Measurements of the /eɪ/ and /əʊ/ vowels of young English speakers in Singapore

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Introduction

Many researchers (eg Tay 1982, Brown 1991, Deterding & Hvitfeldt 1994, Deterding & Poedjosoedarmo 1998:Ch 17, Bao 1998) have claimed that the pronunciation of the vowels /eɪ/ and /əʊ/ is distinctive in the pronunciation of Singaporean English (SgE), exhibiting less diphthongal movement than the corresponding vowels in Standard Southern British English (BrE) pronunciation. The relatively monophthongal pronunciation of these two diphthongs is actually found in many other varieties of English, such as Scottish English, Welsh English, and many varieties of American English (Wells 1982:407, 382, 487).

Some have suggested that these vowels might be represented in SgE as long monophthongs [eː] and [oː] (Tay 1982, Brown 1991:133) or maybe as [e] and [o] if distinctions in vowel length are not maintained in SgE (Deterding & Poedjosoedarmo 1998:156, Bao 1998:155).

These previous studies on SgE have been based on the experience of the researchers in teaching and listening, and none of them have attempted to make measurements of the diphthongs. Furthermore, the previous studies have not considered whether there may be a difference between the different ethnic groups in Singapore.

This paper will investigate the pronunciation of these two diphthongs /eɪ/ and /əʊ/, to try to answer two questions:

1. To what extent is the pronunciation of these two diphthongs different from the corresponding vowels in BrE?
2. Is there any difference in the pronunciation of these two diphthongs between ethnically Chinese and Malay speakers in Singapore?

Data

Ten ethnically Malay Singaporean speakers and ten ethnically Chinese Singaporean speakers were recorded, each talking to the author of this paper about their language usage, and their hopes and aspirations for the future. These speakers were all first-year female trainee teachers at NIE. Recordings were also made of five female British English lecturers, all of whom teach at NIE. A comprehensive description of the speakers and the recording conditions can be found in the section discussing the conversational data in Deterding & Poedjosoedarmo (this volume), where it was demonstrated that the ethnic group

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of most of the speakers can be identified by Singaporean listeners with a high degree of accuracy on the basis of just 8 seconds of speech.

In addition, measurements were made of the vowels of five female BBC broadcasters from the MARSEC corpus (Roach et al 1993). These five speakers were the first broadcaster from the first file in each of the following MARSEC directories: ASIG, DSIG, ESIG, FSIG, and GSIG. The use of the latter material was included to allow comparison with measurements of speakers with a BrE accent taken from a publicly-available corpus. Reference can also be made to measurements of the monophthongs of these same five speakers (Deterding 1997).

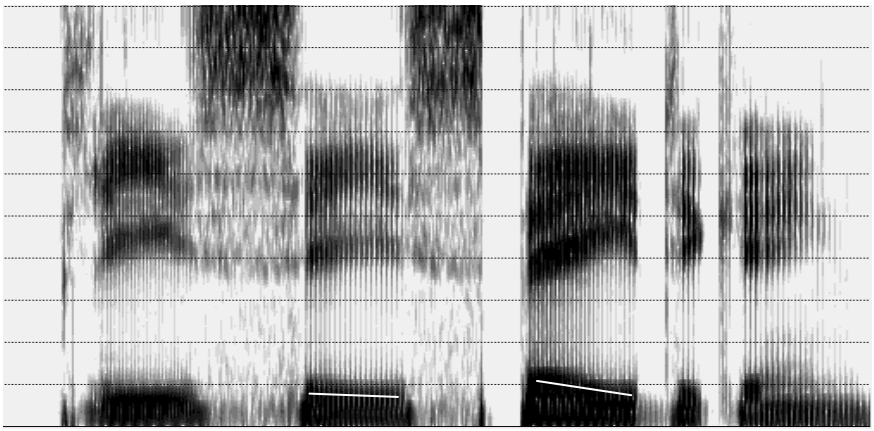
Measurement of diphthongs

It is not clear how best to measure diphthongs. Although it is well established that there is a strong correlation between vowel openness and the frequency location of the first high concentration of energy, known as the *first formant* or F1 (Ladefoged 1993:196), it is harder to determine how to deal with diphthongs, which are characterised by a changing vowel quality.

Closing diphthongs are sounds in which the vowel quality changes from a relatively open position to a more close position during the course of the vowel, and as the vowel quality is becoming less open, we would expect that F1 would decrease. When /eɪ/ and /əʊ / are pronounced as diphthongs, they can be classified as closing diphthongs, so we can look for a decrease in F1 as an indication of how diphthongal they are. However, it would be naïve to expect the difference between F1 at the start and end of the vowel to provide a reliable measure of the degree of diphthongization, because the absolute change in frequency must inevitably depend on the duration of the vowel.

An alternative approach is to measure the *rate of change* (ROC). To achieve this, we find the difference in F1 at the beginning and end of the vowel and divide by the duration. The figure thereby obtained is in Hertz per second, and we would expect this to be negative for a closing diphthong. The use of ROC of a formant is recommended by Gay (1968) and it is one of the possibilities discussed by Kent & Read (1992:103). Measurement of the ROC is illustrated in Figure 1, which shows the spectrogram of a British male speaker saying 'Please say spade again' with the diphthong in *say* spoken almost as a monophthong, while that in *spade* was deliberately made highly diphthongal.

In Figure 1, white lines have been overlaid on the F1 of the two instances of /eɪ/, to illustrate how the measurements were made. The calculation of ROC for these two diphthongs is shown in Table 1. In the actual measurements, the measurement of F1 was made using LPC-based formant tracks overlaid on a digital spectrogram output by CSL software from Kay.



p l i: z s eɪ s p eɪ d ə g e n

Figure 1. Spectrogram of a British male saying 'Please say spade again' directly on to the computer

	Start F1 (Hz)	**End F1 (Hz)**	**Change (Hz)**	**Duration (sec)**	**ROC (Hz/sec)**
say	319	276	-43	0.138	-312
spade	478	276	-202	0.165	-1224

Table 1. Illustration of the measurement of ROC of F1 for the diphthongs in the spectrogram shown in Figure 1

Although this is the approach that will be adopted here, it must be emphasized that it is not the only, or even necessarily the best, way to describe diphthongs acoustically. Other researchers have proposed rather more complex acoustic modelling and description of diphthongs. For example, Ren (1986) makes detailed measurements of the trajectory of F2 at various points in the diphthong, and Clemont (1993) suggests that sometimes even the third formant, F3, must be taken into consideration. However, both of these studies used carefully enunciated citation forms for their data, and it is not clear how such subtle perturbations in the F2 and F3 tracks could be found or measured in the kind of conversational speech used here.

While the simplistic use of ROC of F1 that is adopted here is undoubtedly inadequate to provide a comprehensive acoustic modelling of the diphthongs, it may suffice to give an indication of different diphthong usage between the groups being studied.

For each of the speakers, 20 tokens of each of the /eɪ/ and /əʊ/ vowels were measured. In selecting words for measurement, particular care was taken to avoid vowels followed by segments such as /l/ which would have a substantial influence on the location of F1.

In some cases, it was not possible to make reasonable measurements of F1, and in these cases, the word was ignored and another token sought. Even among those measurements that were included, there was considerable variation between individual tokens of the same speaker, and it is not clear to what extent this reflects true variation in the production of the vowels or limitations in the methods of measurement.

In a few cases, it was not possible to find 20 instances of both /eɪ/ and əʊ/, because the conversation was not long enough; but at least 13 measurements were made in all cases for each vowel.

For many speakers, particularly the Singaporeans, some individual tokens exhibited a positive ROC, and this is to be expected if the vowel is indeed realized as a long monophthong — random variation would predict that a vowel with unchanging quality would sometimes be measured with a small positive ROC. For one Malay speaker, the average value for all the tokens of /əʊ/ showed a small positive value for ROC.

Results

The average ROC for each of the diphthongs for each speaker is shown in Table 2.

It can easily be seen from Table 2 that the ROC for the British speakers is substantially more negative than that for the Singaporean speakers.

There is no significant difference between the two groups of British speakers either for /eɪ/ ($t = 0.085$, $df = 8$, ns) or for /əʊ/ ($t = 0.623$, $df = 8$, ns) and this suggests that we can pool all the British speech.

Using the pooled data for the two sets of British data, we then find that the ROC of the British /eɪ/ is significantly greater than that of the Malays ($t = 6.80$, $df = 18$, $p < 0.01$) and also that of the Chinese ($t = 6.45$, $df = 18$, $p < 0.01$). We also find that the ROC of the British /əʊ/ is significantly greater than that of the Malays ($t = 6.73$, $df = 18$, $p < 0.01$) and also the Chinese ($t = 6.32$, $df = 18$, $p < 0.01$).

		/eɪ/		/əʊ/	
	Speaker	**ROC**	**Average**	**ROC**	**Average**
Malay	M1	-436		-97	
	M2	-118		-82	
	M3	-426		-191	
	M4	-254		-694	
	M5	-336		-646	
	M6	-277		-202	
	M7	-114		-243	
	M8	-417		-440	
	M9	-386		+36	
	M10	-253	-302	-166	-273
Chinese	C1	-395		-19	
	C2	-585		-317	
	C3	-480		-303	
	C4	-926		-523	
	C5	-549		-155	
	C6	-200		+370	
	C7	-528		-467	
	C8	-512		-202	
	C9	-232		-738	
	C10	-342	-475	-260	-261
British lecturers	B1	-681		-904	
	B2	-1812		-1603	
	B3	-1640		-1632	
	B4	-1694		-1118	
	B5	-996	-1365	-823	-1216
BBC British	ASIG	-1027		-1261	
	DSIG	-1522		-1681	
	ESIG	-1044		-771	
	FSIG	-2273		-2018	
	GSIG	-1095	-1392	-1202	-1387

Table 2. Average Rate of Change (ROC) in Hz/sec for the /eɪ/ and /əʊ/ vowels of ten Malay and ten Chinese Singaporean speakers, and ten British speakers

When comparing the two different Singaporean groups, we find that the ROC of the Chinese /eɪ/ is a little greater than that of the Malays, and this just reaches the 5% significance level ($t = 2.29$, $df = 18$, $p < 0.05$); but there is no significant difference between the measurements for /əʊ/ ($t = 0.09$, $df = 18$, $p > 0.05$).

These ROC are slightly higher than those found by Lee & Lim (this volume), although this may be because of differences in recording conditions.

Discussion

The measurements have shown that Singaporean /eɪ/ and /əʊ/ are indeed less diphthongal than the corresponding vowels in standard British English. This confirms the impressionistic observations of previous studies.

Although the measurements suggest that there may be a difference between the pronunciation of /eɪ/ by Malay and Chinese Singaporeans, with the Chinese exhibiting a slightly greater diphthongal movement, this difference does not extend to /əʊ/. And, given that the difference is small and only marginally significant, we should be cautious in concluding that there really is any substantial difference in the pronunciation of /eɪ/ on the basis of these data. Further research is needed on this.

Given the large difference between the British and Singaporean pronunciation of these two diphthongs and the small or non-existent difference in their pronunciation by the two Singaporean ethnic groups, we can conclude that they serve as identity markers for speakers as Singaporeans, but provide little if any clue to the ethnic group of the speaker. Listeners' ability to identify correctly the ethnic group of speakers must be based on other features of speech, such as intonation and rhythm.

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