Reversal of Short Front Vowel Raising in Australian English

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Abstract
In this paper we present the results of a trend analysis comparing acoustic vowel data collected from Australian English speakers over the past 40 years. Results reveal the final stage of short front vowel raising and provide evidence for subsequent lowering as a change in progress. We argue that this result reflects the reversal of a series of vowel changes that have been in progress for over 100 years. These findings raise interesting theoretical questions about the nature of vowel shifts and challenge Bybee’s [1] assertion that sound change reversals cannot occur.

Index Terms: phonetics, vowels, sound change

1. Introduction
Since the 1960s researchers have used the techniques of acoustic analysis to chart the Standard Australian English (SAusE) vowel system and we are therefore fortunate to have access to a large body of data that allows us to trace recent sound change through trend analysis. The major datasets that are at our disposal for this purpose are those of Bernard [2], Cox [3], ANDOSL (The Australian National Database of Spoken Language [4]), and Australian Voices [5]. In each of these datasets, vowels have been collected in a number of phonetic contexts, including the standard /hVd/ frame, making direct comparisons of the citation form possible.

Changes to vowel systems are the inevitable consequence of language in use and provide information that contributes to our understanding of the ecology of linguistic systems, the forces that shape such systems, and human ability to adapt to sound evolution.

Speech sounds change as a consequence of both internal and external pressures [6] but typically remain sufficiently different from one another so that the integrity of the system of contrasts in the language is maintained [7]. It is well known that in vowel systems change to one sound typically affects neighbouring sounds [8]. The requirement for intelligibility (that is, contrast maintenance) may result in the phenomena known as drag- and push-chains where sounds are presumed to “push” and “pull” each other in order that equilibrium be preserved [8]. In functional approaches to phonology, such changes may be considered the consequence of the interplay between the clear speech necessary for intelligibility (hyperarticulation) and the need for physiological economy (hypoarticulation) [7]. In non-functional approaches, change may result from listener based reinterpretation of contextual effects that occur as a result of hypoarticulation ([9], [10], [11]). Regardless of the mechanism, the result is ultimately the maintenance of an efficient and functional system.

The vowel changes that have occurred in Southern Hemisphere varieties of English are often cited as evidence for chain shifting (eg, [12], [13], [14], [8]). These varieties are traditionally considered to exhibit short front vowel raising relative to many British and American dialects [15], [8] and there has been some debate in the literature about the source of this shift. Gordon et al. [15], through an examination of historical data, conclude that the already raised TRAP vowel arrived with the first settlers to New Zealand and continued to influence the vowels in DRESS and KIT through a push chain process. Cox, Palethorpe and Tsukada [16], in a comparison of historical Australian data, suggest that raising of DRESS occurred subsequent to the raising of TRAP, further supporting the push chain hypothesis for the short front vowel change. Over the past 15 years there have been considerable changes to TRAP in SAusE. Cox [17] showed that this vowel had begun to lower and retracted in the 25 years between the late 1960s and 1990s and Cox and Palethorpe [18] show that change has progressed to the extent that / æ / is now situated at the extreme open position in the vowel spaces of their young Australian informants. Mannell [19] has found that listeners’ perception of the short front vowels has changed in parallel with the production change.

In this paper we compare recent acoustic data from young speakers of SAusE in a trend analysis with previous citation form datasets to establish the progression of change in the short front vowels. This examination will be illuminating in the study of sound change because the same vowels in New Zealand English are currently moving in the opposite direction to the Australian change [15]. Some researchers claim that sound change reversals of this type are not possible and use this as evidence to support a usage based model of phonology. Bybee [1] asserts that “sound change has a permanent effect on the lexical representation of the words of a language” ([1]:59). She states that if sound change involved the addition of or modification to rules, as in generative phonology, the underlying forms would remain unchanged and could therefore resurface if the sound change ceased. She argues against generative models on the basis that “Once affected by sound change, old underlying forms never resurface” ([1]:60). We will examine the Australian English vowel data to test whether reversal of sound change does in fact appear to be possible.

2. Method

2.1. Databases
The databases used in statistical comparison with the new data collected for this project include:
- Australian National Database of Spoken Language (ANDOSL, [4]): 12 females < 30 years from Sydney.
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We will also make reference to:
- Australian Ancestors [16]: speakers born in rural areas between 1885 and 1895 and recorded in oral history interviews between 1960 and 1980
- Australian Voices [5]: 15-year-old boys from rural NSW recorded in interviews in 1998.

All speakers selected above use a General Australian accent.

2.2. Speech Data

30 SAusE speaking female university students from Sydney’s northern districts were recorded for this project between 2005 and 2007. All were under 30 years and could be considered speakers of General Australian English. Recordings were made in a sound treated recording studio in the Centre for Language Sciences at Macquarie University. Speakers read from a computer screen the 18 stressed monophthongs and diphthongs of SAusE in the hVd frame three times in random order. The vowels used in this analysis are given in Table 1. /hVd/ words were used to provide a consistent phonetic context for comparison with archival data. Speech data was recorded using an AKG C535 EB microphone, Cooledit audio capture software via M-Audio delta66 soundcard, to a Pentium 4 PC at 44.1kHz sampling rate. The frequencies of the first two formants were automatically tracked using the ESPS/Waves (12th order LPC analysis with a 49 ms raised cosine window and a frame shift of 5 ms). Speaker normalization has not been carried out due to the large size of the sample. Labelling was carried out using EMU [20], (http://emu.sourceforge.net/) with reference to wideband spectrograms and aligned waveforms. The beginning and end of each vowel was labeled according to criteria in [17] and the resulting formant traces were hand-corrected where required. The formant frequencies of F1 and F2 at the vowel target were extracted. Results will be presented in F1/F2 vowel space plots to illustrate the relative positions of the vowels within the monophthong space and will be presented in Hertz to facilitate comparison with earlier datasets.

| Table 1. The words used to elicit /hVd/ vowels |
|-----------------|-----------------|
| HID             | /i/             |
| HEAD            | /e/             |
| HAD             | /æ/             |
| HUD             | /æ/             |
| HOD             | /o/             |
| HOOD            | /o/             |
| HEED            | /i/             |
| HARD            | /æ/             |
| HOARD           | /o/             |
| WHO’D           | /æ/             |
| HEARD           | /o/             |

3. Results

3.1 Comparison 1: Australian Ancestors and Australian Voices

The comparison 1 analysis [16], carried out in 2004, compared continuous speech data from 5 male speakers each from the Australian Ancestors database (speakers born in the late 19th century) and the Australian Voices database (15-year-olds from rural NSW recorded in 1998). This represented a potential one hundred year time difference and found, among other things, lowered /æ/ and raised /e/ and /i/ in the modern group compared with the old group. Figure 1 illustrates these results. It is important to acknowledge that aging could potentially affect the formant data here. However, the results do provide some support for the idea that short front vowel raising continued for /e/ and /i/ throughout the 20th century. We cannot say whether there was any further raising of /æ/ during the 20th century but we know from Cox [21] that /æ/ appeared stable in the years prior to the mid 1960s as no change was present for this vowel in an apparent time analysis based on Bernard’s [2] data from the period.

Figure 1: Comparison 1: Vowels extracted from the continuous speech of 5 male speakers each from the Australian Ancestors (old-archival) and Australian Voices databases (modern-1998).

Figure 2: Comparison 2: The 1965/1990 comparison for monophthongs produced by male speakers discussed in Cox [17] is illustrated here.
3.2. Comparison 2: 1965 and 1990

This analysis from Cox [17] compared data from Bernard’s [2] 27 General Australian speaking 15 year old male pupils from Sydney, recorded in the mid 1960s (1965 data) with data from 60 speakers matched for age and accent from Sydney’s north, recorded in the early 1990s (1990 data). This comparison represents a 25 year time span. Results for the monophthong comparison between the 1965 and 1990 data are represented in Figure 2 and, for the short front vowels, show significantly raised /i/ and lowered and retracted /æ/ in the 1990’s dataset (see [17] for details). Lowering of /e/ was just beyond significance at p< 0.056 possibly indicating the incipient stage of change to this vowel. The 1965 data was only collected from males and we therefore have no citation form data from females before the 1990s.


The current data (henceforth referred to as 2007 data) was compared with the 1990 data [3] and ANDOSL (1995) to determine the more recent changes to the short front vowels. One-way ANOVA with post-hoc t-tests (Bonferroni alpha adjusted) was used to examine the relationship between the independent variables (three datasets) and the dependent variables (F1 and F2). These results are illustrated in Figures 3 and 4. A main effect was found in F1 for each of the short front vowels indicating height differences between the datasets (/i/ F(2,69)=17.19 p<.000, /e/ F(2,69)=47.20 p<.000, /æ/ F(2,69)=28.21 p<.000). Post-hoc comparisons show that for /i/ the 1990 data differs significantly from both ANDOSL and the 2007 data. Although ANDOSL and the 1990 data represent similar periods in history, the 1990 data contains younger speakers and therefore characterizes a later time than ANDOSL. The 1990 /i/ is phonetically closer than that in ANDOSL and the 2007 data (p< .000 in each case). For both /e/ and /æ/, the 2007 production is significantly more open than both the 1990 and ANDOSL datasets (post-hoc: p<.000 in each case). ANOVA also reveals a major significant difference between the 2007 data and the other two datasets for F1 of /æ/ (F(2,69)=49.53 p<.000; post-hoc p<.000 for both comparisons). It is clear from Figures 3 and 4 that this vowel is substantially more open than in the older datasets. For F2, the only main effect to separate the 2007 data from both ANDOSL and 1990 was for /æ/ (F(2,69)=17.51 p<.000: post-hoc tests p<.000 for both comparisons) showing that the most progressive form of this vowel is both lowered and retracted.

4. Discussion

The data reported here provides an indication of how the short front vowels have changed in Australian English over the past 100 years. Much more robust evidence is provided for the recent past, particularly since the 1960s, but the analysis from Comparison 1 does offer some suggestion of how these vowels were realized at a much earlier time in Australian history. This first comparison shows the relationship between the short front vowels that we believe to be present in male speakers around the end of the 19th century. This suggestion is based on the idea that once an individual reaches maturity, their accent may change but will do so more slowly than changes in the community. Therefore, the speech of the elderly men may be suggestive of speech patterns from an earlier time in history. As the speakers in the Australian Ancestors database were born as early as 1885, they would have been around 15 years of age at the beginning of the 20th century.

The raised /e/ and /i/ of the Australian Voices data relative to the much older Australian Ancestors data therefore suggests that raising of these two vowels was in progress throughout the 20th century.

Figure 3: Monophthong comparison between female speakers from the ANDOSL (1995) and 2007 datasets.

Figure 4: Monophthong comparison between female speakers from the 1990 and 2007 datasets.

In comparison 2, we examined the findings from the Cox [17] comparison between 1965 data and 1990 data for young
male speakers. Here the difference for the short front vowels indicates a new change in progress; that of /æ/ lowering. Raising of /ɪ/ is also present, as well as the seeds of change just beginning for the lowering of /ɛ/. It could be argued that this comparison reveals the final stages of short front vowel raising in SAusE with the raised /ɪ/ at the end of its closing progression. Data from comparison 1 also shows a very close /ɪ/ in the speech of 15 year-olds recorded in 1998 providing further evidence that /ɪ/ reached its closest realisation in the late 1990s in the speech of young people.

The comparison 3 analysis of present day speech with two previous datasets representing an approximate 15 year time span, reveals lowering of all the short front vowels. This shift began with /ɛ/ (as evidenced in comparison 2) followed by /ɛ/ and has now extended to /ɪ/. This comparison provides persuasive evidence that short front vowel raising has reversed in SAusE.

The analysis here does not demonstrate any raising of /æ/.

However, raising of /ɛ/ and /ɪ/ through the 20th century and subsequent lowering initiated by /ɛ/ after the late 1960s and followed by /ɛ/ then /ɪ/ offers an interesting insight into the interrelated nature vowel shifts. The changes to these vowels appear to occur in two overlapping stages related in a chain shift fashion. The first stage of raising is facilitated by a push chain process and the second stage, the reversal, which begins before the completion of the first stage, is based on a drag chain effect. Each stage is initiated by changes to /æ/. It is interesting that /ɛ/ also participates in this short vowel change and, as can be seen in all figures above, moves in parallel with /ɛ/. It appears quite clear that the vowel changes documented here represent a reversal of a sound change that continues its trajectory of raising for at least the past 100 years culminating in the most raised variants in the late 1990s. This result challenges Bybee’s [1] assertion that sound change reversals do not occur. The sound change cannot be considered to have resulted in a “permanent effect on the lexical representation” ([1]:59) and this may suggest a level of representation detached from the word.

There are a number of limitations to the present study that restrict the interpretation of results. The data has been drawn from a number of disparate sources, from both continuous speech and citation form laboratory speech, from males and females, from different geographical location and speakers of different ages. These limitations allow us to form hypotheses about the direction of vowel change but prevent us to making definitive statements or generalizations about SAusE as a whole. We have shown that such changes may have occurred in SAusE and may be currently progressing but we offer no explanation for the ontogeny of the initiating change. Vowels change due to both internal and external pressures and we are currently involved in a perceptual study of /æ/ to examine whether Ohala’s theory of perceptual misinterpretation may offer some insights into why such changes may have occurred. It is probable that a variety of internal and external motivations are at play in determining the nature of the sound change in any individual dialect [6].

5. Conclusions

The results of this analysis reveal an initial raising and subsequent lowering of the short front vowels of SAusE over a 100 year period and an interesting pattern of shifts in keeping with theories of dispersion [7]. This analysis also identifies the final stage of the Southern Hemisphere short front vowel raising and provides evidence for a reversal of this sound change raising questions about the nature of linguistic representations.

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7. References