Acoustic Analysis on English Oral Vowels Produced by Acehnese Speakers from Aceh Besar by Using PRAAT Software

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Abstract

This research intends to acoustically analyze English oral vowels produced by the female and male speakers of English teacher candidates in Indonesia, specifically from Aceh Besar. Previous studies have focused on the production of English vowels produced by the Malaysians, Thais, Singaporeans, and the Philippines, among others, but no research has focused on the Indonesian speakers. Hence, this study intends to fill in this research gap. Purposive sampling was used to select five female and five male participants with age ranging from 18-22 years old and born, raised and live in Aceh Besar. Data were recorded in the phonetics laboratory at Syiah Kuala University. The vowels were collected through elicitations of English words which contained the target vowels articulated in carrier sentences. The wordlist is adapted from Pillai, Manueli and Dumanig (2010). The recordings were saved in WAV files, and Praat software version 6.0.14 (Boersma & Weenink, 2016) was used to analyze the vowel qualities. The results showed approximate measurements of the English vowels produced by Indonesians who reside in Aceh, by both male and female speakers. The results are expected to become starting points for future related research in the production of English vowels by Indonesian speakers (i.e. English vowel contrasts between native speakers of English and Indonesians, varieties of English, Indonesian English, etc.).

Keywords: English, oral vowels, Acehnese speakers, acoustic analysis, Praat software.

Introduction

There are differences between English and Indonesian vowels because each language has different number of vowels and consonants that are produced differently (Achmad & Yusuf, 2014). Fox, Flege and Munro (1995, p. 2540) mentioned that:

Language distinguishes a number of vowels to distinguish meaning, as well as phonetic analysis that distinguishes vowels in their own language. This difference has implications for the listener who receive the vowels, in addition to the phonetic quality analysis of the language vowels that cannot be represented by native speakers. (Fox, Flege & Munro, 1995, p. 2540)

Iverson and Evans (2007, p. 2842) concluded that language learners of different mother tongues studied new aspects of English vowels rather than assimilating English vowels with their mother tongues. Moreover, research shows that learners have difficulty in pronouncing vowels that have no reference in their mother tongue. Accordingly, Escudero, Benders and Lipski (2009) explained that the linguistic language background tends to influence the techniques and methods of receiving and producing foreign language sounds. Early-level foreign language learners also tend to assimilate the value of vowels of foreign language with their mother tongues (Escudero & Williams, 2011).

Various scientific studies and studies have been published about acoustic phonetics related to English vowels in the scope of Southeast Asia. Among these studies are Malaysian English (Pillai, et al., 2010; Pillai, 2014), Singaporean English (Deterding, 2000, 2005), Bruneian English (Sharbawi, 2006), Thai English (Pillai & Salamae, 2013; Tsukada, 2008), Taiwanese English (Li, 2004), and Phillipine English (Pillai, Manueli and Dumanig, 2010).

For example, Yap, Wong and Yasran (2010) found that Malay-English speakers are difficult to distinguish between the front vowels of /ɪ/ and /i/, and /ɛ/ and /æ/, which may be caused by the influence of the vowel quality in Malay. Pillai et al. (2010) further found that Malaysian English vowels occupy a smaller vowel space than those of British English. The lack of contrast in vowel quality between vowel pairs was more apparent for /i:/-/I/, /e/ - /æ/ and /ʌ/-/ɑ:/.

However, there is no previous study that specializes on the acoustic analysis of Indonesian-English vowels. Therefore, this pilot study intends to investigate the quality of English oral vowels produced by Indonesian speakers, focusing on those who reside in Aceh province. The results are expected to become starting points for future related research in the production of English vowels by Indonesian speakers (i.e. English vowel contrasts between native speakers of English and Indonesians, varieties of English, Indonesian English, etc.).

Research Method
This study recorded 10 respondents aged 18-22 years who was born and raised in Aceh Besar, Indonesia. Data are collected through structured speech and vowels were captured in a word list. The word list used was the one constructed by Pillai, Manueli and Dumanig (2010). From eleven oral monophtong vowels in English (/I/, /i:/, /e/, /a/, /ʌ/, /ɑ:/, /ɒ/, /ɔ:/, /ʊ/, /u:/, and /ɜ:/), they are extracted from the following target words: *bib, beep, beck, back, buck, bard, boot, bought, burp, pot* and *put*. The words were produced by the respondents in a carrier sentence of "Say ___ again" (i.e. "Say *bib* again"). The respondents were recorded individually with Marantz PMD 660 digital recorder in the Phonetics Laboratory, Faculty of Teacher Training and Education, Syiah Kuala University.

The recordings were then converted to WAV files and input into Praat software version 6.0.14 (Boersma & Weenink, 2016). The measurement of F1 and F2 in Hertz was done at midpoint of each vowel (Ladefoged, 2003; Pillai & Yusuf, 2012; Yusuf, 2013; Yusuf & Pillai, 2016) by using the LPC or the automatic linear predictive coding located in Praat. Hayward (2000) mentioned that the first and second formants are important because it is used to analyze the perception and recognition of vowels with F1 for the upper and lower dimensions, and F2 for the front and rear dimensions. The duration of each vowel was also measured using milliseconds from the beginning and ending of its production (see Figure 1). With each respondent producing each word in the carrier sentence as much as six times, and thus as much as 660 tokens were measured. Later, the measurements were input into Exel and converted into Bark scale (Zwicker & Terhardt, 1980) and plotted in the F1-F2 vowel

space. Bark scale was used because the scale is "a good approximation of actual thinking of frequency analysis based on hearing" (Kent & Read, 2002, p. 115).
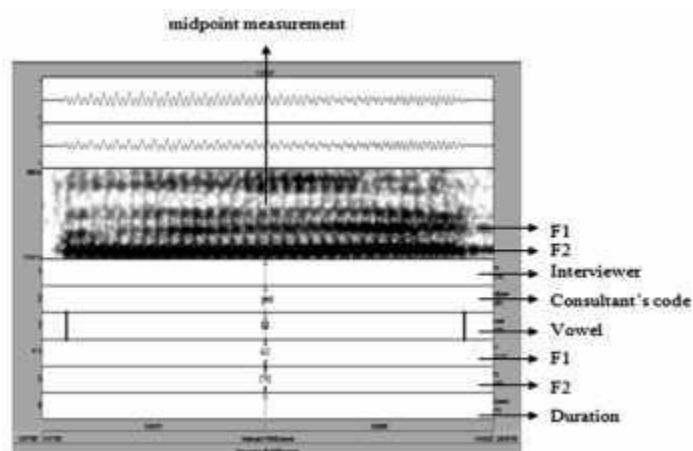

Figure 1. Example of monophthong vowel measurement in Praat (Yusuf. 2013, p. 108)

Results and Discussion

The average F1 and F2 of each vowel is presented in Table 1 (male speakers) and Table 2 (female speakers).

Table 1. The average F1 and F2 of the male female speakers for each vowel.

Vowel	Target Word	Duration (sec)	Ave. F1 (Hz)	Ave. F2 (Hz)	Ave. F1 (Bark)	Ave. F2 (Bark)
I	*bib*	0.164	371	2279	3,58	13,98
i	*beep*	0.209	380	2253	3,66	13,85
e	*beck*	0.194	654	1970	6,02	13,00
a	*back*	0.181	669	1896	6,13	12,75
ʌ	*buck*	0.167	773	1435	6,94	10,88
ɑ	*bard*	0.184	717	1258	6,52	10,01
u	*boot*	0.179	435	1035	4,16	8,71
ɔ	*bought*	0.169	663	1190	6,08	9,60
ɜ	*burp*	0.171	558	1325	5,23	10,35
ɒ	*pot*	0.146	678	1149	6,21	9,38
ʊ	*put*	0.146	461	1037	4,39	8,74

Table 2. The average F1 and F2 of the female speakers for each vowel.

Vowel	Target Word	Duration (sec)	Ave. F1 (Hz)	Ave. F2 (Hz)	Ave. F1 (Bark)	Ave. F2 (Bark)
I	*bib*	0.134	454	2607	4,33	14,74
i	*beep*	0.158	455	2620	4,34	13,11
e	*beck*	0.163	713	2347	6,48	14,10
a	*back*	0.160	712	2358	6,48	14,13
ʌ	*buck*	0.160	845	1587	7,46	11,56
ɑ	*bard*	0.168	806	1453	7,21	11,05
u	*boot*	0.128	523	1110	4,95	9,18
ɔ	*bought*	0.125	663	1206	6,00	9,73
ɜ	*burp*	0.160	596	1459	5,60	11,09
ɒ	*pot*	0.1294	742	1246	6,69	9,95
ʊ	*put*	0.105	543	1148	5,11	9,40

From the data presented in Table 1 and Table 2, the following vowel plots for each vowel produced the male and female speakers can be seen in Figure 2.
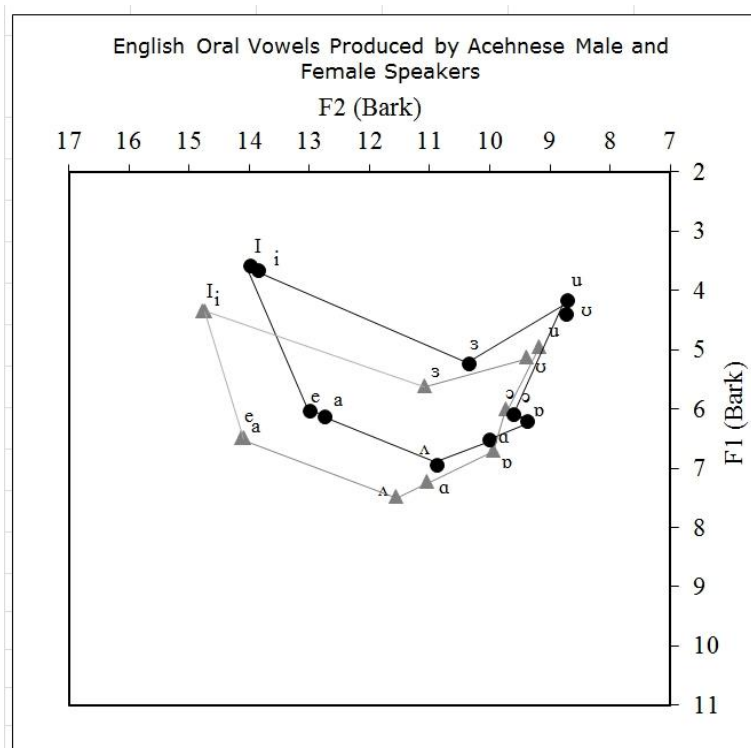

Figure 2. The English vowel plots for the male (black dots) and female (grey dots) in the vowel space.

In general, Figure 2 shows that the males produced English vowels more higher and back compared to the females which are more fronted and low. Some theories have shown that the formants (F1 and F2) in the pronunciation of the vowels between male and female speakers are very different (Jacobi, 2009). In addition to gender and age, this difference supports the theory that the vocal cords between men and women greatly affect the pronunciation of the vowels themselves (Ladefoged, 2003).

Moreover, Figure 2 roughly shows that most of the English vowels produced by the Acehnese male and female speakers are seen to be produced similarly. For example, both male and female produce /I/ and /i/ closely together. Other vowels are such as /e/ and /a/, /u/ and /ʊ/, and /ɒ/ and /ɔ/. Nevertheless, to determine whether these near vowels are produced significantly similarly or not, further t-tests need to be conducted. Meanwhile, the vowels /ɜ/, /ʌ/, and /ɑ/ are produced quite distinctively from each other in the vowel space. Again, t-tests are also needed to confirm their distinction. This suggestion is recommended for further investigation in related future research.

Conclusions
The results of this pilot study have shown the vowel plots of English vowels produced by the Acehnese male and female speakers, which are: (/I/, /iː/, /e/, /a/, /ʌ/, /ɑː/, /ɒ/, /ɔː/, /ʊ/, /uː/, and /ɜː/. The findings showed that there are vowels which are seen to be produced similarly by the speakers, such as: /I/ and /i/, /e/ and /a/, /u/ and /ʊ/, and /ɒ/ and /ɔ/. To verify their similar production or not, we recommend t-tests to be conducted in the future study of this research.

Acknowledgements

References

Achmad, D., & Yusuf, Y. Q. (2014). Activities to overcome EFL learners' pronunciation problems. *RATE Issues, Summer.* Retrieved from http://rate.org.ro/media/blogs/b/newsletter13.html?mtime=1434569609

Boersma, P., & Weenink D. (2016). *Praat: doing phonetics by a computer*. Retrieved from http://www.fon.hum.uva.nl/praat/

Deterding, D. (2000). Measurements of the /eɪ/ and /əʊ/ vowels of young English speakers in Singapore. In A. Brown, D. Deterding & Low, E. L. (Eds.), *The English language in Singapore: Research on pronunciation* (pp. 93-99). Singapore: Singapore Association for Applied Linguistics.

Deterding, D. (2003). An instrumental study of the monophthong vowels of Singaporean English. *English World-Wide, 24*(1), 1-16.

Escudero, P., T. Benders, & S.C. Lipski. (2009). Native, non-native and L2 perceptual cue weighting for Dutch vowels: The case of Dutch, German, and Spanish listeners. *Journal of Phonetics, 37*, 452–465.

Escudero, P., & Williams, D. (2011). Perceptual assimilation of Dutch vowels by Peruvian Spanish listeners. *Journal of the Acoustical Society of America, 129*(1). E1–E7.

Fox, R. A., Flege, J. E., & Munro, M. J. (1994). A multidimensional scaling analysis of Spanish and English vowels. *Journal of the Acoustical Society of America, 97*, 2540-2551.

Hayward, K. (2000). *Experimental phonetics.* Harlow, UK: Pearson Education.

Iverson, P., & Evans, B. G. (2007). Learning English vowels with different first-language vowel systems: Perception of formant targets, formant movement, and duration. *Journal Acoustic Society, 122*(5), 2842–2854.

Jacobi, I. (2009). *On variation and change in diphthongs and long vowels of spoken Dutch.* (Published doctoral dissertation). University of Amsterdam, Amsterdam. Available at: http://www.fon.hum.uva.nl/theses/IreneJacobiPhD2009.pdf

Kent, R. D. & Read, C. (1992). *The acoustic analysis of speech.* San Diego, CA: Singular Publishing Group.

Ladefoged, P. (2003). *Phonetic data analysis: An introduction to fieldwork and instrumental techniques.* Oxford: Blackwell Publishing.

Li, C-Y. (2004). Acoustic analysis of Taiwanese learners' pronunciation in English vowels. Journal of Language and Learning, 2(2), 186-201.

Pillai, S. (2014). The monophthongs and diphthongs of Malaysian English: An instrumental analysis. In Shakila, A.M. & Hajar A.R. (Eds.), *English in Malaysia: Postcolonial and beyond* (pp. 55 – 86). Frankfurt: Peter Lang.

Pillai, S., Don, Z. M., Knowles, G., & Tang, J. (2010). Malaysian English: An instrumental analysis of vowel contrasts. *World Englishes, 29*(2), 159–172.

Pillai, S., Manueli, M. K., and Dumanig, F. P. (2010). Monophthong vowels in Malaysian and Philippine English: An exploratory study. *Philippine Journal of Linguistics, 41*, 80-93.

Pillai. S. & Salamae, W. (2012). An instrumental analysis of English monophthongs produced by Thai EFL learners. *Pertanika Journal of Social Sciences & Humanities 20*(4), 1143 - 1160.

Pillai, S., & Yusuf, Y. Q. (2012). An instrumental analysis of Acehnese oral vowels. *Language and Linguistics, 13*(6), 1029-1050.

Sharbawi, S. (2006). The vowels of Brunei English: An acoustic investigation. *English World-Wide, 27*(3), 247-264.

Tsukada, K. (2008). An acoustic comparison of English monophthongs and diphthongs produced by Australian and Thai speakers. *English World-Wide, 29*(2), 194-211.

Yap, N.T., B.E. Wong & A. Yasran. (2010). Representation of vowels by bilingual speakers. *Pertanika Journal of Social Sciences & Humanities, 1*(2). 379–389.

Yusuf, Y. Q. (2013). *A comparative study of vowels in the Acehnese language spoken in Kedah, Malaysia and Aceh, Indonesia* (Doctoral dissertation). University of Malaya, Kuala Lumpur.

Yusuf, Y. Q., & Pillai, S. (2016). An instrumental study of oral vowels in the Kedah variety of Acehnese, *Language Sciences, 54*, 14–25.

Zwicker, E. & Terhardt, E. (1980). Analytical expression for critical bandwidths as a function of frequency. *The Journal of the Acoustical Society of America, 68,* 1523-1525.