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Vietnamese Vowels Produced by Australian Vietnamese Speakers

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Abstract: This paper reported a study that acoustically examined the vowel features of Vietnamese language used by the Vietnamese community in Australia. Vowels produced by older (n=10) and younger (n=10) Vietnamese Australians residing in Brisbane, Australia, were acoustically examined and compared with those produced by corresponding older (n=10) and younger (n=10) Vietnamese residing in Ho Chi Minh/Can Tho City, Vietnam. The results showed that *(i)* almost all vowel tokens produced by the four groups of speakers were acoustically significantly different in vowel space; *(ii)* the Younger Vietnamese Australian residents' tokens of vowels which look similar in conventional Vietnamese orthography tended to cluster with each other; *(iii)* the vowel productions of the Younger Vietnamese residents in Australia tended to occupy higher and/or more front regions than those of the Younger Vietnamese residents in Vietnamese group in terms of the acoustic vowel space; and *(iv)* the vowel tokens produced by the Older Vietnamese residents in Australia and Older Vietnamese residents in Vietnam groups occupied different regions in the acoustic vowel space.

Keywords: Vietnamese, Immigrant Language, Phonetics, Language Contact, Language Ship

1. Introduction

This paper reported a study that acoustically examined the vowel features of Vietnamese language used by the Vietnamese community in Australia, a language that the Vietnamese migrants brought with them to Australia and which has been deeply influenced by English, through close contact with English, for more than 30 years. Vowels produced by older (n=10) and younger (n=10) Vietnamese Australians residing in Brisbane, Australia, were acoustically examined and compared with those produced by corresponding older (n=10) and younger (n=10) Vietnamese residing in Ho Chi Minh/Can Tho City, Vietnam.

1.1. Research into Vietnamese Language Overseas

Vietnamese nationals have become significant immigrants abroad since the mid-1970s. According to the State Committee of Vietnamese in foreign countries, there are currently about 4 million Vietnamese nationals who are living, working and studying in over 100 countries and territories; the largest number of Vietnamese immigrants (80%) live in developed countries (Nguyen, 2012). In addition, Vietnamese nationals have settled in English-speaking countries and other countries and territories, thus making Vietnamese a significant migrant language abroad, and bringing Vietnamese into contact with English and other host community languages. This is a phenomenon which has not been seen before in the history of Vietnamese language and in cultural exchanges between Vietnam and the rest of the world.

Research into the Vietnamese language overseas is of interest to many Vietnamese researchers in Vietnam. It has been suggested that the Vietnamese government should introduce appropriate policies to encourage research in this field, and Vietnamese scientists have been asked to undertake research in order to help the Vietnamese, particularly the younger Vietnamese generation both in Vietnam and abroad, to understand the variations in each other's Vietnamese language (Vuong, 1998; Vo, 2002; Nguyen, 2002; Dao, 2003b). However, the literature on the study of the Vietnamese language of Vietnamese nationals residing abroad in contact with English and other adopted languages is limited in scope.

In Australia, there have been various studies on the Vietnamese Australian community, in terms of profile (Thomas, 1996, 1997, 1999, 2001; Viviani, 1980, Viviani & Davies, 1980; Lewins & Ly, 1985; Coughlan, 2001; Ngo and

Cahill, 2001) and Vietnamese cultural activities (Ha, 1988; Ngo, 2005). However, research on the change undergone by the Vietnamese language of Vietnamese Australian community in contact with Australia English is also scarce. Researchers working in this field include Pittam and Ingram (1990), Ho-Dac (2003), Thai (2005a and 2005b). A published doctoral thesis 'Vietnamese-English Bilingualism: Patterns of Codes-witching' carried out by Ho-Dac (2003) is particularly relevant. This research was based on spoken language data including recorded natural speech and interviews with bilingual Vietnamese-English people. The author showed that the phenomenon of code-switching occurs in all types of word classes in Vietnamese speech and in tonal facilitation and personal pronouns. Pittam and Ingram (1990) studied Vietnamese refugees acquiring proficiency with Australian-English vowels.

1.2. Phonetic Interference in Language Contact

Studies on language contact show that one of the most common results of language contact is phonetic interference (Weinreich, 1953; Rayfield, 1970). In line with this definition, Bullock & Gerfen (2004a) claim that when languages are in contact, a weaker language may be vulnerable to change by internal/external influence. This may finally lead to the situation where the phonology of the weaker language converges with, or is even replaced by, the dominant language. In addition, Appel and Muysken (1987) argue that when languages have been spoken in the same area by the same people for a long time, the phonetic systems of these languages converge. In particular, they pointed out that: 'this convergence is most apparent on the phonetic level: the sound systems of the languages may grow to be more and more similar, without clear influence in one direction' (Appel and Muysken, 1987, p. 154).

When studying the language of a community of Jewish immigrants who came to the United States forty or fifty years ago, Rayfield (1970) noted that 'the secondary language is always subject to 'phonic interference' in the speech of adult bilinguals (p.107). In the speech of Jews who were born in the United States, Yiddish is their language at home until they begin school, after which English is their language of preference. His results showed that Yiddish had been very little affected by English phonology, except in stress and intonation. According to him, when Yiddish was in contact with English, there is a just perceptible difference in the pronunciation of /γ/ in Yiddish substituting for the flapped /t/ of English.

In situations where immigrant languages are in contact with larger host community languages, phonetic interference occurs not only in stress, intonation and consonants, but also in vowels. In research on a French enclave community in the United States, Bullock and Gerfen (2004a; 2004b) observed that their two bilingual participants tended to level out the allophonic distinction between two mid-front rounded vowels [œ] and [ø], converging in an English-like rhoticised schwa [ɚ].

In Australia, the influence from the host community language on the immigrant community language in terms of phonetic interference has been extensively researched. In research into Italian English bilinguals resident in North Queensland, Bettoni (1981) showed that her participants' productions of the English diphthongs and vowels were influenced by Italian vowels. For example, her participants produced: the English diphthong /oʊ/ sometimes as /ao/, as in word 'milo' [ˈmalao], or /ɔ/, as in word 'golden' [ˈɡɔlne], or /a/, as in word 'quota' [ˈkwadra]; the Australian vowel /a/ as the Italian more backed /a/ or /ɛ/, as in word 'farm' [ˈfarma] or [ˈfɛrma] respectively; the Australian vowel /ʌ/ as /a/, as in the word 'son' [san] or /o/, as in the word 'sulky' [soIki]; and the Australian vowel /æ/ as /a/, as in the word 'tank', pronounced as [ˈtaŋk] or [ˈtɛŋka].

According to Clyne (2003), phonological transference usually occurs in second, and particularly in third-generation, bilinguals of the immigrant communities in Australia. He observed that 'the salient features of Australian English replace the community language equivalents' (p.115), and among these salient features are: 'the alveolar [ɪ], the velar [ɫ] and, to a lesser extent, the diphthongization of monophthongs such as /o/, /e/ and /u/ in most community languages' (p.115). In addition, he also showed the substitution of some phonetic features of Australian English in the phonetics of some community languages, such as the substitution of /ts/ and /ç/ by [s] and [k] in German.

In terms of Vietnamese as a community language, Tang (2006) showed the potential interaction of English with Vietnamese when Vietnamese American students substitute the English diphthong /oʊ/ for the Vietnamese vowel /o/. In relation to Vietnamese as a community language in Australia, Clyne (2003) noted that 'English transfers may be integrated phonologically and/or tonemically in Vietnamese by the loss of final –t and/or the use of a particular mid or high tone' (p. 143).

1.3. The Vietnamese Vowel System

The Vietnamese vowel system contains 9 long vowels, 2 short vowels and 3 diphthongs. The long vowels are /i, ɯ, u, e, ɤ, o, ɛ, a, ɔ/; short vowels are /ă, ɤ̆/; diphthongs are /ie, ɯɤ, uo/ (Dinh & Nguyen, 1998). The vowels of Vietnamese in terms of tongue raising and advancement are shown in Table 1, each phonetic symbol is followed by its equivalent letters in parentheses:

Table 1. *The Vietnamese vowels (Cited by Dinh and Nguyen, 1998, p. 94).*

Position of the tongue / Openness of the mouth	front	central	back
close	i (i, y)	ɯ (ư)	u (u)
mid-close	ie (iê, ia, yê, ya)	ɯɤ (ươ, ưa)	uo (uô, ua)
mid	e (ê)	ɤ, ɤ̆ (ơ, â)	o (ô)
open	ɛ (e, a)	a, ă (a, ă)	ɔ (o)

2. Method

2.1. Participants

There were four groups of participants: two groups in

Australia and two groups in Vietnam.

Group 1: Older Vietnamese residents in Australia (OVA)

This group involved ten Vietnamese aged between 35 and 54, 5 females and 5 males, who arrived in Australia as adults after 30 April, 1975 (mean of AOA (age of arrival): 27.3 years) and who were native speakers of Vietnamese. They are representative of the generations of Vietnamese in Australia who were first exposed to English as adults. They also represent the generations of Vietnamese who resided in the South of Vietnam before 30 April, 1975 and who speak Vietnamese of the pre-1975 era.

Group 2: Younger Vietnamese residents in Australia (YVA)

This group included 10 young Vietnamese, 5 females and 5 males, aged between 18 and 25. They were students or graduates of the University of Queensland or the Queensland University of Technology. Seven participants in this group arrived in Australia as infants (mean of AOA: 3.7 years) and three participants were born and grew up in Australia and were aged between 24 and 25. They are native speakers of English, and Vietnamese can be considered functionally their second language. These students first learnt and used Vietnamese at home. However, as soon as they began their education in English, their English began to overtake their Vietnamese, and Vietnamese has to be considered their second language. They are representative of the second generation of Vietnamese migrants in Australia.

Group 3: Older Vietnamese residents in Vietnam (OVV)

This group consisted of ten Vietnamese aged between 29 and 45, 5 females and 5 males, who lived in Vietnam in Ho Chi Minh City or Can Tho City. They are representative of older Vietnamese speaking the contemporary Southern dialect of Vietnamese.

Group 4: Younger Vietnamese residents in Vietnam (YVV)

This group consisted of 10 Vietnamese students, 5 females and 5 males, aged between 18 and 23. They are representative of the younger generations in Vietnam who speak the contemporary Southern dialect of Vietnamese and who were all studying at the University of Social Science and Humanities of Ho Chi Minh City, Vietnam.

2.2. Linguistic Materials

The linguistic materials employed in this experiment included eleven monophthongal Vietnamese vowels /i/, /e/, /ɛ/, /ɤ/, /ɤ̆/, /ɯ/, /a/, /ă/, /u/, /o/, and /ɔ/. These vowels were then embedded in /t_t/ and /t_n/ carrier words. However, vowel /ɯ/ was embedded in /t_c/ and /t_ŋ/ respectively in order to allow these two words to be embedded in a meaningful word, like the other carrier words (See Table 2).

***Table 2.** Vietnamese stimuli - Monophthongal vowels of Vietnamese.*

Phonemic Symbol	/i/	/e/	/ɛ/	/ɯ/	/ɤ/	/ɤ̆/	/a/	/ă/	/u/	/o/	/ɔ/
Word	tít	tét	tét	túrc	tót	tất	tát	tắt	tút	tốt	tót
	tín	tến	tén	túrng	tớn	tấn	tán	tắn	tún	tốn	tón

The target words were then elicited in a sentential form in which the target word was embedded in a carrier sentence, with all the carrier sentences having the same grammatical structure:

V + O + imperative particle.

For example: Đọc   lại   từ   'tốt'   đi nhé.
                   Read   again   word   good   please.
                   'Say the word 'tốt' again please'.

The target words were elicited in a picture naming task. Picture cards which contained a picture, the target Vietnamese word and its corresponding English gloss (meaning) were presented to subjects. The English gloss was provided to remind the younger Vietnamese group resident in Australia of the target words and to help them read the words. This was an investigation into pronunciation, not into word recall.

2.3. Procedures

The participants were given an appropriate time to practise the pronunciation of the linguistic materials. They were then asked to speak the target sentence in normal speech into the microphone connected to a laptop computer for recording. The Praat sound recording and editing computer software (Boersama and Weenink, 2007) was again employed to record the samples at a 22050 Hz sampling rate.

2.4. Measurements

Quantitative methods were used to analyse the data in order to assess whether each individual vowel of eleven examined vowels produced by one Vietnamese group of speakers was acoustically different from those produced by the other three Vietnamese groups. The data was quantitatively analysed using specialized speech analysis software (Emu Speech Tools). First, the edges of the target syllables and vowels were marked by using the Emu Labeller. The marking relied mainly on the spectrographic display in the Labeller. The segmentation criteria were generally based on the major discontinuities of the energy distribution over frequency, and visible time periods on the spectrograms.

The Emu-R statistical software was then used to extract the key acoustic parameters: the Fundamental frequency $F0$ at 10 equidistant points on the vowel of each syllable rime, and the first and second formant frequencies ($F1$ and $F2$).

Second, in order to normalise the age and gender differences in vowel production, the vowel formant values which were currently in Hertz (Hz) were converted to Bark scale values (Syrdal & Gopal, 1986). The formula: $B=26.81/(1+(1960/F))-0.53$ (F is the formant value of $F0$, $F1$ and $F2$ respectively of each vowel) was utilized to convert the vowel formant values to the Bark scale. Hence, the formant values $F0$, $F1$ and $F2$ would became B0, B1 and B2

respectively as a result of this conversion.

Third, the two vowel formant values B1-B0 (B1 minus B0) and B2-B1 (B2 minus B1), which represented vowel height and vowel frontedness respectively, were then calculated.

2.5. Analysis

Four analyses were then carried out in order to examine and compare the Vietnamese vowels produced by the four groups of speakers:

(*i*). Analysis of the mean acoustic values of all vowel productions, in which the vowel formant values B1-B0 (vowel height) and B2-B1 (vowel frontedness) were plotted in the vowel acoustic space, the B2-B1 value on the x-axis and the B1-B0 value on the y-axis (see Figs. 1).

(*ii*). A statistical analysis was conducted to compare B1-B0 and B2-B1 values from the four groups of speakers for each vowel in terms.

(*iii*). A Post-hoc Tukey test was conducted for all vowels in

terms of both the B1-B0 and the B2-B1 values; and finally,

(*iv*). A Post-hoc pairwise comparison was used to investigate B1-B0, and B2-B1 of all vowels for each pair of groups.

3. Results

3.1. Analysis 1: Means of Acoustic Values of All Vowel Productions

Means of acoustic values of all vowel productions were calculated using the EMU program. The phonetic notation employed in the following analysis is derived from the Speech Assessment Methods Phonetic Alphabet (SAMPA) - a computer readable phonetic alphabet (Wells, 1997). The vowels are listed with their corresponding phonemic symbols in the International Phonetic Alphabet (IPA), and in conventional Vietnamese orthography:

Table 3. SAMPA, IPA Phonemic and Vietnamese orthography symbols.

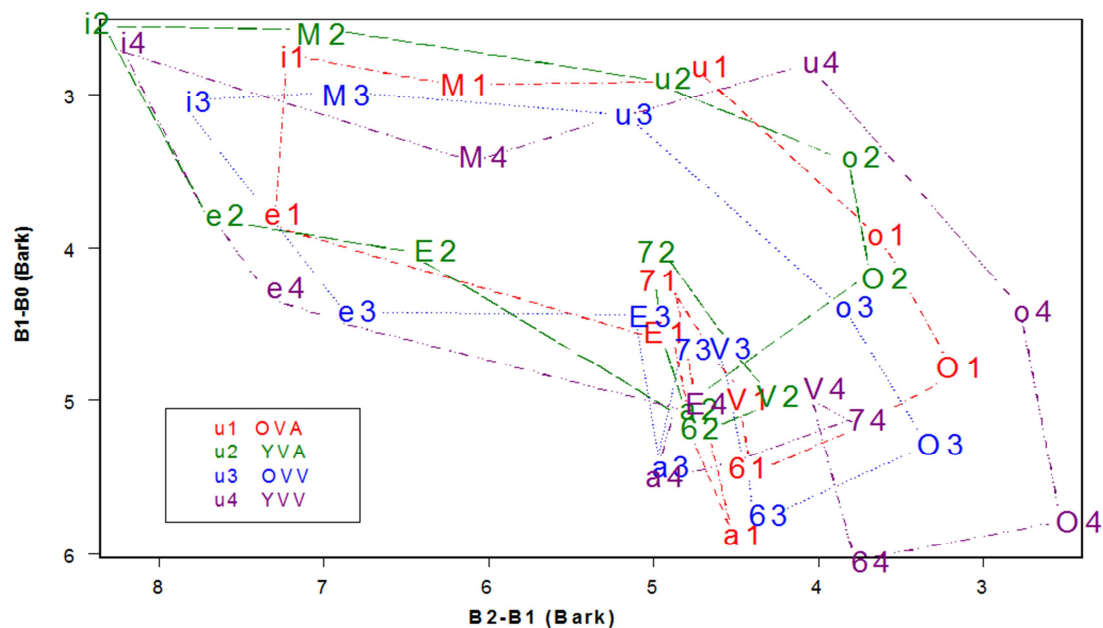| SAMPA symbols	IPA Phonemic symbols	Conventional Vietnamese orthography	SAMPA symbols	IPA Phonemic symbols	Conventional Vietnamese orthography
i	i	i	M	ɯ	ư
e	e	ê	6	ă	ă
E	ɛ	e	u	u	u
7	ɤ	ơ	O	ɔ	o
V	ɤ̆	â	o	o	ô
a	a	a			

Figure 1. Means of acoustic values of Vietnamese vowels.

Discrimination of tokens in the acoustic vowel spaces produced by the four separate groups of speakers (Figure 1) was as follows:

The vowel symbols (tokens) with the number 1 (for example: 'u1') and connected by a dash-dot-dash line were produced by the Older Vietnamese residents in Australia (OVA).

The vowel symbols with the number 2 (for example: 'u2') and connected by a dashed line were produced by the Younger

Vietnamese residents in Australia (YVA).

The vowel symbols with the number 3 (for example: 'u3') and connected by a dotted line were produced by Older Vietnamese residents in Vietnam (OVV).

The vowel symbols with the number 4 (for example: 'u4') and connected by a dash-dot-dot-dot line were produced by the Younger Vietnamese residents in Vietnam (YVV).

Figure 1 shows plots of the vowel formant values B1-B0

(B1 minus B0) and B2-B1 (B2 minus B1) for the eleven examined vowels produced by the four Vietnamese groups of speakers.

3.1.1. Means of Acoustic Values of the Vowels Produced by the Four Groups of Speakers

Figure 1 shows that the means of the acoustic values of each individual vowel of the eleven vowels examined produced by the four groups of speakers basically occupied four separate regions on the chart (plotted in four different graphs), except the vowels /ɛ/ produced by the OVA and OVV groups, which overlapped or clustered with each other. This result was not unexpected, since each individual group of speakers was different from the other three groups in terms of both age and type of native language (English or Vietnamese) or type of Southern Vietnamese dialect (older or current Southern Vietnamese dialect).

The two younger groups of speakers (YVA and YVV) were different from the two older groups of speakers (OVA and OVV) in terms of age. The mean age of the two younger groups was 21.1 years, while the age mean of the two older groups was nearly double that at 41.6 years.

The two younger groups of speakers were also different from each other, as the younger group in Australia use English as their native language, and rated their Vietnamese ability as 'Elementary' or 'Not so fluent', while the younger group in Vietnam are Vietnamese native speakers and rated their English ability as 'Elementary' or 'Not so fluent'.

To some extent, the two older groups of speakers (OVA and OVV) show differences of vowel productions. The older group of speakers resident in Australia (OVA) still use and speak the older South dialect of Vietnamese before 1975 in the South of Vietnam that they brought to Australia about 30 years ago. In contrast, the older group of speakers resident in Vietnam (OVV) speaks the contemporary South dialect of Vietnamese, which has been in contact with the Central and the North dialects after the unification of Vietnam in 1975.

The vowel tokens produced by the four groups of speakers were partly different, but also partly overlapped with each other in terms of acoustic vowel space: (*i*) The tokens of the vowel /ɛ/ (symbol 'E1' and 'E3') produced by the OVA and OVV groups clustered acoustically, and (*ii*) the tokens of the vowel /a/ (symbols 'a3' and 'a4') produced by the OVV and YVV were merged acoustically.

However, there was no case where the vowel tokens of the younger Vietnamese resident in Australia merged with the corresponding vowel tokens of the other three groups of speakers.

3.1.2. Means of Acoustic Values of the Vowels Produced by the YVA Group of Speakers

Figure 1 indicates that the vowel tokens produced by the YVA group show significant differences compared with those of the three other groups (OVA, OVV and YVV).

First, the vowel tokens of the YVA group generally were significantly different when compared with the three other groups (OVA, OVV and YVV) in terms of their mean acoustic values. Specifically, the tokens of vowels produced by the YVA group tended to occupy the highest and the more front regions in the charts (Figure 1). For example, the vowels /i/, /ɛ/, /ɤ/, /ɯ/, /a/, /ă/, /o/, and /ɔ/ (the symbols 'i2', 'E2', '72', 'M2', 'a2', '62', 'o2' and 'O2' respectively).

Second, the tokens of the vowel /ɛ/ (symbol 'E2' in the Figure 1) of the YVA group were not only the highest and more fronted compared with the three other groups, but also tended to cluster with the tokens of the vowel /e/ (the symbols 'e1', 'e3', and 'e4') produced by the three other groups in terms of vowel acoustic space. These results suggest that the YVA group of speakers may confuse the Vietnamese vowel /ɛ/ with /e/. There are three possible reasons for this confusion.

The Australian English vowel system has the close mid /e/ but not the open mid /ɛ/. Therefore, the YVA group may tend to produce the English vowel /e/ instead of the Vietnamese vowel /ɛ/.

The Vietnamese vowels /ɛ/ and /e/ are both described as front, mid, unrounded vowels, but when pronouncing the vowel /ɛ/ the mouth is more open than for the articulation of the vowel /e/ (Dinh & Nguyen, 1998; Mai, Vu & Hoang, 1997). It is also possible that they were unable to distinguish between the quality of the two vowels: /e/ is upper mid while /ɛ/ is lower mid in terms of tongue height.

The Vietnamese vowel /ɛ/ is written 'e' and the Vietnamese vowel /e/ is written 'ê' in terms of script. The only difference between these two Vietnamese vowels is that the vowel /ɛ/ is written without a diacritic while the vowel /e/ is written with a diacritic (ˆ). Hence, the YVA group of speakers may not be able to distinguish the difference between the vowel /ɛ/ and the vowel /e/ in terms of script. They either produced the vowel /e/ instead of the vowel /ɛ/ or the reverse, producing the vowel /ɛ/ instead of the vowel /e/. It is possible that the participants simply ignored the diacritic when they saw the word form.

These three factors presented above may be consistent with the token of the vowel /ɛ/ produced by the YVA group being significantly different compared with the three other groups of speakers.

Third, the tokens of the vowel /ɔ/ (the symbol 'O2' in Figure 1) produced by the YVA group also tended to cluster with the tokens of the vowel /o/ (the symbols 'o1' and 'o3') produced by the three other groups in terms of vowel acoustic space. The similarity between the vowels /ɔ/ and /o/ in terms of acoustic space shows that the YVA group could not produce the difference in pronunciation between these two vowels. This can be explained by the following factors:

The Vietnamese vowel /ɔ/ was written as 'o' was sometimes pronounced as the English vowel /oʊ/ by the YVA group who are English speakers.

The Vietnamese vowels /ɔ/ and /o/ are both described as back, rounded vowels, but the difference between the vowels /ɔ/ and /o/ is that when pronouncing the vowel /ɔ/, the mouth is more open and the tongue's position is lower than for the articulation of the vowel /o/ (Dinh & Nguyen, 1998; Mai, Vu, & Hoang, 1997). The YVA group could not perceive the difference in terms of tongue height when they pronounced the vowels /ɔ/ and /o/. They produced a similar sound for both vowels (see for instance the articulation of O2, o1 and o3 in

Figure 1).

The YVA group could not distinguish the difference in diacritics between the vowels /ɔ/ and /o/, which are written as 'o'' and 'ô' respectively. The vowel 'o'' /ɔ/ is not written with a diacritic but the vowel 'ô' /o/ has a diacritic.

There is an interesting parallel in vowel height between the /e/ ~ /ɛ/ contrast and the /o/ ~ /ɔ/ contrast, which reflects a shortfall on the part of the speakers in close-mid and open-mid vowels, both front and back.

Fourth, the tokens of the vowels /a/, /ă/, and /ɤ̆/ (the symbols 'a2', '62' and 'V2' in Figure 1) produced by the YVA group clustered together. In particular, the vowels /a/ and /ă/ (the symbols 'a2', '62') of the YVA group overlapped in terms of vowel acoustic space, while these three vowels produced by the three other groups did not overlap. This phenomenon suggests that the participants in the YVA group could not discriminate between these three vowels. There were possible reasons which are consistent with this confusion.

In terms of script, the only different feature between the vowels /a/, /ă/, and /ɤ̆/, which are written as 'a', 'ă', and 'â' respectively, is their diacritics. The YVA group could not perceive the difference between these three vowels in terms of diacritics. Hence, they may have mistaken these three vowels for each other, so that the tokens of the three vowels /a/, /ă/, and /ɤ̆/ of the YVA group clustered together or even overlapped with each other in the vowel space.

The vowels /ă/ and /a/ differ from each other in length: the vowel /ă/ is well known as a short vowel, while the vowel /a/ is a long vowel (Doan, 1977, 1999). The merger of two tokens of these two vowels /ă/ and /a/ (Figure 1) showed that the YVA group could not produce the contrast of vowel length of the vowels /ă/ and /a/.

The Vietnamese vowel system, unlike English, has the vowels /ă/ and /ɤ̆/. This can make it difficult for the YVA group who are English speakers to perceive and produce these two vowels accurately. The YVA group produce the vowels /ă/ and /ɤ̆/ as similar to the long vowel /a/.

Fifth, the tokens of the vowel /ɤ/ (symbol '72' in Figure 1) produced by the YVA group were higher compared with those produced by the three other groups. These significant differences show that the YVA group failed to produce this Vietnamese vowel accurately. A possible reason is that this vowel only exists in the Vietnamese vowel system and there is no similar vowel in the English vowel system.

3.1.3. Means of Acoustic Values of the Vowels Produced by the YVA and YVV Groups

Figure 1 shows there is a very significant difference between the tokens of vowels in terms of vowel acoustic space produced by the younger group of Vietnamese resident in Australia and the younger group of Vietnamese resident in Vietnam. The data in the Figure 1 reveals that the tokens of the vowels produced by the YVA group in terms of acoustic vowel space tended to occupy a higher and/or more fronted region than those of the other three groups. For example:

- The tokens of the vowels /i/ and /ɛ/ were not only higher but also more fronted. This was also the case for the tokens of the vowels /ɯ/, /ă/ and /ɔ/.

- The tokens of the vowels /ɤ/ and /o/ were higher than those of the three other groups.

In contrast, in terms of vowel acoustic space the tokens of these vowels produced by the YVV group tended to occupy a lower and a more backed region than those of the three other groups:

The tokens of the vowels /ɛ/, /ɤ/, /ɯ/, /o/ and /ɔ/ were not only lower but also more backed.

The tokens of the vowel /ă/ was lower.

The tokens of the vowels /ɤ̆/ and/u/, and the tokens of the vowel /ă/, were more backed.

These results showed that there were striking differences in the tokens of most vowels in terms of acoustic vowel space produced by the younger group resident in Australia and the younger group resident in Vietnam. This significant acoustic difference between the YVA group and the YVV group could be expected because the two groups have a completely different experience of English. The results of the 'Language Background Questionnaire' showed that the participants in the YVA group were born or raised in Australia, have been exposed to Australian English for more than twenty years, and are considered to be English speakers. They rated their English proficiency as 'Fluent' on a five-point scale (None, Elementary, Not so fluent, Fairly fluent and Fluent) in the four skills of speaking, listening, reading and writing. In addition, they estimated that they used English about 90% of the time and Vietnamese 10% of the time, mainly speaking English with their friends in school and with their siblings. They rated their Vietnamese abilities as 'Elementary' or 'Not so fluent' on the same scale, and mainly used Vietnamese with their parents. In contrast, the YVV group were born and raised in Vietnam, and are all Vietnamese native speakers. They rated their Vietnamese ability as 'Fluent', but their English proficiency as 'Not so fluent'. Additionally, according to the results of the questionnaire, they estimated that they used Vietnamese about 90% and English 10% of the time, and they usually spoke Vietnamese in the family, at school, and at work, while they had limited use of English in their English classes in school, where they were generally taught by the Grammar Translation method. The difference in the experience of English between the YVA and YVV groups is one of the factors which is consistent with the significant acoustic differences of vowels produced by these two groups.

In addition, there is also a significant difference in terms of the Vietnamese Southern dialect between the YVA group and the YVV group. The YVA groups of speakers are speaking a Vietnamese Southern dialect that their parents and/or teachers brought to Australia more than 30 years ago, and this kind of Vietnamese Southern dialect has had limited contact with the contemporary Southern dialect in Vietnam. The reasons for this are the geographic distance between Vietnam and Australia, and especially the limited contact during the intervening 30 years between the Vietnamese community in Australia and the Vietnamese in Vietnam. In contrast, the YVV group speaks the contemporary Southern

dialect of Vietnamese which has interacted especially with the Northern dialect of Vietnamese since unification in 1975. In addition, the YVV group of speakers are living and studying in Ho Chi Minh City – the capital city of the South of Vietnam – where all the dialects of Vietnamese are in contact.

The difference in the experience of English between the YVA and YVV groups and the kind of Vietnamese Southern dialect used by the YVA and YVV groups can be factors which are consistent with significant difference in the tokens of vowels produced by these two groups.

3.1.4. Means of Acoustic Values of the Vowels Produced by the OVA and OVV Groups

The tokens of each individual vowel produced by the OVA and OVV groups were generally significantly different from each other in terms of vowel acoustic space, except in one cases the tokens of the vowel /ɛ/ (see Figure 1).

These results showed that the vowels produced by the OVA and OVV groups had similar acoustic characteristics. However, in terms of tokens of vowels in the acoustic vowel space the differences between the two older groups of speakers were not as significant as the difference between the two younger groups of speakers.

Summary

The results indicated by the means of the acoustic values of the all vowel productions show that each individual vowel of the eleven examined vowels produced by the four groups of speakers was acoustically significantly distinct from the other vowels, except for one case of token of a vowel produced by the OVA and OVV groups, and one case produced by the OVV and YVV group, which overlapped or clustered with each other. In addition, the vowel productions of the YVA group were very significantly different compared to the two groups OVV and YVV. In particular, there were significantly contrasting differences in terms of acoustic production of vowels between the two younger Vietnamese groups (YVA and YVV).

3.2. Analysis 2: Statistical Analysis to Compare B1-B0 (Vowel Height) and B2-B1 (Vowel Frontedness) Values Among the the Four Groups of Speakers.

3.2.1. Vowel Height

A repeated measures two-way analysis of variance (ANOVA) of the results of B1-B0 (vowel height) showed a significant difference for the four groups and the vowels, but no significant difference for the interaction of Groups x Vowels: Groups: $F(3, 862) = 18.18$ $p<0.0001$; Vowels: $F(10, 862) = 80.79$, $p<0.0001$; Groups x Vowels: $F(30, 862) = 1.53$, $p = 0.034$ ns.

Figure 2 shows a comparison of the B1-B0 (vowel height) values among the four groups of speakers for each vowel. As is evident from the Figure 2, there was a significant difference between the YVA group and the three other OVA, OVV and YVV groups in terms of the vowel height of all vowels. In particular, the YVA group was very significantly different

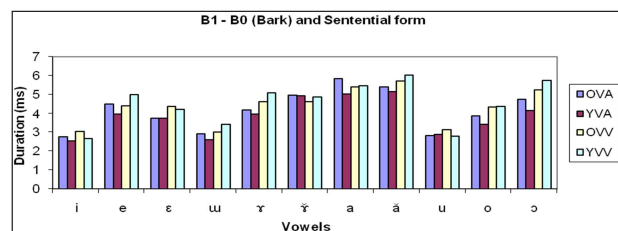from the YVV group in terms of vowel height for /e/, /ɯ/, /ɤ/, /o/ and /ɔ/ in and also the vowel /ă/.

Figure 2. B1-B0 (vowel height) values among the four groups.

3.2.2. Vowel Frontedness

The ANOVA also revealed significant differences in terms of B2-B1 (vowel frontedness) for the four groups, the eleven vowels and the interaction of Groups x Vowels: Groups: $F(3, 862) = 16.3$, $p<0.0001$; Vowels: $F(10, 862) = 128.83$, $p<0.0001$); Groups x Vowels: $F(30, 862) = 1.97$, $p = 0.0015$ ns, $(p<0.05)$.

Figure 3 shows a comparison of B2-B1 values among the four groups of speakers for each vowel. As can be seen, the data in the Figure 3 (B2-B1 [vowel frontedness]) show that all tokens of vowels produced by the YVA group were generally significantly different from the other three OVA, OVV and YVV groups. In particular, the tokens of the vowels /e/, /ɯ/, /ɤ/, /u/, /ɔ/, /o/, and the vowel /ă/, produced by the YVA group differed very significantly from those of the YVV group.
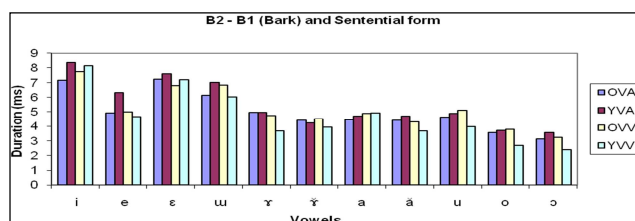

Figure 3. B2-B1 (vowel frontedness) values among the four groups.

Summary

The results of statistical analyses of B1-B0 (vowel height) and B2-B1 (vowel frontedness) above showed a significant difference for the four groups (OVA, YVA, OVV and YVV), the vowels (/i/, /e/, /ɛ/, /ɤ/, /ɤ̆/, /a/, /ɯ/, /ă/, /u/, /ɔ/ and /o/), and the interaction of Groups x Vowels. These results supported the previous results of the means of acoustic values of all vowels (see section 3.1.1), in which the productions of each individual vowel produced by the four groups were generally different.

In addition, Figure 2 (B1-B0 [vowel height]) showed a very significant difference between the YVA group and the YVV group in terms of the vowels /e/, /ɯ/, /ɤ/, /o/, /ɔ/ and /ă/. The Figure 3 (B2-B1 [vowel frontedness]) also showed that there was a significant difference between the YVA group and YVV group in terms of the tokens of the vowels /e/, /ɯ/, /ɤ/, /u/, /ɔ/, /o/ and the vowel /ă/. The results of the Figures presented above are consistent with the previous mean acoustic values of all vowels (see section 3.1.2 and section 3.1.3), in which most of the vowels produced by the YVA group were very

significantly different from those of the YVV group.

3.3. Tukey Post-Hoc Analysis

A Tukey Post-hoc test was employed for all groups of speakers in terms of the B1-B0 parameter (vowel height) and in terms of B2-B1 (vowel frontedness). The analyzed results confirmed that the comparison pairs of the younger groups resident in Australia and resident in Vietnam (YVA-YVV) were consistently and significantly different (p<0.0001) in the terms of all vowels in all groups in both B1-B0 (vowel height) and B2-B1 (vowel frontedness) comparisons.

In addition, the results of these analyses also revealed that the comparison pairs of the two older Vietnamese groups resident in Australia and in Vietnam (OVA-OVV) were not significantly different for all vowels in terms of B1-B0 and B2-B1. This result reflects the findings of the means of acoustic values of all the vowel productions (see section 3.1.1) in which the two vowels /u/ and /ɤ/ produced by the OVA and OVV groups overlapped with each other.

Finally, the inconsistently significant difference between the four comparison pairs of the OVA-YVV, OVA-YVA, YVA-OVV and OVV-YVV groups in both tests shows that there are changes occurring, but not consistently throughout the groups. This is consistent with the beginning of the process of vowel quality change. This will need to be tested and confirmed in the future by subsequent research.

3.4. Post-Hoc Pair-Wise Comparison

A post-hoc pair-wise comparison was carried out to investigate the B1-B0 (vowel height) and B2-B1 (vowel frontedness) values of all vowels for each pair of groups. The results from the analysis of the post-hoc pair-wise comparison allowed further conclusions.

First, the YVA-YVV comparison showed a consistent and significant difference in the two tests (B1-B0 and B2-B1), in terms of the vowels /ɤ/, /o/ and /ɔ/. In terms of the vowels /e/, /ɯ/, /ă/, and /u/ the YVA-YVV comparisons was also significantly different, but not consistent in all cases.

Second, the OVA-YVV comparisons showed consistent and significant differences in the vowel /ɔ/ in terms of two tests (B1-B0 and B2-B1). This pair's comparison of the vowels /ɤ/, /o/, /ɯ/ and /u/, although not consistent, also showed a significant difference. For instance, the vowel /o/ was significantly different in B2-B1 but not significantly different in B1-B0.

Third, the OVA-YVA pair of comparisons although inconsistent, showed a significant difference in the vowels /o/, /i/, and /e/.

Fourth, the YVA-OVV pair of comparisons was significantly different for the vowels /ɔ/, /o/ and /e/, but not consistent in all cases. For example, the vowels /ɔ/ and /o/ were significantly different in B1-B0, but not significantly different in B2-B1. The vowel /e/ was significantly different in B2-B1 but not in B1-B0.

Fifth, the OVV-YVV pair of comparisons was significantly different for the vowels /ɔ/, /o/ and /ɤ/ in B2-B1. But it was not significantly different in terms of B1-B0.

4. Conclusion

Taking all the major results from the four analyses together ((*i*) Means of acoustic values of all vowel productions; (*ii*) Statistical analysis to compare B1-B0 (vowel height) and B2-B1 (vowel frontedness) values among the four groups of speakers; (*iii*) Tukey Post-hoc; and (*iv*) Post-hoc pair-wise comparison) several general conclusions can be drawn.

First, there were significant differences between the younger Vietnamese group resident in Australia and the parallel younger group in Vietnam in terms of the vowels /ɤ/, /o/, /ɔ/, /e/, /ɯ/, /ă/ and /u/. These differences revealed that the participants of the YVA group could not pronounce the Vietnamese vowels accurately. Because they could not distinguish the different characteristics of the Vietnamese vowels, they pronounced the Vietnamese vowels similarly to English vowels, perhaps under the influence of English vowel characteristics. The changes of production of Vietnamese vowels produced by the YVA group due to contact with Australian English will need to be further investigated in later research.

Second, the vowel productions of the two older Vietnamese groups resident in Vietnam and in Australia (OVA and OVV) were found to be not significantly different. The results of this study have implications for language maintenance in Australia and Vietnamese abroad language policy in Vietnam.

Acknowledgement

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