Formant frequencies of /hVd/ vowels in the speech of South Australian females

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Abstract

Various assertions have been made from time to time in the literature about possible regional differences in the pronunciation of Australian English vowels. However, apart from a number of excellent studies of New South Wales speakers, we have very little recent data from other states to substantiate such assertions. This study presents formant frequency data from a group of > 90 young adult female speakers who grew up in South Australia. The results are compared with the most recent data from the most similar subjects in NSW. Amongst the monophthongs very few differences were observed. The major differences appeared amongst the diphthongs. The differences between the two accents are discussed in terms of conservative and innovative trends, without any definite conclusion being reached.

1. Introduction

Mitchell and Delbridge's (1965) groundbreaking work of more than 40 years ago concluded that there was a "great uniformity" in the phonology and phonetics of Australian English across the continent. Their research and the acoustic measurements of Bernard (1970) supported a view which has been the dominant one until comparatively recently, that the major parameter of phonetic and phonological variation in Australian English is social rather than geographical (ranging from 'Broad' through 'General' to 'Cultivated'). Less than 20 years ago Bernard (1989) was still of the opinion that the dialect was "quite unusually uniform throughout its wide domain", apart from what he calls a "trifling odd occurrence of a strange variant expression of /oʊ/ in Adelaide". However, in that same volume (Collins & Blair, 1989) a number of other papers, including Oasa (1989), present evidence of regional variation in both phonetics and phonology.

Since this time much valuable research has been conducted on the pronunciation of Australian English vowels. However, most of this work has either used geographically undifferentiated groups of speakers, predominantly from New South Wales (NSW) (e.g. Harrington, Cox & Evans, 1997) or has focused specifically on NSW speakers (e.g. Cox, 1999, 2006). More recently Squires & McLeod (2003) have carried out a small-scale perceptual study in rural Victoria and Cox & Palethorpe (2003) have published acoustic data on variation within NSW and between NSW and Victoria.

Meanwhile a couple of studies have been conducted using South Australian (SA) speakers, although these are problematic in various ways: Penny (1991) presented contemporary monophthong data from young adult females, using /hVd/ words, but remains unpublished; Penny (1992) presents the diphthong data from the same group as Penny (1991); Penny, Russell & Pemberton (1994), whilst of great interest, in that it compares data from the same group of female speakers recorded in 1945 and in 1992, uses words in connected speech, rather than the standard /hVd/ words. Unfortunately, none of the Penny papers includes formant frequency data in numerical form.

Thus, whilst there are clear indications of regional variation in vowel pronunciation within Australia (e.g. Oasa, 1989; Cox & Palethorpe 2003), there is a relative paucity of reliable data from outside the south-eastern corner of the country. It is to be hoped that a collaborative and comprehensive study of vowel variation across the country will be undertaken before too long. In the meantime a simple but robust study of the formant structure of /hVd/ vowels from an Australian state whose initials are not NSW may be timely and not without interest.

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2. Method

2.1. Subjects

Over a period of 5 years (2002-2006) vowels have been recorded from students enrolled in the second year of the Bachelor of Speech Pathology degree at Flinders University in Adelaide. Only data from young female adults who grew up in South Australia have been included in this study (n=92, mean age 22 years, 3 months), as they form the overwhelming majority in this group.

2.2. Material

The standard /hVd/ word list was used (see e.g. Cox, 2006) and three tokens of each vowel were read from randomized lists. (The 2006 cohort [n=22] recorded the additional word "who'll", in order to produce tokens of the pre-lateral allophone of /u/). In all cases speech was recorded directly on to a computer hard drive in a quiet environment, digitized at 22.05 kHz with 16-bit resolution.

2.3. Analysis

Formant frequencies were measured from LPC displays, measurement points being determined with reference to broad band spectrograms, using the SIL *Speech Analyzer* program (versions varied over the years from 1.5 to 2.7). Vowel targets (one for monophthongs, two for diphthongs) were identified using much the same criteria as Cox (2006). Formants were measured at the centre of the 'steady state' portion(s), if present; otherwise at F1 maximum for open vowels and F1 minimum for close vowels. Close vowels /i/ and /u/ in particular often did not reach this F1 minimum until almost the end of the vowel.

Unfortunately, time constraints did not allow for any formal testing of measurement reliability.

3. Results

Tables 1 and 2 show the mean formant values obtained for all vowel types. In the following sections each set of vowels is compared with the corresponding set from the most recent data for young adult female speakers from NSW (Cox, 2006).

Table 1: Mean formant values of SA monophthongs

vowel	F1(Hz)	F2 (Hz)
i	396	2737
a	940	1504
ɔ	456	875
u	417	1960
ɜ	566	1843
*uɫ	404	988
ɪ	410	2623
e	558	2352
æ	871	1953
ʌ	906	1574
ɒ	678	1139
ʊ	430	1038

**/u/ as in "who'll" (n=22)*

Table 2: Mean formant values of SA diphthongs

vowel	F1(Hz)	F2 (Hz)
aɪ	834	1334
	555	2150
eɪ	816	1952
	425	2563
ɔɪ	461	946
	419	2350
aʊ	843	1807
	575	1214
oʊ	618	1346
	422	2009

3.1. Long monophthongs

NSW data for the long monophthongs are compared with the results of this study in Figure 1. Amongst the long vowels, the /i/ and the /a/ are remarkably similar to those of the NSW data. However, both /u/ and /ɜ/ appear to be less fronted in SA than in NSW, although the former appears to have moved considerably further forward in both accents since Oasa's (1989) study. Amongst the back vowels, /ɔ/ in SA appears to have a somewhat closer articulation than in NSW.

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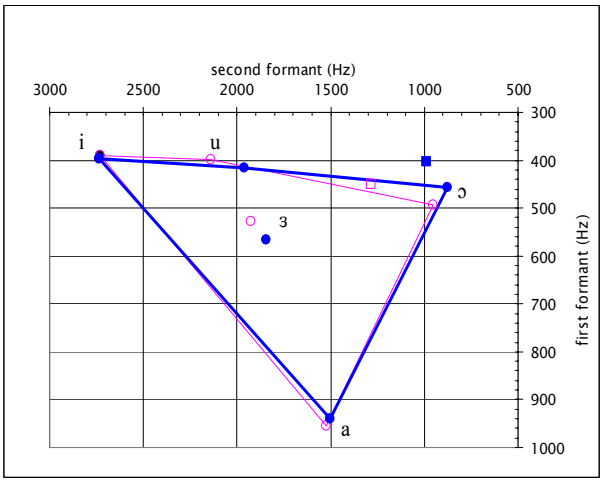

Figure 1: Formant chart comparing long monophthongs in SA (thick lines, filled circles) and NSW (thin lines, open circles). Squares represent the position of pre-lateral /u/ (see text).

3.2. Short monophthongs

The short vowel systems of the two groups of speakers appear to be almost identical. Amongst a few minor differences, the /e/ appears to be more open in the SA speakers than in the NSW group, whereas /æ/, /ʌ/ and /ɒ/ all appear to be somewhat closer.

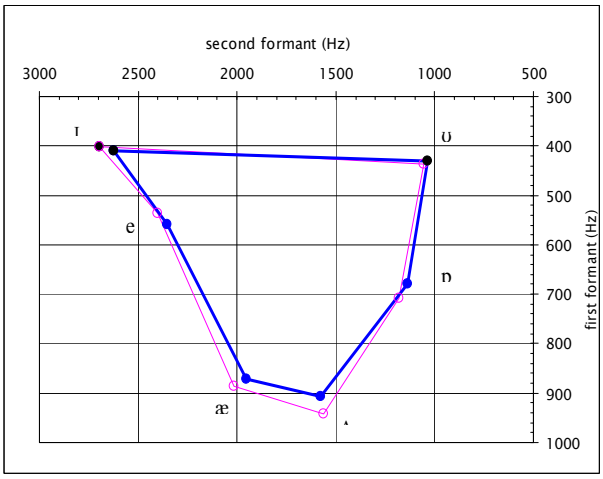

Figure 2: Formant chart comparing short monophthongs in SA (thick lines, filled circles) and NSW (thin lines, open circles)

3.3. Pre-lateral /u/

The solid square in Figure 1 represents the position of the allophone of /u/ produced before dark /l/ by the most recent cohort of speakers. This appears to be considerably more retracted and closer than the comparable variants recorded by NSW speakers (Palethorpe & Cox, 2003), represented by the open square. On the other hand the acoustic distance between each of these variants and its pre- alveolar stop counterpart is quite comparable.

3.4. Diphthongs

It is amongst the diphthongs that the greatest differences are found between the two regional groups. The fronting diphthongs /aɪ/ and /eɪ/ were quite similar across the two groups, with somewhat closer initial targets for SA speakers but with practically identical final targets in both cases. The remaining three diphthongs show some interesting divergences. Both /ɔɪ/ and /aʊ/ start from a considerably closer and more retracted position in the SA speakers. Whilst /ɔɪ/ finishes in a very similar position in both groups, the second target of the /aʊ/ vowel is very much closer in SA speakers (half way between /ɒ/ and /ɔ/, as opposed to more or less at /ɒ/). The most divergent realizations of all were found for the /oʊ/ diphthong. The final target appears to be considerably more retracted in the SA speakers than in the NSW, but in both groups this target is more or less exactly in the region of their long monophthong /u/. It is the massive difference in initial targets for /oʊ/ which is undoubtedly the most striking feature distinguishing the two groups overall. Whereas the NSW vowel begins in the region of a somewhat raised /a/ or /ʌ/, the SA version has as its initial target a raised and fronted /ɒ/.

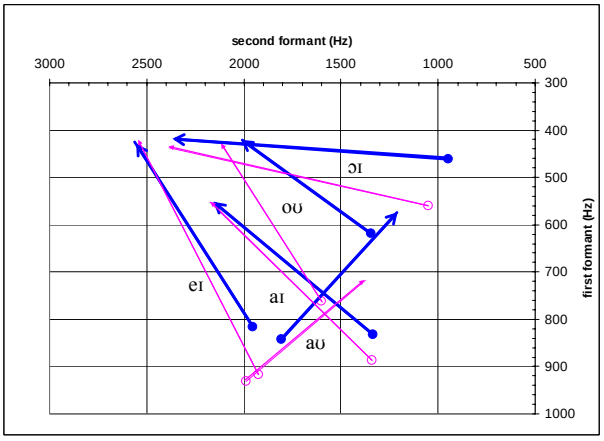

Figure 3: Formant chart comparing diphthongs in SA (thick lines, filled circles) and NSW (thin lines, open circles).

4. Discussion

It is hardly surprisingly that the most striking acoustic difference corresponds to the most audible difference between SA and NSW speakers. Mitchell & Delbridge (1965) found this to be the only regionally distinctive

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sound in their survey, describing the /oʊ/ diphthong in SA as a "curiously variable glide", ranging "from [ɛʊ] to [ɛy], and from [ɔʊ] to [ɒy]". More than two decades later, Oasa (1989) found the range in Adelaide to be between [ɒy] and [ɔy], with variation in degree of lip-rounding on the second target. The findings of the current study would suggest that this is still a fairly accurate summary of contemporary Adelaide pronunciation.

The question remains whether it is possible or indeed useful to account for differences between SA and east coast vowel pronunciations in terms of any overall trend. Perhaps the most obvious approach would be to look at recent historical changes and determine which accent is leading such changes and which is following behind.

As far as the short monophthongs are concerned, the main changes which Cox (1999) has noted between 1960's and 1990's data in NSW are that /æ/ is becoming more open and retracted, whilst /ɒ/ and /ɪ/ are both becoming closer. None of these vowels appear to show very large differences in pronunciation between SA and NSW, although both /æ/ and /ɒ/ are slightly closer in SA. It is not clear whether the more open /e/ of SA is a conservative feature. In the long monophthong system, Cox found that both /u/ and /ɜ/ have become more fronted over the past 30 years. In the case of these two vowels, the differences between the NSW and SA speakers appear to indicate a more conservative pronunciation in the latter case. SA speakers have lower F2 values for both these vowels.

When it comes to the diphthongs, however, the situation is more complex. Cox (1999) found that the first target of /eɪ/ was becoming more fronted in NSW, but the main difference between the two accents with regard to this vowel seems to be that the SA variant has a more raised first target. With respect to /ɔɪ/, Cox noted no great change, but our data again shows the first target to be much closer in SA. The first target of /aɪ/ was found by Cox to be moving back in NSW. Our data show that SA speakers also have a closer first target for this vowel relative to the NSW group, but that the horizontal positions, in terms of F_2 values, are in fact very similar. Cox's data show the second target of /aʊ/ moving up in the vowel space over the years. The present study, on the other hand, indicates that SA speakers have a closer and more retracted articulation than NSW for *both* targets of this diphthong. Finally, Cox indicates that the highly distinctive diphthong /oʊ/ may be 'rotating' in NSW speech – i.e. its first target is becoming closer and its second target more fronted. Whilst the SA variant has a considerably closer first target than that found in the NSW speakers, there is very little difference in the second target, suggesting perhaps that this 'shibboleth' vowel is an SA peculiarity, which is not indicative of systematic change moving in any particular (geographical) direction.

5. Conclusions

Whilst it certainly seems possible that SA speakers are more conservative in terms of 'lagging behind' NSW speakers with respect to the fronting of the two long monophthongs, /u/ and /ɜ/ (and possibly the raising of /e/), there are several other differences, especially among the diphthongs which are not explicable in this way. Rather, there seems to be a general trend for closer articulations (as indicated by lower F_1 values) in SA for open short vowels (/æ/, /ʌ/, /ɒ/) as well as for /ɔ/. At the same time, corresponding elements of the diphthongs seem to show a similar raising in the SA data. These include the first target of /eɪ/ and /aʊ/ (both of which are phonetically in the area of /æ/) and also those of /aɪ/ and /ɔɪ/ (in the areas of /ʌ/ and /ɔ/ respectively). The remaining differences also involve a greater degree of closeness of these four vowels in SA than in NSW, but the differences are so large that they probably should not be described in terms of the same general trend toward (phonetically) closer articulation, but rather in terms of (phonologically) different targets. The second target of /aʊ/, for example, is not in the area of /ɒ/, as in NSW, but firmly in the area of /ɔ/. Similarly, the first target of /oʊ/, which in NSW is in the /ʌ/ area, is not only raised but more rounded in SA, to a point in the area of /ɒ/.

Thus, while a few differences between the NSW and SA data (especially in the long monophthongs) may be indicative of a more conservative pronunciation in the latter state, the majority of differences (especially amongst the open short vowels and the diphthongs), may simply indicate a more general trend to closer articulation in SA. The two most striking differences are among the diphthongs and these may be due to different 'category choices' – i.e. not interpretable as the result of systematic movement of vowels within the phonetic vowel space. In the absence of reliable data from previous generations, we may have to wait another 20 or 30 years to ascertain whether any of these differences are the result of changes still in progress.

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