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An Instrumental Analysis of English Vowels Produced by Omanis

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Abstract

This article examines the pronunciation of English monophthongs by ten male Omani speakers. Vowel quality was measured according to the frequencies of the first (F1) and second formants (F2), and vowel duration was measured to investigate length contrasts between typical vowel pairs. The findings suggest that the vowels produced by the Omani speakers occupied a similar vowel space as British English vowels although individual vowels have different qualities. The vowels also showed a length contrast between vowel pairs with quality contrast being less distinctive. In addition, the vowels produced by the Omani speakers were similar to those produced by Arabic speakers from different regions, giving rise to the perception of an Arabic-accented English. Although the findings presented in this article are preliminary in nature, they contribute to the growing body of research on the production of vowels in different varieties of English.

Keywords: vowels, Arabic English, instrumental analysis, vowel quality, vowel length, Omani English

1. Background

Global English is today spoken in a multitude of accents, and one of the major differences in the pronunciation of English lies in the realisation of vowels in different varieties of English (see e.g. Maxwell & Fletcher, 2009; Mutonya, 2008; Salbrina, 2006; Yan & Vaseghi, 2003). Since differences in the number of vowels and in vowel quality have been found in varieties of English as a first (L1) and second language (L2), the same phenomenon can be anticipated in the English vowels produced by Omanis whose L1 is usually Arabic.

Most references claim that Modern Standard Arabic has just six vowels: three short and three long, and no diphthongs (e.g. Al-Ani, 1970; Alghamdi, 1998; Kotby et al., 2011; Newman, 2002). Arabic thus has a smaller vowel set compared to English (Mitchell, 1993).

1.1. Arabic-Accented English

Arabic-accented English has been investigated by Flege and Port (1981), Mitleb (1981) and Munro (1993). The findings from these studies suggest that speakers from different parts of the Arab world display similar characteristics in the way

that they produce English sounds. These include a lack of vowel length contrast and the tendency to produce diphthongs as monophthongs. However, like Mitleb (1981), Munro (1993) found that Arabic speakers used a greater difference of duration to make a vowel length contrast than American English speakers. These findings were derived from the production of English vowels by Arabic speakers from seven Arabic speaking countries, and compared to the vowels of 23 native speakers of American English. Munro (1993, p. 51) explained that the durational ratios used by the Arabic speakers in making English tense and lax vowel pairs tended to be similar to the ratios in similar vowel pairs in Arabic, which suggests that the subjects in his study "may have applied Arabic perceptual and productive strategies to English". He suggests that in view of the greater length contrast in Arabic, there tends to be an exaggeration in length difference in English vowel pairs, which unlike Arabic vowels, may also be contrasted in terms of their quality. However, Munro (1993) reported that on average, all the vowels produced by Arabic speakers were consistently shorter that those produced by American speakers, which according to him could be due to a transfer from the length properties of similar Arabic vowels, which are shorter. A similar finding was reported by Cox and Palethorpe (2005) who found that long vowels and diphthongs tend to be shortened by Lebanese Australian speakers.

In relation to vowel quality, Munro (1993) found that the back vowels produced by Arabic speakers tend to be similar to their analogous Arabic vowels. Other studies of Arabic speakers' production of English vowels also showed similarities across speakers from different regions. For example, Jordanian and Saudi speakers were found to transfer length contrast as in Arabic to their English vowels (Flege & Port, 1981; Mitleb, 1981).

1.2. Acquiring Sounds in L2

Flege's (1995) Speech Learning Model (SLM) posits that the acquisition of L2 sounds depends on the level of perceived similarity between phonemes in the first and second language, with phonemes with a higher level of dissimilarity being easier to acquire than those that are similar. The rationale for this model is that when a different phoneme is encountered in L2, the differences are noticed or perceived and following this, learners are able to create a new category for the particular phoneme (Flege, 1995). On the contrary, L2 sounds which are similar to L1 sounds will be merged with existing L1 categories and therefore, it can be expected that such sounds will be less native-like (Flege, MacKay & Meador, 1999).

There is a problem, however, with SLM in relation to the identification of perceived similarity between sounds, and perhaps because of this, other studies have found contrary evidence on the relationship between perceived similarity and the level of difficulty of learning L2 sounds. For instance, Munro (1993) did not find the correspondence between the degree of dissimilarity and ease of learning in his study of Arabic speakers and their production of English vowels. Hence, there is still no adequate explanation as to why similar categories of L1

and L2 sounds are easily learnt while those that are more dissimilar may not be learnt and produced accurately.

2. The Present Study

In accordance with the current literature, it can be predicted that Omanis will have fewer problems with vowels with equivalents in Arabic, and more problems with those with no Arabic equivalent. Since length is contrasted in Arabic, it can be assumed that length distinctions between English vowels are unlikely to cause problems for Omanis.

With these two points in mind, this study aims to address the following research questions:

- What are the qualities of English monophthongs produced by the Omani subjects?
- To what extent are contrasts in vowel pairs maintained by the Omani subjects?
- To what extent does Arabic influence the English vowels produced by Omanis?

3. Method

The following sub-sections describe the methodology used in the study.

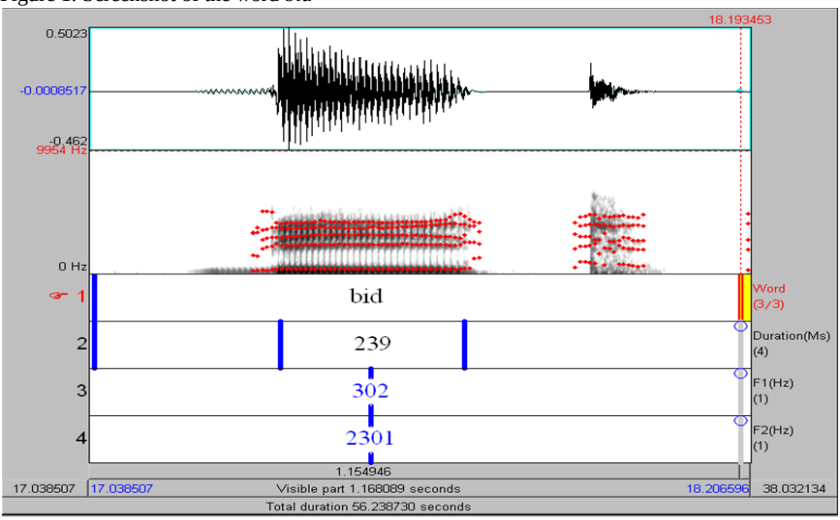
3.1. Subjects

The subjects in this study were 10 male Omani postgraduate students with an average age of 31 (Hubais, 2009). All had Arabic as their L1 and English as their L2, and they had all completed their Bachelor's degree in Oman, where English is the medium of instruction in higher education for most subjects. At the time of the study, they were doing postgraduate courses in Malaysia, where the medium of instruction was English. The subjects used English on a daily basis to communicate with their lecturers and classmates not from Arabic-speaking countries.

3.2. Data

The data consisted of a word list containing the target vowels embedded in a CVC context, in which the consonants were bilabial stops. The rationale for using stops is to ensure easy identification of the target vowel while minimising the effects of co-articulation on the vowel. The use of the stops also made it easier to identify the vowel on the spectrogram and in the waveform (see Figure 1).

Figure 1. Screenshot of the word *bid*



Each target vowel was embedded in two CVC words, making a total of 220 tokens. The words were in turn embedded in a carrier sentence to provide a more natural speaking context. The list of words is provided in the Appendix. In the event, the vowel /ɪ/ for Speaker 3 was removed from the analysis as it was produced as a diphthong. Schwa was not examined in this study as it only appears in unstressed syllables. The recordings were carried out in a quiet place using a headset microphone and a laptop installed with Praat Version 5.0.34 (Boersma & Weenink, 2008). A sampling rate of 44, 100 Hz and 16 bits was used to ensure good quality recordings for instrumental analysis.

3.3. Transcription and Annotation

The recorded data was transcribed and annotated using Praat 5.0.34 (Boersma & Weenink, 2008). The measurements of the first and second formant were taken and annotated. The target vowels were segmented on a wide-band spectrogram, with reference to the related waveform and auditory inspection (see Pillai, Zuraidah, Knowles & Tang, 2010). The first and second formants (F1 and F2) of the vowels were measured at the midpoint of the vowels (see Figure 1), where vowels tend to be at their most steady state, and are considered the most reliable point to measure monophthongs (Hillenbrand, Getty, Clark & Wheeler, 1995). Vowel duration was measured from the onset of the vowel (determined from the beginning of the formant structure following the release of the initial stop) to the offset of the vowel (determined as the point just before the cessation of the acoustic signal for the following stop consonant (see Figure 1). The formants were measured based on Linear Predictive Coding (LPC) formant tracks overlaid on spectrograms generated in Praat. Where the formants shown on the spectrogram were off-mark, the measurements were taken manually.

3.4. Data Analysis

The analysis of the first two formants is based on the Formant Frequency Model (see Watt & Tillotson, 2001). This model is based on the premise that the first and second formants relate to vowel height and advancement/ retraction respectively. Most studies of vowels focus on the first two formants, as these are generally deemed to be important for the perception of vowel quality (see e.g. Flemming & Johnson, 2007; Hawkins & Midgley, 2005).

The average F1 and F2 values for each of the eleven vowels were then converted into the Bark Scale (Zwicker & Terhardt, 1980) in order to plot the vowels on a vowel chart. This conversion provided an indication on the relative quality of the vowels produced by the speakers and enabled a comparison with similarly produced results of other studies. The F1 and F2 values of each speaker's vowels were also generated to examine the distribution of the vowels in terms of how widely each vowel was distributed and also how pairs of vowels contrasted. In relation to this, an F1 vs. F2 vowel plot was used as is common practice in the study of vowels (e.g. Flemming & Johnson, 2007; Hawkins & Midgley, 2005). The mean durations for each of the vowel pairs were also compared to see whether the length contrasts were maintained.

4. Findings

The average distance from the centroid for each vowel was calculated to get an indication of how spread out they were in the vowel space. This was done by calculating the Euclidean distance for all the vowels for /ɜː/ (see Deterding, 1997). The average formant frequencies and Euclidean distance (in Bark) for the Omani subjects are shown in Table 1.

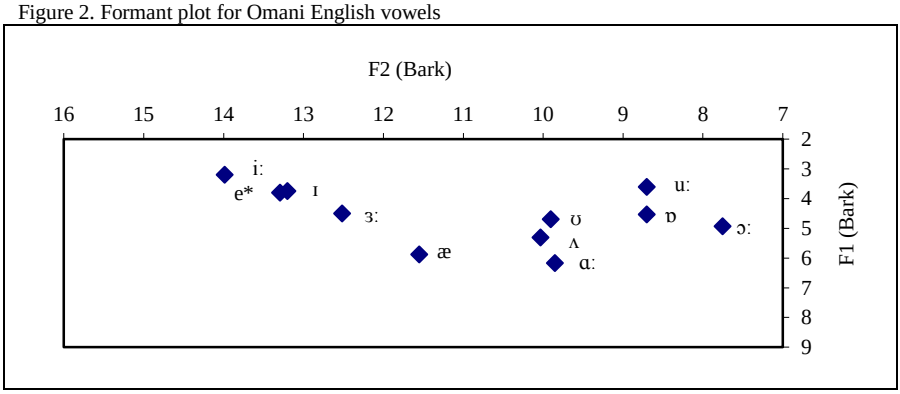
Table 1. Average F1 and F2 of English monophthong vowels produced by male Omani subjects

Vowels	F1 (Hz)	F2 (Hz)	F1 (Bark)	F2 (Bark)	Euclidean Distance (Bark)
ɪ	389	2029	3.75	13.20	2.49
iː	329	2296	3.19	13.98	3.43
e	394	2059	3.80	13.29	2.56
æ	636	1580	5.88	11.55	1.47
ʌ	567	1261	5.31	10.03	1.10
ɑː	672	1227	6.17	9.85	1.88
ɒ	476	1030	4.53	8.70	2.15
ɔː	522	886	4.93	7.75	3.12
ʊ	496	1237	4.70	9.90	0.95
uː	374	1030	3.61	8.70	2.36
ɜː	474	1827	4.51	12.51	1.67
Ave	485	1497	4.58	10.86	2.15

Data from Deterding (1997, p. 49) were used as a comparison to the data in this study to ascertain the extent to which the vowels produced by the subjects were different from native British English models. The average distances from the centroid for the vowels produced by the Omanis and British speakers were compared. In comparison with British English vowels produced in citation form

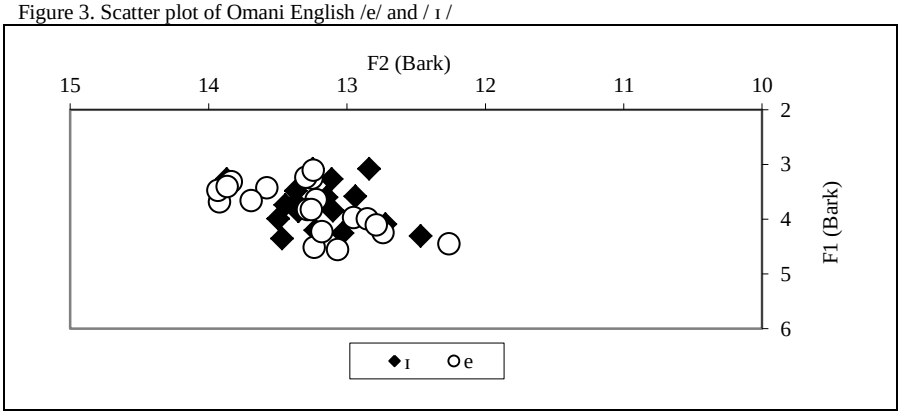
(2.57 Bark), the Omani English vowels (2.15 Bark) proved to be less peripheral. However, according to a correlated samples t-test, there was no significant difference between the average distances for the two sets of data (t = 2.81, df = 9, p > 0.01). An F1 vs. F2 plot generated using the F1 and F2 measurements converted to Bark is presented in Figure 2.

Figure 2. Formant plot for Omani English vowels



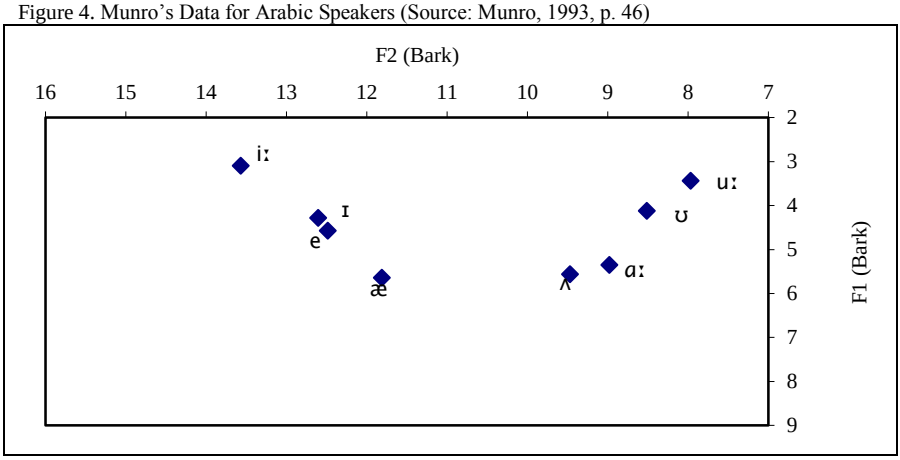
As shown in Figure 2, the vowel /e/ (marked with an asterisk) appears to be collapsed with /ɪ/. Thus, the words *pet* and *bet*, and *pit* and *bit* are realised with a vowel approximating /ɪ/. In a blind perceptual test which involved asking listeners to identify the words being played (*Say pit again* or *Say pet again*), nine subjects were perceived to be producing the word *bit* and only one as *pit*, when in actual fact the word *pet* was being played in each case. The word *pit* was also perceived as having a voiced bilabial stop. This auditory perceptual test further confirms that there is a merger of the /e/ and /ɪ/ vowels by the speakers. A scatter plot of the distribution of these two vowels produced by all the speakers illustrates the overlapping tendency of these vowels (see Figure 3).

Figure 3. Scatter plot of Omani English /e/ and / ɪ /



A similar phenomenon is also evident in Munro (1993) although this is not discussed at length. As depicted in Figure 4 /ɪ/ and /e/ are produced close together by the subjects in his study (Munro, 1993, p. 46), although these vowels are produced lower and more back than the ones produced by the Omani subjects in this study. This could be because of the different phonetic contexts in which the vowels were placed in both studies and also the English-speaking environment of the speakers in Munro's study. The data obtained from Munro's study and the Omani subjects in this study show that the front vowels occupy a similar vowel space with the Omani English vowels being produced slightly more fronted than the ones in Munro's study. On the other hand, there appears to be more differences in the back vowels with those in Munro's study being more back in the vowel space.

Figure 4. Munro's Data for Arabic Speakers (Source: Munro, 1993, p. 46)



It is also interesting to note that not only is there evidence of /e/ being collapsed with /ɪ/, essentially producing one vowel, there is also the phenomenon of the voiceless stop /p/ being perceived as /b/. This can be explained by the lack of aspiration in the production of the voiceless stops. The average Voice Onset Time (VOT) for the stop in *pet* and *pit* produced by the Omani subjects was 14 msec. This results in /p/ being perceived as /b/, and is consistent with findings from other studies on the production of English /p/ by Arabic speakers (e.g. Flege & Port, 1981; Rasmussen, 2007).

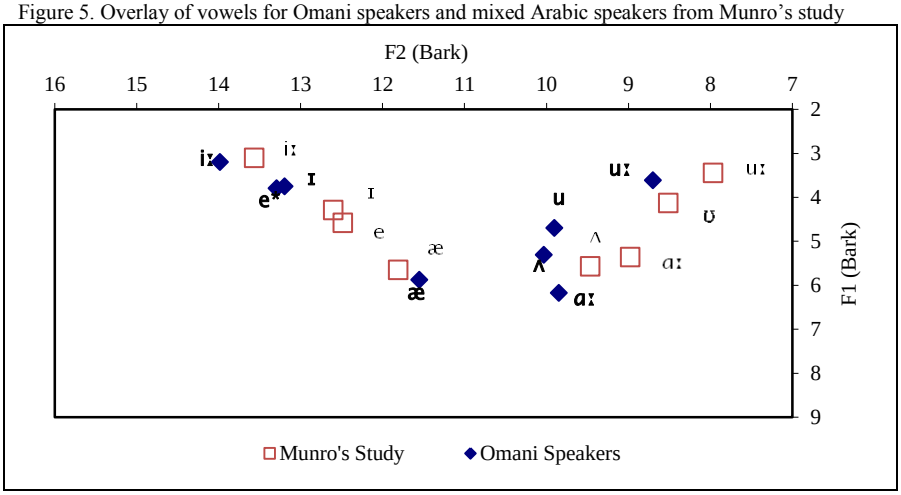
Another vowel that is produced differently is /ɜː/ which was produced in a front rather than central position by the Omani subjects (see Figure 2). Munro's study did not report on this vowel probably because it tends to be rhotacised in American English preceding an *r*, such as in the word *bird*. The speakers in this study also tended to pronounce the post-vocalic *r*, thus affecting the quality of the preceding vowel producing an almost diphthong-like quality. This could explain why /ɜː/ appears more fronted in the vowel chart.

From Figure 2, it can also be noticed that /ɒ/ is produced higher than /ɔː/ and closer to /uː/. To ascertain how different the vowels produced by the Omani

subjects in the present study compared with the speakers in Munro's (1993, p. 46) study, the F1 and F2 of the vowels reported in the latter were compared with the same ones in the present study (see Figure 5 and Figure 6).

Figure 5 shows an overlay of the vowels (except for /ɜː/, /ɒ/ and /ɔː/**)** from both studies to illustrate the similarities and the differences between the vowels produced by Arabic speakers. The conflation of the /ɪ/ and /e/ pairings occurs in both sets of data but while both groups of speakers display similar vowel quality in some instances, which would probably result in the identification of an Arab accent, the differences in vowel quality may be due to the fact that the speakers in Munro's study had been living in the United States for an average of 5.7 years, and also the different regional origins of all the speakers.

Figure 5. Overlay of vowels for Omani speakers and mixed Arabic speakers from Munro's study

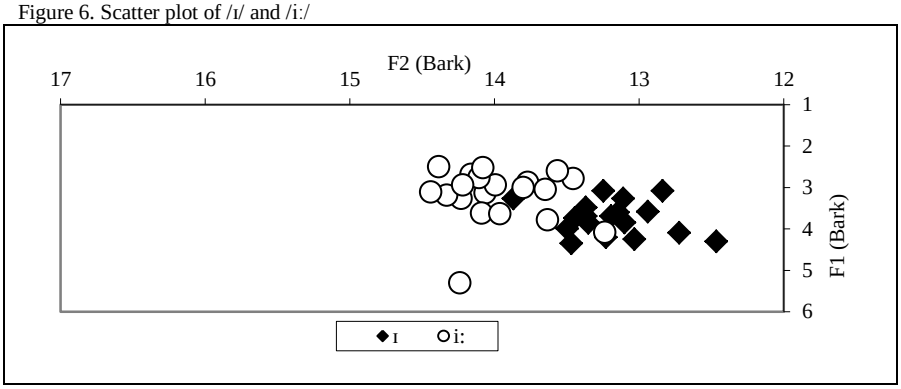


To obtain a clearer picture on the extent to which particular vowel pairs are contrasted, average vowel durations and scatter plots of /ɪ/-/iː/, /ʊ/-/uː/, /ʌ/-/ɑː/ and /ɒ/-/ɔː/ were generated. Since /e/ appears to be closer to /ɪ/ (see Figure 2), the vowel pairs, /e/ and /æ/, were not included in this analysis.

4.1. Vowel Contrast between /ɪ/ and /iː/

A scatter plot for the vowel pair /ɪ/ and /iː/ indicates that /iː/ was produced higher and more front than /ɪ/ (see Figure 6). This is similar to Munro's findings, where the F1 is higher for /ɪ/ (449 Hz) than for /iː/ (319 Hz), indicating a lower vowel. Further, the F2 for /iː/ is higher than for /ɪ/, indicating that the former is a higher vowel. Although the two sets of vowels do not overlap very much, they appear quite close to each other on the chart suggesting that there is a lack of contrast in terms of quality between them.

Figure 6. Scatter plot of /ɪ/ and /iː/

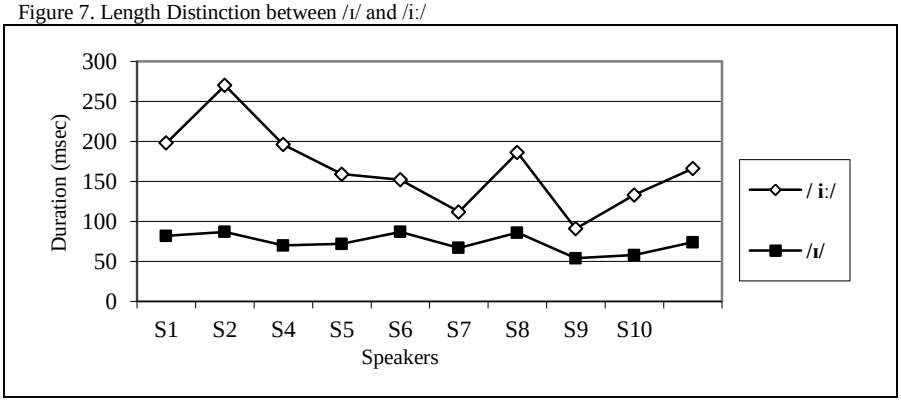


In terms of vowel length, all the speakers distinguish between /iː/ and /ɪ/ (see Table 2), with the mean length for /iː/ being 166 msec and 74 msec for /ɪ/, resulting in a short/long ratio of .44. This finding is similar to Cox and Palethorpe (2005) who found a ratio of .69 for /hVd/ and .73 for /hVt/ contexts for all their vowel pairs. Similarly, Munro (1993) also found that the Arabic speakers in his study tend to exaggerate length contrast between this pair of vowels with a ratio of 1:6, probably imitating such contrast that is present in similar Arabic vowel pairs. The difference in average duration between the vowel pairs of each speaker is evident in Figure 7. The line graph also shows that while the average length is more consistent for /ɪ/ (m = 74 msec, s.d. = 13 msec), that of /iː/ is more distributed (m = 166 msec, s.d. = 54 msec). The inconsistent distribution in the average duration for /iː/ could be due to speakers' idiosyncrasies.

Table 2. Comparison of the average duration of /ɪ/ and /iː/ (in msec.)

Speakers	S1	S2	S4	S5	S6	S7	S8	S9	S10	Average
/ iː/	198	270	196	159	152	112	186	91	133	166
/ɪ/	82	87	70	72	87	67	86	54	58	74
Difference	116	183	126	87	65	45	100	37	75	92

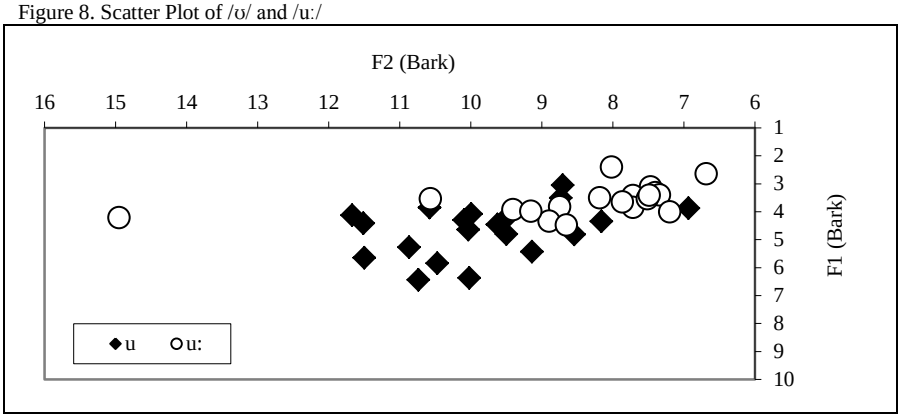
Figure 7. Length Distinction between /ɪ/ and /iː/



4.2. Vowel Contrast between /ʊ/ and /uː/

Figure 8 shows the distribution of the /ʊ/ and /uː/ vowels produced by the subjects, where it can be seen that there is an overlap between the two vowels where vowel quality is concerned. The F1 for /ʊ/ (496 Hz) is higher than for /uː/ (374 Hz) indicating that the former is produced more open. The F2 for /ʊ/ (1237 Hz) is slightly higher than for /uː/ (1030 Hz) which suggests that it is more fronted. A similar finding was reported in Munro (1993).

Figure 8. Scatter Plot of /ʊ/ and /uː/

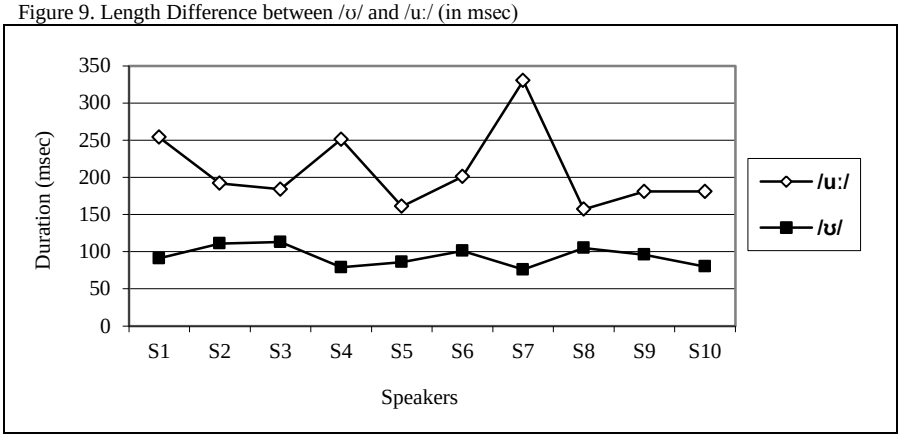


In relation to length contrast, similar to previous studies, length is contrasted with the ratio of short to long vowels being 0.45 (see Cox & Palethorpe, 2005; Munro, 1993). The average duration of /uː/ (m = 209 msec, s.d. = 54 msec) is longer than that of /ʊ/ (m = 94 msec, s.d. = 13 msec) as shown in Table 3, and is comparable to the average durations reported in Munro (1993, p. 44), which are 221.6 msec and 154 msec for /uː/ and /ʊ/ respectively. This length contrast is reflected in Figure 9, which shows the average duration for /uː/ being consistently higher than for /ʊ/ despite the inconsistent pattern among the speakers. For example, Speaker 7 tended to exaggerate length in words like *booed* and *cooed* resulting in a mean duration of 330 msec for /uː/, the highest among all the speakers.

Table 3. Comparison of the average duration of /ʊ/ and /uː/ (in msec)

Speakers	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	Average
/uː/	254	192	184	251	161	201	330	157	181	181	209
/ʊ/	91	111	113	79	86	101	76	105	96	80	94
Difference	163	81	71	172	75	101	254	52	85	101	115

Figure 9. Length Difference between /ʊ/ and /uː/ (in msec)



4.3. Vowel Contrast between /ɒ/ and /ɔː/

Figure 10 shows the distribution of /ɒ/ and /ɔː/, where it can be seen that there is a tendency for the two vowels to overlap in terms of vowel quality. Although the pattern of distribution is inconsistent, probably due to difficulties in producing these back vowels by the speakers, there is a general tendency for /ɒ/ to be produced more front than /ɔː/, and this is attested by the higher F2 of this vowel (1030 Hz). Comparison with Munro (1993) is not made for this vowel pair as Munro used American English as a reference point, where this vowel is generally replaced by /ɑ/. The average durations for the vowel pair are shown in Table 4 and illustrated in the line graph in Figure 10.

Figure 10. Length contrast between /ɒ/ and /ɔː/ (in msec)

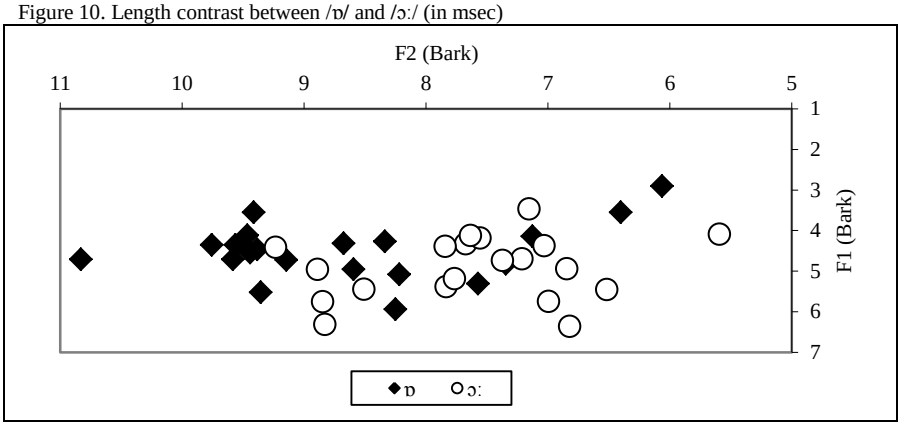
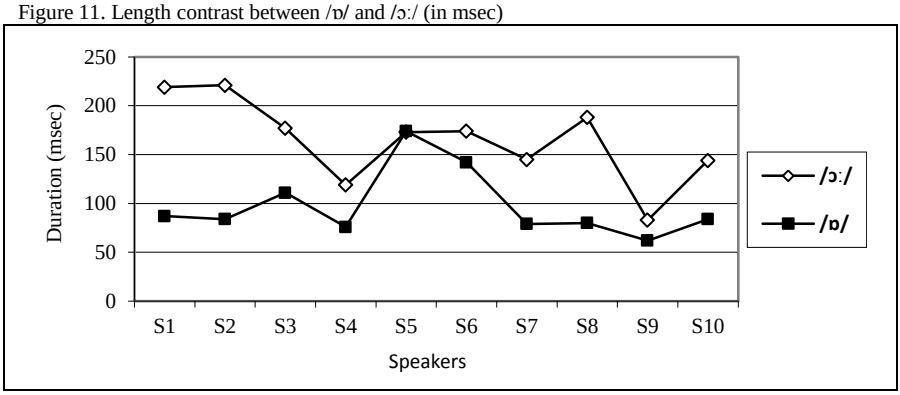


Table 4. Comparison of the average duration of /ɒ/ and /ɔː/ (in msec)

Speakers	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	Average
/ɔː/	219	221	177	119	173	174	145	188	83	144	164
/ɒ/	87	84	111	76	174	142	79	80	62	84	98
Difference	132	137	66	43	-1	32	66	108	21	60	66

The mean length differences for /ɔː/ (m =164 msec, s.d. = 50 msec) and /ɒ/ (m = 98 msec, s.d. = 43 msec) are the most inconsistent among the pairs examined in this study. Again like the inconsistent pattern for vowel quality, this could indicate that the speakers were having difficulties in the production of these back vowels. Although length is contrasted, for seven of the speakers the difference in mean duration is below 100 msec, and for one speaker (S5) vowel length is not discriminated.

Figure 11. Length contrast between /ɒ/ and /ɔː/ (in msec)



4.4. Vowel Contrast between /ʌ/ and /aː/

From Figure 12 , it can be seen that there is considerable overlap between /ʌ/ and /ɑː/ but with the latter being produced lower than /ʌ/. This is reflected in the higher F1 average of /ɑː/ (672Hz) compared to /ʌ/ (672Hz). The average durations for the vowel pair are shown in Table 5 and illustrated in the line graph in Figure 13 which shows that the speakers consistently produced /ʌ/ (m = 93 msec, s.d. = 35 msec) with a shorter duration than /ɑː/ (m =184 msec, s.d. = 37 msec). Although the quality of the two vowels differs from British English, the same trend can be observed in Southern British English (Deterding, 1997).

Figure 12. Scatter plot of /ʌ/ and /ɑː/

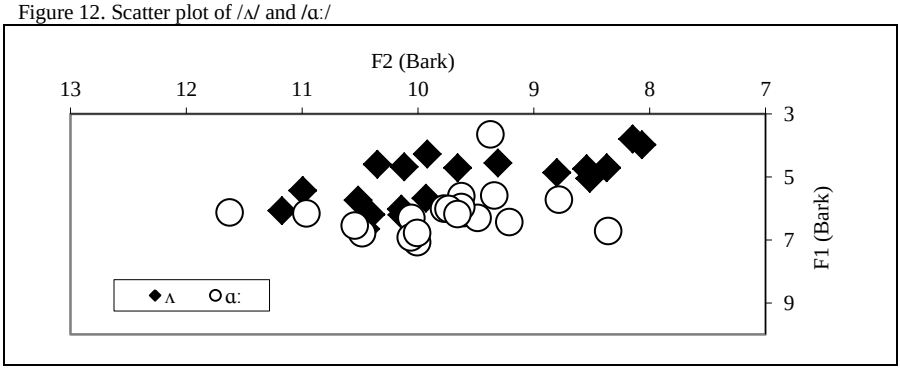
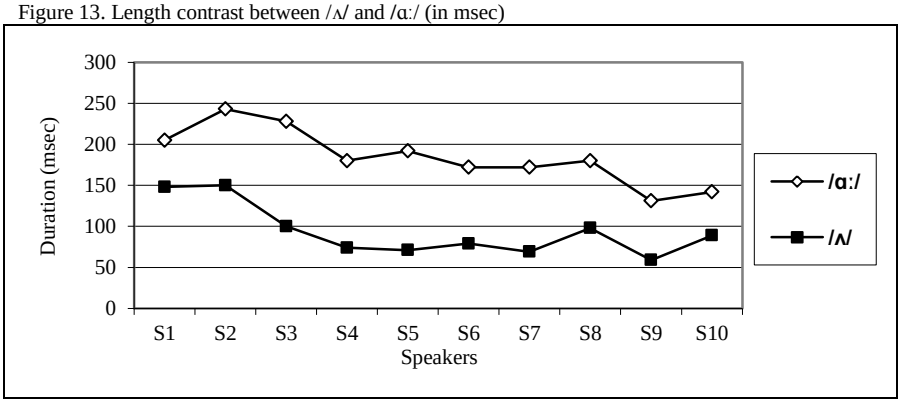


Table 5. Comparison of the average duration of /ʌ/ and /ɑː/ (in msec)

Speakers	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	Average
/ɑː/	205	243	228	180	192	172	172	180	131	142	184
/ʌ/	148	150	100	74	71	79	69	98	59	89	93
Difference	58	93	129	106	121	93	104	82	72	53	91

Figure 13. Length contrast between /ʌ/ and /ɑː/ (in msec)



The analysis of the four vowel pairs are consistent with previous studies which show that Arabic speakers tend to maintain, if not exaggerate, length contrast even if vowel quality is not strongly contrasted. This is perhaps to be expected given that Arabic has been found to have a short to long vowel ratio of 0.51 (Alghamdi, 1990, as cited in Alghamdi, 1998).

4.5. Influence of Arabic Vowels

The analysis on vowel quality and vowel contrast show that the Omani subjects in this study displayed particular characteristics when producing English vowels. These include the merger of /ɪ/ and /e/ and the fronting of /ɜː/ as well as the indefinite pattern of length discrimination for the rounded back vowels, /ɔː/ and /ɒ/. Since the L1 of the subjects is Arabic, this study sought to examine the possible influence of Arabic vowels on their production of English vowels. The basis of the comparison is that the speakers may transfer the properties of Arabic vowels to their production of analogous English vowels. Thus, since Modern Standard Arabic has /i/, /a/ and /u/ and their lengthened counterparts, the Omanis may produce corresponding English vowels with similar acoustic characteristics as their Arabic counterparts in terms of vowel quality and length contrast. On the other hand, it might be expected that Arabic speakers will have problems with the vowels that are not present in Arabic. Measurements for F1 and F2 were obtained from Al-Ani (1970, p. 23) to enable comparison with the data from this study (see Table 6).

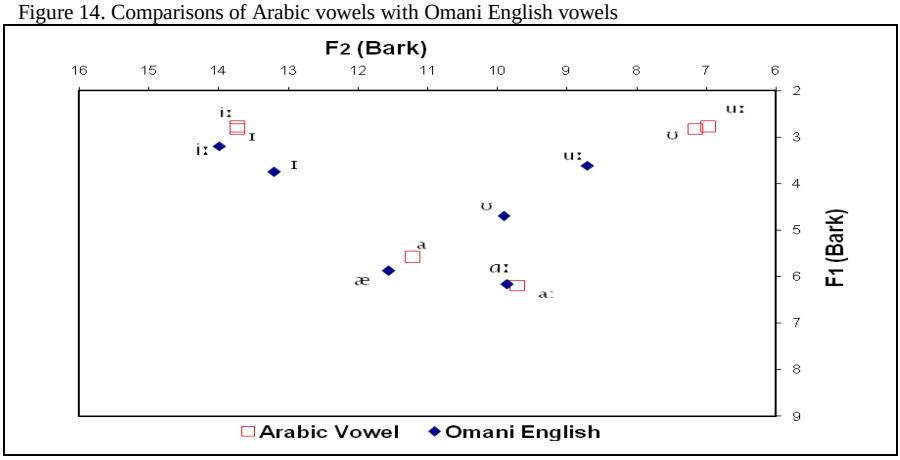
Table 6. F1 and F2 of Arabic Vowels (Source: Al-Ani, 1970, p. 23)

Arabic vowels	F1 (Hz)	F2 (Hz)	F1 (Bark)	F2 (Bark)
iː	285	2200	2.78	13.71
i	290	2200	2.83	13.71
a	600	1500	5.58	11.20
aː	675	1200	6.19	9.70
u	290	800	2.83	7.14
uː	285	775	2.78	6.96

A juxtaposition of Arabic vowels and similar English vowels is presented in Figure 14 which shows the Arabic vowels being produced more peripherally than the Arabic English vowels. There is some indication of Arabic vowel quality spilling over into the speakers' production of English vowels for /iː/, /æ/and /ɑː/ but not for /ʊ/ and /uː/ which is more fronted than the Arabic equivalents. The latter reflects the trend in British English of fronting back vowels (Fabricuis, 2007; Ferragne, & Pellegrino, 2010).

The Omanis produce English /iː/ quite similarly to Arabic /i/ and / iː/, while /æ/ is produced with a similar quality to Arabic /a/, and /ɑː/ to Arabic /aː/. However, the lack of vowel quality contrast for Arabic /i/-/iː/ and /u/-/uː/ is not replicated in the production of similar pairs in English. Thus, the speakers distinguished both quality (albeit not so distinctly) and length, which is predictable since Arabic makes use of length contrast more than quality (Alghamdi, 1998). It should be noted that while there appears to be L1 influence on the production of some of the vowels, these vowels are produced similar to British English vowels such as is the case with /iː/ and /æ/ or in the case of /ɑː/ with British English /ʌ/. The vowels which are not present in Arabic such as /e/ and /ɜː/ display different peculiar characteristics with the former merging with /ɪ/, and the latter produced closer to British English /e/.

Figure 14. Comparisons of Arabic vowels with Omani English vowels



5. Summary

In relation to the first research question on the qualities of English monophthongs produced by the Omani subjects, it was found that the vowels occupied a slightly smaller vowel space than British English. However, the quality of most of the vowels showed stark contrast to British English. In general /iː/, /æ/, /ɑː/, /ʌ/ and especially /ɪ/, /ɜː/, /ʊ/ and /ɔː/ appeared to be produced more fronted than in British English. The fronting of /ɜː/ could be attributed to the realisation of the following *r* in the target words by the speakers, while /e/ seemed to have shifted towards /ɪ/, a phenomenon which was found in Munro (1993).

In terms of vowel contrast between vowel pairs, the Omani subjects contrasted vowel length more than vowel quality in the vowel pairs /ɪ/-/iː/, /ʌ/-/ɑː/, /ʊ/-/uː/, and /ɒ/-/ɔː/. The pairs of vowels were produced close to each other with overlaps between the vowels in all these pairs, especially for the back vowels, suggesting that there is no clear separation in terms of how they were produced. In other words, the pairs were not always produced as distinct vowels in terms of quality. While there was evidence of length contrast, there was no uniformity in the average duration of the length difference between these pairs of vowels, and this discrepancy was mainly due to the inconsistent average duration of the long vowels. Still, similar with the findings from previous studies, length distinction was maintained by the Omani speakers.

The Omani subjects produced /iː/ similar to Arabic /i/ and /iː/, while /æ/ is produced similar to Arabic /a/, and /ɑː/ to Arabic /aː/. The implication of this is that they may have assimilated Arabic vowel qualities into their production of corresponding English vowels as predicted by the SLM. However, this phenomenon did not occur for /ʊ/ and /uː/. In Arabic, these vowels are produced more back in the vowel space but the Omani subjects produced /uː/ quite close to the British English equivalent, which is more fronted. The same did not occur for /ʊ/ which is instead a lot more fronted than Arabic /u/ and /uː/. The fronting of these back vowels by the Omani subjects could be a reflection of the current phenomenon in British English for /uː/ fronting, which has also been observed in Brunei and Hong Kong English. The vowels which are not present in Arabic such as /e/ and /ɜː/ display different peculiar characteristics with the former merging with /ɪ/. The Omani subjects also distinguished vowel length in these pairs of vowels, which is predictable since Arabic makes use of vowel length contrast more than quality (Alghamdi, 1998).

6. Conclusion

Based on instrumental analysis, this study showed that Omanis share certain vowel qualities with other Arab speakers of English, contributing to them having perceivable Arab-accented English, and simultaneously, a more distinct variety, which may interfere with intelligibility. It also provided preliminary data and findings from which to launch further research, and which can also inform the teaching and learning of pronunciation, an area that is much neglected in Oman.

The findings from this research imply that particular English vowels may need more attention when it comes to the teaching of English sounds to Omanis. Although there is general acceptance and tolerance of different English accents, there is a possibility that unfamiliar realisations may cause problems of intelligibility especially in cross-cultural communication. This is especially so with the lack of contrast between English /ɪ/ and /e/. Thus, the teaching of English in Oman may need to take into consideration the need to focus on English pronunciation, an area that tends to be glossed over.

However, this study was limited to ten male subjects and therefore constitutes a preliminary look at the production of English vowels by Omanis. In order to obtain a more detailed description of the way in which Omanis produce English vowels, future research should firstly, comprise a bigger number and a wider range of subjects. Secondly, the data collection should be expanded to include different speaking contexts, to enable a richer data set from which to extract vowel quality and length contrast, and include diphthongs as well. Thirdly, the phonetic environment in which the target vowels are placed has to be extended to counter for co-articulatory effects, such as that encountered with the realisation of post-vocalic *-r*. In addition, future research should include perceptual tests to examine the rate of intelligibility, that is, the extent to which listeners from different areas understand Omani speakers and how this correlates with their production of English vowels. Finally, as inadvertently discovered in this study, there are issues with other areas of sound production, such as the lack of VOT for voiceless stops. Thus, there is a need for research into other areas of the English pronunciation of Omanis.

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Appendix

List of words with target vowels

Vowels	Word 1	Word 2
iː	Peat	Beat
ɪ	Pit	Bit
e	Pet	Bet
æ	Pat	Bat
ʌ	Putt	But
ɑː	Part	Bart
ɒ	Pot	Bottom
ɔː	Port	Bought
ʊ	Could	Buddhist
uː	Cooed	Booed
ɜː	Pert	Bert

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