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GRADUATION PAPER

**QUANTIFYING THE ARTICULATION MECHANISM
OF THE MEDIAL PHONEME IN VIETNAMESE**

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TRƯỜNG ĐẠI HỌC NGOẠI NGỮ
KHOA SƯ PHẠM TIẾNG ANH**

KHÓA LUẬN TỐT NGHIỆP

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ABSTRACT

Speech Therapy is a new profession in development in Vietnam. However, available assessment tools and treatment protocols contain phonology elements meant to assess English speakers. A better understanding of Vietnamese phonology would be greatly beneficial to the adaptation of these material for Vietnamese patients. On the other hand, the medial phoneme is a topic of debate between segmental and suprasegmental classification and available models of the phoneme contains elements not recognized by the International Phonetic Association which could cause confusion for Vietnamese speech therapists. Understanding the mechanism of the articulation of the medial phoneme would help Vietnamese health care professionals diagnose, assess, and manage patients better. 10 people participated in this research and audio-visual of 650 video snippets were analyzed, containing 13 minimal pairs of syllables with and without the medial phoneme. The results of the study confirm the hypothesis that the initial consonant is labialized and the vowel is lowered with the presence of the medial phoneme. Future research can explore employing participants of different or multiple dialects, participants of Speech Therapy patient population; or using different research tools such as videofluoroscopy for inner articulator investigation or praat for acoustics analysis.

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ABBREVIATION

ASD	:	Autism Spectrum Disorder
CP	:	Cerebral Palsy
IPA	:	International Phonetic Alphabet
LD	:	Labialization Deviation
MDD	:	Maximum Distance Deviation
TFA	:	Trinh Foundation Australia

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CHAPTER 1. INTRODUCTION

1.1 Statement of research problem

The researcher is an interpreter for Trinh Foundation Australia (TFA), a non-governmental organization with the aim of promoting Speech Therapy in Vietnam. Although Speech Therapy has been a well-established profession in the West for more than 50 years, it is still in the very early development stage in Vietnam. Since 2008, TFA has helped train the first 2 batches of Vietnamese speech therapists in collaboration with Pham Ngoc Thach Medical University in Ho Chi Minh City.

However, TFA has only begun expanding operations in Hanoi since early 2016, sending volunteering Australian and British speech pathologists help train doctors, nurses, and therapists in Faculty of Rehabilitation – Hanoi Medical University, Hanoi Rehabilitation Hospital, and National Geriatric Hospital through short workshops and in-clinic trainings. The researcher was the interpreter for these events – the very first Speech Therapy lessons in the Hanoi.

During the course of my work, I found myself translating/interpreting different assessment tools and therapy planning which are responsible for the diagnosis and treatment of patients. However, these often have parts of them testing the speech/language of patients based on English phonology and not always applicable to Vietnamese patients. To make a phonetically appropriate adaptation, not a direct translation of these material, was outside the scope of my ability but it has inspired me to study Vietnamese phonology, specifically Kinh people's Vietnamese language – the most commonly spoken language in Vietnam. Deeper understanding of language itself can provide the foundation for better adaptations with the implication of better treatment outcomes for patients.

An area of interest is the medial phoneme of Vietnamese language which has been a polarizing topic between linguists. The prevalent viewpoint which was pioneered by Đoàn (1977) is that the medial phoneme (*âm đệm*) is segmental. Đoàn (1977) described two distinctive features of the phoneme as labialization and lowering the pitch of the whole syllable, and transcribed it as /ɸ/ or /w/. However, Đoàn contradicted himself by describing suprasegmental features yet using segmental phonemic transcription. On the other hand,

linguists who classify the medial phoneme as suprasegmental have proposed their alternate models of the Vietnamese syllable: Hoàng & Hoàng (1975) and Cao (2006) divided the phoneme into labialization of the onset (*thủy âm*) and labialization/velarization of the medial (*chính âm*). Nevertheless, labialization of vowel is not a feature recognized by International Phonetic Association (2005). Speech therapists, who work primarily with muscle control, would benefit from understanding how the articulators move differently with and without the medial phoneme.

Moreover, while many qualitative studies have touched on the medial phoneme, the researcher has not found any quantitative ones on the subject.

1.2 Rationale

It was estimated by Trinh Foundation Australia (2016) that there were 13 million Vietnamese people with communication disorders. These conditions could be congenital or acquired later in life which affect a large part of the population.

Inborn deficits such as Autism Spectrum Disorder (ASD) or Cerebral Palsy are prevalent and tend to create communication disorders for the affected. The Department of Social Assistance at the Ministry of Labor, Invalids and Social Affairs estimated that Vietnam has about 200,000 children diagnosed with ASD (Nam, 2016). It was also approximated that 40% of children with ASD are non-verbal (National Autism Association, 2016). Professor Nguyễn Hữu Thanh, director of National Hospital of Acupuncture, estimated there are 200,000 new children with CP in Vietnam each year (Thu, 2012). Out of the people with Cerebral Palsy, data suggested that up to 81% have speech problems and 25% are non-verbal (Surveillance of Cerebral Palsy in Europe, 2000; Access Economics, 2008).

Communication disorders may also be acquired later in life due to stroke, traumatic brain injury, brain neoplasm or other etiologies that leave a huge number of patients with impairment. For example, it is estimated that there are 100,000 stroke survivals annually in Vietnam (Vân, 2015). Berthier (2005) estimated that 28-31% acute stroke patients have aphasia - a language deficit condition. The Royal College of

Physicians (2012) also suggested that one third of stroke patients have dysarthria, a medical condition characterized by articulation difficulties.

Therefore, with millions of patients or clients suffering from communication disorders, there is a need for new research studies that further our understanding of how Vietnamese speech is produced which can assist speech therapists. Firstly, different communication disorders may present themselves differently such as phonemic substitution, slurred speech due to muscle weakness, discoordination of speech muscles, etc. Phonology knowledge can help speech therapists provide better diagnosis. Secondly, with the new profession in development, there is a lack of clinical assessment tools specific to Vietnamese. Translated assessment tools contain phonology elements meant to assess patients speaking English and need to be adapted for local usage. With better phonology knowledge, assessment tools can be adapted with better practicality. Last but not least, current models of medial phoneme do not adequately explain its mechanism of articulation. A quantitative investigation would be useful in exploring the articulators used in producing this phoneme. This also provide an objective evidence-based discussion on the topic.

1.3 Research aims and research questions

This research study will aim at understanding how the medial phoneme is articulated. The question that the research aims to answer is:

What is the articulation mechanism of the medial phoneme in Vietnamese?

CHAPTER 2: LITERATURE REVIEW

2.1 Đoàn's model of the Vietnamese phoneme

Đoàn Thiện Thuật is a prominent pioneer in the study of phonology in Vietnam. In 1977, he proposed the following model of the Vietnamese syllable structure in his book *Ngữ âm tiếng Việt* (Vietnamese Phonology) which later received the *State Prize*, the second most prestigious prize awarded by the government of Vietnam in recognition of scientific and/or cultural achievement in 2010.

Tone (Thanh điệu)			
Initial consonant (Âm đầu)	Rhyme (Vần)		
	Medial Semivowel (Âm đệm)	Main Vowel (Âm chính)	Final consonant/ Semivowel (Âm cuối)

Figure 1: Đoàn's Vietnamese syllable model

For example, *quá* (much) is transcribed as /kʷa⁵/ or /kwa⁵/; *khuôn* (mold) is transcribed as /xʷon¹/ or /xwon¹/.

His syllable structure model was positively received and became the most widely used model in Vietnamese phonology literature such as Mai & Hoàng & Vũ (2002), Võ (2009), Ngô (2001), Nguyễn (2006), Tang & Barlow (2006), Pham & Mcleod (2016).

In Đoàn's book, *âm đệm* was considered to be semivowel with the characteristics of labialization and lowering of the pitch, transcribed as /ɯ/.

“Âm” means sound - or in this context - phoneme and “đệm” means the thing added to middle of the initial consonant and the vowel. With *âm đệm* as the Source Text, there are different Target Text for it in English. Ngô (2001) referred to it as *labialization*. Tăng (2007) called it *medial*. Latest meta research by Pham & Mcleod (2016) used the term *medial semivowel* which possibly captured most of the meanings intended by Đoàn. However, because the nature of the phoneme is debatable, the name **Medial Phoneme** was chosen to be used in this paper.

In terms of symbols, Võ (2009) used /ɥ/ to denote the semivowel which is similar to Đoàn (1977), Mai & Hoàng & Vũ (2002) prefer to use /w̥/ while Nguyễn (2006), Tăng (2007), Pham & Mcleod (2016) all use /w/. The diacritic *combining inverted breve* is used to denote non-syllabicity. All vowel are syllabic therefore non-syllabic vowel /ɥ/ need the diacritic to denote that it is a semivowel. However, if the approximant /w/ is used, using the diacritic like Mai & Hoàng & Vũ (2002) is redundant.

The advantage of Đoàn's model is the ease of both teaching and transcription using IPA characters, which is possibly why it is so widely used. However, the described labialization of the whole syllable is not accurate because the lips are not protruded in the entire duration of the syllable articulation. Moreover, lowering the pitch is not IPA-recognized distinctive feature.

2.2 Alternate models

While most of the mainstream researchers agree with the medial phoneme as segmental following Đoàn's position, several have proposed different approaches.

Ngô (2001) called the phoneme *labialization* and added that it only labializes the beginning consonant and the main vowel but he still used the syllable structure set by Đoàn.

Hoàng & Hoàng (1975) proposed another model of the Vietnamese syllable in Figure 2.

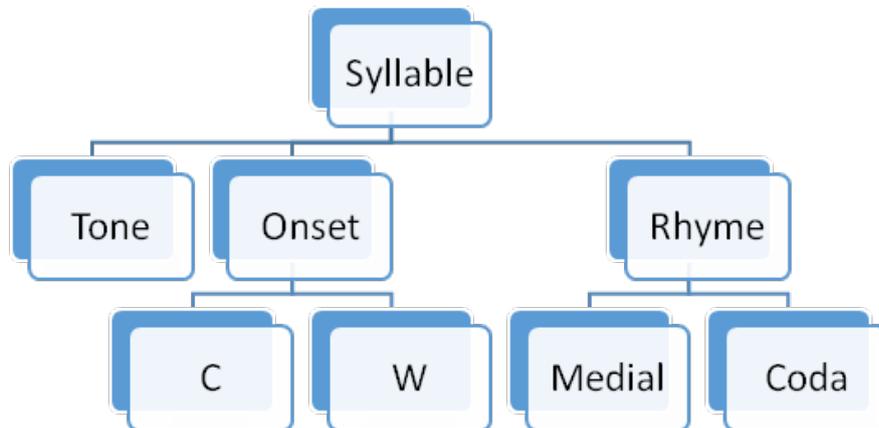


Figure 2 - Hoàng & Hoàng’s Vietnamese syllable model

Hoàng & Hoàng (1975) promoted the view of looking at components of syllable in a more suprasegmental view. The initial consonant and the medial semivowel make up the onset (*thủy âm*) in which the initial consonant is labialized, similar to what Ngo (2002) noted. The medial (*chính âm*) is defined as the vowel and the vocal quality of the syllable. The suprasegmental vocal quality is thought to be affected by the labialization and velarization of the vowel.

Cao (2006) generally agreed with Hoàng & Hoàng (1975) and also presented a similar model of the Vietnamese syllabeme in Figure 3. In this model, the syllabeme (*tiết vị*) is a syllable-morpheme cohesive unit in which the coda and the onset extend beyond the consonant boundaries to signify their suprasegmental features. I do not agree with calling Vietnamese syllables the syllabemes. Although it is true that most of Vietnamese syllables also carry certain meanings and therefore, are also morphemes, there are syllables are not meaningful by itself such as “pa”, “tê” in “pate” (*pâté*), and therefore, not morphemes.

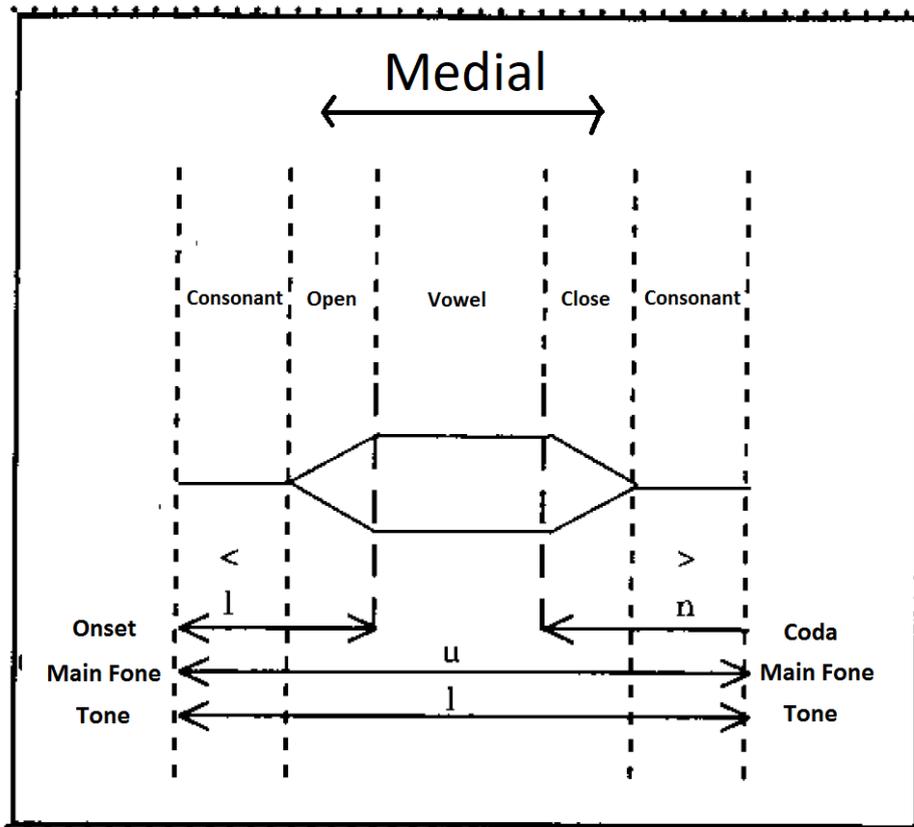
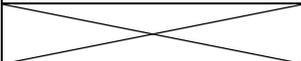


Figure 3 - Cao's Model (2006)

Hoàng & Hoàng (1975) and Cao (2006)'s models both called the change affecting the medial "labialization". However, lip rounding is a distinctive feature of vowels and therefore, labialization, if happens, would change one vowel into another. Moreover, both models are quite abstract compared to traditional model and the labialization of vowels does not comply with IPA, which creates difficulties for speech therapists.

2.3 Medial phoneme hypothesis

Taking the shortcomings of the previous research studies into consideration, this paper proposes a new model of the Vietnamese syllable, which would be measured and tested in the following sections.

Tone		
	Rhyme	
Onset	Nucleus	Coda
Initial consonant ([+labialization])	Vowel ([+lower])	Final consonant

[+labialization] and [+lower] are optional, similar to the how the medial semivowel is optional in Đoàn (1977)' model. The onset and coda are also optional.

If the syllable has the *medial phoneme*, the **initial consonant** will be **labialized**, and the **vowel** will be **lowered**. The mechanism of the [+labialization] (transcribed as ᵛ) will be the articulation happening at the lips at the beginning of the syllable. The type of labialization will be *endolabial* or *protrusion* (Trask, 1996) in which upper and lower lips come forward to forms the stricture. The mechanism of the ([+lower] (transcribed as ᵝ) is the lower jaw dropping further down during vowel articulation compared to the syllable without the medial phoneme.

As for words beginning with the medial phoneme but without an initial consonant, the onset would be voiced labio-velar approximant, transcribed as /w/.

For example, *quá* (much) will be transcribed as /k^wᵝᵗ/;

<quá> /k^wᵝᵗ/

Onset: k^w (labialized voiceless velar stop consonant)

Nucleus: ᵝ (lowered open front unrounded vowel)

Tone: *sắc* tone. In the six-tone classification, Đoàn (1977) described the tone as a high pitch tone, with a relatively level, non-broken contour which is agreed with by Mai & Hoàng & Vũ (2002), Võ (2009), Bình (2002). Nguyễn (2006) expanded the description of the tone as a creaky, non-glottalized tone with a long duration.

“*khuôn*” (mold) will be transcribed as /x^wɔ̄n¹/;

<khuôn> /x^wɔ̄n¹/

Onset: x^w (labialized voiceless velar fricative)

Nucleus: ɔ̄ (lowered close-mid back rounded vowel)

Tone: *ngang* tone, described by Đoàn (1977), Mai & Hoàng & Vũ (2002), Võ (2009), Bình (2002), as a high pitch tone with a relatively level, broken contour. Nguyễn (2006) added to the phonemic description with non-creaky, non-glottalized tone with a long duration.

“*oanh*” (oriole) will be transcribed as /wɔ̄n¹/.

<oanh> /wɔ̄n¹/

Onset: w (voiced labio-velar approximant)

Nucleus: ɔ̄ (lowered open front unrounded vowel)

Tone: *ngang* tone, described by Đoàn (1977), Mai & Hoàng & Vũ (2002), Võ (2009), Bình (2002), as a high pitch tone with a relatively level, broken contour. Nguyễn (2006) added to the phonemic description with non-creaky, non-glottalized tone with a long duration.

The advantage of this model is the fully compliance with the International Phonetic Alphabet (International Phonetic Association, 2005). First of all, it is an international standardized way of phonemic transcription, which can avoid confusion for future learners. Secondly, using standard IPA letters and descriptions only convey the distinctive features and not the prosodic features such as Hoàng & Hoàng (1975), Cao (2006)’s models. This approach convey enough essential articulation mechanism which is suitable for new learners with no linguistic background such as speech therapists.

2.4 Medial Phoneme Statistical Analysis

The author rechecked the listing of syllables containing the medial phoneme done by Nguyễn & Văn & Hoàng (2004) in consultation with the Vietnamese Dictionary by Hoàng P. (2016) and has performed several revisions. The numbering was fixed and duplicated entries removed. Same items with alternative grapheme representation were

merged such as *quí* and *quý* (*expensive*). The full and corrected listing is in Appendix A.

There are in total 565 unique syllables carrying the medial phoneme. Among them, there are 405 syllables that are standalone words and 160 syllable only have meaning in multi-syllabic words.

The beginning consonants are listed below and sorted by prevalence.

/k/	/s/	/h/	/t/	/x/	/l/	/ŋ/	/c/	/w/
116	58	57	51	50	41	41	37	35
/tʰ/	/ɲ/	/z/	/d/	/n/	/ɣ/	/m/	/v/	/b/
30	19	12	12	2	1	1	1	1

(unit: number of times it appears in the list of syllables in northern dialect)

Table 1: Beginning consonants prevalence of medial phoneme syllables in northern dialect

/k/	/s/	/h/	/t/	/x/	/l/	/ŋ/	/c/	/w/
116	45	57	51	37	41	41	31	35
/tʰ/	/ɲ/	/z/	/d/	/n/	/ɣ/	/m/	/v/	/b/
30	19	12	12	2	1	1	1	1
ɣ	t							
13	6							

(unit: number of times it appears in the list of syllables in southern and central dialects)

Table 2: Beginning consonants prevalence of medial phoneme syllables in southern and central dialects

The medial phoneme can only be paired with /i, e, ε/ě, iε, a/ǎ ɤ/ǎ/ which coincides with what Nguyễn (2006) observed with examples below.

Close front unrounded vowel /i/: tuy, nguy, quy, etc.

Close-mid unrounded vowel /e/: quê, tuê, thuê, etc.

Open-mid front unrounded vowel /ε/: xoẹt, khỏe, loét, etc.

Extra short open-mid front unrounded vowel /ě/: oách, hoạch, etc.

Open front unrounded vowel /a/: loa, xóa, khoa, etc.

Extra short open front unrounded vowel /ǎ/: hoắm, xoắn, khoắn, etc.

Close-mid back unrounded vowel /ɤ/: thuở, quở, etc.

Extra short close-mid back unrounded vowel /ǎ/: quắy, khuắy, khuắng etc.

Diphthong /iε/ (close front unrounded moving vowel moving toward close-mid front unrounded vowel): khuya, khuyên, chuyện, etc.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Research design

The researcher employed minimal pair analysis as the basis of the research. The articulation of words **without** a medial phoneme was measured as the **baseline**. The articulation of words **with** a medial phoneme was measured as the **benchmark**. The quantitative parameters collected were **Labialization Deviation** and **Maximal Distance Deviation**.

3.1.1 Labialization Deviation

With protrusion labialization, the lips curl forward to form the stricture and while doing so, reveal the vermilion - inner red layer of the lips, hence the name endolabial (Trask, 1996). As a result, the inner parts of the upper and lower lips will be visible more during labialization articulation.

Therefore, Visible Inner Upper Lip (VIUL) and Visible Inner Lower Lip (VILL) are the height of the lips, marked by the lip red tissue and measured horizontally with both baseline and benchmark articulations. Cosmetic items such as lipstick that can affect the results must be cleaned.

Labialization Deviation will be calculated as

$$LD = \frac{\text{Benchmark VIUL} + \text{Benchmark VILL}}{\text{Baseline VIUL} + \text{Baseline VILL}} * 100\% - 100\%$$

The LD will signify how much the visible inner lip area in the benchmark differs from that in the baseline.

The LD was calculated at the moment the word started to be articulated, signified by a change in the audio spectrum on analysis software.

3.1.2 Maximal Distance Deviation

Maximal Distance is the highest measured value of the vertical line center of the face with the beginning and the end marked by the top edge of the top lip vermillion and the lower edge of the lower lip vermillion during the articulations.

$$\text{Maximal Distance Deviation} = \frac{\text{Benchmark Maximal Distance}}{\text{Baseline Maximal Distance}} * 100\% - 100\%$$

Maximal Distance Deviation (MDD) represents how the openness of the mouth differs between the benchmark and the baseline.

3.2 Research subjects and Sampling

3.2.1 Participants

Due to time and resource constrains, convenient sampling of 10 participants was used. Participants for the research were friends, relatives, and studio staff recruited per convenient sampling. All 10 participants used Northern dialect of /s/ instead of /ʃ/ for [s].

There were 7 males and 3 females among 10 participants.

Participants	Age	Gender	Hometown
A	26	Male	Ha Noi
B	26	Male	Ha Noi
C	26	Male	Ha Noi
D	26	Male	Ha Noi
E	50	Female	Ha Noi
F	29	Male	Ha Tay
G	27	Female	Nam Dinh
H	22	Male	Ha Noi
K	22	Female	Ha Noi
G	22	Male	Ha Noi

Table 3 – Participant Demographic

3.2.2 Minimal pairs

3.2.2.1 Minimal Pairs Listing

The criteria for the minimal pairs are that both the items in comparison have to be Vietnamese words with distinct meanings but different in only one phoneme (with and without the medial phoneme), therefore excluding syllables that only have meaning in multi-syllable words or syllables having different tonemes.

However, in the Northern dialect, <s> and <x> are both pronounced as /s/, <tr> and <ch> are both pronounced as /c/ while they are distinctive with Central and Southern dialects. Therefore, there are more possible minimal pairs in Northern dialect than the counterparts. In total, there are 258 minimal pairs in Northern dialect and 245 minimal pairs in Central and Southern dialects.

The listing of minimal pairs can be seen in Appendix A.

3.2.2.2 Minimal pair Sampling

Without Medial Phoneme	Phonemic Transcription	With Medial Phoneme	Phonemic Transcription
ba (father)	/ba ¹ /	boa (tip)	/b ^w ɔ̌ ¹ /
chả (help poor people)	/čɲ ⁴ /	chuả (correct)	/c ^w ̌ɲ ⁴ /
danh (name, fame)	/žɲ ¹ /	doanh (army barrack)	/z ^w ̌ɲ ¹ /
đản (egg)	/dan ⁴ /	đoản (short)	/d ^w ɔ̌n ⁴ /
hen (asthma)	/hɛn ¹ /	hoen (rusty)	/h ^w ɛ̌n ¹ /
ký (sign)	/ki ⁵ /	quý (expensive)	/k ^w ̌i ⁵ /
thở (breath)	/t ^h ɤ ⁴ /	thuở (once upon a time)	/t ^{hw} ̌ɤ ⁴ /
lạt (bamboo string)	/lat ⁶ /	loạt (a series of)	/l ^w ɔ̌t ⁶ /
khê (burnt rice)	/xe ¹ /	khuê (room of a maiden)	/x ^w ɛ̌ ¹ /
nghiệt (bad karma)	/ɲiɛ̌t ⁶ /	nguyệt (moon)	/ɲ ^w ̌iɛ̌t ⁶ /

ách (suffering)	/ǎ̃n ⁵ /	oách (dapper)	/wǎ̃n ⁵ /
sạn (grit)	/san ⁶ / (Northern dialect) or /sạn ⁶ / (Central and Southern dialect)	soạn (prepare)	/s ^w ạn ⁶ / (Northern dialect) or /s ^w ạn ⁶ / (Central and Southern dialect)
tan (dissolve)	/tan ¹ /	toan (acidic)	/t ^w ạn ¹ /

Table 4 – Minimal Pairs

Purposive sampling method was employed to select the minimal pairs. These 13 minimal pairs cover all of the most commonly seen consonants for syllables having a medial phoneme. They also cover all of the vowels possible in syllables having medial phonemes including /i, e, ɛ/ǎ̃, iɛ, a, ɤ/ǎ̃/ except for /ǎ̃/ because there is no minimal pair for that syllables containing that vowel.

3.3 Recording procedures

The recording was done in a soundproof studio. The recorded videos have a resolution of 1920x1080, 30 frames per second and audio bitrate of 48000 Hz.

Participants were informed and explained how the data would be used as well as signed a consent form prior to the recording. The consent forms (in English and Vietnamese) can be found in Appendix B and C. The investigator ensured that the participants sat still, facing the camera with no movement during the recording to ensure measurement accuracy and consistency during each take. The participants were instructed to not move their heads during the recording. The height of the video recorder was adjusted to the height of the mouths of participants to ensure consistency.

Each of 10 participants pronounced all 13 minimal pairs. Each pair was performed 5 times to collect enough samples.

3.4 Data analysis

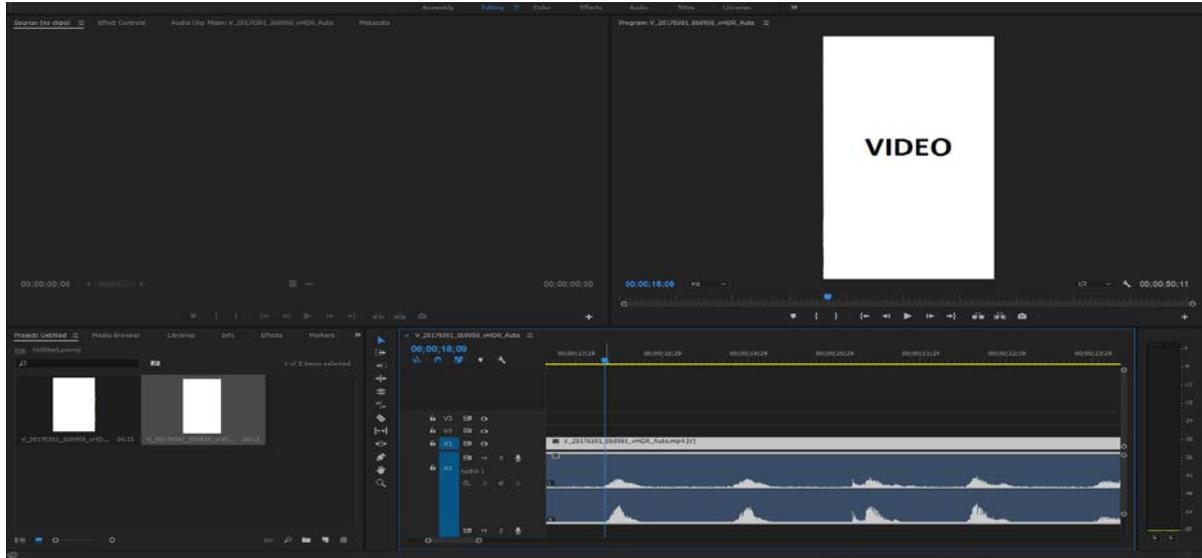


Figure 4 Adobe Premiere Pro 2017

(video image removed to protect the participant's privacy)

Video and Audio Analysis: the software Adobe Premiere Pro 2017 by Adobe Systems running on Microsoft Windows 10 was used for audio and video analysis. The video would be playing on the upper right panel of the windows and the audio will be visualized on the bottom right of the window. With both playing in synchronization, the beginning of the audio can be targeted and extract the image at the exact moment with margin of error within 1/30 of second. The moment with the widest Maximal Distance can also be selected via frame-by-frame viewing. Samples of the collected images were displayed below.



Figure 5: Beginning of “chân” (*help poor people*) turn 1 by participant A

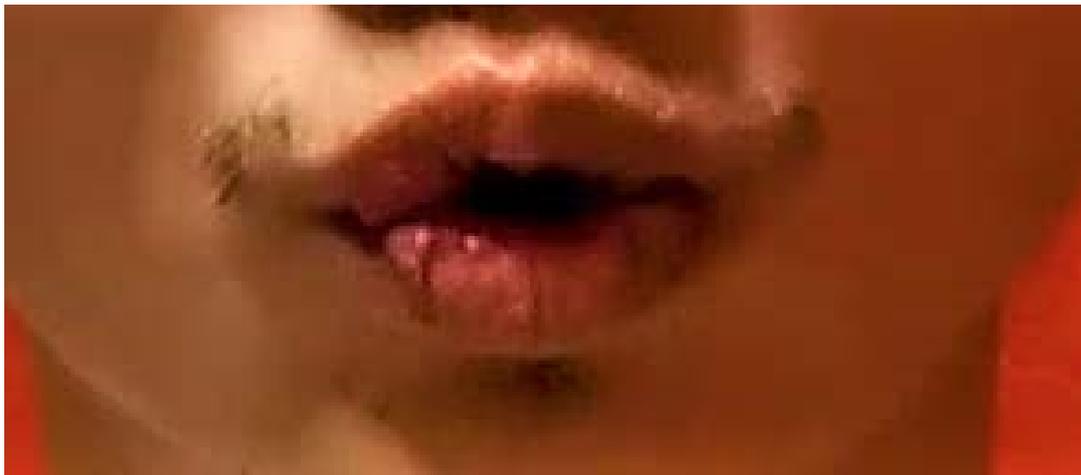


Figure 6: Beginning of “chuân” (*correct*) turn 1 by participant A



Figure 7: Maximal Distance of “thở” (*breath*) turn 1 by participant G

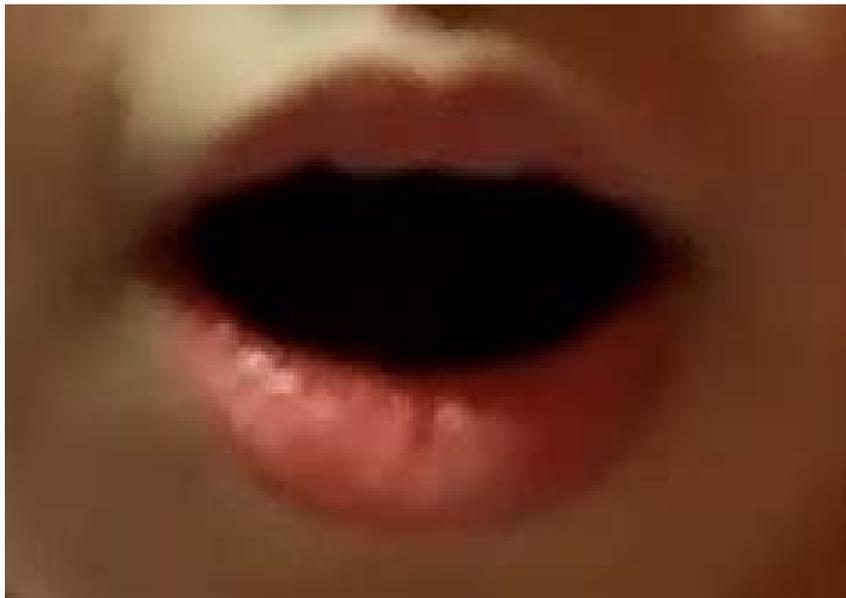


Figure 8: Maximal Distance of “thuở” (*once upon a time*) turn 1 by participant

G

After being extracted, the image files were labeled accordingly and then put through Adobe Photoshop, a software also by Adobe Systems, for measuring, with distance calculated in pixels.

Afterward, the collected statistics was processed in IBM SPSS Statistics 2015 by IBM Corporation to calculate the mean and standard deviation of the data.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Findings

In total, 650 snippets of video were measured and analyzed. The procured data is presented in the following table.

Minimal Pairs	LD		MDD	
	Mean	SD	Mean	SD
ba/boa	14.9%	0.32	20.0%	0.41
chân/chuẩn	29.6%	0.56	10.4%	0.35
danh/doanh	25.0%	0.73	10.0%	0.39
đản/đoản	19.1%	0.63	8.6%	0.62
hen/hoen	36.3%	0.50	7.3%	0.22
ký/quí	41.5%	0.47	9.7%	0.34
thờ/thuở	27.6%	0.35	14.5%	0.47
lạt/loạt	16.2%	0.30	8.1%	0.29
khê/khuê	25.3%	0.39	6.9%	0.26
nghiệt/nguyệt	32.1%	0.43	12.1%	0.57
ách/oách	17.6%	0.52	7.2%	0.33
sạn/soạn	21.2%	0.41	7.9%	0.41
tan/toan	25.6%	0.37	12.4%	0.44

Table 5 – Labialization Deviation and Maximal Distance Deviation Results

In general, syllables with medial phoneme have **higher labial deviation** compared to their minimal pairs with all the samples. The average LD is 25.54%, ranging from 14.9% to 36%, the lowest being *ba/boa* and the highest being *hen/hoen*. The least dispersive results are *ba/boa* (SD = 0.32), *thở/thủa* (SD = 0.35) and *tan/toan* (SD = 0.37). The most scattered results are *danh/doanh* (SD=0.73) and *đản/đoản* (SD=0.63).



Figure 9: Beginning of “ba” (*three/father*) turn 1 by participant E

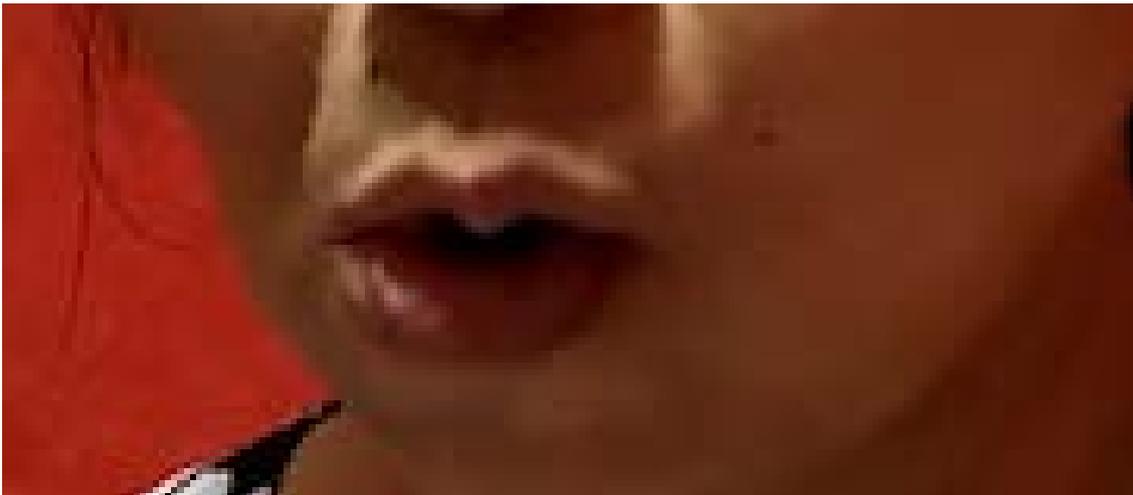


Figure 10: Beginning of “boa” (*tip*) turn 1 by participant E



Figure 11: Beginning of “danh” (*name/fame*) turn 2 by participant E

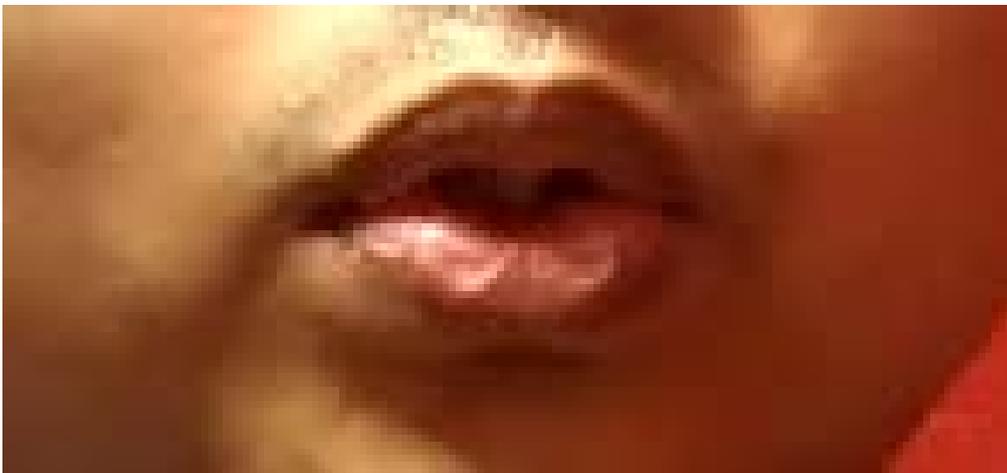


Figure 12: Beginning of “doanh” (*army barrack*) turn 2 by participant E

The **Maximum Distance Deviation** results all show an increase from non-medial-phoneme syllables to medial-phoneme syllables. On average, the labials at maximum distance is 10.4% more open in articulations with medial phoneme. The highest deviation is 20.0% with *ba/boa* and lowest is at 7.2% with *ách/oách*. The least spread result is *hen/hoen* (SD = 0.22) and the most dispersive is *đản/đoản* (SD = 0.62).



Figure 13: Maximal Distance of “ách” (*suffering*) turn 2 by participant K



Figure 14: Maximal Distance of “oách” (*dapper*) turn 2 by participant K

4.2 Discussion and implications

4.2.1 Labialized consonants

Acquired data suggests that the vermilion in syllables containing the medial phoneme is more exposed, confirming the that endolabial labialization occurs as soon as the articulation of those syllables starts. It is in line with observation that the initial consonant is labialized as put forward by Ngô (2001), Hoàng & Hoàng (1975), Cao (2006), Nguyễn (2006). /k/, /s/, /h/, /t/, /x/, /l/, /ŋ/, /c/, /t^h/, /ɲ/, /z/, /d/, /n/, /y/ and /v/, when labialized, will have two places of articulation, also called co-articulators, the original place of articulation and the endolabial. The labialization is more complex than the counterpart in the minimal pairs as it requires two articulators working simultaneously and have a higher strain on labial movement. /w/ will also have two places of articulation, labials and velar. However, labialized labial consonants /b/ and /m/ will have only one place of articulation – endolabial, more inward compared to their non labialized counterparts. All labialized consonants require protrusion of the lips compared to the non labialized ones.

4.2.2 Lowered vowel

Syllable <boa> containing the open vowel /a/ is on average 20% more open than <ba>, the highest observed. It is an anomaly because /a/ is already an open vowel which would suggest the opening would not be much wider. It can be theorized that in <ba>, due to the labial consonant /b/, the starting position of the syllable is with both lips pressed together which reduces the opening of the syllable. On the other hand, <boa> starts with the lips already curving forward, which might have been the reason why it is more open.

While <đản>/<đoản> and <ba>/<boa> both include the open front unrounded vowel /a/, the former is less open (8.6%) than the other (20%). Similarly, <chuân> /<chủn> and <thuở>/<thở> both contain close-mid back unrounded vowel /ɤ/ or its short

form /ʃ/, the former is less open (10.4%) than the later (14.5%). It can be argued that ending with a vowel allow the syllable to be opened further. Possible explanation is that <chuân> /<chân>, <đản>/<đoản> end with a non-aspirated consonants /n/ or a “closed” coda. Đoàn (1977) viewed that all the final consonants excluding /w/, /j/ in Vietnamese syllables were closed consonants (*âm đóng*) which is concurred with by Mai & Hoàng & Vũ (2002), Võ (2009), Bình (2002). Furthermore, Đoàn (1977) thought that there were 2 allophones, short form and long form, of the final consonants excluding /w/, /j/. According to his rule, consonants after /ɾ/ and /a/ in this case would be the short form, less articulated and even more closed than long form. Nguyễn (2006) thought differently from others, calling syllables ending with nasal – sonorant consonants /n, m, ɲ, ŋ/ only semi-closed because the air still escaped through the nasal cavity due to the lowered velum. Nevertheless, they all agreed that the air tract through the mouth is closed with final consonant /n/ and not aspirated through the mouth, which would suggest ending the syllable quicker, preventing the mouth from opening further.

It can also be concluded that the syllables containing the medial phoneme require wider opening for the vowel based on higher maximal labial distance. Therefore, it is more taxing for the jaw muscles, although not by much with the openness only 10.4% higher on average.

4.2.3 Clinical implications

There are several possible etyologies that can particularly differentiate articulation of the minimal pairs. The first is muscle weakness caused by cranial nerve impairment, possible through stroke or other neurodegenerative diseases. Muscles of interest include **orbicularis oris muscle** (for lip protrusion), **jaw muscles** (for mouth opening), **tongue muscles** (for tongue movement), and **glottis muscles** (for articulation). According to Benesty (2017), protrusion is initiated by the contraction of peripheral bundles (near the outer edges) of the orbicularis oris muscle which makes up area around

the vermillion (Benesty, 2017). The orbicularis oris muscle is a quadrant of four independent but interlaced muscle groups controlled by the buccal branch of the **cranial nerve VII** (facial nerve) (Saladin, 2011). On the other hand, the places of articulation of /k/, /s/, /t/, /x/, /l/, /ŋ/, /c/, /ɲ/, /z/, /d/, /tʰ/, /n/, /y/ and are positioned by movement of the tongue. The tongue is controlled by **cranial nerve XII** (hypoglossal nerve) (Benesty, 2017). Glottal /h/ requires glottis muscles controlled by **cranial nerve X** (vagus nerve) (Benesty, 2017). Additionally, activation of the vocal folder is controlled by **cranial nerve X** and the opening of the jaw is controlled by **cranial nerve V** (Benesty, 2017) but these two muscle movements are required in all syllable articulation which is not useful in finding disctintons. Therefore, the knowledge would be particularly useful in identifying, confirming damage to the **cranial nerve VII** as well as predicting its effects on speech using medial/non-medial minimal pairs such as below.

Syllable	Damage to:	
	cranial nerve VII (facial nerve)	cranial nerve XII (hypoglossal nerve)
ha /h̩a1/ (<i>exclamation sound</i>)	Not affected	Not affected
hoa /h̩w̩a1/ (<i>flower</i>)	Affected	Not affected
ca /k̩a1/ (<i>cup</i>)	Not affected	Affected
qua /k̩w̩a1/ (<i>come over</i>)	Affected	Affected

Table 6: Using medial/non-medial minimal pairs in evaluating cranial nerve VII

<ha>/<hoa> which hardly require any movement of tongue would be particularly suitable in diagnosing cranial nerve VII in the present of damaged cranial nerve XII.

Other conditions that can affect the medial phoneme syllables are impaired motor planning (dyspraxia) and motor coordination, movement timing (which are some aspects of dysarthria) which can manifest in both adult (The Royal College of Physicians, 2012) and pediatric (Surveillance of Cerebral Palsy in Europe, 2000; Access Economics, 2008) patients. Due to the syllables having multiple places of articulation, it can be theorized that these groups of clients will have more difficulties articulating syllables containing the medial phonemes.

With regard to the openness of the lowered vowel, <boa> would be noted as some of the highest requirement of jaw opening which can be utilized in assessment and a target for higher level of rehabilitation.

In conclusion, speech/language assessments could be adapted differently for Vietnamese patients. Minimal pairs with/without the medial phoneme can be used to diagnose cranial nerve VII. In the phonology parts of assessments, words that include medial phoneme could be placed higher in the difficulty hierarchy to test the patients. The same can also be done with treatment protocols. Treatment plans employing difficulty-stepup progression system should consider bringing syllables containing the medial phoneme higher in the difficulty levels.

CHAPTER 5: CONCLUSION

5.1 Significance of the study

This research paper contributes to the existing body of knowledge about phonology of the Vietnamese language, specifically the articulation mechanism of the medial phoneme. A new model of the Vietnamese syllable was propose to accommodate the medial phoneme with the labialization of the initial consonant and the lowering of the vowel, aspects that was not made clear in previous literature. The acquired data suggests that labialized /k/, /s/, /h/, /t/, /x/, /l/, /ŋ/, /c/, /t^h/, /ɲ/, /z/, /d/, /n/, /ɣ/ and /v/ have coarticulation with protrusion of the lip and the original place of articulation happening simulatously at the beginning of the syllable while labialized /b/ and /m/ move the place of articulation inward to the endolabial. The vowels are 10.4% lower on average compared to those in syllables not having the medial phoneme. This will in turn help speech therapists understand exactly how the mussels move differently at the present of the medial phoneme. In turn, it provides the health care professionals with better phonology foundation to provide more accurate diagnosis and assessment, and subsequently, better management of different medical conditions concerning verbal production.

5.2 Limitation and suggestions for future studies

Due to limited time and resources, several shortcomings can be improved for the research.

There are no participants from the South or Central of Vietnam joining the research. Thus, future studies can incorporate people of a different dialect or multiple dialects of Vietnamese to replicate and validate the study.

The results of the study stop short at theorizing clinical implications. If the study could be replicated with speech therapy patients as population, it would be more

meaningful to test the level of sensitivity and specificity of using medial/non-medial minimal pairs in assessing patients.

The research has only showed how the labials move during the articulation of the medial phoneme. Future studies that can make use of fluroscopy imaging, which can provide an x-ray video of the body from the side during the articulation, will expand the understanding of inner articulators.

Finally, the acoustics differences between the minimal pairs such as formant measurement with and without the medial phoneme can also be analyzed. This approach can be done using praat or other softwares.

REFERENCE LIST

- Access Economics. (2008). *The economic impact of cerebral palsy in Australia in 2007*. Retrieved November 14, 2016, from <https://www.deloitteaccesseconomics.com.au/uploads/File/The%20economic%20impact%20of%20cerebral%20palsy%20in%20Australia%20in%202007.pdf>
- American Speech–Language–Hearing Association. (2016). *Dysarthria*. Retrieved November 13, 2016, from <http://www.asha.org/public/speech/disorders/dysarthria/>
- Autism Fact Sheet. (n.d.). Retrieved November 13, 2016, from <http://nationalautismassociation.org/resources/autism-fact-sheet/>
- Benesty, J.S. (2017). *Handbook Of Speech Processing* (1st ed.). Verlag Berlin An: Springer.
- Cao, X.H. (2006). *Âm vị học và tuyển tính-suy nghĩ về các định đề của âm vị học đương đại*. Ha Noi: Social Science Publishing house.
- Davenport, M., & Hannahs, S. J. (1998). *Introducing phonetics and phonology*. London: Arnold.
- Đoàn, T. T. (1977). *Ngữ âm tiếng Việt*. Ha Noi: Vietnam National University Press.
- Hayes, B. (2009). *Introductory phonology*. Malden, MA: Wiley-Blackwell.
- Hoàng, C. C. (1986). *Điều tính và phi điều tính trong thanh điệu tiếng Việt*. Ha Noi: Vietnam Institute of Linguistics.
- Hoàng, P. (2016). *Từ điển tiếng Việt*. Viện ngôn ngữ học.
- Hoàng, T. & Hoàng, M. (1975). *Vietnamese Studies*. Issues No. 40.
- International Phonetic Association. (2015). *International Phonetic Alphabet*.
- Mai, C. N., Hoàng, P. T., & Vũ, N. Đ. (2002). *Cơ sở ngôn ngữ học và tiếng Việt*. Ha Noi: Vietnam Education Publishing House.
- Nam, P. (2016, April 2). Cảnh báo gia tăng trẻ mắc hội chứng tự kỷ. Retrieved November 14, 2016, from <http://suckhoe.vnexpress.net/tin-tuc/suc-khoe/canh-bao-gia-tang-tre-mac-hoi-chung-tu-ky-3379959.html>
- Ngô, B. N. (2001). The Vietnamese Language Learning Framework. Part One: Linguistics. *Journal of Southeast Language Teaching 10*: 1-23.
- Nguyễn, V. P. (2006). *Ngữ âm tiếng Việt thực hành*. Ha Noi: Vietnam National University Press.

- Nguyễn, Q. H. (1994). *Âm tiết và loại hình ngôn ngữ*. Ha Noi: Social Science Publishing House.
- Nguyễn, V.H., Văn, N.C., Hoàng, M.N. (2004). *Các tiếng chứa âm đệm trong tiếng Việt - Nguồn gốc và hướng giải quyết*. University of Social Sciences and Humanities, Vietnam National University Hanoi.
- Pham, B., & Mcleod, S. (2016). Consonants, vowels and tones across Vietnamese dialects. *International Journal of Speech-Language Pathology*, 18(2), 122-134. doi:10.3109/17549507.2015.1101162
- Royal College of Physicians (2012). Guideline for Stroke 2012. Retrieved from <https://www.strokeaudit.org/Guideline/Historical-Guideline/National-Clinical-Guidelines-for-Stroke-fourth-edi.aspx>
- Saladin, K. (2011). *Anatomy & Physiology: The Unity of Form and Function* (ed 6). McGraw-Hill.
- Styler, W. (2014). *Using Praat for linguistic research*. Version 1.4.5.. Retrieved from: <http://savethevowels.org/praat>
- Surveillance of Cerebral Palsy in Europe. (2000). Surveillance of cerebral palsy in Europe: A collaboration of cerebral palsy surveys and registers. *Dev Med Child Neurol Developmental Medicine and Child Neurology*, 42(12), 816. doi:10.1017/s0012162200001511
- Tang, G. & Barlow, J. (2006). Characteristics of sound systems of monolingual Vietnamese-speaking children with phonological impairment. *Clinical Linguistics & Phonetics*, 20(6), 423-445.
- Thu P. (2012, September 27). Trẻ bị bại não cần được phục hồi chức năng sớm. Retrieved November 14, 2016, from <http://www.vietnamplus.vn/tre-bi-bai-nao-can-duoc-phuc-hoi-chuc-nang-som/164622.vnp>
- Trask, R. L. (1996). *A dictionary of phonetics and phonology*. Routledge: London & New York.
- Vân, A. (2015). Đột quy: Những con số ám ảnh ở Việt Nam. Retrieved November 14, 2016, from <http://vietnamnet.vn/vn/doi-song/dot-quy-nhung-con-so-am-anh-o-viet-nam-232841.html>
- Võ, H. X. (2009). *Giáo trình ngữ âm tiếng Việt hiện đại*. Quy Nhơn: Quy Nhơn University.

APPENDIX A: Syllables containing the medial phoneme and their minimal pairs

No	Syllables containing medial phoneme	Meaning	Corresponding minimal pair	Meaning
1	boa	tip money	ba	father, three
2	choa	I, we	cha	father
3	choá	blinding light	x	
4	choạc	to open wide legs	chạc	fork
5	choai	not too old but not too young	chai	bottle
6	choài	reach toward	chài	fishing
7	choãi	to stand astride	x	
8	choái	a stick for plants to grow	chái	small room
9	choại	slipping	x	
10	choác	no meaning	x	
11	choán	take place	chán	bored of
12	choang	sound of metal clashing	chang	harsh sunny
13	choàng	cover over	chàng	that guy
14	choảng	combat	x	
15	choáng	dazed	x	
16	choạng	to open wide legs	x	
17	choắt	small children	chắt	great-grandchild
18	choe	no meaning	x	
19	choé	bright color	x	
20	choẹ	show off	x	
21	choen	no meaning	x	
22	choèn	no meaning	x	
23	chuân	correct	chẫu	help poor people
24	chuech	no meaning	x	
25	chueh	no meaning	x	
26	chuyeh	no meaning	x	
27	chuy	club	x	
28	chuyên	focus on one area	x	
29	chuyền	pass by	x	
30	chuyên	transfer	x	
31	chuyén	trip	x	
32	chuyệ	story	x	
33	doa	widen the drill hole	Da	skin
34	doá	angry	x	
35	doạ	scare off	Dạ	night
36	doãi	stretch arm or leg	Dãi	drool
37	doãng	loose	x	

38	doạng	widen the legs	dạng	form
39	doanh	army barrack	danh	fame, name
40	doành	natural water	dành	save up
41	duềnh	natural water	dềnh	rising water
42	duy	limited to	x	
43	duyên	red string	x	
44	duyệt	approve	x	
45	đoá	angry	đá	rock
46	đoạ	get into bad situation	x	
47	đoác	đoác tree	x	
48	đoài	a pattern in bagua	đài	a piece of machine
49	đoái	look back	đái	pee
50	đoan	custom of the France	đan	knit
51	đoàn	a group	đàn	a musical instrument
52	đoản	short	đản	egg
53	đoán	guess	x	
54	đoạn	break	đạn	bullet
55	đoảng	forgetful	đảng	party
56	đoạt	rob	đạt	achieve, get
57	goá	widow	x	
58	hoa	flower	ha	exclamation sound
59	hoà	peaceful	hà	river
60	hoả	fire	hả	what?
61	hoá	change into	há	exclamation sound
62	hoạ	disaster	hạ	summer
63	hoác	open wide	x	
64	hoạch	no meaning	x	
65	hoại	feces that can be used to nurture plants	hai	two
66	hoài	always	hài	comedy
67	hoại	decay	hại	harm
68	hoan	no meaning	x	
69	hoàn	return	hàn	weld
70	hoãn	delay	x	
71	hoán	no meaning	x	
72	hoạn	castrate	hạn	bad luck
73	hoang	wild	hang	cave
74	hoàng	gold	hàng	line
75	hoảng	scared	x	
76	hoãng	Muntjac	hãng	a firm
77	hoáng	scared	háng	
78	hoành	lateral	hành	onion
79	hoạch	no meaning	x	
80	hoạt	living	hạt	nuts

81	hoay	no meaning	x	
82	hoáy	no meaning	x	
83	hoác	no meaning	x	
84	hoặ	or	x	
85	hoắm	deep	x	
86	hoản	no meaning	x	
87	hoẵng	Muntjac	x	
88	hoe	light red or yellow	he	quiet
89	hoè	a type of tree	hè	summer
90	hoẹ	no meaning	x	
91	hoen	rusty	hen	asthma
92	hoẻn	no meaning	x	
93	huân	no meaning	x	
94	huần	no meaning	x	
95	huê	no meaning	x	
96	huề	break even	x	
97	huệ	a type of flower	hệ	classification
98	huếch	no meaning	x	
99	huênh	no meaning	x	
10	huơ	flashing an object in hand	hơ	dry something over
10	huy	no meaning	x	
10	huỷ	destroy	hỷ	wedding
10	huỷ	something forbidden	x	
10	huỷch	nudge	hích	nudge
10	huych	no meaning	x	
10	huyên	no meaning	x	
10	huyề	mystery	x	
10	huyễn	mysterious	x	
10	huyệ	district	x	
11	huyét	blood	hết	over
11	huyệt	Acupuncture point	hết	exactly
11	huynh	big brother	x	
11	huỳnh	fluorescent	hình	picture
11	huýt	whistle	hít	sniff
11	khoa	falcuty	x	
5				
11	khoả	use the feet to stir up the	x	
11	khoá	lock	khá	decent
11	khoác	carry over	khác	different
11	khoai	potato	khai	stink of pee
12	khoái	plesant	x	
12	khoan	wait	khan	dry
12	khoản	an amount of money	x	

12	khoán	work package agreement	khán	watching
12	khoang	cabin	x	
12	khoảng	estimate	x	
12	khoáng	no meaning	x	
12	khoanh	set the boudary of	x	
12	khoảnh	a piece of land	x	
12	khoát	hand-length	khát	thirsty
13	khoáy	dig deep into	x	
13	khoãm	no meaning	x	
13	khoãm	crooked chin	x	
13	khoãm	old	x	
13	khoản	no meaning	x	
13	khoảng	get the rest of something	x	
13 6	khoắt	no meaning	x	
13	khoe	show off	khe	valley
13	khỏe	healthy	x	
13	khỏe	near the end of the eyes	x	
14	khoen	a hole	khen	commend
14	khoeo	ham (body part)	kheo	thin
14 2	khoèo	use hand or leg to pull something over	x	
14	khoét	get a piece of	x	
14	khuân	carry over	x	
14	khuẩn	microorganisms	x	
14	khuất	out of sight	khất	pay back at another
14	khuây	no meaning	x	
14	khuáy	stir a cup of liquid	x	
14	khuê	no meaning	x	
15	khuếch	no meaning	x	
15	khuơ	no meaning	x	
15	khuy	button	x	
15 3	khụy	get down on the knees	x	
15	khuya	night	x	
15	khuyên	advise	khiên	shield
15 6	khuyển	dog	x	
15	khuyến	no meaning	x	
15	khuyết	lack of	x	
15	khuynh	no meaning	x	
16	khuỷnh	lower down the body	x	

16 1	khuỷnh	no meaning	x	
16	khuỷp	no meaning	x	
16	khuỷu	no meaning	x	
16	khuyu	no meaning	x	
16	loa	speaker	la	scream
16	loà	blinding light	là	to be
16	loã	bleeding	lã	thin water
16	loả	no meaning	x	
16	loá	blind eyes	lá	leaf
17	loạc	no meaning	x	
17	loài	species	x	
17	loại	type of	lại	again
17	loan	a type of bird	lan	spread
17	loàn	disorder	làn	hand bag
17	loạn	disorder	lạn	poor condition
17	loang	spread	lang	wolf
17	loàng	no meaning	x	
17	loãng	thin	lãng	bouquet
17	loảng	no meaning	x	
18	loáng	shiny	láng	glossy
18	loạng	no meaning	x	
18 2	loanh	no meaning	x	
18	loạt	a series of	lạt	bamboo string
18	loay	no meaning	x	
18	loãn	no meaning	x	
18	loãng	no meaning	x	
18	loảng	no meaning	x	
18	loắt	no meaning	x	
18	loe	flaring	le	to loll the tongue
19	loè	to bluff	x	
19	loé	dazzled	lé	dazzled
19	loét	gaping	x	
19	loệt	no meaning	x	
19	luân	no meaning	x	
19	luản	no meaning	x	
19 6	luẩn	no meaning	x	
19	luận	a thesis	lận	even
19	luật	law	lật	flip pages
19 9	lũy	barrier	x	

20	luy	get somebody involved	x	
20	luych	no meaning	x	
20	luyên	no meaning	x	
20	luyén	love	x	
20	luyên	practice	x	
20	luyñh	no meaning	x	
20	moay	no meaning	x	
20	noãn	egg	x	
20	nuy	nude	x	
20	ngoa	Lying	Nga	Russia
21	ngoã	no meaning	x	
21	ngoác	open wide	x	
21	ngoạc	open wide	x	
21	ngoai	no meaning	x	
21	ngoài	outside	ngài	mister
21	ngoải	no meaning	x	
21	ngoái	look back	x	
21	ngoại	grandpa/ma	ngại	apprehensive of
21	ngoạm	a big bite	x	
21	ngoan	obedience	ngan	goose
22	ngoãn	no meaning	x	
22	ngoạn	no meaning	x	
22	ngoảnh	look back	x	
22	ngoao	cat's sound	ngao	oyster
22	ngoáo	no meaning	x	
22 5	ngoáp	gape for air	ngáp	yawn
22	ngoay	no meaning	x	
22	ngoáy	no meaning	x	
22	ngoáy	dribble	ngáy	snore
22	ngoạỵ	no meaning	x	
23	ngoác	tie two fingers together	ngắc	get stuck
23	ngoạc	hook	x	
23	ngoần	no meaning	x	
23	ngoắt	sudden	ngắt	turn off
23	ngoặt	sudden turn	ngắt	strict
23	ngoèò	no meaning	x	
23	ngoéo	no meaning	x	
23	ngoẹo	no meaning	x	
23	nguy	no meaning	x	
23	nguy	no meaning	x	
24	nguy	no meaning	x	
24	ngúech	no meaning	x	
24 2	ngùech	no meaning	x	

24	nguy	danger	nghi	doubt
24	ngụy	fake	x	
24	nguyên	preserved	nghiên	study
24	nguyên	curse	nghiền	really like
24	nguyện	willing	nghiện	addicted to
24	nguyệt	moon	nghiệt	bad karma
24	nguyt	look of disapproval	x	
25	nhoà	blurry	nhà	house
25	nhoai	lean forward with difficulty	nhai	chew
1				
25	nhoài	lean horizontally	nhài	jasmine
25	nhoàng	no meaning	x	
25	nhoáng	a short amount of time	x	
25	nhoay	no meaning	x	
25	nhoáy	fast	nháy	flash
25	nhoe	no meaning	x	
25	nhòe	blurry (ink)	nhè	spit out
25	nhoen	no meaning	x	
26	nhoèn	more than enough	x	
26	nhoẻn	pleasant smile	x	
26	nhoét	not very solid/ooze	nhét	put into
26	nhoẹt	not very solid/ ooze	x	
26	nhuần	deep	x	
26	nhuận	deep	nhận	receive
26	nhuệ	no meaning	x	
26	nhụy	pistils	nhị	two
7				
26	nhuyễn	soft	x	
26	oa	no meaning	x	
27	oà	no meaning	à	ah
27	oách	dapper	ách	mute
27	oạch	sound of falling to the ground	x	
2				
27	oai	grand	ai	who
27	oài	no meaning	x	
27	oải	tired	ải	short
27	oái	sound of hurt	ái	love
27	oại	no meaning	x	
27	oan	unjustly	an	peaceful
27	oản	truncated cone of sticky	x	
28	oán	to resent	án	sentence, verdict
28	oang	loud noise	ang	container
28	oanh	orion	anh	older brother
28	oành	no meaning	x	

28	oạch	no meaning	x	
28 5	oát	no meaning	x	
28	oãm	no meaning	x	
28	oản	to be bended	x	
28	oắt	kid	ắt	definitely
28	oặt	to be bended	x	
29	oe	sound of infants crying	x	
29	ỏe	to be bended	x	
29	oẹ	vomit	ẹ	ew
29	qua	come over	ca	cup
29	quà	gift	cà	to rub
29	quả	fruit	cả	the oldest child
29	quá	too much	cá	fish
29	quạ	crow	ạ	to rub
29	quác	sound of duck	các	multiple
29	quạc	no meaning	x	
30	quách	sarcophagus	cách	way
30	quạch	deep color	ạch	stop doing
30	quai	handle	cai	stop doing
30	quài	reach out	cài	install
30 4	quải	drop things on the ground	cải	convert
30	quái	monster	cái	the thing
30	quại	hit very hard	x	
30	quan	official	can	can
30	quàn	buried temporarily	càn	search and destroy
30	quản	control	cản	stop
31	quán	store	cán	handle
31	quang	light	cang	x
31	quàng	wide	càng	more
31	quảng	no meaning	x	
31	quãng	distance	x	
31	quáng	difficulty seeing	cáng	stretch
31	quanh	around	canh	soup
31	quánh	ooze	cánh	wings
31	quạnh	dry	cạnh	nearby
31	quào	no meaning	cào	scratch
32	quát	scream	cát	sand
32	quạt	fan	x	
32	quàu	no meaning	x	
32	quạu	no meaning	x	
32	quay	rotate	cay	spicy
32	quày	no meaning	cày	plough

32 6	quạ̉y	carry	cạ̉y	a type of plant
32	quạ̣y	no meaning	cạ̣y	pry open
32	quặ́c	bright	cặ́c	coin
32	quặ̣c	to retort back	cặ̣c	penis
33	quặ́m	no meaning	x	
33	quặ́m	no meaning	x	
33	quặ́m	knife with a curve	cặ́m	put it
33	quặ́m	curve downward	x	
33	quặ́n	curly	cặ́n	root
33	quặ́n	to bend, to curve	x	
33	quặ́n	in a hurry	cặ́n	bite
33	quặ̣n	hurt	cặ̣n	sediment
33	quặ́ng	throw	cặ́ng	tight
33	quặ́ng	throw	cặ́ng	leg
34 0	quặ́ng	ore	x	
34	quặ́p	to grasp	cặ́p	to grasp
34	quặ́p	to grasp	cặ́p	bag
34	quặ́t	dry	cặ́t	cut
34	quặ́t	bend backward	x	
34	quặ́c	no meaning	x	
34	quặ́n	soldier	cặ́n	scale
34	quặ́n	pants	cặ́n	need
34	quặ́n	despair	x	
34	quặ́n	despair	x	
35	quặ́n	tie around	cặ́n	not fit
35	quặ́n	district	cặ́n	Short-sighted
35 2	quặ́ng	halo	x	
35	quặ́ng	impulsive act	x	
35	quặ́t	kumquat	cặ́t	to put up
35	quặ́t	to dig up	cặ́t	kidney
35	quặ́y	gather around	cặ́y	tree
35	quặ́y	desk	cặ́y	plough
35	quặ́y	a type of fried food	x	
35	quặ́y	waggle	x	
36	quặ́y	disturb	cặ́y	implant
36	quặ́y	no meaning	x	
36	quề	stick	x	
36	quề	broken leg	x	
36	quề	no meaning	x	
36	quề	lots	kề	draw a line

36 6	quen	know each other	x	
36	quèn	puny	x	
36	queo	bent	x	
36	quèo	trip up	kèo	bugle
37	quẹo	to turn	keo	candy
37	quéo	bend	kéo	scissors
37	quét	scan	x	
37	quẹt	swipe	ket	stuck
37	quê	hometown	kê	chicken
37	quế	cinnamon	x	
37	quêch	no meaning	x	
37	quên	forget	x	
37	quện	mix together	x	
37	quênh	no meaning	x	
38	quét	no meaning	két	ending
38	quệt	stick a liquid to	x	
38	quêu	no meaning	x	
38	qui/quy	turtle	ki	stingy
38	quì/quỳ	kneel	kì	rub
38	quĩ/quỹ	budget	kĩ	careful
38	quỉ/quỷ	devil	x	
38	quí/quý	valuable	kí	sign
38	quị/quỵ	no meaning	kị	avoid
38	quít/quýt	mandarin orange	x	
39	quịt/quyít	stop paying back	x	
39	quọ	no meaning	x	
39	quơ	throw hands in the air	x	
39 3	quờ	touch something without looking	x	
39	quở	scold	x	
39	quớ	clumsy	x	
39	quých	panic	kích	boost
39	quyên	raise fund	kiên	persistent
39	quyền	fist	x	
39	quyển	volume	x	
40	quyén	silk paper	kiến	meet
40	quyện	mix together	kiện	to sue
40	quyết	decide	kiết	stingy
40	quyệt	deceitful,	kiệt	run out of
40	quỳnh	red stone	kình	whale
40	quýnh	simpleton.	x	
40	quýnh	very happy	kính	glasses
40	quyp	to lower	kịp	in time
40	quýu	no meaning	x	

40	soái	no meaning	x	
41	soàn	no meaning	x	
41 1	soán	no meaning	x	
41	soạn	to prepare	sạn	imperfect
41	soát	recheck	sát	close
41	soạt	sound of paper flipping	sạt	no meaning
41	suất	handsome	x	
41	suy	degenerate	sỉ	deeply in love
41	suý	incite	x	
41	suyễn	asthma	x	
41	suyễn	no meaning	x	
42	suýt	almost	xít	Porphyrio porphyrio
42	suyt	be quiet	xịt	spray
42	thoa	apply on skin	tha	pardon
42	thoả	reasonable	thả	release
42	thoá	no meaning	x	
42	thoai	no meaning	x	
42	thoải	slope	thải	waste
42	thoái	degenerate	thái	chop
42	thoại	speaking	x	
42	thoán	no meaning	x	
43	thoang	no meaning	x	
43	thoảng	slight	x	
43	thoáng	slight	tháng	month
43	thoát	escape	x	
43	thoạt	no meaning	x	
43	thoãn	no meaning	x	
43 6	thoảng	no meaning	x	
43	thoắt	very fast	thắt	tighten
43	thuần	pure	thần	god
43	thuần	shield	x	
44	thuận	easy	thận	kidney
44	thuật	skill	thật	true
44	thuê	rent	thê	wife
44	thuế	tax	thế	so, therefore
44	thử	once a time	thở	breath
44	thùy	lobe	thì	then
44	thủy	water	x	
44	thúy	no meaning	x	
44	thụy	sleep	thị	woman
44	thuyên	saying	thiên	sky
45	thuyền	boat	thiền	meditate
45	thuyết	convince	thiết	steel

45	toa	carriage	ta	myself
45	toà	building	tà	
45	toả	block	tả	describe
45 5	toá	no meaning	tá	a dozen
45	toạ	sit	tạ	a kilo
45	toác	rip	tác	age
45	toạc	rip	tạc	carve
45	toài	no meaning	x	
46	toái	no meaning	x	
46	toại	no moving	tại	situated in
46	toan	acidic	tan	dissolve
46	toàn	all	tàn	broken
46	toán	calculate	tán	to pulverize
46	toang	wide open	tang	funeral
46	toàng	no meaning	x	
46	toáng	no meaning	táng	burry
46	toát	resemble	tát	slap
46	toáy	no meaning	x	
47	toe	smile	x	
47	toè	smashed	x	
47	toẽ	no meaning	x	
47	toẻ	no meaning	x	
47	toé	splashing	té	fall down
47	toen	no meaning	x	
47	toèn	no meaning	x	
47	toét	smile	x	
47	toẹt	direct	x	
47	truân	no meaning	x	
48 0	truất	depose	chất	substance
48	truy	hunt	tri	know
48	trụy	no meaning	x	
48	truyền	relay a message	triền	slope (of mountain)
48	truyện	a book/story	triện	triện
48	tuân	follow order	tân	new
48	tuần	week	x	
48	tuần	no meaning	x	
48	tuần	no meaning	x	
48	tuất	dog	tất	socks
49	tuế	no meaning	x	
49	tuệ	no meaning	x	
49	tuếch	no meaning	x	
49	tuệch	no meaning	x	
49	tuênh	no meaning	x	

49	tuy	although	ti	nipple
49	tuỳ	follow	tì	to press against
49	tuỷ	bone marrow	tỉ	billion
49	tuý	drunk	tí	arm
8				
49	tuy	pancreas	tị	avoid
50	tuyên	announce	tiên	fairy
50	tuyền	river	tiền	money
50	tuyển	employ	x	
50	tuyến	gland	tiến	move forward
50	tuyết	snow	tiết	period
50	tuyệt	great	tiệt	extinct, clean
50	tuyn	no meaning	x	
50	tuýp	tube	x	
50	tuýt	no meaning	x	
50	uân	no meaning	x	
51	uất	angry	ất	the second circle of
51	uê	no meaning	x	
51	uế	dirty	ế	unsold; unmarried
51	uy	supremacy	y	medicine
51	uỷ	authorized	ỷ	chair
51	uý	no meaning	í	wait
51	uych	hitting	x	
51	uyên	no meaning	yên	quiet
51	uyễn	no meaning	x	
51	uỳnh	no meaning	x	
9				
52	voan	veil	van	van
52	xoa	spread on skin	xa	far
52	xoà	to spread out	sà	throw oneself into
52	xoã	relax	x	
52	xoả	no meaning	x	
52	xoá	delete	xá	forgive
52	xoác	hug	xác	body
52	xoạc	spread legs wide apart	sạc	charge
52	xoạch	no meaning	x	
52	xoai	no meaning	sai	wrong
53	xoài	mango	xài	use
53	xoải	stretch arms	sải	spread of arms
53	xoan	China-tree	san	flatten
53	xoàn	diamond	sàn	floor
53	xoang	chamber	sang	across
53	xoàng	mediocre	sàng	bed, to sieve
53	xoảng	no meaning	x	
53	xoạng	to spread wide apart	x	

53	xoành	no meaning	x	
53	xoát	no meaning	x	
54	xoay	rotate	xay	grind
54	xoáy	whirl	x	
54 2	xoăn	curly	săn	hunt
54	xoắn	shortened, very small	x	
54	xoắn	twist	sắn	cassava
54	xoe	round	xe	car
54	xoè	fluff	x	
54	xoen	no meaning	x	
54	xoèn	no meaning	x	
54	xoét	consider	xét	consider
55	xoẹt	in a flash	xẹt	in a flash
55	xuân	spring	sân	yard
55	xuẩn	stupid	x	
55	xuất	export	sất	at all
55	xuê	good, nice	x	
55	xuè	no meaning	x	
55	xuê	be capable of	xê	to rent
55	xuêch	no meaning	x	
55	xuyềnh	no meaning	x	
55	xuỳ	to cough up	xì	
56	xuý	no meaning	x	
56	xuya	reliable	x	
56 2	xuyên	pierce through	xiên	slanting
56	xuyén	bracelet	x	
56	xuýt	almost	x	
56	xuyt	be quiet	xịt	deflated

APPENDIX B: CONSENT FORM FOR ALL PARTICIPANTS

ĐƠN CHẤP THUẬN THAM GIA NGHIÊN CỨU

Người làm đơn đang trả lời đơn chấp thuận tham gia vào nghiên cứu: “Định lượng cơ chế cấu âm âm đệm tiếng Việt” của tác giả Ngô Đức Nhật, phục vụ làm đề tài khóa luận cho trường Đại học Ngoại Ngữ - Đại học Quốc gia Hà Nội.

Tôi hiểu rằng việc tham gia nghiên cứu này là hoàn toàn tự nguyện.

Tôi hiểu rằng mình sẽ được quay phim và ghi âm trong khoảng 15 phút vào ngày_____.

Tôi đã được giải thích rằng tất cả tư liệu của tôi sẽ chỉ được dùng cho nghiên cứu ngữ âm học nói trên.

Tôi đã được giải thích rằng tất cả tư liệu của tôi sẽ được bảo vệ để bảo đảm quyền riêng tư cho tôi.

Tôi đã đọc kỹ tài liệu này, đã được trả lời các thắc mắc (nếu có), đã hiểu rõ nội dung tài liệu này, và chấp nhận tham gia nghiên cứu này.

Chữ ký

Ngày _____ Tháng _____ Năm _____

APPENDIX C: CONSENT FORM (TRANSLATED FROM VIETNAMESE)

RESEARCH CONSENT FORM

You are filling a form to give consent to participating in a research called “Quantifying the Articulation Mechanism of the Medial Phoneme” by author Ngô Đức Nhật as his thesis paper for the University of Languages and International Studies, Vietnam National University, Hanoi.

I understand that participating in this research is completely voluntary.

I understand that I will be videotaped for about 15 minutes on the date _____.

I have been explained that all my recorded material will only be used for the aforementioned phonology research.

I have been explained that all my recorded material will be protected in accordance to my right to privacy.

I have read this form, and all my questions (if any) have been answered. I hereby give my consent to participating in this research.

Participant Signature

Date: _____