to be a common characteristic to them.

Ladefoged (2006), gave an account on the variations on spectrograms. According to his claim, individual variation is readily apparent when studying spectrograms. In general when two different speakers pronounce sets of vowels or consonants with the same phonetic quality, the relative positions of these sounds on a formant chart will be similar but the formant frequencies will differ from speaker to speaker. His assertion on individual effects in the results of calculations for formant frequency values are factual as this reflected on the measurement of individual records for this study. Spectrograms of the participants are similar but there are differences in the values calculated for each of them.

Ferguson (1965) in his effort to encourage the search for universals in linguistics said 'every language has at least one Primary Nasal Consonant in its inventory and no language has Nasal Vowels unless, it has also one or more Primary Nasal Consonants'. His assertion confirmed that nasal consonants form an integral part of language as a tool for communication. These nasals, when acoustically investigated and experimented, would augment the study of language, since acoustics is universal in phonetic investigations.

Stevens (1998) explains why some articulatory and acoustic dimensions are favoured over others in distinctive features contrast across languages. According to him, though most linguists and phoneticians agree that the distinctive features of spoken languages are realized in terms of concrete physical and auditory properties, there is little agreement on exactly how they are defined. Citing Jakobson, Fant and Halle (1952), he asserted that a tradition launched by Jakobson and his collaborators stated that features are defined mainly in acoustic (or perhaps auditory) domain.

The central claim in their assertion is that there are phonetic regions in which the relationship between an articulatory configuration and its corresponding acoustic output is not linear. He further asserted that within such regions, small changes along articulatory dimensions have effect on the acoustic output and it is such regions of acoustic *stability* that define the articulatory inventories used in natural languages. In other words, these regions form the basis for the universal set of distinctive features, each of which corresponds to an articulatory-acoustic coupling within which the auditory system is insensitive to small articulatory movements. His assertion on distinctive features of a spoken language was one major factor that pushed the researcher into investigating the Ewe nasal consonants acoustically. This was to ascertain whether they occur as distinct phonemes, at word-initial, word-medial and word-final positions in the language.

UC Berkeley phonology lab annual report asserted that nasalized vowels are more acoustically similar to velar nasal than they are to labial or coronal nasal. The velar nasal /ŋ/ has no oral acoustic anti-formants while the mouth cavity in /m/ and /n/ functions as a side branch in the vocal tract and contributes a significant low frequency acoustic zero or anti-formant. Because the mouth cavity does not form a significant oral side branch in the mouth in /ŋ/ this acoustic zero is not present, and thus the acoustic spectrum is more vowel-like than other nasals. Consequently, if a nasalized vowel is misperceived as a nasal segment the place of segment will be a velar because of the acoustic similarity of /ŋ/ and nasalized vowels.

Ohala (1993) claims of nasalized vowels being similar acoustically to velar nasal might not be far from right. However, in their own assertion, the acoustic similarity hypothesis has not been adequately tested. This might also call for a further research in another study on similarities and differences between velar nasals and nasalized vowel in the near future.

The acoustic structure of nasal consonants has long been predicted by the acoustic theory speech production (Flanagan 1972). The presence of a side-branching resonator (the blocked oral cavity) will introduce anti-resonance (zero) in the spectrum of nasal consonants. Theoretically, the anti-resonance can be used to identify the place of articulation of the nasal consonants because the frequency of the anti-resonance is determined by the dimension of the side-branching resonator. For example, the frequency of the anti-resonance for /m/ according to his assertion, should be lower than /n/ because the blocked oral cavity attached to the pharyngeal-nasal passage is longer for /m/ than /n/. Such differences, however, are difficult to detect using conventional techniques of spectral analysis.

Though Flanagan's claims suggested some levels of difficulty in detecting the anti-resonance for the nasal consonants, the application of the wave-surfer or PRAAT in this situation usually makes the spectral visible for easy analysis. Physiologically, a nasal speech sound is quite simple: it just involves lowering of the soft palate to a degree sufficient to couple the oral and nasal cavities acoustically. With a concomitant oral closure, a nasal consonant is produced; without it, a nasal vowel. Nevertheless, this simple gesture has a major and complex phonological consequences due to the interconnectedness of all the parts of the vocal tract. Ohala (1993).

His claim was that, in nasal consonants, resonances are contributed primarily by the pharyngeal-nasal airway, whereas anti-resonance are contributed by the oral cavity, which branches off from the pharynx. The shape and length of the pharyngeal-nasal airway is relatively constant for all nasal consonants and therefore so are its resonance, at approximately 300, 1000 and 1900Hz for the lowest three formants. But the antiresonances are inversely related to the length of the oral branch which varies greatly from a maximum the bilabial nasal /m/ to a minimum for the velar nasal /ŋ/ or the uvular /N/. The first (lowest) for anti-resonance for /m/ about 1000Hz, that for /ŋ/ around 3000Hz.

Another explanation to his work stated that, in addition to static cues, there are dynamic cues to nasal segment. Nasal consonants offer abrupt and therefore auditory highly salient changes in the overall amplitude and spectrum of the acoustic signal. Since the nasal cavity has such a large acoustically absorbent surface area, all nasal and nasalized segments have lower amplitude vis-à-vis comparable oral sonorants. The on-glides and off-glides of only the palatal and dorsal nasal /ɲ/, and /ŋ/ tend to be relatively long and more glide-like than the shorter transitions of the labial and apical nasals.

Ohala opined that the production of nasal speech sound was quite simple. On the contrary its production from one of his own statements has a major and complex phonological consequences; an undisputable fact. However, with the application of the wave-surfer in gathering and analyzing the data on the Ewe nasal consonants, the challenges were minimal.

Lodge (2009) reiterated that, 'there is a tendency these days to rely more on acoustic analysis than impressionistic transcription. Both are equally important, as is an understanding of the relationship between the two; articulatory and acoustics. Every articulatory movement and posture has its own acoustic effect and it is probably necessary to understand the basics of acoustic analysis'. His line of argument suggested the study acoustic is gaining grounds these days in the phonetic field where most of the sound systems of the world's known languages like English and Portuguese have been acoustically analyzed. Based on these fact, Ewe as a developing language, should not be left out in this field of description, hence, the need to analyze the nasal consonants in acoustic to contribute to its description in phonetics.

2.4 Gender and Age Characteristics

Speech signals vary acoustically across gender and age (Eguchi & Hirsh, 1969). Anatomical and physiological changes during development are largely responsible for many of these acoustic differences. During typical development, the larynx descends, the vocal folds increase in size and mass and the vocal tract lengthens, they asserted. Their claim suggested one of the factors that contributed to the differences in the results of the formant frequency measurements in this study which might be due to the physiological formation and development of the individual speakers. This was a fact well acknowledged and supported as far as this study also involved both male and female participants.

According to Robison (2011), the average fundamental frequencies (F0) for adult males, adult females and children are approximately 124, 221 and 300Hz respectively, due mainly to the size and mass of the vocal folds. She cited Pearson et al (1977) to have measured teacher's speech level and background noise level in classroom providing signal-to-noise ratio of 'everyday' situations. Speech spectra of males, females and children were measured in a quiet environment at different efforts; casual, normal, raised, loud and shouted speech. The results showed that the speech level spectrum of male speakers have the most energy at 125Hz but that in frequency range of 250-8000Hz. The loud and shouted speech of the male speakers have increased energy in the 1250-1600Hz region while female and children's voices were very similar across all speaking styles.

In her assertion, some of the temporal and spectral differences between adult and children speech may be attributed to the fact that young children are still developing their speech-motor skills. However, differences in the perception between male and female adult talkers' speech may be primarily related to the differences in the spectral energy of certain sounds which can have very high frequency content. As far as the study of the nasal consonant sounds in Ewe involved both male and female speakers, such differential phenomena was bound to occur in the frequency value measurements, hence this review on gender which was one of the factors underlining the varieties in the results.

Krause (2015) carried out an investigation into the effect of age and gender on sounds in American English mainly on pronunciation and vocabulary. He asserted that, age and gender are two variables that commonly influence language variation. In his opinion, differences in speech between males and females have been some of the most consistent findings in socio-linguistic research. One of his hypothesis was to find out the statistical differences in sound symbolic association between males and females. He approached his work using a mixed-method procedure, collected his data via online survey of speakers whose L1 was American English. The alveolar nasal consonant /n/ was one of the phonemes targeted in the dissertation.

He further augmented his claim by citing Labov (1990) who supplied two principles reflecting a traditional views of gender preferential phenomena in language: men use nonstandard forms of speech more frequently than women and women more frequently use the incoming variant. His suggested asymmetry was that, not only do men and women favour vowel spaces, but women lead linguistic changes.

One of his findings in the case of Belfast was that, females more frequently led the shift from low to high front vowels while males led the shift from backing and rounding of /a/. This according to him is to say that between males and females, there exist what are largely subconscious preferences in language use extending across various functions. Whether social or biological, variation by gender is not uncommon. This discovery from the results of Krause's assertion sustained the objective of acoustically analyzing the data on gender bases to identify the similarities and differences that exist between the male and female speakers.

Holmes & Meyerhoff (2003), argued that theorists in gender and language research cannot continue to discuss gender simply in terms of the differential linguistic behavior of males and females as groups. They called for the need to analyze the various strategies, which gathered, raced, and classed women and men adopt in particular circumstances and with particular goals and interests.

The Cross Cultural Politeness Research Group was set up to discuss the problems associated with language and gender and to develop a new way of analyzing linguistic politeness. It was discovered in their discussion that women were more polite than men in the utterances. These outcome was based on analysis made on a research conducted on some activities where they found out girls and boys building systematically different social organizations and gender identities through their use of talk and, at certain point build similar structures.

In the final analysis it was discovered that stereotypes about women's speech fall apart when talk in the range of activities was examined; in order to construct social personae appropriate to the event of the moment, the same individual will articulate talk and gender differently as they move from one activity to another, they asserted.

Holmes' and Meyerhoff's assertion clearly depicted similarities and differences in the talks or speeches of the men and women involved in the activities, hence the need to analyze the results of the Ewe nasal consonants on gender bases to find out the differences and similarities that exist between them.

2.5 Conclusion

This chapter reviewed among others the studies conducted by earlier linguists on nasal consonants in various languages. Further reviews were made on the acoustic studies of languages related to the study. It also discussed the effects of gender characteristics and age on the production of sounds where it was seen that gender issues actually have effect on speech. These phenomena contributed largely to the differences and similarities that occurred between male and female speakers.

From the review of the related literature, it has become clear that the role nasal consonants play in the description of our sound system cannot be overemphasized; hence the need to acoustically analyzed them in the three selected dialects of the Ewe language spoken in Ghana. This at the end will present the description of the sound waves, where the acoustic correlates of the nasal consonants will be discussed.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

This chapter discusses the methodology of the research. This includes the selection of language communities, selection of speakers or participants, research design, word lists, structure, data collection, procedure for measurement and analysis of the study. It also experimented on the nasal consonants at different word positions where the formant frequency values were measured in Hertz. Samples of the durational measurements of the four nasal consonants in Milliseconds for selected speakers have also been discussed.

3.1 Selection of Language Communities

The demands of this research topic show that the researcher needed both verbal and recorded response. She therefore visited selected communities preferably Mafi Adidome and Sogakope traditional environs, Ho, Fodome and its environs and finally, Aŋlɔgã and Dzodze traditional areas in the Volta Region of Ghana where the native speakers of the three dialects under study were located to collect data for her work.

The Ewe language spoken in Ghana has been classified under three major umbrellas of dialect; Tɔŋu, Aŋlɔ and Eʋedome as mentioned early on. However there are many sub-dialects within these three variants which are mutually intelligible to native speakers across the entire region. But for the purpose of this survey, at least two communities were chosen to represent each dialect. The Tɔŋu dialect comprised Mafi and Agave which are spoken in Adidome, Sogakope and their traditional environs. Ho and Fodome varieties were selected to represent Eʋedome dialects. Finally, Aŋlɔgã and Dzodze traditional areas were also chosen to cater for the Aŋlɔ variety.

The selection of these indigenous communities was with the anticipation that the speakers were born, bred and lived there over the years and therefore, could speak the language using the nasal consonants naturally. Some of them could also read and write at least simple sentences put in a carrier frame which helped to meet the needed demands of the data collected. On page three is the geographical map of the Volta Region of Ghana showing some of the Ewe communities and settlements carved out of the map of Ghana.

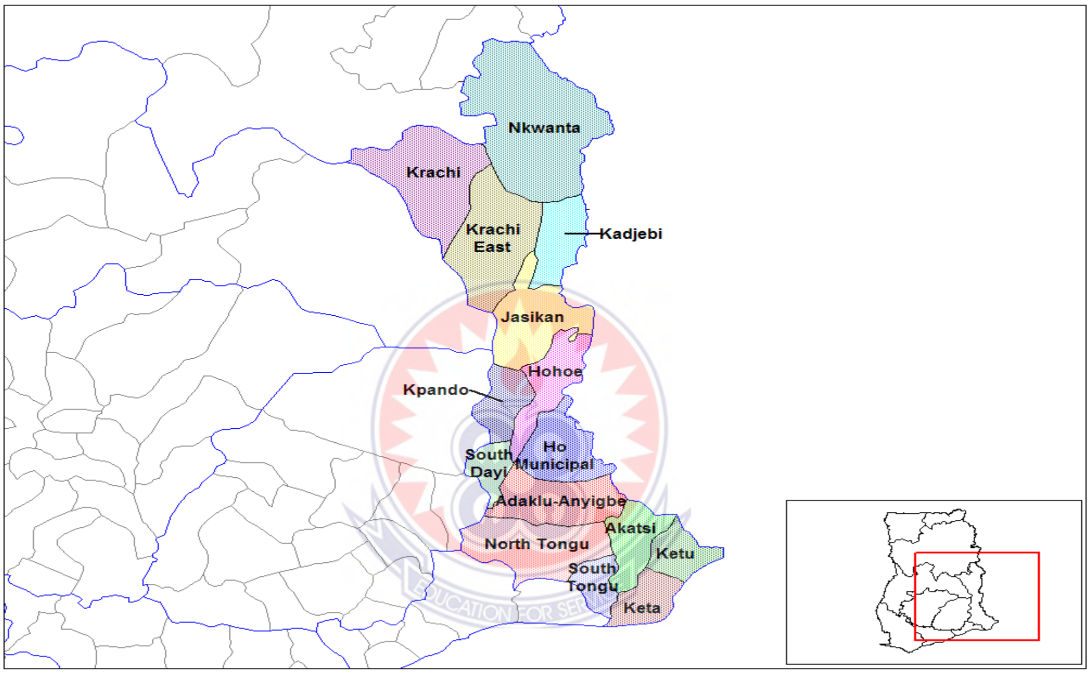


Figure 3.1.1: Map of the Volta Region Carved out of Map of Ghana showing the Distribution of Ewe Language and some of its Major Dialects

The Volta Region is not inhabited by only the Ewe people. There are equally other ethnic or language groups. Majority of these groups are Akan, Kokomba and Guan settlers located around Jasikan, Krachi, Kadjeibi, Nkwanta and their environs.

The native speakers of Ewe in Ghana have their settlements around Keta in the south-eastern part of the region through Tɔŋu traditional areas in the south-west to Xɔxɔe in Central Volta. The Aŋlɔ dialect speakers are located around Keta, Ketu, Akatsi, Aŋlɔgã, Agbozume and its environs. Tɔŋu speakers are also located around north and south Tɔŋu as shown on the map. The Eʋedome speakers who occupy the largest geographical settlements are located around Adaklu, Ho, Fodome, Kpedze, Aŋfɔegã, Dayi, Peki, Kpando and Xɔxɔe in their surounding areas.

3.2 Selection of Speakers or Participants

In all a hundred and twenty (120) speakers were targeted; sixty (60) males and females each to ensure gender balance. This was further divided to represent the three dialects, thus, twenty (20) males and twenty (20) females for Tɔŋu, Aŋlɔ and Eʋedome respectively. However, only 60 participants willingly offered themselves in the data collection: ten (10) males and ten (10) females represented each dialect. The purpose of applying this sampling technique and approach were to get the requisite participants. Thus, speakers were selected from the typical native communities where the targeted dialects are predominantly spoken for the recordings. Their ages ranged between 24-62 years and none of them demonstrated any speech or hearing disorder. They were adults who had lived in their various communities almost their entire lives and spoke their language without any constraints.

3.3 Research Design

This project work of study involved Tɔŋu, Aŋlɔ and Eʋedome dialects spoken in the Volta region of Ghana within the West African sub-region. The transformative mixed method approach was extensively used. Citing Creswell and Clark, Owu-Ewie (2012) described this type of method as one in which the researcher uses a theoretical frame work or hypothesis as an overreaching perspective that contains both qualitative and quantitative data.

3.4 Data Collection and Instrumentation

Since work on the research required experiments through spectrographic analysis of the nasal consonant sounds, the data collection followed these procedures or principles: The targeted sounds were within the scope of prevocalic, intervocalic and postvocalic nasal consonants within the scope of mono or disyllabic word, with the structure NV, VNV, NVN, CVN, and NCV was prepared on the carrier frame 'Gblɔ…tututu'. The formula, N=/m, n, ɲ and ŋ/. V=/a, ə, i or ɔ/. C=/k, or g/ was applied. The words with the nasals were put into a carrier frame; Gblɔ… tututu 'say … exactly'. Critical observations were also made on how the nasal consonants were pronounced in the syllables since the study involved analysis of speech sounds. All the utterances made were recorded for analysis. The recordings were done using Window sound recorder with an external microphone and the software used for the analysis was PRAAT. Tables and charts were also drawn in excel Microsoft ware.

Individual speakers were taken through the structure and asked to repeat each sentence containing the nasals in the carrier frame thrice. The English versions of the sentences were also constructed to help speakers identify and read in their natural form or structure without panicking. Ewe is a tonal language and one word could mean another thing in a different context and this was the purpose for which the carrier frame was constructed in order to avoid ambiguity. The words for the Ewe word list was carefully selected to cater for the four nasal consonants at word-initial, medial-medial and final-final positions in all the dialects chosen for this study, within the Ewe language.

Following these procedures, the simple sentences with the nasal consonants were presented to the speakers for recording. The word lists used in this exercise were presented in the table as followed;

Table 3.4.1: Ewe Word List

Word	IPA Transcription	English Gloss
ma	[ma]	Divide/dough
ame	[amə]	Human being
mim	[mim]	Swallowing
kum	[kum]	Fetching/driving
na	[na]	(to) give
ene	[ənə]	Four
nya	[ɲa]	Word/wash/sack
enyi	[əɲi]	Eight
ŋɔ	[ŋɔ]	Perforate/worm
aŋe	[aŋə]	Catapult/rubber
keŋ	[kəŋ]	Entirely
Ŋgɔ	[ŋgɔ]	Front/ahead/forward

3.7 Measurement and Analysis

The acoustic measurement and analysis of the nasal consonants were performed through a series of experiments. It was conducted on a database of utterances. The analysis was also made on gender bases. Measurement of the formant frequency and the durations of the nasal consonants were taken. The similarities and differences within the nasals were analyzed among others.

Following these procedures, the nasal consonants were segmented into tokens visually on wide band spectrograms. The recordings were taken within sampling frequency of 44100Hz. The data values of the first (F1) and second (F2) formant frequencies in Hertz (Hz) were calculated. The values were used to draw tables and charts. Furthermore the comparisons of the nasal consonants at word positions and within nasal consonants were made. The differences and similarities between the dialects were measured. Calculations were done on gender basis within dialects. The nasal durations were also measured at word positions for each dialect. The selected nasal consonants in each token was played back before the measurement was taken to avoid ambiguity of the sound. The vertical and dotted lines in figure 3.5.1 and 3.5.2 are samples of the recorded nasal consonant sounds of Tɔŋu and Eʋedome dialect speakers in spectrographic forms.

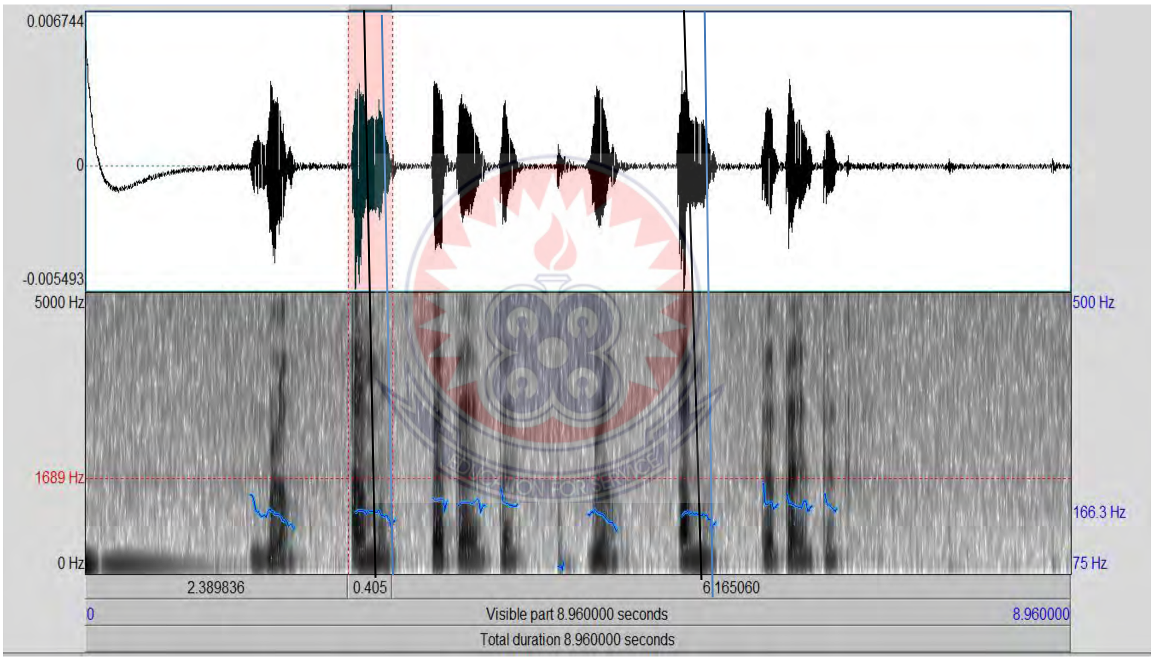


Figure 3.5.1: Waveform and Spectrogram of Tɔŋu female Speaker from Mafi Adidome Repeating "Gblɔ amə tututu". The Vertical Lines indicated the Selected Nasal /m/.

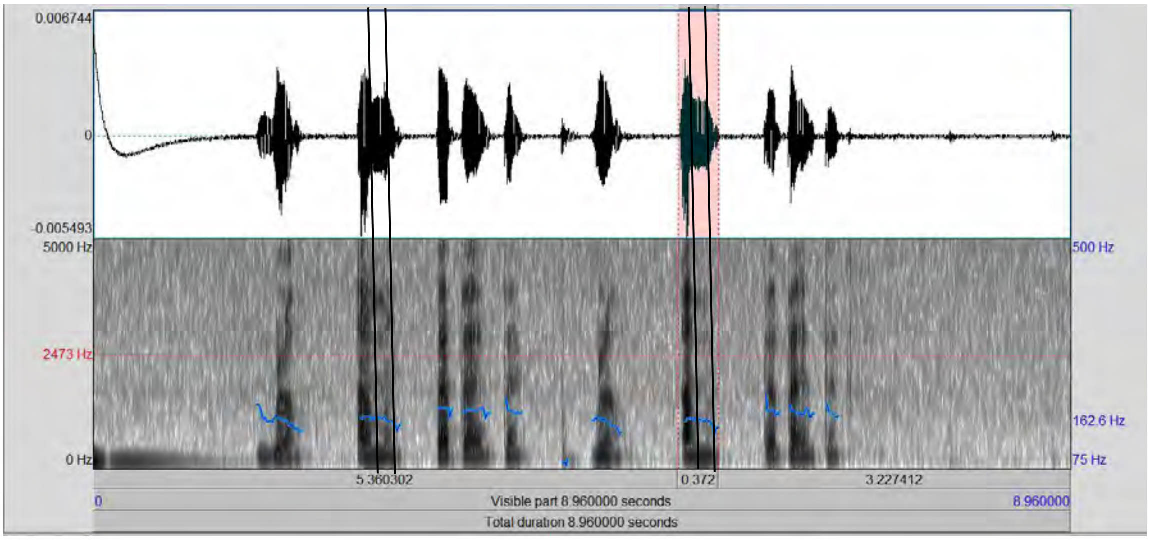


Figure 3.5.2: Waveform and Spectrogram of Eʋedome Male Speaker from Dzolo, a Village close to Ho repeating "Gblɔ ənyi tututu". The Vertical lines through the Waveform and the Spectrogram indicated the Selected Nasal Consonant /ɲ/

The durational measurements for each of the nasal consonants were also calculated and analyzed. According Glass (1982), the primary focus of the durational study is to quantify the effect of the phonetic context on the duration of the nasal consonant. He further explained that duration is relatively easy to compute, since it is defined by time alignment of the phonetic description. Although in the past it has not been an easy matter to find the exact boundaries of any given phoneme, the use of spectrogram simplifies this task. In his assertion, the temporal boundaries of the nasal consonants are relatively easy to establish, since they are usually denoted by sharp spectral changes which occur at the beginning and end of the period of the oral closure. In general, the boundaries produced by different transcription experts, are within 10msec of each other, he asserted.

The durations of the nasal consonants of the Ewe language were also discussed. The results show the bilabial nasal consonant /m/ has the lowest duration at word-initial position and the highest is the velar nasal /ŋ/. Here are some selected spectrographs showing durations measured for the analysis of nasal consonants in Ewe.

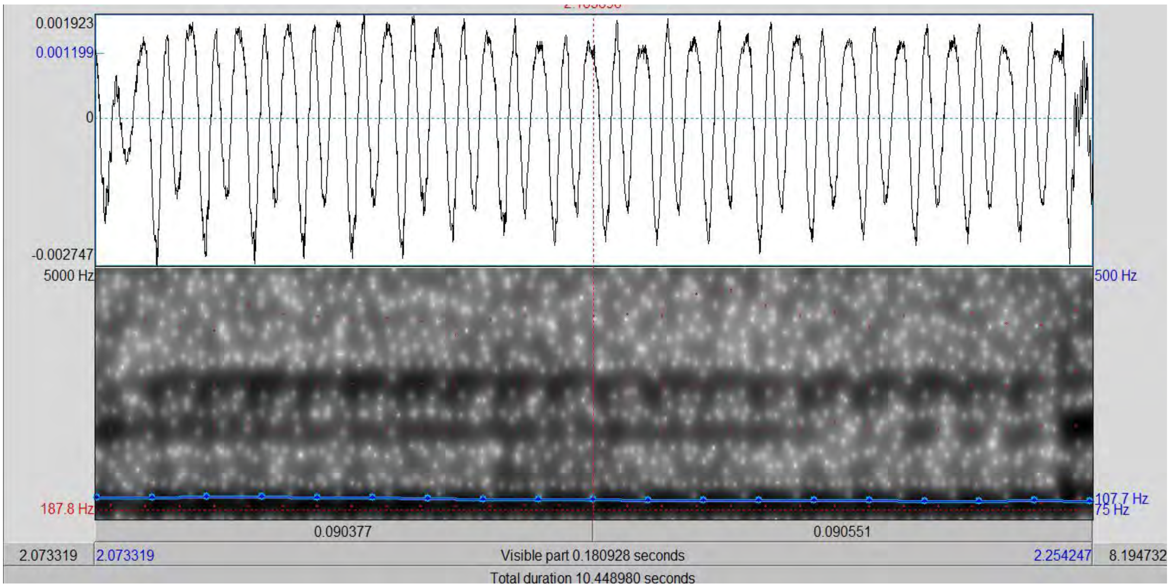


Figure 3.5.3: The Spectrograph of the Alveolar Nasal Consonant /n/ at Word Initial Position with duration of 181msec of Aŋlɔ Male Speaker

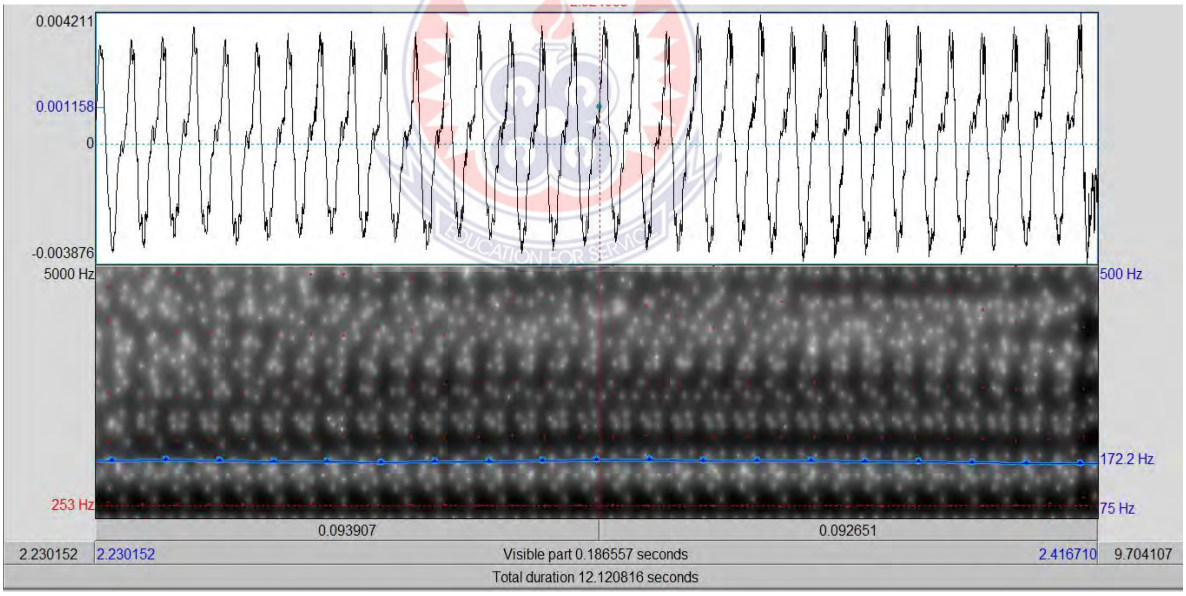


Figure 3.5.4: The Alveolar Nasal Consonant /n/ at Word-Medial Position with Duration of 186msec of Tɔŋu Male Speaker

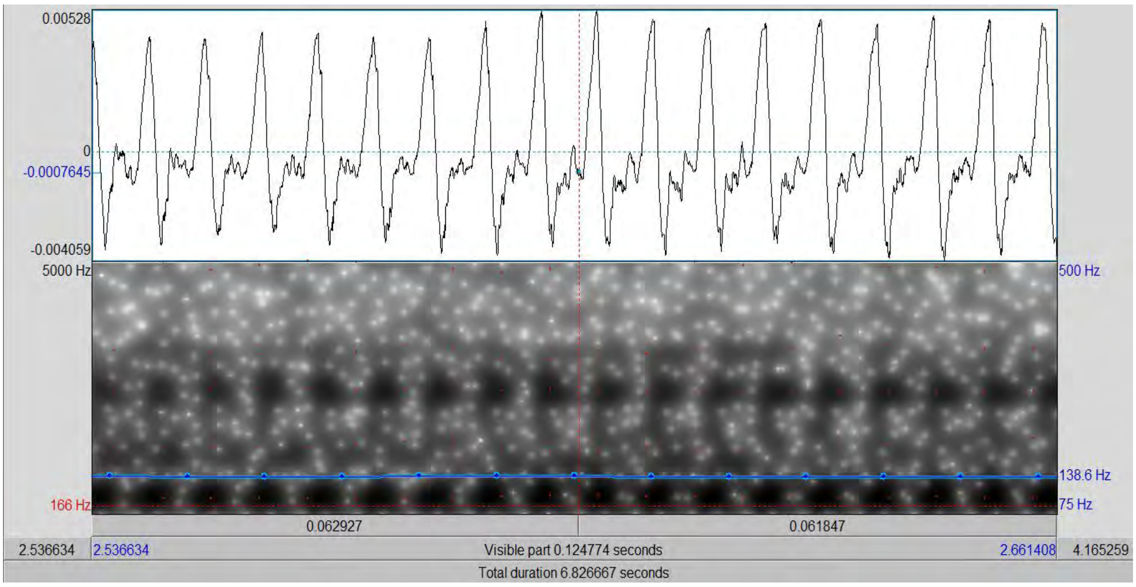


Figure 3.5.5: The Palatal Nasal Consonant /ɲ/ at Word-Initial Position within the Duration of 124msec of Evedome Male Speaker

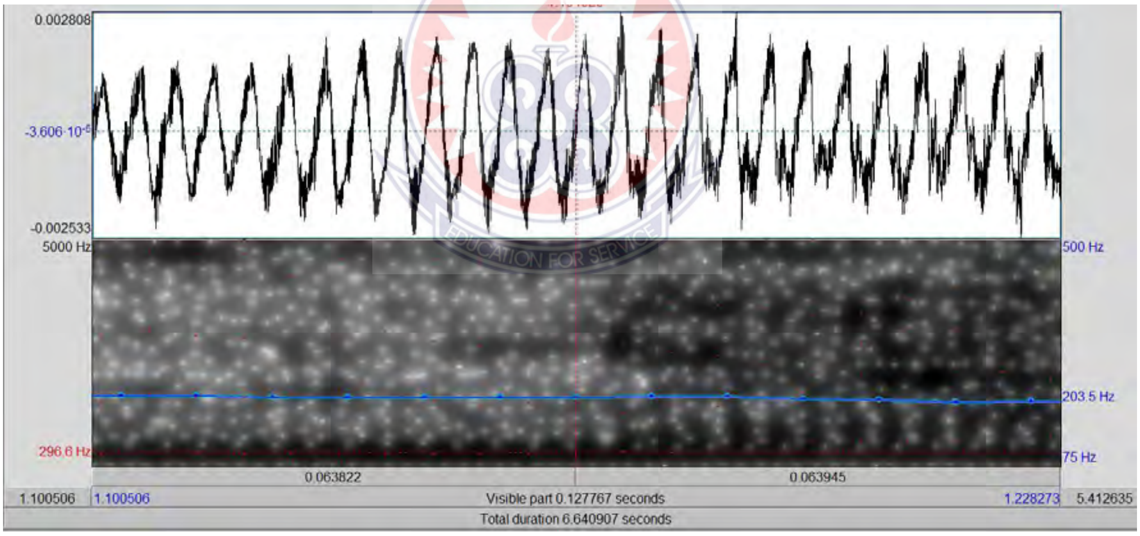


Figure 3.5.6: The Spectrogram of the Alveolar Nasal /ɲ/ selected at Word-Initial Position within the Duration of 127msec for Evedome Female Speaker

3.6 **Conclusion**

In all, the needed methodology and procedure to the research have been discussed. This included the selection of language community, selection of speakers, research design, data collection and instrumentation, word list and sample spectrograms of nasal formant frequency in Hertz and durations. Sixty participants took part in the exercise. A carrier frame "Gblɔ (key word) tututu" was prepared containing the Ewe nasal consonants at different word positions in very simple sentences to aid the recordings without creating any ambiguity. The recordings were done in a congenial atmosphere or environment devoid of external pressure or interference.

In the analysis, the first and second formant frequency values for each participant were measured and average results were calculated for each dialect. This procedure was followed to reduce the three tokens recorded for each participant into an average score value. The durational measurement for the nasal consonants for recorded for each speaker were also measured following the same procedures. The One-Way analysis of variance (ANOVA) was applied to measure and ascertain the similarities and differences that exist between the dialects where a Paired Sample T-Test was conducted. The average frequency measurements for the dialects were also used to calculate the overall score values for the Ewe language. The entire results for the analysis are presented in chapter four.

CHAPTER FOUR

THE RESULTS

4.0 Introduction

This chapter discusses the entire results of the study. This includes the presentation of all the results of the spectrographic and statistical analysis of the Ewe nasal consonants. Durations were also measured in milliseconds. The tables in each section gave a fair representation of the F1 and F2 values. There are three tokens in each nasal consonant per speaker for the first two formants. The values for the nasal consonants measured in Hertz were represented in the tables and charts. Paired Sample T-Test was also conducted to find out the similarities and differences in the dialects.

Sixty (60) native speakers of Tɔŋu, Aŋlɔ and Eʋedome dialects speakers, selected from six communities in the Volta Region of Ghana participated in the recording exercise. Results of the variance within dialects and between dialects were presented. Tables of formant values and figures were also fairly represented for easy description of the acoustic characteristics of the dialects as far as the study on the nasal consonants in the Ewe language is concerned. All measurements and acoustic analysis of the entire work was done using PRAAT. The tables and charts were drawn in Excel.

4.1 Tɔŋu Dialect

Selected native speakers from Mafi Adidome and Sogakoƒe respectively were chosen and recorded for the Tɔŋu dialect. In all twenty (20) native speakers were involved in this exercise. They were made up of ten (10) males and ten (10) females respectively. The final analysis of the formant frequency values for F1 and F2 measured in Hertz for the nasal consonants were presented as follows: /m/ word- initial 335Hz and 1273Hz, word-medial 385Hz and 1298Hz, and word- final 302Hz and 1424Hz respectively. /n/ at word-initial has 333Hz and 1430Hz, word-medial 336Hz and 1572Hz. There were no records of /n/ existing in word-final position as far as the dialect is concerned. Values for /ɲ/ were, word-initial 328Hz and 1413Hz, word- medial, 315Hz and 1524Hz. The palatal nasal consonant /ɲ/ also had no record of its existence in word-final in the dialect. The measurements for /ŋ/ at word-initial had 331Hz and 1395Hz, word-medial 346Hz and 1397Hz and word-final 437Hz and 1455Hz.

After comparing the results of the F1 values for the nasal consonants in the Tɔŋu dialect it was discovered that, the value for /m/ at word-medial position is higher than /m/ in the word-initial position and /m/ at word-initial position is also higher than /m/ at word-final position. The values measured for /n/ at word-medial position is higher than the /n/ at word-medial. In the results for the /ɲ/ formant frequency, the value for /ɲ/ at word-initial position is higher than /ɲ/ at word-medial. Value for /ŋ/ at word-final position is higher than /ŋ/ at both word-initial and word-medial positions respectively. The lowest is /ŋ/ measured at word-final position.

In the comparison of the F2 values /m/ at word-final position is higher than /m/ at word-initial. The least is /m/ at word-initial position. Furthermore /n/ at word-medial position is higher than /n/ at word-initial position. Likewise, the value for /ɲ/ at word-medial position is higher than /ɲ/ at word-initial position. Finally /ŋ/ value at word-final position is higher than /ŋ/ at word-medial position and /ŋ/ at the word-initial position has the least value.

The analysis of the nasal consonants in the Tɔŋu dialect for all F1 values at word-initial positions revealed that, the bilabial nasal /m/ has the highest value of 335Hz. This is followed by the alveolar nasal /n/ with a value measurement of 333Hz. The velar nasal has 331Hz and the least is the palatal nasal /ɲ/, recording 328Hz. Values compared within the word-medial positions have the following results: /m/ at recorded 385Hz as the highest value, /ɲ/ has 346Hz, /n/ also recorded 336Hz and the lowest is /ɲ/ with a value of 315Hz. It has been discovered that both /n/ and /ɲ/ have no records of word-final positions in the dialect. In view of this, the word-final position comparison is only between /m/ and /ŋ/, where /ŋ/ recorded 437Hz as the highest value and /m/ has the least measurement of 302Hz. The highest frequency measurement for F1 in the four nasal consonants is /ŋ/ at word-final and the lowest is /m/, also at word-final position.

These are the results as compared within the F2 formant frequency measurements; at word-initial, 1430Hz is recorded for /n/ as the highest value, /ɲ/ has 1413Hz. /ŋ/ measured 1395Hz and the least, is 1274Hz being the measurement for /m/. Word-medial position comparison has the following values; /n/, 1572Hz, /ɲ/, 1524Hz, /ŋ/, 1397Hz and /m/ 1298Hz. Word-final position recordings are, /ɲ/, 1455Hz and /m/, 1424Hz. The highest F2 values is /n/ at word-medial and the least is /m/ at word-initial. These results have been illustrated in the tables and figures for a better understanding of the study. The word-positions for Initial, Medial and Final respectively are indicated in series 1, 2 and 3 for all the charts throughout the analysis as follows: Series 1: word-initial, Series 2: word-medial and Series 3: word-final position.

Table 4.1.1: F1 and F2 Values at Different Word Positions of the Nasal Consonants for the Tɔŋu Speakers

Position of the Nasal Consonants in Hz			m	n	ɲ	ŋ
Tɔŋu Dialect	Initial	F1	335	333	328	331
		F2	1273	1430	1413	1395
	Medial	F1	385	336	315	346
		F2	1298	1572	1524	1397
	Final	F1	302			437
		F2	1424			1455

Source: Field Data: August, 2014

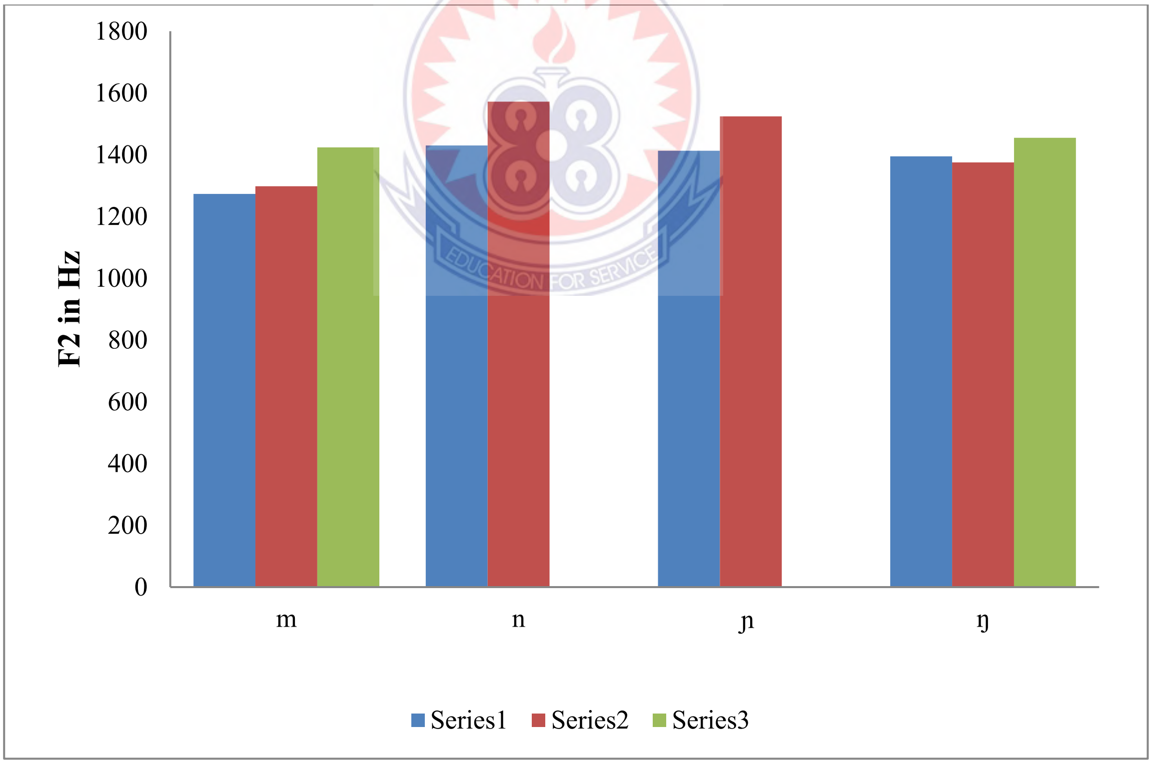


Figure 4 1.1: Bar Charts Showing the F2 Values of the Nasal Consonants at Different Word-Positions for Tɔŋu Speakers (*Source: Field Data: August, 2014)*

4.1.2 Tɔŋu Male Speakers

These are the results of the nasal consonant measurement for Tɔŋu male speakers in Hertz for F1 and F2 values: /m/ at word-initial position 305Hz and 1262Hz, word-medial position 363Hz and 1279Hz and word-final position 281Hz and 1371Hz respectively. The values for /n/ at word-initial 309Hz and 1419Hz, word-medial 311Hz and 1548Hz. The values for /ɲ/ at word-initial 331Hz and 1491Hz and word-medial 325Hz and 1687Hz respectively. The values for /ŋ/ at word-initial 336Hz and 1430Hz, word-medial 373Hz and 1449Hz and word-final 453Hz and 1391Hz. As indicated early on in the Tɔŋu dialect, there are no records for /n/ and /ɲ/ at word-final positions. However /m/ and /ŋ/ occur at all the word-final position.

Comparing the values measured in F1 for the nasal consonants of the Tɔŋu male speakers, it has been discovered that, /m/ at word-medial position is higher than /m/ at word-initial and /m/ at the word-final has the least values. /n/ at word-initial is higher than /n/ at word-medial position. The palatal nasal /ɲ/ at word-initial is also higher than /ɲ/ at word-medial position. The values calculated for /ŋ/ at word-final are higher than /ŋ/ at word-medial and /ŋ/ at word-initial has the least values.

F1 records within the nasals at word-initial position measurements are as follows: 336Hz is recorded for /ŋ/ as the highest formant frequency, /ɲ/ has 331Hz, /n/ 309Hz and the least is /m/, with a value of 305Hz. Within the word-medial values, /ŋ/ measurement has the highest recording of 373Hz and /m/ has 363Hz. /ɲ/ also has 325Hz and /n/ recorded the least word-medial value of 311 Hz. The word-final position values compared between /m/ and /ŋ/ have 453Hz and 281Hz respectively. The comparison show that, the highest F1 value for the male speakers in Tɔŋu male speakers is /ŋ/ at word-final and the least is /m/, also at word-final position.

In terms of the F2 values /m/ at word-final is higher than /m/ at both word-medial and word-initial positions. /n/ at word-medial positions is also higher than /n/ at word-initial position. /ɲ/ at word-medial position is higher than /ɲ/ at word-initial. /ŋ/ at word-medial and word-final positions recorded the highest and lowest formant frequency values respectively. Within the word-initial values, /m/ recorded the lowest value of 1262Hz and /ɲ/ has 1491Hz as the highest recording. Word-medial calculations proves /ɲ/ to have recorded the highest scores of 1687Hz and the least is /m/, recording 1262Hz. Values compared for the word-final positions between /m/ and /ŋ/ are 1371Hz and 1391Hz respectively. This comparison indicates that, /ɲ/ at word-medial position recorded the highest F2 values and the lowest is /m/ at word-initial.

Table 4.1.2: F1 and F2 Values at Different Word Positions for Tɔŋu Male Speakers

Position of the Nasal Consonants in Hz			**m**	**n**	**ɲ**	**ŋ**
Tɔŋu Male speakers	Initial	F1	305	309	331	336
		F2	1262	1419	1491	1430
	Medial	F1	363	311	325	373
		F2	1279	1548	1687	1449
	Final	F1	281			453
		F2	1371			1391

Source: Field Data: August, 2014.

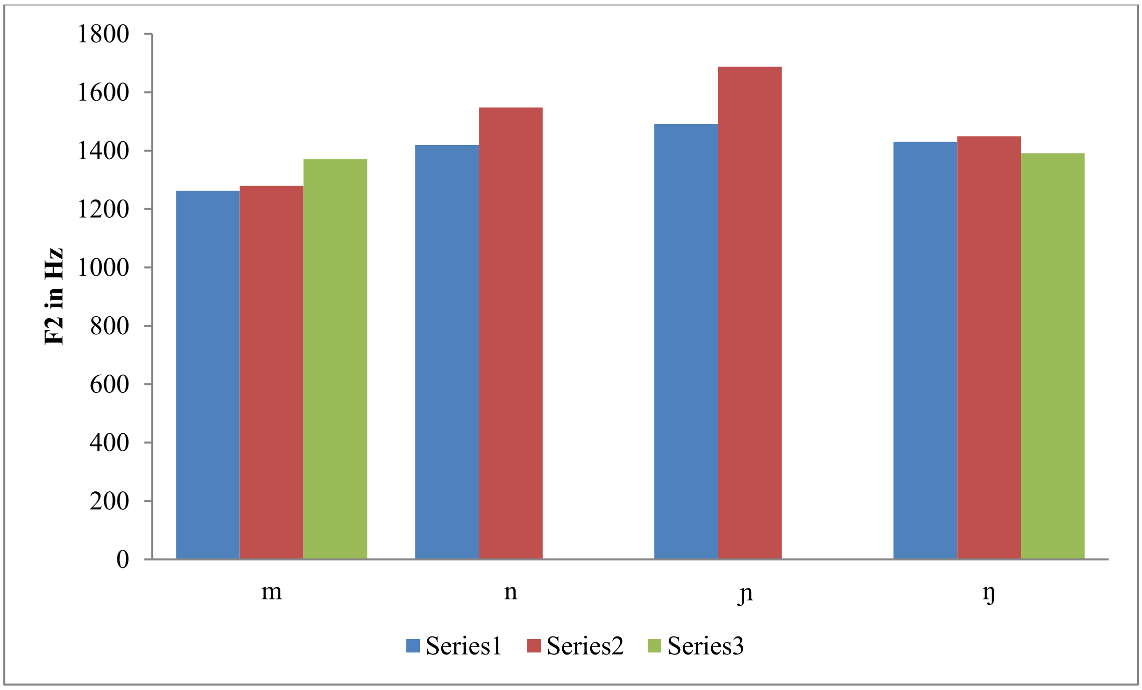


Figure 4.1.2: Bar Charts showing F2 Nasal Consonant Values at Different Word Positions for Tɔŋu Male Speakers (*Source: Field Data: August, 2014)*

4.1.3 **Tɔŋu Female Speakers**

The results for the Tɔŋu female speakers measured in F1 and F2 values are presented in this order of word positions: /m/ at word-initial 363Hz and 1283Hz, word-medial 407 Hz and 1317Hz and word-final 322Hz and 1476Hz. Value for /n/ at word-initial 356Hz and 1441Hz and word-medial 360Hz and 1596Hz. /ɲ/ at word-initial position has 324Hz and 1334Hz and word-medial position is 305Hz and 1360Hz respectively. /ŋ/ measurements are, word-initial 325Hz and 1359Hz, word-medial 318Hz and 1345Hz and word-final position 421Hz and 1519Hz.

All the F1 values for the Tɔŋu female have been compared. The results has shown that, /m/ at word-medial position is higher than it is at word-initial and word-final positions. /n/ at word-medial is also higher than /n/ at word-initial position. /ɲ/ at word-initial position is also higher than it is at word-medial position. Value for /ŋ/ at word-final is higher than /ŋ/ at word-initial and word-medial respectively.

Comparing their F2 values, /m/ at word-final is higher than /m/ at word-medial. The lowest in value is /m/ at word-initial. The values for /n/ and /ɲ/ at word-medial positions are higher than their respective values at word-initial positions. /ŋ/ at word-final is higher than /ŋ/ at word-initial. The least is /ŋ/ at word-medial position. There are no records of /n/ and /ɲ/ at word-final positions. Thus, they do not occur in the dialect.

Word-initial values have been compared for all the F1 measurements. /ŋ/ at word-final position has the highest values of 421Hz and the least is /ɲ/ with a value of 324Hz. Word-medial values have /m/ recording the highest value of 407Hz. /ɲ/ recorded the least value of 305Hz. Word-final measurements for /m/ and /ŋ/ have 322Hz and 421Hz, indicating /ŋ/ as the highest. The F2 measurements at word-initial positions are as follows: /n/ recoded 1441Hz as the highest. The lowest formant frequency was /m/ with a value of 1283Hz. Within the word-medial positions, 1596Hz was recorded for /n/ as the highest value and the least was /m/ recording 1317Hz as the lowest. /ŋ/ recorded 1519Hz for the highest word-final position and 1476Hz, was realized for /m/ as the least. The analysis showed that, /n/ at word-medial position, had the highest value measurement among the nasal consonants in F2 and the least was /m/ at word-initial.

Table 4.1.3: F1 and F2 Formant Values at Different Word Positions for Tɔŋu Female Speakers

Position of the Nasal Consonants in Hz			m	n	ɲ	ŋ
Tɔŋu Females	Initial	F1	364	356	324	325
		F2	1283	1441	1334	1359
	Medial	F1	407	360	305	318
		F2	1317	1596	1360	1345
	Final	F1	322			421
		F2	1476			1519

Source: Field Data: August, 2014.

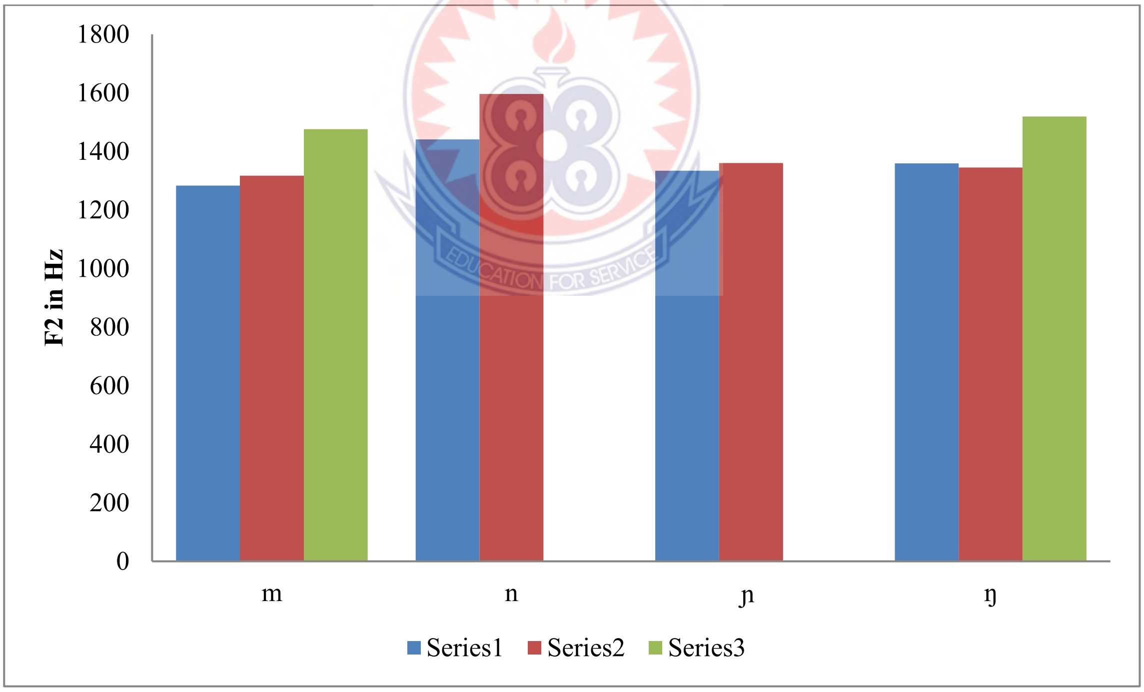


Figure 4.1.3: Bar Charts showing the F2 Values at Different Word Positions for Tɔŋu Female Speakers (*Source: Field Data: August, 2014)*

The Formant Frequency values for the nasal consonants were analyzed to find out similarities and differences on gender bases. The significance level is p<0.05. The analysis in Table 4.1.4 show the level of significance for /m/ is p<0.26 with F value = 1.34. /n/ is p<0.41 with F value = 0.70. /ɲ/ is p<0.00 with F value of 34.97 and /ŋ/ is p<0.78 with F value of 0.07. This result showed that there were some significant similarities between the male and female Tɔŋu nasal consonants /m/, /n/ and /ɲ. However, there was some significant difference between the male and female palatal nasal consonant /ɲ/.

Table 4.1.4: Similarities and Differences in the Nasal Consonants for Male and Female Speakers of Tɔŋu Dialect

Nasal Format Values – Sex		F-Value	Sig.
Tɔŋu dialect	m	1.34	0.26
	n	0.70	0.41
	ɲ	34.97	0.00 *
	ŋ	0.07	0.78

Source: Field Data August, 2014

4.2 Aŋlɔ Dialect

Native speakers of the Aŋlɔ dialect were selected from Dzodze and Aŋlɔgã communities for the recording. Twenty (20) of them were involved in this exercise. They were made up of ten (10) male and ten (10) female speakers between the ages of 25-62 years. These selected communities are some of the typical settlements of the Aŋlɔ dialect speakers. The participants were given the sentences on carrier frames to read for the recordings. This exercise went on smoothly devoid of ambient noise.

The F1 and F2 formant values at word positions were measured for the dialect and gender. The similarities and differences were also calculated. The average formant frequency results presented in F1 and F2 are as follows: /m/ at word-initial, 313Hz and 1367Hz, word-medial position, 312Hz and 1350Hz and word-final, 313Hz and 1385Hz. Values for /n/ are, word-initial 342Hz and 1590Hz, word-medial 386Hz and 1806Hz respectively. /ɲ/ recorded 359Hz and 1469Hz for word-initial, 348Hz and 1489Hz respectively, for word-medial positions. Recorded frequency values for /ŋ/ at word-initial are 374Hz and 1419Hz, word-medial position has 357Hz and 1531Hz, and word-final, 353Hz and 1370Hz.

The F1 values for the nasal consonants show /m/ at word-initial and word-final have the same values and are just one point higher than /m/ at word-medial position. The value for /n/ at word-medial is higher than /n/ at word-initial position. /ɲ/ at word-initial is also higher than /ɲ/ at word-medial position. Values for /ŋ/ at word-initial are higher than the /ŋ/ at word-medial and /ŋ/ at word-final positions.

F2 measurements for the nasal consonants also have the following results: /m/ at word-final is higher than /m/ at word-initial and /m/ at word-medial has the lowest values. Values for /n/ and /ɲ/ at word-medial positions are higher than their measurements at word-initial positions. The analysis for /ŋ/ at word-medial is higher than /ŋ/ at word-initial and word-final position respectively.

The results obtained show that /n/ as well as /ɲ/ has no records of existence in the Aŋlɔ dialect at word-final position. This implies, they do not occur at word-final in the dialect. However, /m/ and /ŋ/ exist at all three word-positions as in Tɔŋu. F1 values at word-initial positions were compared within the nasal consonants. /ŋ/ recorded the highest formant frequency values of 374Hz and the least is /m/ which recorded 313Hz. Word-medial position records saw /n/ with the highest frequency of 386Hz and the lowest is /m/

with 313Hz. /ŋ/ has 353Hz as the highest records at word-final and the lowest was /m/, with a value record of 313Hz. F2 value analysis at word positions also have the following results: 1590Hz was recorded for /n/ as the highest word-initial value and 1367Hz was the lowest which was measured for /m/. /n/ had the highest formant frequency value of 1806Hz within the word-medial positions. The least was /m/ with 1350Hz. For word-final, /m/ had the highest value of 1385Hz and /ŋ/ also recorded 1370 as the least measurement.

The analysis of the results of this study show that the nasal consonants /m/, /n/, /ɲ/ and /ŋ/ function as distinct phonemes in the Aŋlɔ dialect.

Table 4.2.1: F1 and F2 Values at Different Word Positions for Aŋlɔ Dialect Speakers

Position of the Nasal Consonants in Hz			**m**	**n**	**ɲ**	**ŋ**
Aŋlɔ dialect	Initial	F1	313	342	359	374
		F2	1367	1590	1469	1419
	Medial	F1	312	386	348	357
		F2	1350	1806	1489	1531
	Final	F1	313			353
		F2	1385			1370

Source: Field Data: August, 2014.

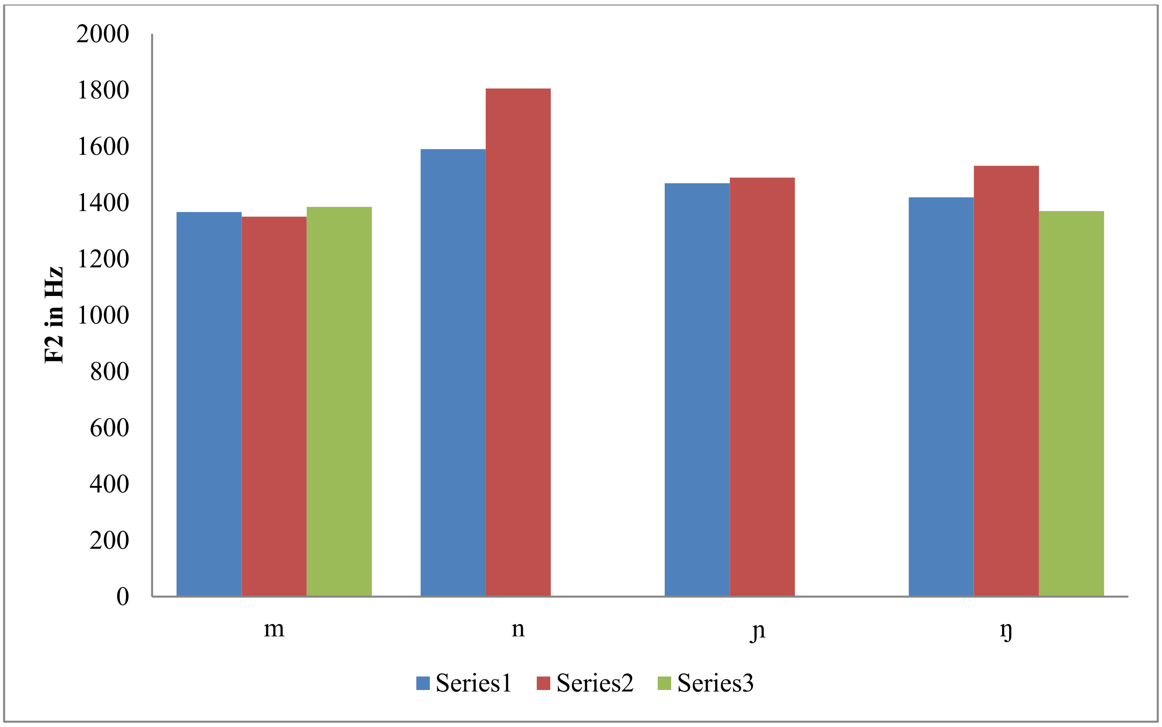


Figure 4.2.1: Bar Charts showing F2 Values of the Nasal Consonants at Different Word Positions for Aŋlɔ Dialect Speakers Measured in Hertz (*Source: Field Data: August, 2014)*

4.2.1 Aŋlɔ Male Speakers

The F1 and F2 results for the Aŋlɔ male speakers are /m/ at word-initial 275Hz and 1271Hz, word-medial 280Hz and 1283Hz, and word-final, 297Hz and 1311Hz. The values for /n/ at word-initial are 320Hz and 1533Hz, word-medial has 349Hz and 1661Hz. /ɲ/ at word-initial are 331Hz and 1509Hz, and word-medial, 358Hz and 1487Hz. /ŋ/ at word-initial also has 360Hz and 1437Hz, word-medial, 333Hz and 1533Hz, and word-final position, 338Hz and 1217Hz. The measurements within the nasals were compared. /m/ at word-final is higher than /m/ at word-initial and word-medial position. Values for /n/ at word-medial is higher than /n/ at word-initial position. /ɲ/ at word-medial is also higher than /ɲ/ at word-initial position. /ŋ/ at word-initial position, has a higher frequency than /ŋ/ at word-final, and the lowest is /ŋ/ at word-medial position.

The F2 formant frequency values of the nasal consonants were also compared. The outcome shows /m/ at the word-final is higher than /m/ at word-initial and word-initial positions. Calculations for /n/ at word-medial is higher than /n/ at word-initial position. /ɲ/ at word-initial is higher than /ɲ/ at word-medial position. /ŋ/ at word-medial is higher than /ŋ/ at word-initial and word-final positions.

Word-initial values compared for all the nasal consonants proved that, /ŋ/ has the highest measurement of 388Hz whilst /m/ recorded the least, with a value of 351Hz. 423Hz was realized for /n/ as the highest value among the word-medial positions and 338Hz was calculated for /ɲ/ as the least. Word-final position calculations saw /ŋ/ having the highest measurement of 368Hz over /m/ with the least record of 329Hz.

Comparisons between F1 and F2 values for /n/ and /ɲ/ on one side /m/ and /ŋ/ on the other, were made. The F1 values for /ɲ/ at word-initial and word-medial are higher than their equivalence for /n/ at the same word positions respectively. Similarly, the comparison between values for /m/ and /ŋ/ shows that all the F1 values for /ŋ/ at all three word positions are higher than all the values measured for /m/. The results for /n/ and /ɲ/, show /n/ at word-initial is higher than /ɲ/ at word-initial. Also /n/ at word-medial is higher than /ɲ/ at word-medial position. The F2 values compared for /m/ and /ŋ/ show the values for /ŋ/ at word-initial, word-medial and word-final are higher than all the values for /m/ at the same respective word positions. The highest F1 values for the nasal consonants of the Aŋlɔ male speakers is /ŋ/ at word-initial position and the lowest is recorded for /m/ also at word-initial position

Table 4.2.2: F1 and F2 Values at Different Word Positions for Aŋlɔ Male Speakers

Position of the Nasal Consonants in Hz			m	n	ɲ	ŋ
Aŋlɔ Male speakers	Initial	F1	275	320	331	360
		F2	1271	1533	1509	1437
	Medial	F1	280	349	358	333
		F2	1283	1661	1487	1533
	Final	F1	297			338
		F2	1311			1217

Source: Field Data: August, 2014

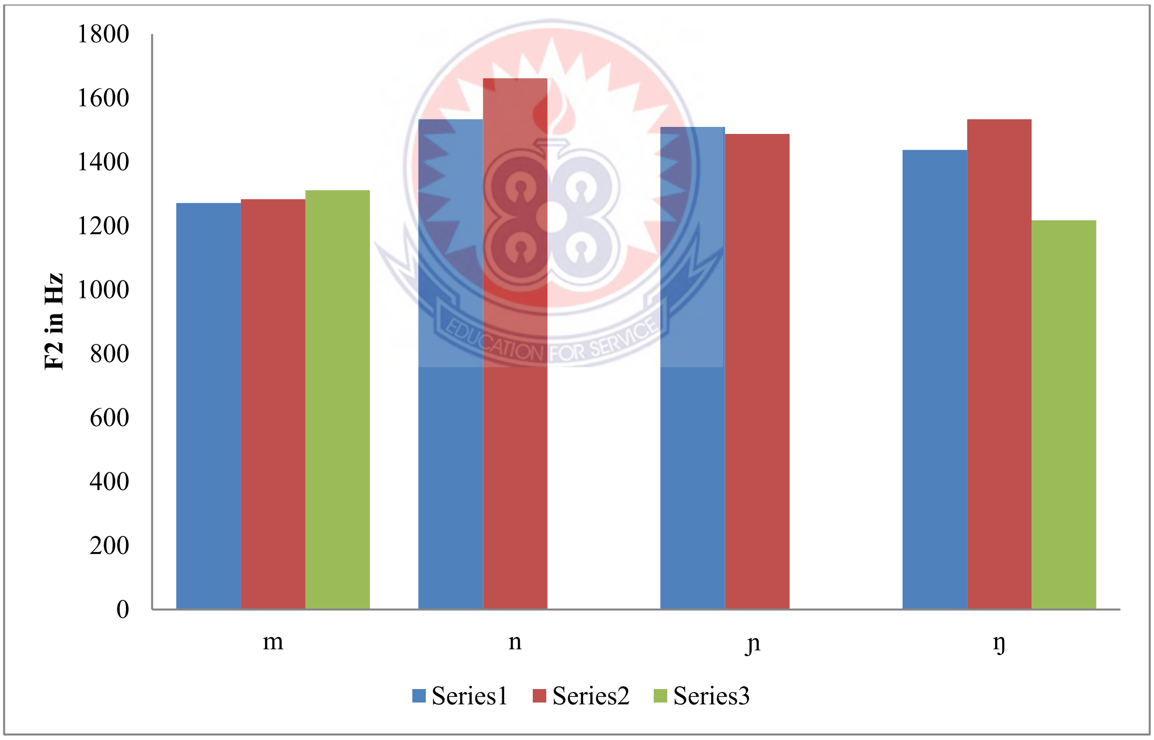


Figure 4.2.2: Bar Charts the F2 Values of the Nasal Consonants at Different Word Positions for Aŋlɔ Male Speakers (*Source: Field Data: August, 2014*)

4.2.2 Aŋlɔ Female Speakers

Results for F1 and F2 recorded for the Aŋlɔ female speakers at different word positions for the bilabial nasal consonant /m/ are, word-initial 351Hz and 1463Hz, word-medial 344Hz and 1417Hz and word-final, 329Hz and 1459Hz. Values for the alveolar nasal consonant /n/ are, word-initial 363Hz and 1646Hz and word-medial, 423Hz and 1950Hz. Records for the palatal nasal consonant /ɲ/ at word-initial are 386Hz and 1428Hz and word-medial has 338Hz and 1491Hz respectively. The velar nasal /ŋ/ recorded 388Hz and 1400Hz at word-initial, 381Hz and 1528Hz for word-medial, and 368Hz and 1522Hz for word-final position.

F1 values within each of the nasal consonants were compared: /m/ at word-final position is higher than /m/ at word-medial but lower than /m/ at word-initial position. /n/ at word-medial is higher than /n/ at word-initial. /ɲ/ at word-initial is also higher than /ɲ/ at word-medial position. The comparison within the /ŋ/ values reveals /ŋ/ at word-final is higher than /ŋ/ at word-medial but lower than /ŋ/ at word-initial position. 388Hz, 423Hz and 368Hz are the highest F1 frequency values recorded for /ŋ/, /n/ and /ŋ/ respectively, within the word-initial, word-medial and word-final positions, for the Aŋlɔ female speakers. /m/ at word-initial, /ɲ/ at word-medial and /m/ at word-final positions, got the least measurements.

At the F2 level, /m/ at word-final is higher than /m/ at word-medial position but lower than /m/ at word-initial positions. /n/ at word-initial is lower than /n/ at word-medial position. /ɲ/ at word-initial is also lower than /ɲ/ at word-medial position. Values recorded within the velar nasal /ŋ/ show /ŋ/ at word-final is higher than /ŋ/ at word-initial but lower than /ŋ/ at word-medial position. The highest F2 values for the Aŋlɔ female speakers has been recorded for /n/ at word-medial and the least is /m/ also at word-medial position.

When the F2 values were compared at word positions, /n/ had the highest value calculated among the word-initial positions. The lowest was /ŋ/. Within the word-medial, /n/ had 1950Hz, being the highest measurement. /ŋ/ recorded 1522Hz as the highest word-final records. Further comparison was also made between /n/ and /ɲ/ and also /m/ and /ŋ. The F1 values prove that /n/ at word-initial is lower than /ɲ/ at word-initial but /n/ at word-medial is higher than /ɲ/ at word-medial position. /m/ at word-initial is lower than /ŋ/ at word-initial. Also /m/ at word-medial is lower than /ŋ/ at word-medial position and /m/ at word-final position has a lower value than /ŋ/ at word-final position. The F2 values also show that /n/ at word-initial is higher than /ɲ/ at word-initial. Again /n/ at word-medial is higher than /ɲ/ at word-initial position. /m/ and /ŋ/ compared show /m/ at word-initial is higher than /ŋ/ at word-initial but /m/ at word-medial is lower than /ŋ/ at word-medial position. Again, /m/ at word-final is also lower than /ŋ/ at word-final.

Table 4.2.3: F1 and F2 Values at Different Word Positions for Aŋlɔ Female Speakers

Position of the Nasal Consonants in Hz			**m**	**n**	**ɲ**	**ŋ**
Aŋlɔ Females	Initial	F1	351	363	386	388
		F2	1463	1646	1428	1400
	Medial	F1	344	423	338	381
		F2	1417	1950	1491	1528
	Final	F1	329			368
		F2	1459			1522

Source: Field Data: August, 2014.

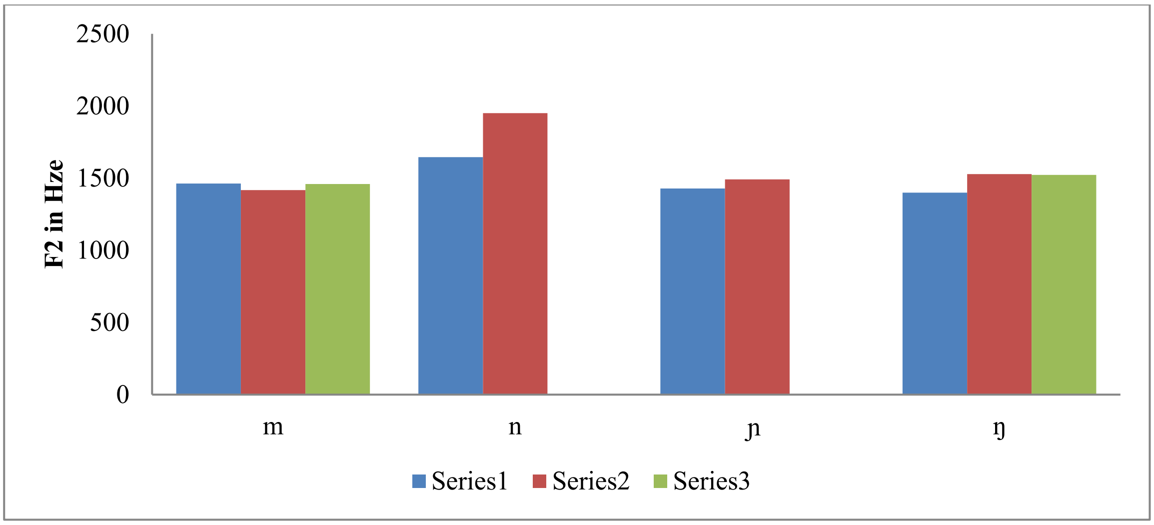


Figure 4.2.3: Bar Charts Showing the F2 Values at Different Word Positions for Aŋlɔ Female Speakers (*Source: Field Data: August, 2014)*

The similarities and differences between male and female speakers of Aŋlɔ dialect were compared where $p < 0.05$. The significant value for /m/ is 0.00 with F-value of 39.63 and the value for /n/ is also 0.00 with F-value of 21.52. The significant value for /ɲ/ is 0.55 with F-value of 0.36 and the value calculated for /ŋ/ is 0.00 with F-value of 8.84. The result as recorded in table 4.2.4 exhibited some level of significant differences between the male and female nasal consonants in exception of /ɲ/ nasal consonant, showing similarities between the speakers of the Aŋlɔ dialect.

Table 4.2.4: Similarities and Difference in Male and Female for Aŋlɔ Dialect

Nasal Formant Values - Sex		F- value	Sig.
Aŋlɔ dialect	m	39.63	0.00*
	n	21.52	0.00*
	ɲ	0.36	0.55
	ŋ	8.84	0.00*

Source: Field Data: August, 2014.

4.3 Eʋedome Dialect Speakers

The analysis of the Eʋedome dialect was conducted based on the results of twenty native speakers from Ho and Fodome. Ten (10) males and females each were involved in this exercise. The purpose of selecting these communities was to get the native speakers as participants for this study. The recordings were done using the same procedure as applied to Tɔŋu and Aŋlɔ dialects speakers respectively. The results for F1 and F2 values were measured and presented in this order: /m/ at word-initial is 357Hz and 1587Hz, /m/ at word-medial 335Hz and 1530Hz and /m/ at word-final 347Hz and 1577Hz. The values for /n/ at word-initial are 372Hz and 1596Hz, and word-medial, 361Hz and 1687Hz. The rest are /ɲ/ at word-initial, 363Hz and 1665Hz and word-medial, 341Hz and 1686Hz. The values for /ŋ/ at word initial are 439Hz and 1814Hz, /ŋ/ at word-medial 423Hz and 1711Hz and /ŋ/ at word-final are 372Hz and 1428Hz.

The values within the nasal consonants were also compared. The results measured in F1 show that, /m/ at word-final is higher than /m/ at word-medial but lower than /m/ at word-initial. /n/ at word-initial is higher than /n/ at word-medial. Measurements for /ɲ/ at word-initial are higher than /ŋ/ at word-medial. In addition, /ŋ/ at word-medial is higher than /ŋ/ at word-final but lower than the value for /ŋ/ at word-initial position. Comparing /m/, /n/, /ɲ/ and /ŋ/ in F1 at different word level, 439Hz and 357Hz were recorded as the highest and lowest among the word-initial positions for /ŋ/ and /m/ respectively. 423Hz and 341Hz, were also the highest and least measurements for /ŋ/ and /ɲ/ respectively, at word-medial positions. The highest word-final position was recorded for /ŋ/ with a value of 372Hz and the lowest was /m/, recording 347Hz.

Comparing the F2 values, /m/ at word-final is higher than /m/ at word-medial but lower than /m/ at the word-initial position. /n/ at word-initial is lower than /n/ at word-medial position and /ɲ/ at word-initial is also lower than /ɲ/ at word-medial position. The average F2 values for /ŋ/ at word-initial is higher than /ŋ/ at word-medial and the least is /ŋ/ at word-final position. The highest word-initial value was calculated for /ŋ/ with an average measurement of 1814Hz. The least average of 1587Hz was recorded for /m/. At word-medial positions, the highest and least average formant values were 1711Hz and 1530Hz. These were measured for /ŋ/ and /m/ respectively. /m/ recorded the highest word-final position value, measuring 1577Hz and /ŋ/ had the least of 1428Hz.

Analysis of the F1 and F2 average values within the nasal consonants were conducted. The results for /m/ and /ŋ/ were compared. The same analysis was made within /n/ and /ɲ/. In the F1 values for /m/ and /ŋ/, /ŋ/ at word-initial, word-medial and word-final positions are higher than the values for /m/ at these respective word positions. This reveals /ŋ/ as having a higher formant frequency value than /m/ in the Eʋedome dialect. The comparison between /n/ and ɲ/ shows /n/ at word-initial is higher than /ɲ/ at word-initial and /n/ at word-medial is also higher than /ɲ/ at word-medial position. Comparing the F2 values between /m/ and /ŋ/, /m/ at word-initial is lower than /ŋ/ at word-initial. Again /m/ at word-medial is lower than /ŋ/ at word-medial position but /m/ at word-final is higher than /ŋ/ at word-final position. /n/ at word-initial is lower than /ɲ/ at word-initial but the values measured for /n/ at word-medial are higher than /ɲ/ at word-medial position with just one point

The average value analysis of the F1 and F2 variance (ANOVA) of the Eʋedome dialect reveals /m/ at word-medial has the lowest values among the F1 values and the highest is /ŋ/ at word-initial position. In the F2 values, the lowest value recorded is /ŋ/ at word-final and the highest is /n/ at word-medial position. The results further show /n/ and /ɲ/ have no final word position in the dialect as pertained to Tɔŋu and Aŋlɔ dialects. All the nasal consonants analyzed are used as distinct phonemes in the Eʋedome dialect.

Table 4.3:1 F1 and F2 Values at Different Word Positions for Eʋedome Dialect Speakers

Position of the Nasal Consonants in Hz			m	n	ɲ	ŋ
Eʋedome Dialect	Initial	F1	357	372	363	439
		F2	1587	1596	1665	1814
	Medial	F1	335	361	341	423
		F2	1530	1687	1686	1711
	Final	F1	347			372
		F2	1577			1428

Source: Field Data: August, 2014

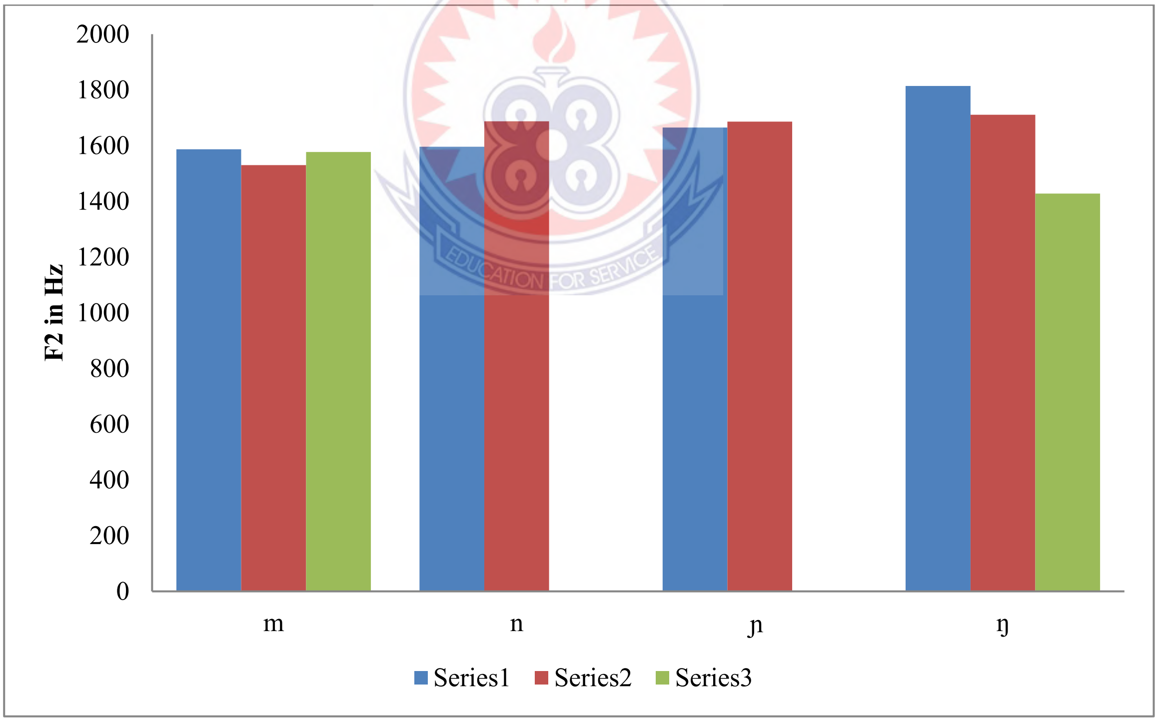


Figure 4.3:1 Bar Charts showing the F2 Formant Frequency Values Measured in Hertz for Eʋedome Dialect Speakers (*Source: Field Data: August, 2014)*

4.3.1 Eʋedome Male Speakers

The F1 and F2 formant frequency values calculated at different word positions for Eʋedome male speakers are /m/ at word-initial 397Hz and 1580Hz, word-medial position 338Hz and 1396Hz and word-final position is 342Hz and 1547Hz. Values for /n/ at word-initial are 420Hz and 1506Hz and word-medial has 417Hz and 1743Hz. The values calculated for /ɲ/ at word-initial are 427Hz and 1974Hz and word-medial is 375Hz and 1781Hz respectively. Values for /ŋ/ at word-initial are 479Hz and 2214Hz, /ŋ/ at word-medial has 471Hz and 1865Hz and /ŋ/ at word-final position also has 392Hz and 1343Hz. After comparing the F1 values of the nasal consonants the following results were realized: /m/ at word-final position is higher than /m/ at word-medial position but lower than /m/ at word-initial position. Within the /n/ values, /n/ at word-initial is higher than /n/ at word-medial position. /ɲ/ at word-initial is higher than /ɲ/ at word-final. Within the values of /ŋ/, /ŋ/ at word-medial is higher than /ŋ/ at word-final but lower than /ŋ/ at word-initial position.

The F2 values show /m/ at word-initial is higher than /m/ at word-final position. The least value is /m/ at word-medial position. /n/ at word-medial position are higher than /n/ at word-initial position. Values measured for /ɲ/ at word-initial are higher than /ɲ/ at word-medial position. The analysis within /ŋ/ shows, /ŋ/ at word-medial is higher than /ŋ/ at word-final but lower than /ŋ/ at word-initial position.

The average Formant Frequency values measured in F1 between /m/ and /ŋ/ on one hand and /n/ and /ɲ/ on the other show that /m/ at word-initial is lower than /ŋ/ at word-initial, /m/ at word-medial is lower than /ŋ/ at word-medial and /m/ at word-final is also lower than /ŋ/ at word-final position. However, /m/ at word-initial is higher than /ŋ/ at word final. After comparing their F2 values, the result reveals /m/ at word-initial is lower than /ŋ/ at word-initial, /m/ at word-medial is also lower than /ŋ/ at word-medial but /m/ at word-final position is higher than /ŋ/ at word-final. The F2 values for /n/ at word-initial are lower than /ŋ/ at word-initial. /n/ at word-medial are also lower than /ɲ/ at word-medial position. The results of the entire formant frequency values measured for Eʋedome male speakers show /ŋ/ at word-initial position has the highest values whilst /m/ at word-medial position has the least values among the F1 values. In terms of the F2 values /ŋ/ at word-initial has the highest values and the lowest is also /ŋ/ at word-final positions.

Table 4.3.2: F1 and F2 Frequency Values Measured in Hertz at Different Word Positions for Eʋedome Male Speakers

Position of the Nasal Consonants in Hz			**m**	**n**	**ɲ**	**ŋ**
Eʋedome Male speakers	Initial	F1	397	420	427	479
		F2	1580	1506	1974	2214
	Medial	F1	338	417	375	471
		F2	1396	1743	1781	1865
	Final	F1	342			392
		F2	1547			1343

Source: Field Data, 2014.

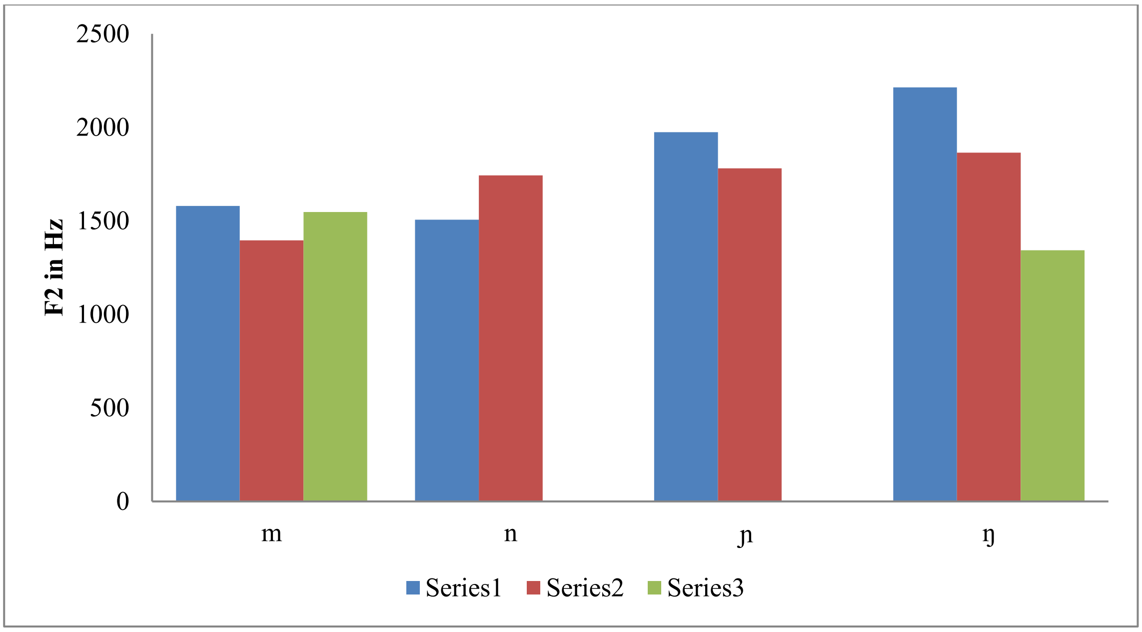


Figure 4.3.2: Bar Chart showing the F2 Formant Values Measured in Hertz at different Word Positions for Eʋedome Male Speakers (*Source: Field Data: August, 2014)*

4.3.2 Eʋedome Female Speakers

Ten female speakers of the Eʋedome dialect were involved in the exercise. These are the results measured in F1 and F2 formant frequency values: /m/ at word initial has 316Hz and 1594Hz, /m/ at word-medial has 331Hz and 1663Hz and /m/ at word-final has 352Hz and 1606Hz. /n/ at word-initial are 323Hz and 1685Hz and /n/ at word-medial is 305Hz and 1631Hz. The values for /ɲ/ at word-initial are 299Hz and 1356Hz and /ɲ/ at word-medial also has 307Hz and 1591Hz respectively. Measurement for /ŋ/ at word initial are 399Hz and 1413Hz, /ŋ/ at word-medial has 375Hz and 1413Hz and /ŋ/ at word-final position also has 351Hz and 1513Hz as its values.

The average formant frequency values measured across the nasal consonants were examined in the F1 and these are the results: values for /m/ at word-medial are higher than /m/ at word-initial but lower than /m/ at word-final. Values for /n/ at word-initial are higher than /n/ at word-medial position but /ɲ/ at word-initial are lower than /ɲ/ at word-medial. The values calculated for /ŋ/ at word-medial is lower than /ŋ/ at word-initial but higher than /ŋ/ at word-final position.

Comparison within the nasals at word potions show that /ŋ/ has the highest F1 value of 399Hz at word-initial position and the lowest is /ɲ/ with an average record of 299Hz. At word-medial, /ŋ/ has an average of 375Hz as the highest and the least is /ɲ/ with 307Hz. Word-final position records 351Hz for /ŋ/ as the lowest formant frequency and the highest is /m/ with an average value of 352Hz. This findings show that the highest and lowest F1 values at word-initial and word-final positions for the Eʋedome female speakers, are between the velar nasal consonant /ŋ/ and the palatal nasal consonant /ɲ/. But the word-final position was between the bilabial nasal /m/ and the velar nasal /ŋ/.

When the F2 values within each of the nasal consonants were compared, the results show /m/ at word-medial is higher than /m/ at word-final. The least value is /m/ at word-initial. /n/ at word-initial is higher than /n/ at word-medial but /ɲ/ at word-initial is lower than /ɲ/ at word-medial position. The values measured for /ŋ/ at word-final is higher than /ŋ/ at word-initial but lower than /ŋ/ at word-medial position. This results show the F2 values for the nasal consonant /m/ in the Eʋedome female speakers have higher values than the velar nasal consonant /ŋ/ at word-initial and word-medial positions and word-final positions.

Comparing /n/ and /ɲ/, results for the F1 values, the analysis reveals that, the nasal consonants /n/ at word-initial is higher than /ɲ/ at word-initial but /n/ at word-medial positions is lower than /ɲ/ at the same word position. The values for /n/ and /ɲ/ calculated in F2 also reveal that, /n/ at word-initial and word-medial respectively are higher than /ɲ/ at the two word positions.

The average analysis for the nasal consonants of the Eʋedome female speakers show the velar nasal /ŋ/ at word-initial has the highest F1 values and the lowest is palatal nasal /ɲ/ also at word-initial position. In the F2 values the highest is alveolar nasal consonant /n/ at word-initial and the least is palatal nasal consonant /ɲ/ also at word-initial position.

Table 4.3.3: Formant Frequency Values Measured in Hertz at Different Word Positions for Eʋedome Female Speakers

Position of the Nasal Consonants in Hz			**m**	**n**	**ɲ**	**ŋ**
Eʋedome female speakers	Initial	F1	316	323	299	399
		F2	1594	1685	1356	1413
	Medial	F1	331	305	307	375
		F2	1663	1631	1591	1556
	Final	F1	352			351
		F2	1606			1513

Source: Field Data: August, 2014.

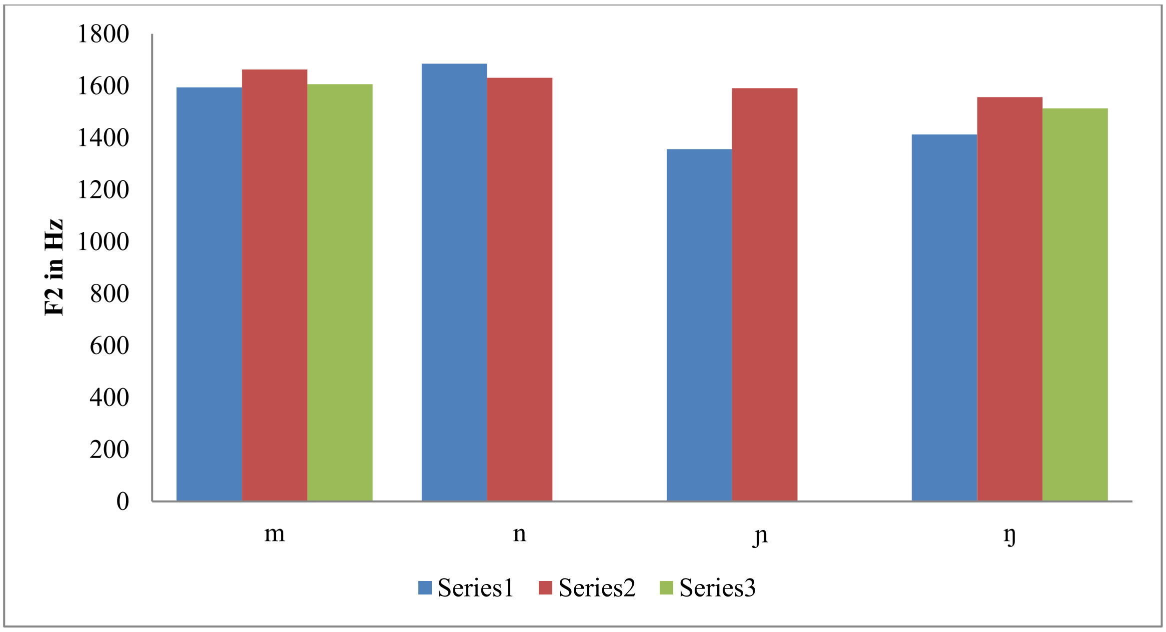


Figure 4.3.2: Bar Charts showing the F2 Values Measured in Hertz of Eʋedome Female Speakers (*Source: Field Data: August, 2014)*

The mean formant values were also calculated to find the significant similarities and differences that exist between the male and female speakers of the Eʋedome dialect. The formula applied is $p<0.05$. /m/ is $p<0.00$ with F-value of 14.52, /n/ is $p<0.06$ with F-value of 3.93, /ɲ/ is $p<0.00$ with F-value of 167.32 and /ŋ/ is $p<0.00$ with F-value of 38.94. The result of this test shows some significance level of differences within the nasal consonants /m/, /ɲ/ and /ŋ/. However, there is similarity between the alveolar nasal consonant /n/ values for both the male and female speakers of Eʋedome dialect.

Table 4.3.4: Similarities and Difference in Male and Female Speakers of Eʋedome Dialect

Nasal Format Values - Sex		F- value	Sig.
Eʋedome dialect	m	14.52	0.00*
	n	3.93	0.06
	ɲ	167.32	0.00*
	ŋ	38.94	0.00*

Source: Field Data: August, 2014.

4.4 The Ewe Language

Though the Ewe language spoken in Ghana has been classified under three major dialects, it has only one common writing system referred to as Standard Ewe. Westermann (1875 and 1927) carried out a linguistic study on African languages and was credited with the writing of the Ewe orthography. He used the term 'Standard Ewe' to refer to the written form of the Ewe language and this has come to stay.

Working within the concept of standard Ewe, average formant frequency values were calculated on the Formant Frequency values of Tɔŋu, Aŋlɔ and Eʋedome dialects. The results obtained from the measurement were presented in tables and figures. The same procedure was followed to calculate the values for the gender characteristics of the Ewe language.

The analysis for the average F1 and F2 values for the nasal consonants were measured as follows: the bilabial nasal /m/ at word-initial has 335Hz and 1409Hz, /m/ at word-medial has 344Hz and 1393Hz and /m/ at word-final has 321Hz and 1462Hz. The alveolar nasal consonant /n/ at word-initial is 349Hz and 1539Hz and /n/ at word-medial is 361Hz. The palatal nasal consonant /ɲ/ at word-initial is 350Hz and 1493Hz and /ɲ/ at word-medial is 335Hz and 1566Hz. The velar nasal consonant /ŋ/ at word-initial has 381Hz and 1543Hz, /ŋ/ at word-medial has 375Hz and 1547Hz and /ŋ/ at word-final position has 387Hz and 1418Hz.

The values were compared at different word positions within the nasal consonants. The results for the F1 values show /m/ at word-initial is lower than /m/ at word-final but lower than /m/ at word-medial. The measurement for /n/ at word-initial position is lower than /n/ at word-medial position. However the values for /ɲ/ at word-initial are higher than /ɲ/ at word-medial position. /ŋ/ at word-initial is higher than /ŋ/ at word-medial position but lower than /ŋ/ at word-final position.

The results of the F2 values measured show /m/ at word-initial are higher than /m/ at word-medial but lower than /m/ at word-final position. /n/ at word-initial position are lower than /n/ at word-medial position. /ɲ/ at word-initial are also lower than the /ɲ/ at word-medial position. Finally the measurement for /ŋ/ at word-initial are higher than the /ŋ/ at word-final but lower than /ŋ/ at word-medial position.

Values measured for the bilabial nasal consonant /m/ and the velar nasal consonant /ŋ/ were compared. The F1 values for /m/ at word-initial, word-medial and word-final positions are all lower than the values measured for /ŋ/ at the same word-positions. This shows that /ŋ/ has higher Frequency than /m/ in the Ewe language. In the F2 values for /m/ and /ŋ/ the values for /m/ at word-initial is lower than /ŋ/ at word-initial. Also, /m/ at word-medial is lower than /ŋ/ at word-medial but /m/ at word-final is higher than /ŋ/ at word-final position. The same comparison was made between /n/ and /ɲ/. The F1 values for /n/ at word-initial are lower than /ɲ/ at word-initial but /n/ at word-medial is higher than /ɲ/ at word-final position. Their F2 values prove /n/ at word-initial and word-medial respectively have higher values than /ɲ/ at these same word positions. However /n/ at word-initial is lower than /ɲ/ at word-medial whilst /n/ at word-medial is also higher than /ɲ/ at word-initial.

At word-initial, word-medial and word-final positions, the highest F1 values have been recorded for /ŋ/. The lowest at word-initial is /m/, word-medial is /ɲ/ and word-final is /m/. Analysis within the F2 values at word positions produce these results: /ŋ/ at word-initial has the highest value of 1543Hz and the least is /m/ with a record of 1409Hz. 1688Hz has been measured for /n/ as the highest average value at word-medial position and the least is /m/ with a measurement of 1393Hz. The word-final position has 1462Hz as the highest average records for /m/ and the least is 1418Hz, calculated for /ŋ/.

The analysis of the entire results of the Ewe nasal consonants proves that /ŋ/ at word-final position has the highest F1 formant frequency values whilst /m/ at word-initial has the least. Among the F2 values /n/ at word-medial position has the highest formant frequency values and the lowest is /m/ at word-medial position in the language.

Table 4.4.1: F1 and F2 Formant Frequency Values Measured at Different Word Positions for Ewe language

Position of the Nasal Consonants in Hz			m	n	ɲ	ŋ
Ewe Language	Initial	F1	335	349	350	381
		F2	1409	1539	1493	1543
	Medial	F1	344	361	335	375
		F2	1393	1688	1566	1546
	Final	F1	321			387
		F2	1462			1418

Source: Field Data: August, 2014.

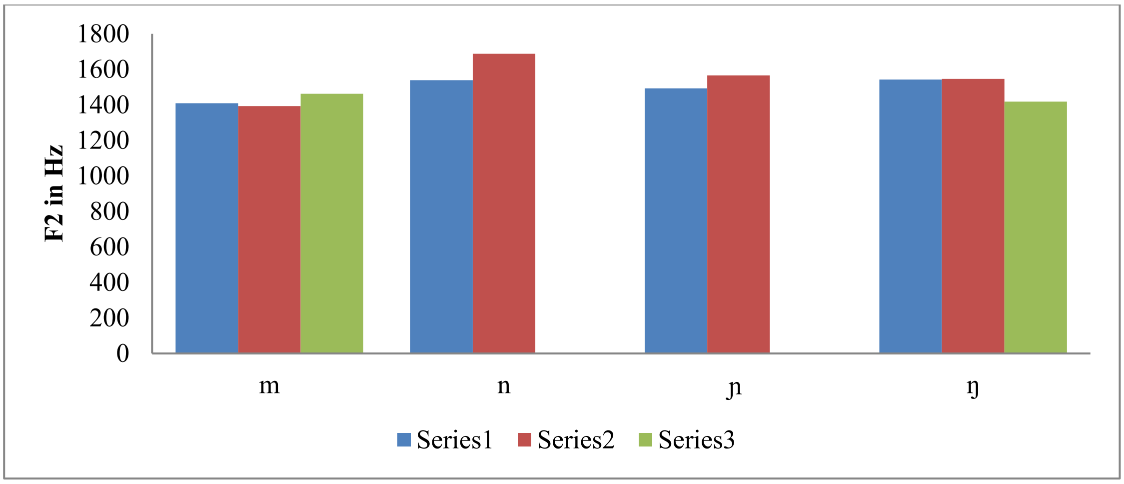


Figure 4.4.1: Bar Charts Showing F2 Values at Different Word Positions Measured for Ewe Language (*Source: Field Data: August, 2014)*

4.4.1 Ewe Male Language Speakers

The formant frequency values for the male speakers of Ewe language were also calculated for thirty (30) native speakers, 10 representing each of the three major dialects. The F1 and F2 values for the nasal consonants show /m/ at word-initial has 326Hz and 1371Hz, /m/ at word-initial has 327Hz and 1319Hz and /m/ at word-final has 307Hz and 1410Hz. /n/ at word-initial has 350Hz and 1486Hz and /n/ at word-medial has 359Hz and 1651Hz. Values for /ɲ/ at word-initial are 363Hz and 1658Hz and /ɲ/ at word-medial has 353Hz and 1652Hz. The values for /ŋ/ at word-initial have 392Hz and 1694Hz, /ŋ/ at word-medial has a value of 393Hz and 1616Hz. The word-final /ŋ/ has 394Hz and 1317Hz respectively.

The values of the nasal consonants were compared at different word positions in F1. Here are the results; /m/ at word-initial is just one mark lower than /m/ at word-medial but relatively higher than /m/ at word-final position. /n/ at word-initial are lower than /n/ at word-medial position. /ɲ/ at word-initial is higher than the values for /ɲ/ at word-medial position. Values measured for /ŋ/ at word-initial are lower than /ŋ/ than /ŋ/ at word-medial. Also /ŋ/ at word-final is also just a point higher than/ŋ/ at word-medial position.

There were comparisons of F1 values between /m/ and /ŋ/.The results shows that values for /m/ at word-initial are lower than /ŋ/ at word-initial, values for /m/ at word-medial are also lower than /ŋ/ at word-medial. Likewise, values for /m/ at word-final are lower than /ŋ/ at word-final positions. Comparing the F2 results, /m/ at word-initial and word-medial positions are lower than /ŋ/ at these two word positions but values for /m/ at word-final are higher than /ŋ/ at word-final respectively.

The F1 values compared between /n/ and ɲ/ show that values measured in /n/ at word-initial are lower than /ɲ/ at word-initial but /n/ at word-medial is higher than /ɲ/ at word-medial position. In the F2 /n/ at word-initial and word-medial are lower than /ɲ/ at word-initial and word-medial respectively.

The analysis of the results for Ewe male speakers show that /ŋ/ has the highest F1 value measurement at word-final position and the least is /m/ also at word-final. The highest F2 value measured is /ŋ/ at word-initial and the lowest is also /ŋ/ at word-final position. These analysis have been displayed in table 4.4.3 and figure 4.4.3 below.

Table 4.4.2: F1 and F2 Values Measured at Different Word-Positions for Male Speakers of Ewe Language

Position of the Nasal Consonants in Hz			**m**	**n**	**ɲ**	**ŋ**
Ewe male speakers	Initial	F1	326	350	363	392
		F2	1371	1486	1658	1694
	Medial	F1	327	359	353	393
		F2	1319	1651	1652	1616
	Final	F1	307			394
		F2	1410			1317

Source: Field Data: August, 2014

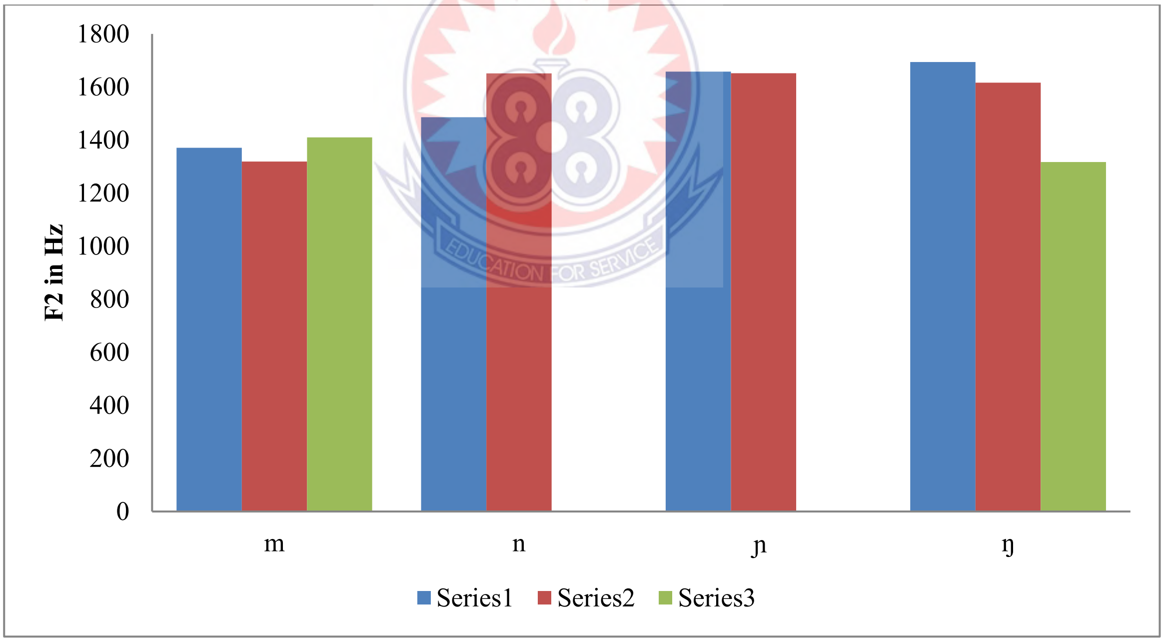


Figure 4.4.2: Bar Charts Showing F2 Formant Values Measured for Male Speakers of Ewe Language (*Source: Field Data: August, 2014)*

4.4.2 Ewe Female Speakers

The results measured for the female speakers of the Ewe language are presented in this order: /m/ at word-initial 344Hz and 1447Hz, /m/ at word-medial 361Hz and 1466Hz and /m/ at word-final 334Hz and 1514Hz. The values for /n/ at word-initial are 347Hz and 1591Hz and /n/ at word-medial has 363Hz and 1726Hz respectively. The values measured for /ɲ/ at word-initial are 336Hz and 1373Hz and /ɲ/ at word-medial is 317Hz and 1481Hz. Values for /ŋ/ at word-initial are 371Hz and 1391Hz, word-medial values are 358Hz and 1391Hz and word-final is 380Hz and 1518Hz.

The nasal consonants at the F1 level reveals that /m/ at word-initial is higher than /m/ at word-final but lower than /m/ at word-medial position. /n/ at word-initial is lower than the values for /n/ at word-medial. /ɲ/ at word-initial is higher than /ɲ/ at word-medial. Measurements for /ŋ/, at word-initial is higher than /ŋ/ at word-medial but lower than /ŋ/ at word-final positions. The F2 values produced the following results: /m/ at word-initial is lower than /m/ at word-medial. The highest value is /m/ at word-final position. /n/ at word-initial is lower than /n/ at word-medial position. Values for /ɲ/ at word-initial also lower than /ɲ/ at word-medial position. The F2 values calculated for /ŋ/ at word-final are higher than /ŋ/ at word-medial. The least is /ŋ/ at word-initial position.

Further comparisons were made between /m/ and /ŋ/ and another for /n/ and /ɲ/. The F1 values for /m/ and /ŋ/ show that /m/ at word-initial is lower than /ŋ/ at word-initial, /m/ at word-medial is however higher than / ŋ/ at word-medial but /m/ at word-final is lower than /ŋ/ at word-final position. Within the F2 values of /m/ and /ŋ/ the results proved that /m/ at word-initial is higher than /ŋ/ at word-initial but /m/ at word-medial is lower than /ŋ/ at word-medial position. /ŋ/ at word-final is higher than /m/ at word-final with just four points.

The following results were produced after comparing the values of /n/ and /ɲ/ at different word positions; The F1 values for /n/ at word-initial and word-medial positions are higher than the values for /ɲ/ at these respective word positions. In addition, the F2 values measured for /n/ at word-initial and word-medial positions are also higher than the values measured for /ɲ/ at word-initial and word-medial respectively.

The overall values measured for the nasal consonants of Ewe female speakers show /ŋ/ at word-final position has the highest F1 value and the least is /ɲ/ at word-medial position. The F2 comparisons show /n/ at word-medial position has the highest Formant Frequency values and the lowest is /ɲ/ at word-initial position. These results confirm the alveolar nasal consonant /n/ and palatal nasal consonant /ɲ/ do not occur at word-final positions in the language.

Table 4.4.3: F1 and F2 Values at Different Word Positions for Female Ewe Speakers

Position of the Nasal Consonants in Hz			**m**	**n**	**ɲ**	**ŋ**
Ewe female Speakers	Initial	F1	344	347	336	371
		F2	1447	1591	1373	1391
	Medial	F1	361	363	317	358
		F2	1466	1726	1481	1476
	Final	F1	334			380
		F2	1514			1518

Source: Field Data: August, 2014

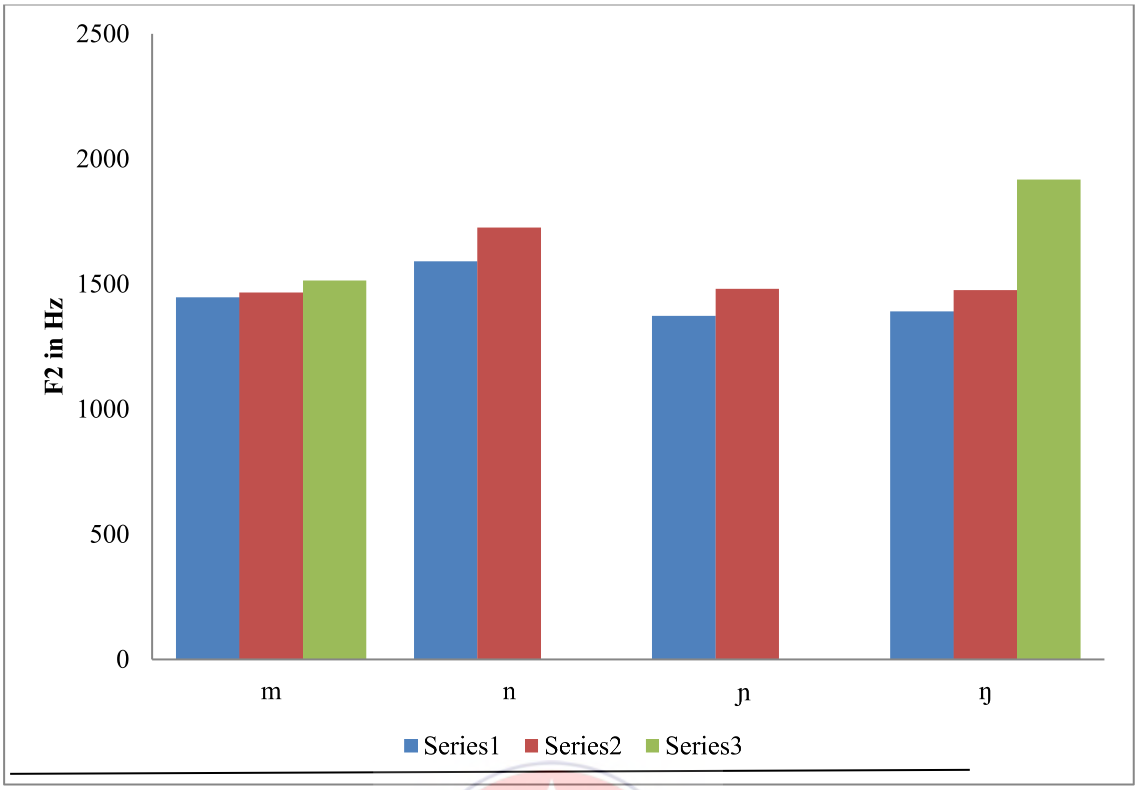


Figure 4.4.3: Charts Showing F2 Values at Different Word Positions for Female Speakers of Ewe (*Source: Field Data: August, 2014)*

The mean formant values of the Ewe language were calculated to find out if there is any significant difference and similarities between male and female speakers of Ewe using $p<0.05$. In the results of the four Ewe nasal consonants, the level of significance for /m/ is $p<0.00$ with F-value of 10.15. /n/ is $p<0.00$ with an F-value of 8.00, /ɲ/ is $p<0.00$ with F-value of 31.50 and /ŋ/ is $p<0.09$ with F-value of 2.97. The final results display that there are significance levels of differences within the nasal consonants /m/ /, /n/, and /ɲ/ between male and female speakers of the Ewe language. However the velar nasal consonant /ŋ/ exhibited some level of similarities between the genders.

Table 4.4.4: Similarities and Differences in Male and Female Ewe Language Speakers

Sex	Nasal Consonants	F-Value	Sig.
Male	m	10.15	0.00*
Female			
Male	n	8.00	0.00*
Female			
Male	ɲ	31.50	0.00*
Female			
Male	ŋ	2.97	0.09
Female			

Source: Field Data: August, 2014.

4.5 Paired Sample T-Test

4.5.1 Ewe Language

Paired sample test was conducted for the four nasal consonants in the Ewe language. The comparisons were made with pairings of the nasal consonants /m-n/, /m-ɲ/, m-ŋ/, /n-ɲ/, /n-ŋ, and /ɲ-ŋ/. The overall analysis of the sample test of the variance (ANOVA) show that there are significance levels of differences between the paired nasal consonants as displayed in the table. On the contrary the paired sample test for /ɲ-ɲ/ shows some significance level of similarity.

Table 4.5.1: Paired Sample T-Test Conducted for the Nasal Consonants in Ewe

Paired Nasals		T - value	p. value
Ewe Language	m - n	-9.13	0.00*
	m - ɲ	-4.39	0.00*
	m - ŋ	-3.30	0.00*
	n - ɲ	2.37	0.02*
	n - ŋ	5.30	0.00*
	ɲ - ŋ	1.92	0.06

**p < 0.05.* *Source: Field Data: August, 2014.*

4.5.2 **Paired Sample T-Test for Tɔŋu Dialect**

The paired sample T-Test conducted in Tɔŋu dialect show that /m-n/, /m-ɲ/ and /n-ŋ/ have p<0.00 respectively. This analysis indicates significant levels of differences in the paired nasal consonants. /m-ŋ/ also exhibited significant level of difference with p<0.04. /n-ɲ/ has p<0.43 and /ɲ-ŋ/ also has p<0.22 which show some level of similarities in the values of the nasal consonants compared.

Table 4.5.2: Paired Sample T-Test in Tɔŋu Dialects

Paired Nasals		T - value	p. value
Tɔŋu Language	m - n	-4.68	0.00*
	m - ɲ	-3.55	0.00*
	m - ŋ	-2.22	0.04*
	n - ɲ	0.81	0.43
	n - ŋ	4.18	0.00*
	ɲ - ŋ	1.22	0.22

**p* < 0.05. *Source: Field Data: August, 2014.*

4.5.3 Paired Sample T-Test for Aŋlɔ Dialect

The paired sample T-Test conducted for the nasal consonants for the speakers of the Aŋlɔ dialect displays considerable significant level of differences in the results with the exception of /ɲ-ŋ/ which has some level of similarities. Where P.value is significantly less than p<0.05, implies there is a considerable level of difference between the nasal consonants that have been compared.

Table 4.5.3: Paired Sample T-Test in Aŋlɔ Dialect

Paired Nasals		T-value	P. value
Aŋlɔ Dialect	m - n	-12.00	0.00*
	m - ɲ	-3.14	0.00*
	m - ŋ	-3.47	0.00*
	n - ɲ	4.18	0.00*
	n - ŋ	11.81	0.00*
	ɲ - ŋ	0.97	0.34

Source: Field Data: August, 2014.

4.5.4 Paired Sample T-Test for Eʋedome Dialect

The Eʋedome dialect Paired Sample T-Test conducted shows a higher significant level of similarities rather than differences except the results of /m-n/ with $p < 0.00$. The P. values between /m-ɲ/, /m-ŋ/, /n-ɲ/, /n-ŋ/ and /ɲ-ŋ/ were less than $p<0.05$. Table 4.5.4 gives the details of the results.

Table 4.5.4: Paired Sample T-Test in Speakers of Eʋedome Dialect

Paired Nasals		T - value	p. value
Eʋedome Dialect	m - n	-4.29	0.00*
	m - ɲ	-1.69	0.11
	m - ŋ	-1.30	0.21
	n - ɲ	-0.55	0.59
	n - ŋ	0.10	0.92
	ɲ - ŋ	1.01	0.31

**p < 0.05.* *Source: Field Data: August, 2014.*

4.6 Nasal Durational Measurements

The durations of the nasal consonants in the three dialects of the Ewe language have been measured in milliseconds. These measurements have also been taken on gender basis and the results are fairly represented in tables and charts.

4.6.1 Nasal Duration for Tɔŋu Dialect

Comparing the nasal duration for Tɔŋu dialect it was found out that at word-initial /ŋ/ has the highest value of 173 followed by /ɲ/ with a value of 163. /m/ and /n/ obtained 141 and 126 respectively. At word-medial, /ɲ/ has the highest value of 207 and the least is

/m/ with a value of 147 milliseconds. In the word-final position /ŋ/ has a record of 191 and /m/ 118 of milliseconds. The highest durational measurement among the four nasal consonants was /ɲ/ at word-medial position with a recorded value of 207 milliseconds.

Table 4.6.1: Nasal Duration for Tɔŋu Dialect Speakers

	Nasal Duration in Milliseconds				
	Position	**m**	**n**	**ɲ**	**ŋ**
Tɔŋu Dialect	Initial	126	141	163	173
	Medial	147	180	207	170
	Final	118			191

Source: Field Data: August, 2014

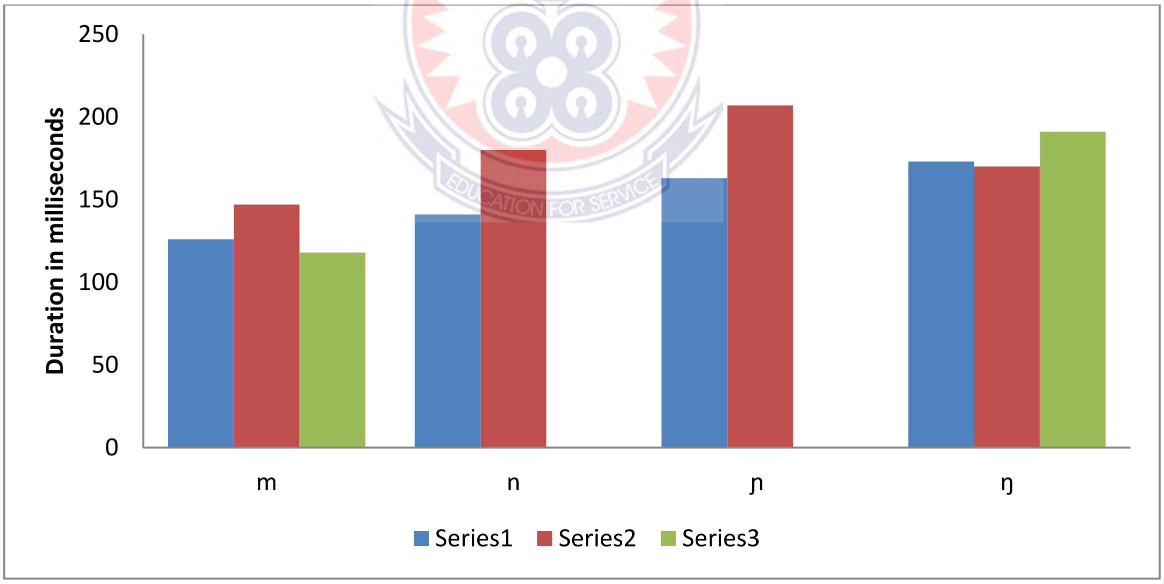


Figure 4.6.1: Bar Charts showing the Nasal Duration of Tɔŋu Dialect Speakers

(*Source: Field Data: August, 2014)*

4.6.2 Nasal Duration for Tɔŋu Male Speakers

Table 4.6.2 below shows the results of the nasal duration of the Tɔŋu male speakers measured in milliseconds at word positions. It was discovered that /ɲ/ has the highest duration at word-medial position followed by /ŋ/ at word-final. /n/ has the third highest duration at word-medial position and the least is recorded for /m/ at word-initial.

Table 4.6.2: Duration for Tɔŋu Male Speakers

	Nasal Duration in Milliseconds				
	Position	**m**	**n**	**ɲ**	**ŋ**
Tɔŋu Dialect	Initial	116	144	155	160
	Medial	147	187	202	164
	Final	125			193

Source: Field Data: August, 2014

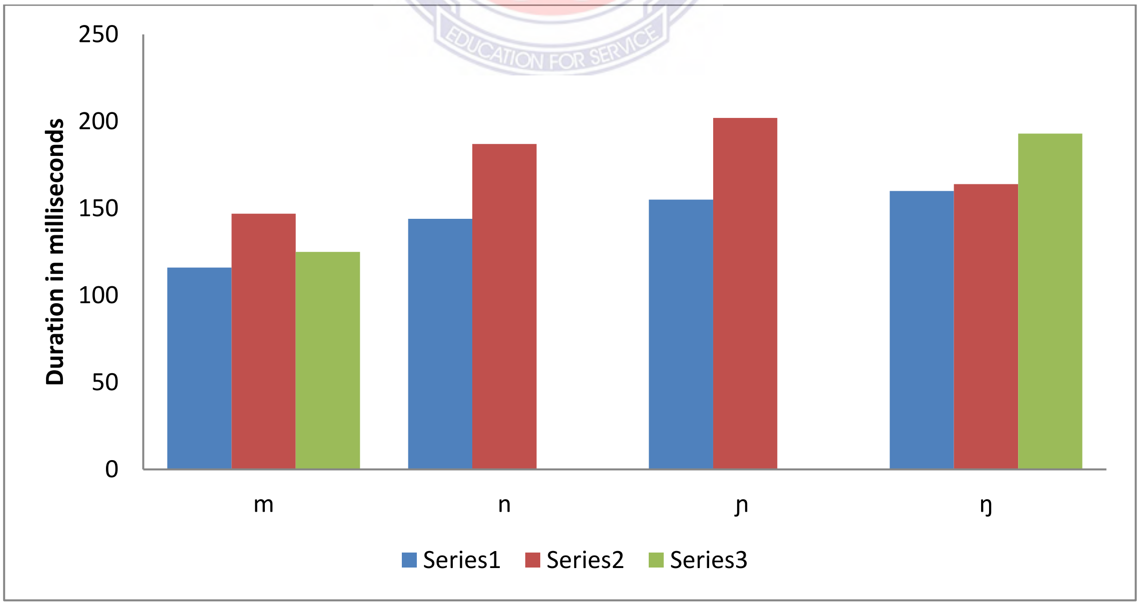


Figure 4.6.2: Bar Charts showing the Nasal Duration for Tɔŋu Male Speakers

(*Source: Field Data: August, 2014)*

4.6.3 **Tɔŋu Female Speakers**

The results of the nasal duration measured for speakers of Tɔŋu female dialect are as follows: /m/ has 135, 147 and 111 respectively. Values for /n/ are 137 and 173 whilst /ɲ/ also has 170 at word- initial and 212 at word-medial positions. The figures for /ŋ/ are 186, 175 and 188 respectively. All the measurements for the nasal durations were calculated in milliseconds at word-initial, medial and final positions. These measurements have been presented in the table and chart for clarity.

Table 4.6.3: Duration for Tɔŋu Female Speakers

	Nasal Duration in Milliseconds				
	Position	**m**	**n**	**ɲ**	**ŋ**
Tɔŋu Female Speakers	Initial	135	137	170	186
	Medial	147	173	212	175
	Final	111			188

Source: Field Data: August, 2014.

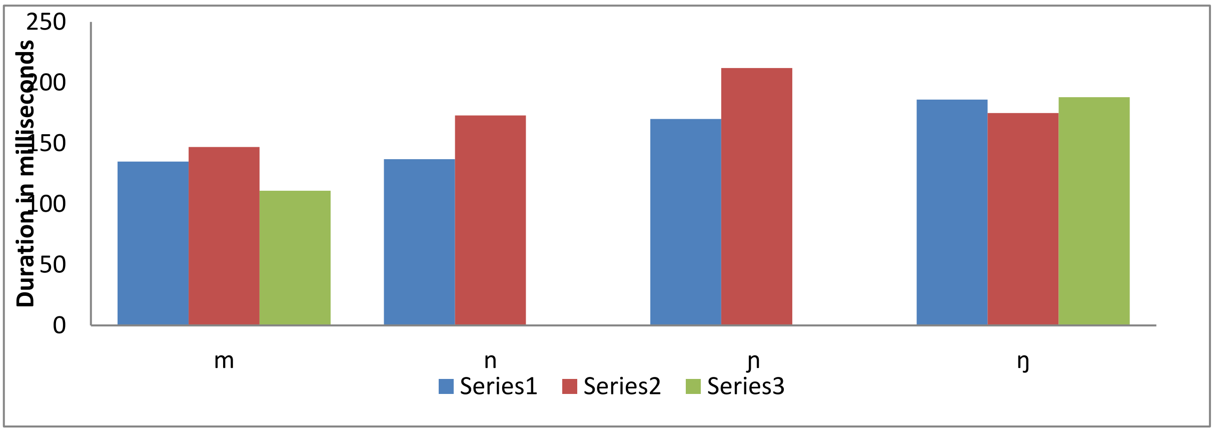


Figure 4.6.3: Bar Charts showing the Nasal Duration Measured for Tɔŋu Female Speakers (*Source: Field Data: August, 2014)*

4.6.4 Nasal Duration for Aŋlɔ Dialect Speakers

The nasal durations of the Aŋlɔ dialect speakers were also measured and presented in tables and chart. Comparing the gender characteristics of the speakers, it was found out that the values for /m/, /n/ and /ɲ/ at word-initial positions of the male speakers were higher than that of the female speakers. However the values measured for /ŋ/ at the same word position for the males were lower than that of the female speakers. At word-medial the female speakers have higher durational values than their male counterparts for /m/ and /n/ but had lower values measured for /ɲ/ and /ŋ/. It is only /m/ and /ŋ/ which have final word positions and the results indicated that the male durational value for /m/ is higher than the female counterparts but lower in values calculated for /ŋ/.

After the calculations on gender characteristics, the durational values for the Aŋlɔ dialect were also considered. Word-initial values measured in milliseconds for the nasal consonants are as followed: /m/ has the highest value of 166 followed by /ɲ/ with a durational value of 157. /ŋ/ and /n/ have 155 and 145 respectively. The word-medial position durations have 148, 154, 171 and 173 respectively for /m/, /n/, /ɲ/ and /ŋ/ which clearly show /ŋ/ as having the highest measurement and the lowest is /m/. The word final-duration measured between /m/ and /ŋ/ recorded 140 and 153 respectively. These records have been shown in table and figure 4.6.6

Table 4.6.4: Duration for Aŋlɔ Dialect Speakers

	Nasal Duration in Milliseconds				
	Position	**m**	**n**	**ɲ**	**ŋ**
Aŋlɔ Dialect	Initial	166	145	157	155
	Medial	148	154	171	173
	Final	140			153

Source: Field Data: August, 2014.

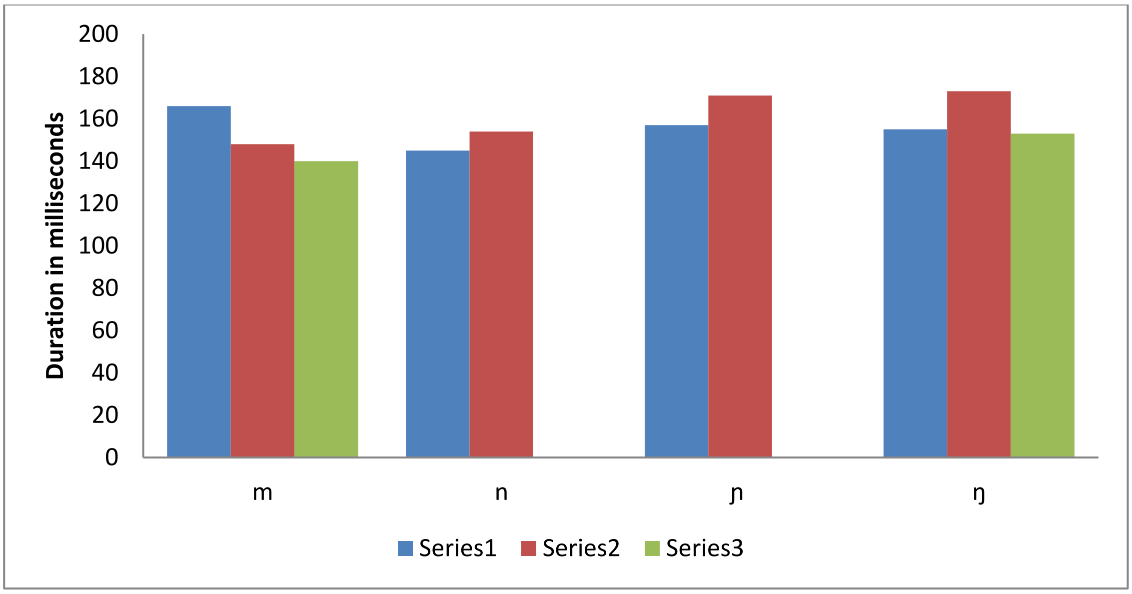


Figure 4.6.4: Chart showing the Duration Measured for Aŋlɔ Dialect Speakers (*Source: Field Data: August, 2014)*

4.6.5 **Aŋlɔ Male Speakers**

The nasal durational values calculated for the male speakers of Aŋlɔ dialect for the word-initial position have shown /m/ recording an appreciable value over /n/, /ɲ/ and /ŋ/. Records for the word-medial shows /ɲ/ have one point or mark lower than /ŋ/ but there is a considerable difference of five points between /m/ and /n/. At word-final, /m/ has three points lower than /ŋ/ with average marks of 142 and 145 respectively.

Table 4.6.5: Nasal Duration Measured in Milliseconds for Aŋlɔ Male Speakers

	Nasal Duration in Milliseconds				
	Position	**m**	**n**	**ɲ**	**ŋ**
Aŋlɔ Male Speakers	Initial	176	150	165	146
	Medial	146	151	174	175
	Final	142			145

Source: Field Data: August, 2014.

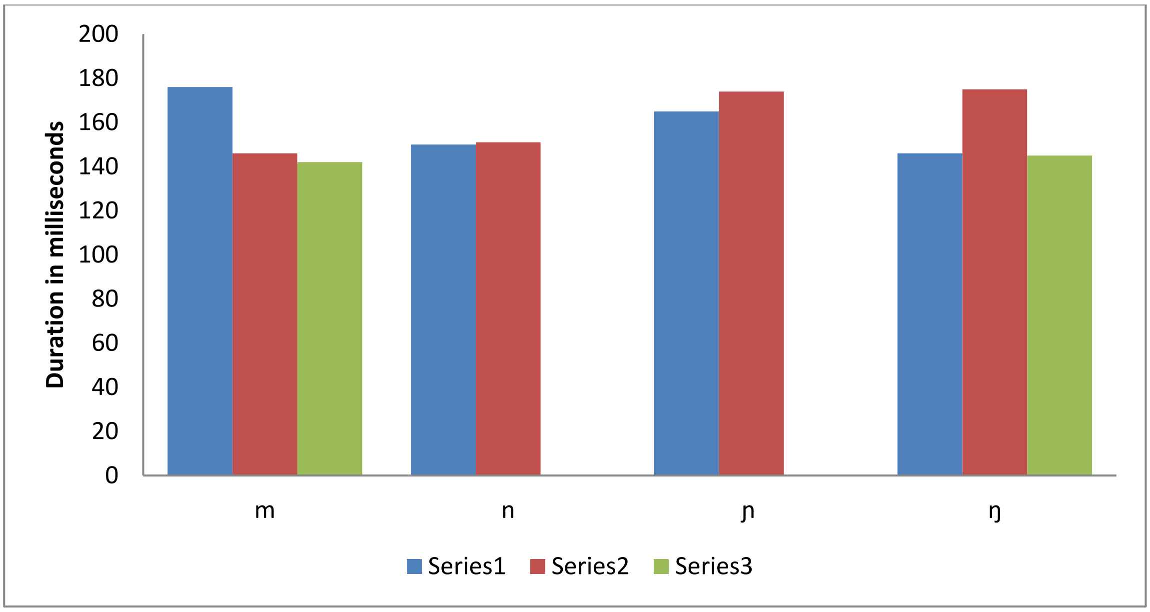


Figure 4.6.5: Nasal Duration Measured in Milliseconds for Aŋlɔ Male Speakers

(Source: Field Data: August, 2014)

4.6.6 Aŋlɔ Female Speakers

Comparing the values calculated for the female speakers only, it was discovered that within the word-initial positions /ŋ/ has a value of 164 which is the highest, /m/ has a value of 156, /ɲ/ has 149 and /n/ has the least value of 140. At word-medial, the values measured in milliseconds are /m/ 150, /n/ 157, /ɲ/ 167 and /ŋ/ 171/. The figures displayed here show that /ŋ/ recorded the highest durational values. /ɲ/ is also higher than /n/ and the least is /m/. Nasal durational values measured for /m/ and /ŋ/, the only nasal consonants at word-final positions are 137 and 160 respectively. These figures have been displayed in table 4.6.4 as well as chart 4.6.4 below

Table 4.6.6: Nasal Duration for Aŋlɔ Female Speakers at Different Word Positions

	Nasal Duration in Milliseconds				
	Position	**m**	**n**	**ɲ**	**ŋ**
Aŋlɔ Dialect	Initial	156	140	149	164
	Medial	150	157	167	171
	Final	137			160

Source: Field Data: August, 2014

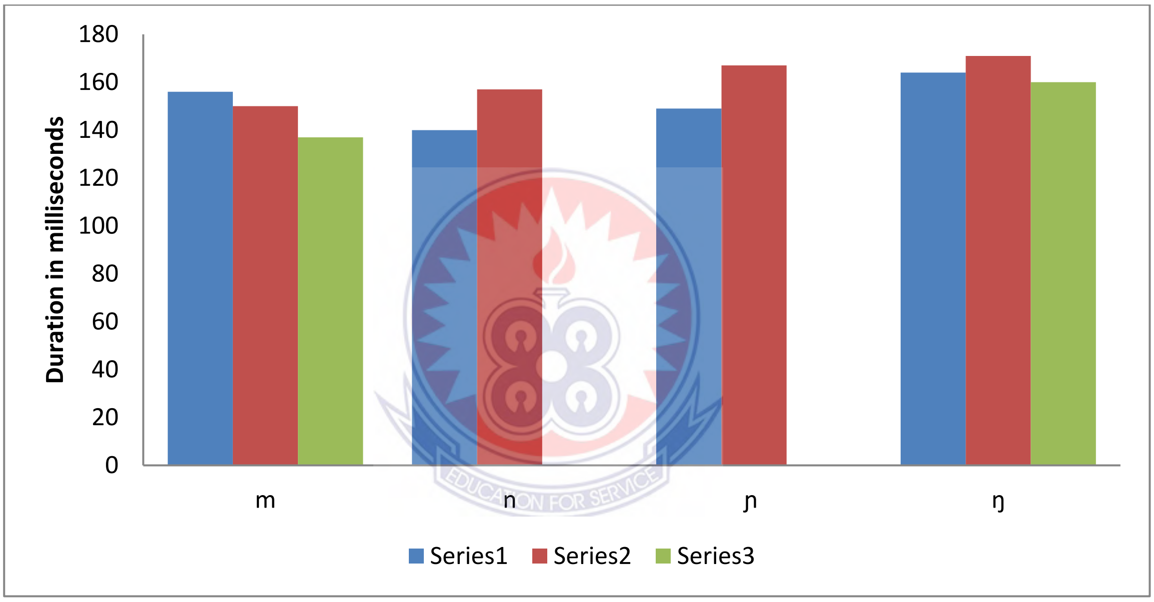


Figure 4.6.6: Bar Showing the Nasal Duration Measured for Aŋlɔ Female Speakers in Milliseconds (*Source: Field Data: August, 2014)*

4.6.7 Duration for Eʋedome Dialect

The nasal duration measurement taken for the Eʋedome dialect speakers are recorded in this order; at word-initial, medial and final positions /m/ has 122, 133 and 96. /n/ and /ɲ/ have 122, 111 and 147, 154 for initial and medial positions only. /ŋ/ also has the following durational values: 115, 118 and 118 for all three word positions.

Within the durational values for the Eʋedome dialect speakers, /ɲ/ has the highest values at both word-initial and final positions and the least is recorded for /m/ at word-final. The table and figure 4.6.9 display the entire duration measured in milliseconds for the dialect.

Table 4.6.7: Duration for Eʋedome Dialect Speakers in Milliseconds

	Nasal Duration in Milliseconds				
	Position	**m**	**n**	**ɲ**	**ŋ**
Eʋedome Dialect	Initial	122	122	147	115
	Medial	133	111	154	118
	Final	96			118

Source: Field Data: August, 2014

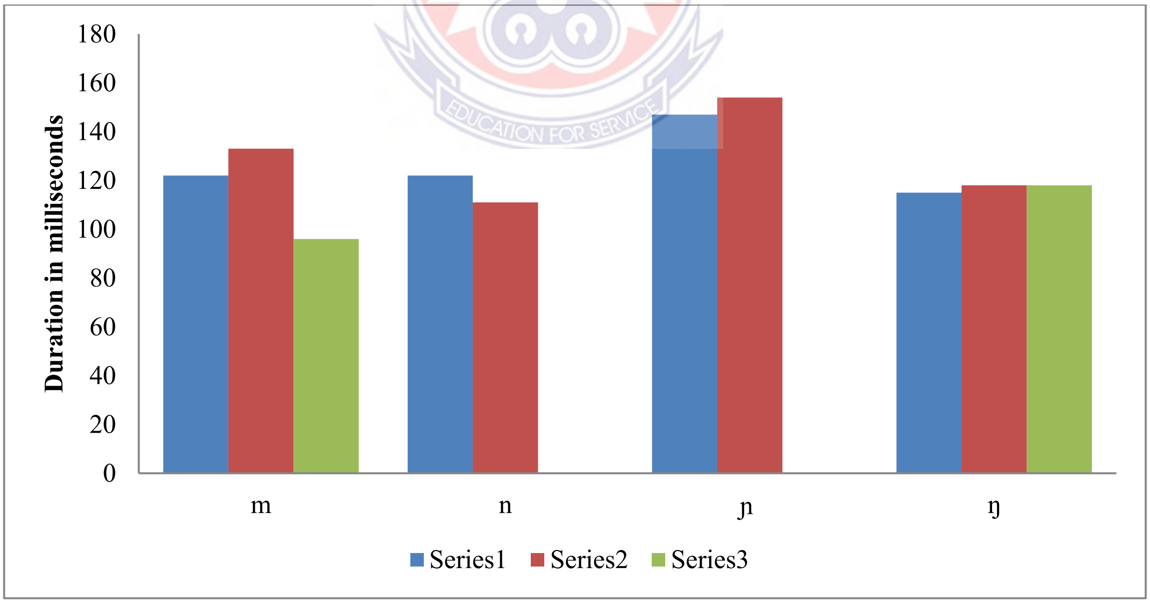


Figure 4.6.9: Bar Charts showing Duration for Eʋedome Dialect Speakers Measured in Milliseconds (*Source: Field Data: August, 2014)*

4.6.8 Duration for Eʋedome Male Speakers

The Eʋedome male durational values measured in milliseconds at word-initial positions are 109 for /m/, 126 for /n/, 153 for /ɲ/ and 98 for /ɲ/. The word-medial measurements are 122, 155, 124 and 111 respectively. At word-final, the results are 122 and 105 for /m/ and /ŋ/. These results have been fairly shown in table and figure 4.6.8 below.

Table 4.6.8: Duration for Eʋedome Dialect Male Speakers

	Nasal Duration in Milliseconds				
	Position	**m**	**n**	**ɲ**	**ŋ**
Eʋedome male speakers	Initial	109	126	153	98
	Medial	122	115	124	111
	Final	112			105

Source: Field Data: August, 2014

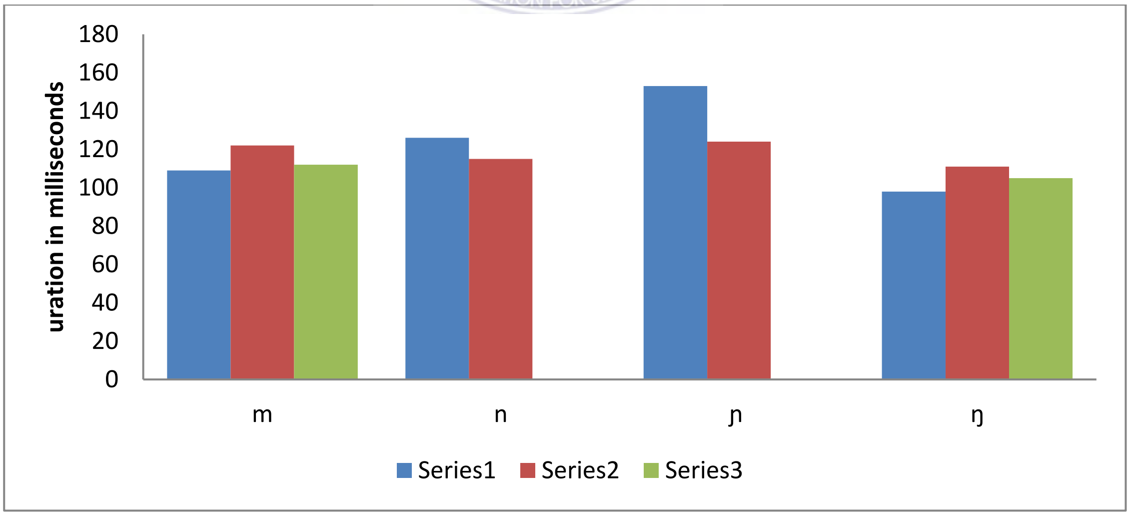


Figure 4.6.8: Bar Chart Showing the Duration for Eʋedome Male Speakers Measured in Milliseconds (*Source: Field Data: August, 2014)*

4.6.9 Duration for Eʋedome Female Speakers

Table 4.6.11 and the figure below show the measurement for the Eʋedome female speakers in milliseconds. A critical analysis of the durational values indicated /n/ has the least measured value at word-initial, followed by /ŋ/, /m/ and /ɲ/ in ascending order. Within the word-medial positions, 183 was recorded for /ɲ/ as the highest value, 143 for /m/, 125 for /ŋ/ and 107 for /n/ which is the lowest. The word-final position calculations have 79 and 131 for /m/ and /ŋ/ respectively.

Table 4.6.9: Showing duration for Eʋedome Female Speakers

	Nasal Duration in Milliseconds				
	Position	**m**	**n**	**ɲ**	**ŋ**
Eʋedome female speakers	Initial	135	118	141	131
	Medial	143	107	183	125
	Final	79			131

Source: Field Data: August, 2014.

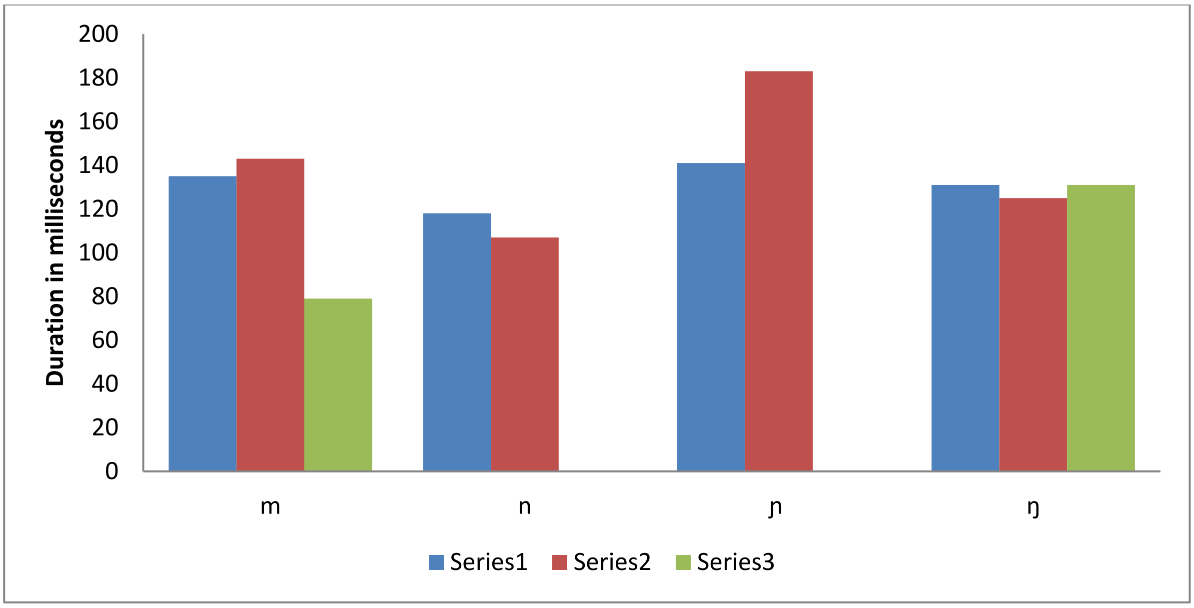


Figure 4.6.11: Bar Chart showing the Duration for Eʋedome Female Speakers Measured in Milliseconds (*Source: Field Data: August, 2014)*

4.6.10 **Duration for Ewe Language**

The Ewe language though has variant dialects but one common writing system referred to as Standard Ewe. The average mean durational values were therefore calculated based on the three major dialects spoken in Ghana to satisfy this condition. The gender characteristics were also taken into consideration where the mean values for male and female speakers were calculated as well as that of the language itself.

The comparison between the male and female tables has shown that the female speakers of Ewe language have higher average durational values at both word-initial and medial for /m/ than the male speakers. On the contrary, /n/ and /ɲ/ at word-initials for male speakers are higher than the values for female speakers. The overall highest average durational measurement recorded is the female /ɲ/ at word-medial positions with a value of 187 milliseconds and the lowest is also the female /m/ at word-final with a value of 109 milliseconds. The table and figure 4.6.12 below show the average mean durations calculated for the Ewe language.

Table 4.6.10: Average Mean Durations Calculated for the Ewe Language

	Nasal Duration in Milliseconds				
	Position	**m**	**n**	**ɲ**	**ŋ**
Ewe Language	Initial	138	136	156	148
	Medial	143	148	177	154
	Final	118			154

Source: Field Data: August, 2014.

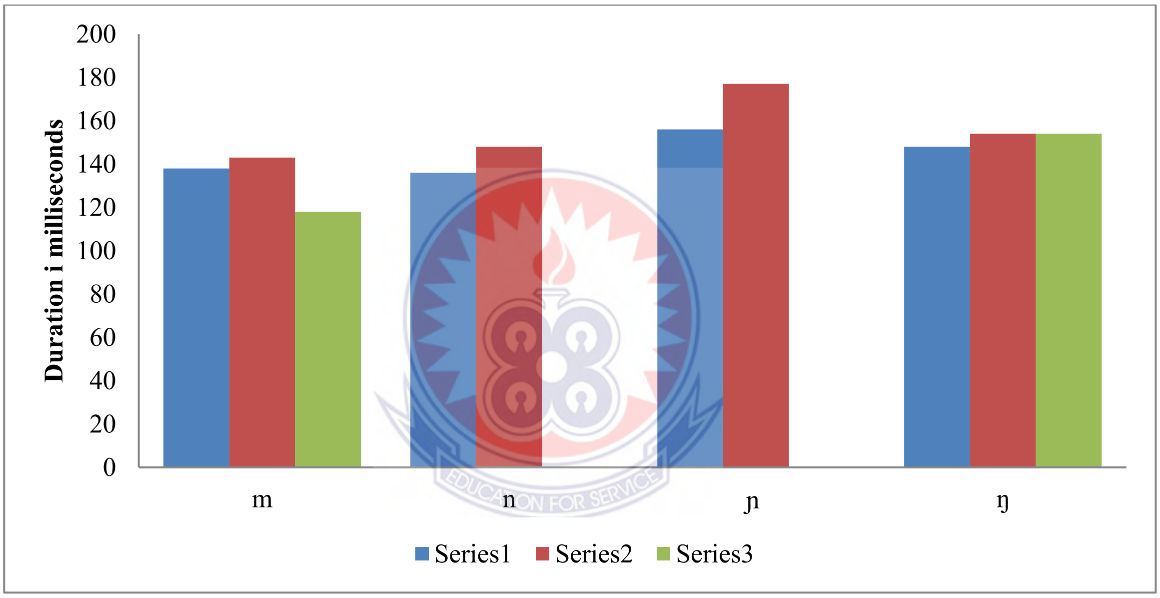


Figure 4.6.12: Chart Showing the Nasal Duration for Ewe Language Speakers in Milliseconds (*Source: Field Data, August 2014)*

4.6.11 **Ewe Male Speakers**

Durational calculations made for the Ewe male speakers were also recorded and displayed in table and figure 4.6.13 below. The initial durational values recorded show /m/ and /ŋ/ separated with only one point having 134 and 135 respectively. /n/ got 140 and /ɲ/ had 158 as the highest value. The word-medial position durations were /m/ 138, /n/ 151,

/ɲ/ 167 and /ŋ/ 150. Word-final position duration for /m/ and /ŋ/ were 126 and 148 respectively.

Table 4.6.11: Durational Values Measured for Ewe Male Speakers in Milliseconds

	Nasal Duration in Milliseconds				
	Position	**m**	**n**	**ɲ**	**ŋ**
Ewe Language	Initial	134	140	158	135
	Medial	138	151	167	150
	Final	126			148

Source: Field Data: August, 2014

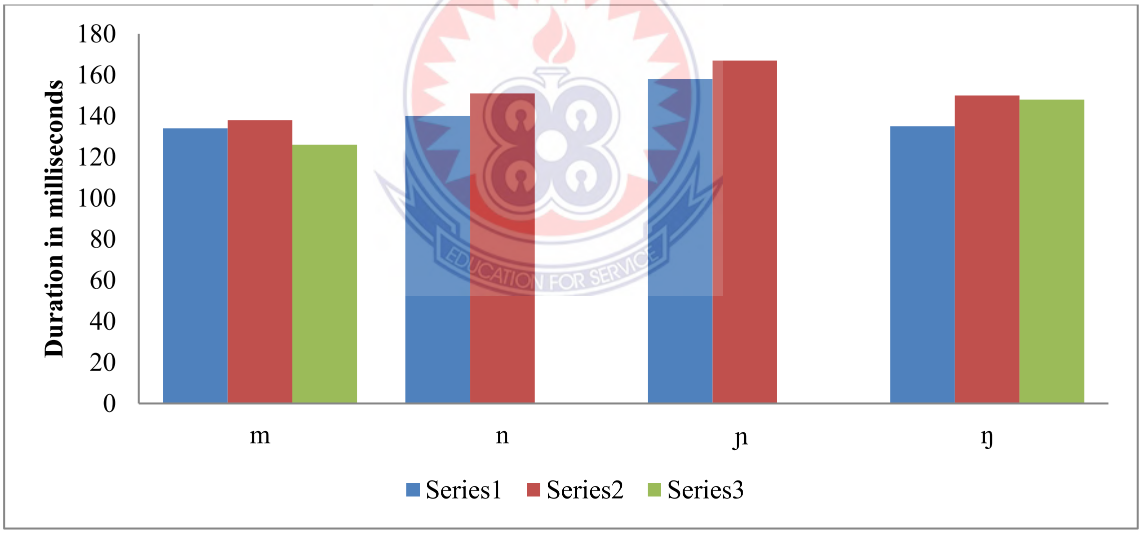


Figure 4.6.13: Chart Showing the Duration for Ewe Male Speakers Measured in Milliseconds (*Source: Field Data, August, 2014)*

4.6.12 **Ewe Female Speakers**

The results as depicted in table and figure 4.6.10 below for the Ewe female speakers show the bilabial /m/ has 142, 147 and 109 for word-initial, medial and final positions. /n/ and /ɲ/ have 132, 146 and 153, 187 for initial and medial positions. The velar nasal /ŋ/ has 160, 157 and 160 for all three word positions. The least value is recorded for /m/ at word-final and the highest is /ɲ/ at word-medial.

Table 4.6.12: Duration for Ewe Female Speakers Measured in Milliseconds

	Nasal Duration in milliseconds				
	Position	**m**	**n**	**ɲ**	**ŋ**
Ewe Language	Initial	142	132	153	160
	Medial	147	146	187	157
	Final	109			160

Source: Field Data: August, 2014

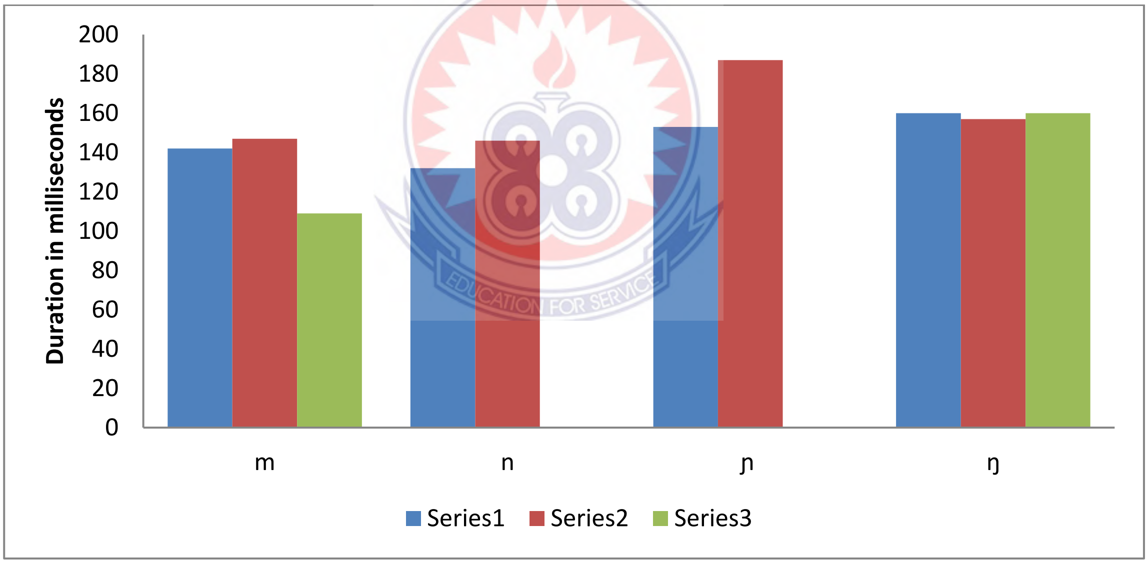


Figure 4.6.14: Bar Charts Showing Duration for Ewe Female Speakers Measured in Milliseconds (*Source: Field Data: August, 2014*)

4.7 Conclusion

This chapter has so far discussed the entire result in the area of the analysis of the four nasal consonants /m/, /n/, /ɲ/ and /ŋ/ in Ewe language and the three main Ewe dialects spoken in the Volta region of Ghana. The discussion focuses mainly on the measurement of the nasal consonants in Hertz at word-initial, word-medial and word-final positions. Gender characteristics have not been left out where similarities between male and female speakers have been looked at. Comparison between and within the nasal consonants have been fairly scrutinized and Paired Sample T-tests have also been conducted. The durational values measured in milliseconds have been tackled. The final analysis and discussion in this chapter focuses on the measurement of the average mean values of Ewe as a language. There were significant levels of similarities within the nasal consonant measurements within the first and second formant frequency values at the three word positions. These values measured in Hertz and milliseconds were used to draw the tables and charts for the analysis. Chapter five discusses findings, summaries and recommendations of the study on the Ewe nasal consonants.

CHAPTER FIVE

DISCUSSION AND CONCLUSION

5.0 Introduction

This chapter discusses discoveries based on the research, recommendation/ suggestions and summary of the entire work. It also examines a comprehensive analysis of the nasal consonant sounds in the Ewe language spoken in the Volta Region of Ghana.

5.1 Summary of Results

The study involved sixty (60) native speakers; 20 representing each of the three main dialects in Ewe. For gender balance, both male and female speakers were involved in the various exercises for comprehensive results of the research. The range of their ages were between 24-62 years. All participants were selected from their communities where the native dialect was predominantly spoken and each one of them had some level of formal education. Native speakers were selected from Mafi Adidome, Sogakope (Tɔŋu), Dzodze, Aŋlɔgã (Aŋlɔ) and Ho, Fodome (Eʋedome) respectively.

The aim of this study was to analyze and give scientific bases to the production and description of the quality of the nasal consonant sounds acoustically in the Ewe language spoken in the Volta Region of Ghana. This was to further analyze the nasal consonant sounds at different word positions of initial, medial and final and to also find out if there ever existed any similarities and differences within the three major dialects spoken in Ghana. Though the analysis within this scope restricted the researcher in a way, it helped strategically, to ensure that the data collected was controlled within the parameters of the study whereby the recordings of the speech sounds on the nasal consonant sounds were limited to the environments of the native communities of the speakers of the selected dialects only.

Notwithstanding these restriction, investigations of the issues on the nasal consonant sounds were carried out successfully and thoroughly through series of recordings where the nasal consonants were carefully selected within the scope of mono and disyllabic words with the structure NV, VNV, NVN, CVN and NCV. Measurements of the formant frequency values were taken to obtain results for F1 and F2 values of the nasal consonants at word initial, medial and final positions. Durations of the nasal consonants were also examined to find out the differences and similarities that existed between the longest and shortest nasal consonant sounds in Tɔŋu, Aŋlɔ and Eʋedome dialects as far as the Ewe language spoken in Ghana is concerned. Statistical analysis were equally conducted where the results of paired nasal consonants as well as the paired -Sample T-Test were also thoroughly calculated.

The findings in chapter four, show some levels of similarities and differences in the male and female speakers of the three dialects, likewise the Ewe language itself. This significance was depicted in the values measured in the results of the nasal consonant sounds.

The comparison of all the F1 measurements for the Tɔŋu dialect within the four nasal consonants show that, /ŋ/ at word-final has the highest Formant Frequency of 437Hz and the least is /m/ at word-final position, recording 302Hz. In their F2 values /n/ at word-medial recorded the highest F2 values of 1572Hz and the lowest was measured for /m/ again at word initial-position with 1273Hz. These records explain that the highest F1 and F2 measurements in the Tɔŋu dialect for the four nasal consonant sounds were within /ŋ/ and /n/ formant frequency values and the least were within /m/.

The Formant Frequency values calculated for the Tɔŋu male speakers indicated /ŋ/ at word-final has the highest F1 values of 453Hz and the least is /m/ also at word-final position having a measurement of 281Hz. Their F2 values show /ɲ/ at word-medial position having the highest frequency values whilst the lowest is /m/ at word-initial. Their respective values are 1687Hz and 1262Hz.

Values for the female speakers of Tɔŋu were also analyzed in F1 and F2. The result indicated 421Hz as the highest measurement for /ŋ/ at word-final position in F1 values and /ɲ/, at word-medial position, recorded the least value of 305Hz among the nasal consonants. 1596Hz and 1283Hz are the highest and lowest F2 values calculated for /n/ at word-medial and /m/ at word-initial positions respectively.

The recordings for the Aŋlɔ dialect speakers also unearthed tremendous discoveries within the four nasal consonants where the measurements proved that /m/ at word-medial position has the lowest F1 values of 312Hz whilst the highest was realized in /n/ at word-initial position measuring 386Hz. Within the F2 values /n/ at word-medial position has1806Hz as the highest Frequency values and /m/ at word-medial position, recorded the least value of 1350Hz.

The values of the male speakers indicated /m/ at word-initial position has 275Hz as the lowest Formant Frequency value within all the F1 measurements on the nasal consonants and the highest is 360Hz measured for /ŋ/ at word-initial position. The F2 values have 1661Hz and 1217Hz being the highest and least measurements for /n/ at word-medial position and /ŋ/ at word-final position respectively.

Among the female speakers, the results for the F1 and F2 values show /m/ at word-final has 329Hz the least F1 values and the highest comes from /n/ at word-medial position with a value of 423Hz. The F2 comparison within the nasals consonants has 1400Hz and

1950Hz to be the lowest and highest measurements for /ŋ/ at word-initial and /n/ at word-medial positions respectively.

The overall results produced from the study of the Aŋlɔ dialect had the female speakers recording the highest frequency value of 423Hz at word-medial position for the palatal nasal consonant /ɲ/ in the F1 and the lowest value was also recorded from the male speakers for the bilabial nasal consonant /m/ at word-initial position with a formant frequency value of 275Hz. The F2 value records produce the highest result in the alveolar nasal /n/ at word-medial of 1950Hz from the female speakers and the least comes from the male speakers which was the velar nasal consonant /ŋ/ at word-final position recording 1217Hz as its frequency value.

The analysis for the Eʋedome speakers also produced unique and remarkable results where the highest F1 value was measured for /ŋ/ at word-initial with a value of 439Hz and the least was /m/ at word-medial positions with a value of 335Hz. The measurement for the F2 values again showed /ŋ/ at word-initial and word-final positions having had the highest and the lowest Frequency values of 1814Hz and 1428Hz respectively.

The analysis on the average values of the nasal consonants calculated for the male speakers has the following final results: /m/ at word-medial has the least F1 formant frequency with a statistical value of 338Hz and the highest was /ŋ/ at word-initial position measuring 479Hz. The F2 measurements show /ŋ/ at word-initial and word-final positions respectively, having the highest and the lowest recordings of 2214Hz and 1343Hz.

The average measurements for the female speakers of the Eʋedome dialect also had the alveolar nasal consonant /n/ at word-medial as the least F1 values and the highest was /ŋ/ at word-initial position. Their respective values are 305Hz and 399Hz. Comparing the F2 values, the palatal nasal consonant /ɲ/ at word-initial recorded the least value of

1356Hz and the highest is the alveolar nasal consonant /n/ at word- initial position also recording1685Hz.

The average Formant Frequency values calculated for the four nasal consonants within the three dialects were compared. It was found out that Tɔŋu dialect had the lowest F1 value measured for /m/ at word-final among the three with a frequency value of 302Hz and the highest was measured for Eʋedome dialect of 439Hz.This was recorded for /ŋ/ at word-initial position. The comparison of the F2 values further recorded the least Frequency value measurement in Tɔŋu dialect for /m/ again at word-initial of 1273Hz and the highest was calculated for the Eʋedome dialect for the velar nasal /ŋ/ at word-initial position of 1814Hz.

The gender characteristics of the three dialects for male speakers show that Aŋlɔ male speakers have the lowest F1 values measured for /m/ at word-initial with 275Hz as its measured figure and the highest is /ŋ/ at word-initial position of 479Hz measured for male speakers of Eʋedome dialect. The average comparison of the F2 values among the male speakers has 1217Hz as the least Formant Frequency value recorded for the Aŋlɔ dialect speakers in /ŋ/ at word-final position. The highest F2 was registered for male speakers of Eʋedome dialect calculated for the velar nasal consonant /ŋ/ also at word-initial position. Its frequency value is 2214Hz. These results show that the highest and lowest average values for the male speakers resulted in the Formant Frequency measurements of the velar nasal consonant /ŋ/.

When the average values for the female speakers in the three dialects were calculated, the lowest F1 value measurement record was calculated for Eʋedome female speakers. This was recorded for /ɲ/ at word-initial position and the highest was Aŋlɔ female speakers which was the alveolar nasal /n/ at word-medial positions. The values were 299Hz and 423Hz for F1 and F2 respectively. In the F2 analysis the lowest average values among the female speakers in the three dialect was Tɔŋu which was recorded for /m/ at word-initial and the highest analyzed for /n/ at word-medial which was also measured for the Aŋlɔ female speakers. Their respective measurements were 1283Hz and 1950Hz.

The study, further confirmed that the labial nasal /m/, alveolar nasal /n/, the palatal alveolar nasal /ɲ/ and the velar nasal /ŋ/ are the four distinct nasal consonants used in the three main dialects of the Ewe language spoken in Ghana.

Linguistically, Ewe language has one common writing system referred to as standard Ewe in Ghana. To satisfy this condition, the average Formant Frequency values were analyzed based on the measurements taken for the three dialects. The findings revealed the bilabial nasal /m/ at word-final position had the least measurements among the F1 Frequency values of 321Hz and the highest was 387Hz at word-final of the velar nasal /ŋ/ in the Ewe language. Within the F2 values the highest was record for the alveolar nasal /n/ with an average record of 1688Hz and the lowest was the again recorded for the bilabial nasal consonant /m/ at word-medial having 1393Hz.

The average Frequency values for the male speakers were also compared using the same statistic procedure. All their results were within the ranges of 300Hz–400Hz for the Formant Frequencies measurements in the F1 and 1000Hz – 2500Hz for the F2. The average values calculated for the velar nasal consonant /ŋ/ at word-initial, word-medial and word-final positions were higher than the values for /m/, /n/ and /ɲ/ at the various word positions. The highest among the three word positions in /ŋ/ was recorded at word-final position. Their average values calculated were as followed; word-initial 392Hz, medial-medial 393Hz and word-final 394Hz. The lowest values recorded for the Ewe male speakers for the F1 values was the bilabial nasal /m/ at word-final positions. The recorded average values was 307Hz.

The average results of the male speakers for the F2 values were also within the ranges of 1300Hz – 1700Hz. The highest word-initial value was recorded for the velar nasal /ŋ/ with an average value of 1694Hz and the least was the bilabial nasal /ŋ/ recording a value of 1371Hz. Word –medial values compared showed /ɲ/ had the highest value of 1652Hz and the lowest recorded for /m/ was 1319Hz. The final-word position values calculated between /m/ and /ŋ/ indicated the bilabial nasal /m/ got the highest average recording of 1410Hz whilst /ŋ/ recorded 1317Hz as the least statistical values for the formant frequency measurements. These have been the overall statistical analysis based on the results of the average formant frequency values measured for the male speakers of the Ewe language within the average scores of the four distinct nasal consonants /m/, /n/, /ɲ/ and /ŋ/:

The average results of the female speakers of the Ewe language have also been analyzed. The highest Formant Frequency value that was measured as F1 was for the velar nasal /ŋ/ at word-final position with an average score of 380Hz and the lowest was /ɲ/ recording 317Hz. The F2 values had 1726Hz and 1373Hz respectively as the highest and lowest figures measured in Hertz for the Ewe female speakers.

Throughout the entire studies, the comparison of the word-final position results were only between /m/ and /ŋ/. This was the revelation as a result of the fact that the two are the only nasal consonants identified through this research, to have word-final positions in the three dialects spoken in Ghana as far as the Ewe language is concerned. Most of the highest recordings were found within the Formant Frequency values of /ŋ/ in both F1 and F2 and the least or lowest were also recorded for /m/. However, the overall average highest F1and F2 Formant Frequency values were measured for the velar nasal consonant /ŋ/ and /n/ at word-final and word-medial positions with values of 387Hz and 1688Hz respectively. In the same parameter, the lowest F1 and F2 average values as calculated for the Ewe language in this research were /m/ at word-final and word-medial positions having 321Hz and 1393Hz as their respective results recorded.

5.2 Discoveries/Findings

The acoustic analysis of the Ewe nasal consonants have produced remarkable results. It was discovered that, all the three dialects selected for the study make extensive use of the nasal consonants [m, n, ɲ, ŋ] at word-initial and word-medial medial positions. However, at word-final positions only /m/ and /ŋ/ occurred. There are no records of /n/ and /ɲ/ existing at word-final positions in the Tɔŋu, Aŋlɔ and Eʋedome dialects. This implied that the alveolar nasal /n/ and the palatal nasal /ɲ/ do not occur at word-final positions in the Ewe language spoken in Ghana. Furthermore, all the nasal consonants function as distinct phonemes. None of them is an allophone of the other in any of the three dialects. There was another major discovery within the Aŋlɔ dialect speakers. When the back high vowel /u/ follows the alveolar nasal consonant /n/ in succession, it is realized as the velar nasal consonant /ŋ/. This is a phonological occurrence peculiar to Aŋlɔ speakers as compared to the other two dialects in this research. Examples of such words are nyɔŋu, ŋufiala, ŋu, ŋudzrala and ŋuvɔ. Nevertheless, an alternative was provided within the word list to cater for the collection of the data.

5.3 Recommendations

One particular point needs to be emphasized; no two utterances are ever exactly alike even made by the speaker. Human beings are not capable of producing carbon copies of everything they utter. Add to this, that all human beings are different from one another in physical terms, then you can begin to appreciate that the acoustic qualities of any linguistic sound are going to vary, however slightly, from one speaker to the next, since acoustic qualities are determined by the physical characteristics of the person making the sound. Lodge (2009).

Based on this assertion, and in order to improve upon the acoustic study of the Ewe language, the researcher would like to recommend that the acoustics should be taught in school as it is done in the articulatory. In addition, there should be a research into the acoustic study of the Ewe oral stops in the near future to balance the equation in the linguistic field of the study of our language.

The investigator, would also like to recommend that, there should be a study on the differences and similarities (variations) between Ewe and Akan nasal consonants since the two belong to the same language grouping of the Kwa branch of the Niger-Congo languages, from which Akan language was proven to have had [m, n, ɲ] as distinct nasal consonant sounds. Dolphyne (1988 b). This recommendation, if taking into consideration, would be a step in the right direction into broadening the horizon and knowledge base of the linguistic investigations within the study of the Ghanaian languages, to give them a firm position in the field of linguistic studies.

5.4 Conclusion

The Ewe language is spoken widely in regions of four West African Countries. These are Ghana, Togo and Benin with a few of them in South-Eastern Nigeria. Political boundaries have separated the speakers of Ewe into such fragmented groupings within these nations. Though most of the variants are mutually intelligible the variations are confronted with dialect continuum. This made the researcher to concentrate her study on only the variants spoken in Ghana.

In summary, three main dialects of the Ewe language spoken in Ghana were selected for the study; Tɔŋu, Aŋlɔ and Eʋedome out of which there exist sub-dialects. All these three variants make extensive use of nasal consonants. Four distinct nasal consonants sounds were identified in the dialects as well as the orthography of the Ewe language spoken in Ghana. This discovery confirmed the existing literature on the nasal consonant sounds in the language. They are /m/, /n/, /ɲ/ and /ŋ/. There were similarities and differences within the production and uses of the nasal consonant sounds in each dialect. They occurred at word-initial and word-medial positions. However, at word-final position only, /m/ and /ŋ/ are used in the three dialects. There are no records of /n/ and /ɲ/ existing at word-final positions in any of the dialects spoken in Ghana as far as the Ewe language is concerned.

The highest F1 and F2 values among the Tɔŋu dialect speakers were 437Hz and 1574Hz. These were calculated for /ŋ/ and /n/ respectively. Within the Tɔŋu male speakers the highest values were measured for /ɲ/ and /ŋ/. Their respective values were 453Hz and 1687Hz whilst the female speakers had 421Hz and 1596Hz measured for /ŋ/ and /n/. Most of the lowest formant frequency values were recorded for /m/ between 300Hz and 370Hz. Among the Aŋlɔ dialect speakers, /ŋ/ and /n/ had the highest F1 and F2 values of 374Hz and 1806Hz respectively. The male speakers recorded 260Hz and 1661Hz for /ŋ/ and /n/ whilst their female speakers also recorded 423Hz and 1950Hz respectively for /n/. The Eʋedome dialect speakers also had 349Hz and 1687Hz as their F1 and F2 value measurements for /ŋ/ and /n/. The measurements for the male speakers were 479Hz and 1865Hz in /ŋ/ and the females measured 399Hz and 1663Hz for /ŋ/ and /m/ respectively. Most of the highest formant frequency value measurements for the nasal consonants were recorded for /n/ and /ŋ/ across the three dialects.

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APPENDIX A

Carrier Frame

	Ewe		English gloss
a.	Gblɔ ma tututu	------	Say dough/divide exactly.
b.	Gblɔ ame tututu	------	Say human/man exactly.
c.	Gblɔ mim tututu	------	Say swallowing exactly.
d.	Gblɔ kum tututu	------	Say fetching exactly.
e.	Gblɔ na tututu	------	Say to (give) exactly.
f.	Gblɔ nu/ŋu tututu	------	Say mouth exactly.
g.	Gblɔ ene tututu	------	Say four exactly.
h.	Gblɔ nya tututu	------	Say word/wash exactly.
i.	Gblɔ enyi tututu	------	Say eight exactly.
j.	Gblɔ ŋɔ tututu	------	Say perforate exactly.
k.	k.Gblɔ aŋe tututu	------	Say rubber exactly.
l.	Gblɔ ŋutsu tututu	------	Say man/male exactly.
m.	Gblɔ keŋ tututu	------	Say entirely exactly.
n.	Gblɔ sɔŋ tututu	------	Say plenty exactly.

APPENDIX B

Raw Data of the Formant Frequency Values Measured in Hertz for the Nasal Consonant Sounds of the Individual Speakers for the Three Selected Dialects

Tɔŋu Male Speakers

	[ŋ] F1	F2	[ŋ] F1	F2	[ŋ] F1	F2	[ŋ] F1	F2
1.1 Initial	361	1256	297	1580	340	1472	318	1472
1.2 Medial	492	1210	296	1537	340	1646	492	1210
1.3 Final	318	1428					318	1428
2.1 Initial:	430	1276	318	1515	297	1493	340	1450
2.2 Medial:	514	1298	340	1580	318	1602	383	1406
2.3 Final:	274	1319					514	1276
3.1 Initial:	340	1210	340	1559	361	1515	340	1385
3.2 Medial:	470	1254	318	1515	340	1646	318	1428
3.3 Final:	274	1406					492	1363
4.1 Initial:	318	1232	361	1667	318	1537	405	1493
4.2 Medial:	488	1189	275	1472	384	1624	384	1450
4.3 Final:	253	1210					514	1363
5.1 Initial:	275	1298	231	1276	340	1472	275	1341
5.2 Medial:	253	1358	361	1580	275	1624	340	1450
5.3 Final:	318	1406					448	1276
6.1 Initial:	297	1298	297	1298	362	1450	384	1515
6.2 Medial:	318	1341	318	1559	318	1580	362	1406
6.3 Final:	253	1341					492	1776
7.1 Initial:	318	1341	318	1341	275	1493	361	1298
7.2 Medial:	210	1298	275	1580	253	1580	427	1580
7.3 Final:	340	1450					470	1254
8.1Initial:	275	1254	253	1210	340	1580	318	1450
8.2 Medial:	274	1276	318	1515	362	1602	362	1428
8.3 Final:	297	1385					448	1341
9.1 Initial:	253	1123	405	1428	318	1406	340	1472
9.2 Medial:	361	1145	318	1450	362	1907	384	1450
9.3 Final:	231	1150					274	1450
10.1 Initial:	275	1341	274	1319	360	1493	276	1428
10.2 Medial:	253	1406	294	1689	297	2037	362	1450
10.3 Final:	253	1711					340	1450

Tɔŋu Female Speakers

	[m] F1	F2	[n] F1	F2	[ɲ] F1	F2	[ŋ] F1	F2
1.1 Initial:	405	1341	396	1472	253	1428	297	1450
1.2 Medial:	427	1363	384	1754	318	1428	318	1493
1.3 Final:	340	1559					448	1559
2.1 Initial:	318	1319	340	1515	275	1472	318	1515
2.2 Medial:	492	1385	448	1667	275	1363	318	1515
2.3 Final:	318	1472					470	1515
3.1 Initial:	384	1319	361	1493	340	1493	361	1450
3.2 Medial:	427	1276	318	1711	318	1363	275	1363
3.3 Final:	318	1580					427	1515
4.1 Initial:	340	1298	405	1537	296	1406	362	1406
4.2 Medial:	405	1298	384	1624	275	1385	318	1341
4.3 Final:	318	1472					427	1450
5.1 Initial:	383	1385	340	1472	340	1363	340	1319
5.2 Medial:	448	1341	340	1646	253	1406	274	1428
5.3 Final:	361	1515					448	1450
6.1 Initial:	405	1432	340	1450	340	1298	297	1319
6.2 Medial:	384	1276	427	1754	296	1298	318	1319
6.3 Final:	340	1559					449	1450
7.1 Initial:	362	1341	427	1515	361	1298	318	1341
7.2 Medial:	361	1319	361	1646	340	1428	297	1298
7.3 Final:	384	1319					384	1428
8.1 Initial:	405	1189	318	1385	318	1254	340	1385
8.2 Medial:	384	1298	340	1711	340	1341	340	1341
8.3 Final:	361	1385					318	2124
9.1 Initial:	296	1015	274	1515	380	1030	340	1450
9.2 Medial:	340	1189	275	1733	340	1120	405	1385
9.3 Final:	253	1036					514	1580
10.1 Initial:	340	1189	360	1058	340	1298	275	950
10.2 Medial:	405	1428	320	1015	297	1472	296	1050
10.3 Final:	231	1493					320	1123

Aŋlɔ male speakers

	[m] F1	F2	[n] F1	F2	[ɲ] F1	F2	[ŋ] F1	F2
1.1 Initial:	253	1232	297	1537	318	1450	297	1319
1.2 Medial:	296	1276	318	1689	384	1580	340	1515
1.3 Final:	275	1405	____	____	____	____	361	1298
2.1 Initial:	296	1232	362	1580	361	1472	340	1298
2.2 Medial:	318	1298	405	1711	362	1537	318	1559
2.3 Final:	318	1385	____	____	____	____	296	1167
3.1 Initial:	296	1276	318	1580	297	1493	405	1667
3.2 Medial:	296	1298	427	1733	362	1450	340	1537
3.3 Final:	253	1254	____	____	____	____	340	1145
4.1 Initial:	275	1210	340	1472	318	1537	318	1385
4.2 Medial:	253	1210	318	1689	405	1646	340	1580
4.3 Final:	318	1278	____	____	____	____	297	1232
5.1 Initial:	253	1298	275	1537	362	1580	470	1537
5.2 Medial:	318	1298	384	1646	340	1341	275	1472
5.3 Final:	296	1276	____	____	____	____	340	1232
6.1 Initial:	274	1210	318	1537	384	1624	362	1341
6.2 Medial:	253	1254	361	1667	362	1537	297	1428
6.3 Final:	296	1276	____	____	____	____	318	1210
7.1 Initial.	296	1296	340	1559	318	1450	340	1450
7.2 Medial:	245	1341	318	1624	340	1472	361	1493
7.3 Final:	318	1298	____	____	____	____	340	1276
8.1 Initial:	253	1276	318	1515	297	1515	362	1646
8.2 Medial:	296	1341	295	1580	262	1624	427	1667
8.3 Final:	275	1276	____	____	____	____	318	1145
9.1 Initial:	298	1409	340	1559	318	1472	384	1341
9.2 Medial:	275	1385	318	1667	340	1319	340	1537
9.3 Final:	318	1167	____	____	____	____	361	1232
10.1 Initial:	256	1271	296	1450	340	1493	318	1385
10.2 Medial:	246	1124	340	1602	318	1363	318	1537
10.3 Final:	405	1232	____	____	____	____	405	1232

Aŋlɔ Female Speakers

	[m] F1	F2	[n] F1	F2	[ɲ] F1	F2	[ŋ] F1	F2
1.1 Initial:	340	1406	202	1733	427	1341	450	1341
1.2 Medial:	340	1385	275	1950	318	1232	427	1298
1.3 Final:	383	1276	______		______		384	1493
2.1 Initial:	384	1363	448	1493	318	1515	362	1254
2.2 Medial:	361	1319	492	2037	231	1493	340	1580
2.3 Final:	275	1341	______		______		449	1515
3.1 Initial:	406	1428	405	1820	384	1319	362	1537
3.2 Medial:	318	1319	449	2124	384	1341	405	1624
3.3 Final:	384	1515	______		______		340	1515
4.1 Initial:	362	1363	427	1754	449	1341	340	1493
4.2 Medial:	361	1298	514	2016	361	1450	427	1580
4.3 Final:	362	1559	______		______		405	1537
5.1 Initial:	318	1298	362	1733	384	1319	362	1580
5.2 Medial:	340	1450	471	1994	361	1537	405	1624
5.3 Final:	361	1537	______		______		384	1559
6.1 Initial:	405	1406	405	1798	362	1276	427	1602
6.2 Medial:	297	1450	427	2081	197	1428	340	1602
6.3 Final:	340	1515			______		340	1515
7.1 Initial:	318	1624	275	1602	362	1646	405	1319
7.1 Medial:	318	1493	471	2059	318	1406	384	1646
7.3 Final:	340	1602	______		______		318	1537
8.1 Initial:	427	1646	253	1559	427	1493	340	1210
8.2 Medial:	405	1537	384	1733	408	2407	362	1450
8.3 Final:	297	1472	______		______		405	1472
9.1 Initial:	297	1537	405	1515	405	1406	449	1428
9.2 Medial:	340	1472	405	1776	340	1363	384	1406
9.3 Final:	275	1385	______		______		318	1580
10.1 Initial:	253	1559	449	1450	340	1624	384	1232
10.2 Medial:	362	1450	340	1733	361	1254	340	1472
10.3 Final:	275	1385	______		______		340	1493

Eʋedome Male Speakers

	[m] F1	F2	[n] F1	F2	[ɲ] F1	F2	[ŋ] F1	F2
1.1 Initial:	405	1493	470	1450	405	1733	514	2211
1.2 Medial:	361	1363	470	1754	427	1711	492	2059
1.3 Final:	318	1450	______		______		405	1363
2.1 Initial:	384	1428	405	1319	384	1733	471	2211
2.2 Medial:	318	1341	405	1798	318	1820	449	2031
2.3 Final:	297	1515	______		______		362	1406
3.1 Initial:	340	1580	470	1559	408	1798	514	2146
3.2 Medial:	275	1254	384	1754	384	1907	471	1450
3.3 Final:	362	1537	______		______		340	1341
4.1 Initial:	362	1450	492	1450	362	1733	470	2190
4.2 Medial:	296	1298	449	1820	340	2124	405	2059
4.3 Initial:	340	1428	______		______		427	1385
5.1 Initial:	427	1537	405	1580	427	2081	492	2190
5.2 Medial:	318	1450	470	1711	384	1646	449	1428
5.3 Final:	362	1493	______		______		448	1298
6.1 Initial:	427	1602	340	1493	514	2059	471	2168
6.2 Medial:	340	1472	387	1667	362	1667	427	1298
6.3 Final:	361	1493	______		______		384	1298
7.1 Initial:	384	1641	362	1602	449	2233	405	2233
7.2 Medial:	340	1385	362	1776	427	1820	514	1741
7.3 Final:	340	1624	______		______		340	1341
8.1 Initial	384	1646	427	1537	470	2168	492	2255
8.2 Medial:	340	1385	362	1711	405	1711	471	1950
8.3 Final:	340	1624	______		______		362	1276
9.1 Initial:	492	1667	405	1602	405	2124	427	2211
9.2 Medial:	340	1428	427	1689	340	1798	535	1994
9.3 Final:	318	1642	______		______		405	1428
10.1 Initial:	405	1754	427	1472	449	2081	536	2320
10.2 Medial:	427	1493	449	1754	362	1602	492	1950
10.3 Final:	340	1733	______		______		448	1298

Eʋedome Female Speakers

	[m] F1	F2	[n] F1	F2	[ɲ] F1	F2	[ŋ] F1	F2
1.1 Initial:	318	1646	340	1711	297	1493	448	1036
1.2 Medial:	275	1689	253	1537	340	1537	318	1559
1.3 Final:	405	1602	______		______		361	1624
2.1 Initial:	340	1646	318	1754	318	1428	492	1602
2.2 Medial:	318	1602	318	1646	318	1559	427	1624
2.3 Final:	318	1559	______		______		318	1580
3.1 Initial:	297	1624	318	1646	253	1319	362	1450
3.2 Medial:	362	1689	361	1602	297	1319	384	1580
3.3 Final:	274	1602	______		______		340	1363
4.1 Initial:	361	1602	340	1667	340	1319	384	1472
4.2 Medial:	340	1646	340	1559	297	1559	362	1602
4.3 Final:	340	1515	______		______		448	1472
5.1 Initial:	318	1559	318	1733	318	1254	361	1472
5.2 Medial:	297	1646	318	1559	318	1602	405	1602
5.3 Final:	405	1689	______		______		318	1559
6.1 Initial:	296	1580	297	1624	231	1232	318	1515
6.2 Medial:	340	1602	340	1602	253	1624	449	1493
6.3 Final:	362	1646	______		______		340	1515
7.1 Initial:	318	1559	361	1689	362	1363	340	1406
7.2 Medial:	340	1754	231	1646	318	1646	405	1559
7.3 Final:	420	1754	______		______		340	1515
8.1 Initial:	340	1537	275	1754	318	1515	405	1406
8.2 Medial:	318	1667	253	1646	275	1602	318	1537
8.3 Final:	340	1537	______		______		318	1428
9.1 Initial:	275	1559	340	1624	275	1341	384	1319
9.2 Medial:	384	1689	297	1754	340	1624	362	1493
9.3 Final:	318	1580	______		______		384	1580
10.1 Initial:	297	1602	318	1646	275	1298	499	1450
10.2 Medial:	340	1646	340	1754	318	1580	318	1515
10.3 Final:	340	1580	______		______		340	1493

APPENDIX C

Average Formant Frequency Value Measurements

Tɔŋu Dialect Speakers

	[m] F1	F2	[n] F1	F2	[ɲ] F1	F2	[ŋ] F1	F2
Initial	335	1273	333	1430	328	1413	331	1395
Medial	385	1298	336	1572	315	1524	346	1397
Final	302	1424	___	___	___	___	437	1455

Tɔŋu Male Speakers

	[m] F1	F2	[n] F1	F2	[ɲ] F1	F2	[ŋ] F1	F2
Initial	305	1262	309	1419	331	1491	336	1430
Medial	363	1279	311	1548	325	1687	373	1449
Final	381	1371	___	___	___	___	453	1391

Tɔŋu Female Speakers

	[m] F1	F2	[n] F1	F2	[ɲ] F1	F2	[ŋ] F1	F2
Initial	364	1282	356	1441	324	1334	325	1359
Medial	407	1317	360	1596	305	1360	318	1345
Final	322	1476	___	___	___	___	421	1519

Aŋlɔ Dialect Speakers

	[m] F1	F2	[n] F1	F2	[ɲ] F1	F2	[ŋ] F1	F2
Initial	313	1367	340	1590	359	1469	374	1419
Medial	312	1350	386	1806	348	1489	359	1531
Final	313	1385	___	___	___	___	353	1370

Aŋlɔ Male Speakers

	[m] F1	F2	[n] F1	F2	[ɲ] F1	F2	[ŋ] F1	F2
Initial	275	1271	320	1533	331	1509	360	1437
Medial	280	1283	349	1661	358	1487	333	1533
Final	297	1311	____	____	____	____	338	1217

Aŋlɔ Female Speakers

	[m] F1	F2	[n] F1	F2	[ɲ] F1	F2	[ŋ] F1	F2
Initial	351	1463	363	1646	386	1428	388	1400
Medial	344	1417	423	1950	338	1491	381	1528
Final	329	1459	____	____	____	____	368	1522

Eʋedome Dialect

	[m] F1	F2	[n] F1	F2	[ɲ] F1	F2	[ŋ] F1	F2
Initial	357	1587	372	1596	363	1665	349	1814
Medial	335	1530	361	1687	341	1686	423	1711
Final	347	1577	____	____	____	____	372	1428

Eʋedome Male Speakers

	[m] F1	F2	[n] F1	F2	[ɲ] F1	F2	[ŋ] F1	F2
Initial	397	1580	420	1506	427	1974	479	2214
Medial	338	1396	417	1743	375	1781	471	1865
Final	342	1547	____	____	____	____	392	1343

Eʋedome Female Speakers

	[m] F1	F2	[n] F1	F2	[ɲ] F1	F2	[ŋ] F1	F2
Initial	316	1594	323	1685	299	1356	399	1413
Medial	331	1663	305	1631	307	1591	375	1556
Final	352	1606	____	____	____	____	351	1513

The Ewe Language

	[m] F1	F2	[n] F1	F2	[ɲ] F1	F2	[ŋ] F1	F2
Initial	335	1409	349	1539	350	1493	381	1543
Medial	344	1393	361	1688	335	1566	375	1546
Final	321	1462	____	____	____	____	387	1418

Ewe Male Speakers

	[m] F1	F2	[n] F1	F2	[ɲ] F1	F2	[ŋ] F1	F2
Initial	326	1371	350	1486	363	1658	392	1694
Medial	327	1319	359	1651	353	1652	393	1616
Final	307	1410	____	____	____	____	394	1317

Ewe Female Speakers

	[m] F1	F2	[n] F1	F2	[ɲ] F1	F2	[ŋ] F1	F2
Initial	344	1447	347	1591	336	1373	371	1391
Medial	361	1446	363	1726	317	1481	358	1476
Final	334	1514	____	____	____	____	380	1518

APPENDIX D

Average Durational Values in Milliseconds

	Tɔŋu Dialect				Tɔŋu Male Speakers				Tɔŋu Female Speakers			
	[m]	**[n]**	**[ɲ]**	**[ŋ]**	**[m]**	**[n]**	**[ɲ]**	**[ŋ]**	**[m]**	**[n]**	**[ɲ]**	**[ŋ]**
Initial	126	141	163	173	116	144	155	160	135	137	170	183
Medial	147	180	207	170	147	187	202	164	147	173	212	175
Final	118	___	___	191	125	___	___	193	111	___	___	188

	Aŋlɔ Dialect				Aŋlɔ Male Speakers				Aŋlɔ Female Speakers			
	[m]	**[n]**	**[ɲ]**	**[ŋ]**	**[m]**	**[n]**	**[ɲ]**	**[ŋ]**	**[m]**	**[n]**	**[ɲ]**	**[ŋ]**
Initial	166	145	157	155	176	150	165	146	156	140	149	164
Medial	148	154	171	173	146	151	174	175	150	157	167	171
Final	140	___	___	153	142	___	___	145	137	___	___	160

	Eʋedome Dialect				Eʋedome Male Speakers				Eʋedome Female Speakers			
	[m]	**[n]**	**[ɲ]**	**[ŋ]**	**[m]**	**[n]**	**[ɲ]**	**[ŋ]**	**[m]**	**[n]**	**[ɲ]**	**[ŋ]**
Initial	122	122	147	155	109	126	153	98	135	118	141	131
Medial	133	111	154	188	122	115	124	111	143	107	183	125
Final	96	___	___	188	112	___	___	105	79	___	___	131

	Ewe Dialect				Ewe Male Speakers				Ewe Female Speakers			
	[m]	**[n]**	**[ɲ]**	**[ŋ]**	**[m]**	**[n]**	**[ɲ]**	**[ŋ]**	**[m]**	**[n]**	**[ɲ]**	**[ŋ]**
Initial	138	136	156	148	134	140	158	135	142	132	153	160
Medial	143	148	177	154	138	151	167	150	147	146	187	157
Final	188	___	___	154	126	___	___	148	109	___	___	160