Monophthongal vowel changes in Received Pronunciation: an acoustic analysis of the Queen's Christmas broadcasts.

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In this paper we analyse the extent to which an adult's vowel space is affected by vowel changes to the community using a database of nine Christmas broadcasts made by Queen Elizabeth II spanning three time periods (the 1950's; the late 1960's/early 70's; the 1980's). An analysis of the monophthongal formant space showed that the first formant frequency was generally higher for open vowels, and lower for mid-high vowels in the 1960's and 1980's data than in the 1950's data, which we interpret as an expansion of phonetic height from earlier to later years. The second formant frequency showed a more modest compression in later, compared with earlier years: in general, front vowels had a decreased F2 in later years, while F2 of the back vowels was unchanged except for [u] which had a higher F2 in the 1960's and 1980's data. We also show that the majority of these F1 and F2 changes were in the direction of the vowel positions of 1980's Standard Southern British speakers reported in Deterding (1997). Our general conclusion is that there is evidence of accent change within the same individual over time and that the Queen's vowels in the Christmas broadcasts have shifted in the direction of a more mainstream form of Received Pronunciation.

1. Introduction

A central area of phonetics is concerned with how accents change with time and in many studies, analyses of vowel differences form an essential part of modelling both diachronic accent change and the phonetic differences between accents (e.g., Eckert, 1988; Gordon, Lewis & Trudgill, 1998; Labov, 1990, 1994; Trudgill, 1988). Although vowel quality provides perhaps the most important cue for identifying accent types, any researcher who makes use of experimental phonetic evidence to help define the characteristics of an accent and how it has changed in time is immediately faced with the difficulty that the acoustic and articulatory structure of vowels is marked to a considerable extent by speaker-specific physiological properties of the vocal tract (Ladefoged, 1967; Johnson & Mullennix, 1997; Peterson, 1961; Pols, Tromp & Plomp, 1973); and, as is also well-known, vowel quality varies considerably with prosodic structure, speaking style, and tempo (Edwards, Beckman, Fletcher, 1991; Fowler & Housum, 1987; Harrington, Fletcher, Beckman, 2000; Hunnicutt, 1987; Moon & Lindblom, 1994). In an ideal experimental analysis of diachronic vowel change, a researcher could largely eliminate these confounding variables by having the same speaker produce approximately the same materials over a long time interval of 20 or 30 years. There are however, very few 'real time' analyses of the same speakers for the obvious reason that such data are so difficult to obtain; and so empirical studies are usually based on 'apparent time' analyses in which diachronic vowel change is inferred

by comparing young with older speakers of the same accent (e.g., Labov, 1994). Alternatively, they are based on another kind of real time study in which present-day speakers are compared with comparable speakers of the same age from the same community recorded and analysed at an earlier time (e.g., Cox, 1999; Trudgill, 1988; Watson, Mclagan, Harrington, 2000; see also Labov, 1994 for a review of 'apparent' and 'real' time studies). However, one of the difficulties with apparent time analyses in particular is that modelling accent change by comparing young with old speakers is valid to the extent that a speaker's accent does not change much in adulthood. As Chambers & Trudgill (1980) comment:

> 'the validity of such a study hinges crucially upon the hypothesis that the speech of, say, 40 year olds today directly reflects the speech of 20 year olds twenty years ago, and is thus comparable for diffusion research to the speech of 20 year olds today...The hypothesis that apparent time can be equated to real time is by no means firmly supported, and the relationship between real and apparent time may indeed be more complex than a simple equation of the two...it is worth remembering that the hypothesis of apparent time remains to be tested' (p. 165/6).

Although Wells (1982) claims that 'On the whole, speakers do not alter their accents much once they are past puberty', Labov (1994) suggests that 'apparent time studies may understate the actual rate of sound change, since older speakers show a limited tendency towards communal change, participating to a small extent in the changes taking place around them'. Since there are so few real time analyses of the same speakers, we actually know very little about the degree to which an adult's accent might be affected by changes in progress in the community. However, two acoustic studies are relevant. Firstly, in an acoustic comparison of the vowels produced by the same speakers of Received Pronunciation (RP) in 1964 and 1983, Bauer (1985) found that the same speaker's vowels had shifted in the direction of community vowel changes. Secondly, Yaeger-Dror (1994) analysed acoustically thirteen speakers of Montreal French in 1971 and 1984 and found that the speakers 'continue to advance towards a newer phonology well into middle age'.

One of the motivations of the present study was to bring further data to bear on this question by analysing acoustically the vowels from the Queen's Christmas broadcasts over a 40-50 year period. These broadcasts to Britain and the Commonwealth, which are recordings of typically around five minutes that have taken place annually on Christmas Day since 1952, are well matched to the aim of investigating vowel changes within the same person for at least three reasons. Firstly, there are likely to be few stylistic variations given that the speaking task (of broadcasting a Christmas message) has been the same over that time period and taking into account that the recording conditions (a live broadcast) have been the same. Secondly, the Christmas broadcasts are one of the very few recordings of the same person producing similar materials under similar recording conditions annually over a period of almost fifty years. Thirdly, in the 20th Century, Received Pronunciation was a prestige accent and today it is still accorded social prestige. Until the early 1970's, BBC announcers were required to be RP speakers and many non-RP speakers modified their accents towards RP for social advancement.

Even today for many, both in Britain and other English-speaking communities, the 'Queen's English' is English as it should be spoken as demonstrated by the existence of a 'Queen's English Society' that has been formed to "defend the precision, subtlety and marvellous richness of our language against debasement, ambiguity and other forms of misuse" (from their web site at http://www.queens-english-society.co.uk/). We can speculate that, as the pre-eminent speaker of the Queen's English, the Queen might be likely to resist innovation and accent change, although we cannot be sure. An analysis of the Christmas broadcasts, then, is ideally suited to a real time analysis, because if we do find vowel changes over a forty year period, we can be reasonably confident that the majority of adult speakers, who are not elevated to the position of defenders of a particular accent, are unlikely to be immune from accent innovation in the community.

Received Pronunciation, of which the speakers form a very small percentage of the British population (Trudgill, 1983), is described by various authors (Gimson, 1966; Trudgill, 1983; Wells, 1982) as an accent of England that is regionless, i.e., not associated with any particular locality. It is also an accent that is associated with educated members of the community, typically of the middle and upper classes and one that seems to be increasingly threatened, partly because the role of RP and attitudes towards it have changed so much in the 20th century (Roach, 1997). As Burridge (1998) comments, far from trying to modify their accent towards RP, "many people are now trying to speak more 'down to earth', more 'ordinary', wishing to avoid the crème de la crème connotations of pure RP" and in his second edition of the *Introduction to the Pronunciation of English*, Gimson (1975) commented that many young speakers were rejecting RP with the implication that "within the next century, RP might be so diluted it could lose its historic identity....a new standard with a wider popular and regional base would emerge". Recently, there have been some suggestions that an accent known as Estuary English (Coggle, 1993) is taking over from RP as the standard accent, defined by Rosewarne (1984) as a 'mixture of non-regional and local south-eastern pronunciation and intonation'; according to Crystal (1995), some of the Estuary English (EE) developments are now increasingly heard in the public domain and have even begun to penetrate the British establishment (however, see Maidment, 1994, for an incisive critique of analyses of Estuary English; a comprehensive web site including a number of articles on EE is provided in Wells, 2000).

As far as the Queen's accent is concerned, this has some characteristics of what Gimson (1966) describes as 'conservative RP', a form "used by the older generation and, traditionally, by certain professions or groups" and only some, but certainly not all, of the features of what Wells (1982) refers to as Upper Crust, or U-RP. For example, in common with U-RP speakers, the Queen has an intervocalic tapped /r/, quite a back /u/, and, in her earlier broadcasts at least, 'lost' rhymes with 'forced' whereas for mainstream RP speakers it has the vowel of 'lot': these features, and in particular this pronunciation of 'lost' belong very clearly to U-RP. On the other hand, there is no evidence from any of the Christmas broadcasts that we have analysed of the elision of /r/ in words like 'very', nor of markedly open qualities in word-final unstressed /ɪ/ ('city'), nor of a diphthongal quality to /æ/ ('had'), nor that the centering diphthongs have an especially open quality – and all these are also reported by Wells (1982) as possible characteristics of U-RP. To the

extent that it is possible to consider U-RP and mainstream RP as a continuum with the collection of U-RP caricatures and stereotypes (e.g., from Wells, 1982: a dowager duchess, a Noel Coward sophisticate, a Terry Thomas cad, an upper-class army officer) at one extreme and mainstream RP at the other (as exemplified by some present-day BBC announcers, e.g., Julian Marshall from the program 'Newshour' on the BBC World Service or Sue McGregor from the 'Today' program on BBC Radio 4), then the Queen's accent in the Christmas broadcasts falls somewhere between the two, and can be closer to U-RP than to mainstream RP in some respects.

In this analysis we will be concerned with stressed monophthongs in nine Christmas broadcasts spanning the period 1952-1988 and so it will be helpful to consider some of the monophthongal changes that are reported to have occurred in RP in the 20th century. Many researchers are in agreement that present-day RP [æ] has a more open quality than in the 1950's, even if there is very little acoustic data that demonstrates this – in Henton (1983), a comparison of then present-day male RP speakers with the RP speakers in Wells (1962) showed no evidence for [æ] lowering while Bauer's (1985, 1992) analysis suggests that the main change is one of retraction, rather than increasing openness. But whatever the acoustic analyses suggest, it is clear that a closer realisation of this vowel, approaching cardinal vowel three, certainly sounds old-fashioned in present times. Interestingly, in 1966, Gimson commented that 'A more relaxed /æ/ — in the region of [a] is heard amongst children in the south of England who otherwise have an RP system and who, later in life, adopt the tenser and closer variety of /æ/'. In his second and third editions, Gimson (1975, 1980) adds that 'Such a lowered /æ/ is maintained by many young women'. As far as other front RP vowels are concerned, Gimson (1966) claimed that closer varieties of [ɪ] and [ɛ] are associated with a conservative or 'over-refined' RP; according to Wells (1982), RP [ɪ] and [ɛ] may have lowered in the 20th Century and he speculates that this may be linked in a chain effect to the lowering of [æ]. This has not been demonstrated in any acoustic analysis and Wells's view that [ɪ] has lowered contradicts Bauer's (1985) impression that RP [ɪ] has become a tenser, higher vowel. Another well-documented change is [u]-fronting (Gimson, 1966), which Roach (1997) describes as a radical shift that has taken place in the last 20-30 years and for which there is acoustic evidence in both Bauer (1985) and Henton (1983). Although many studies report that RP [ʌ] has changed in quality in the last 50-100 years, there is much less consensus about the direction of movement. Some impressionistic analyses associate a more retracted quality with a conservative RP (Gimson, 1966). Bauer's (1985) acoustic analysis shows no evidence that [ʌ] was more retracted in his older RP speakers and he questions whether this was ever a back vowel in the 20th century. Both Gimson (1966) and Wells (1982) have suggested that RP [ʌ] is phonetically closer to [æ] than it had been in the early part of the century, and by 1975 Gimson had suggested that [æ]-lowering combined with [ʌ]-fronting could lead to a confusion between these vowels, 'the meaning being resolved by context'. Finally, Wells (1982) comments that RP [ɔ] has raised phonetically over a fifty year period (from about the 1930's), a suggestion which is also made in Gimson (1966), although again there is no experimental data to support this to our knowledge.

In this study, we present formant data of the Queen's Christmas broadcasts at three time periods between 1952 and 1988. We also compared some of these with formant data from the 'Machine Readable Spoken English Corpus' (MARSEC) (Roach, Knowles, Varadi and Arnfield, 1994) reported in Deterding (1997) of five female BBC broadcasters producing continuous speech materials of various kinds in the 1980's; their accents are described by Deterding (1997) as 'Standard Southern British' (SSB), which we assume corresponds quite closely to what Wells (1982) defines as 'mainstream RP'. Our motivation for this analysis is that if younger speakers, or speakers of a less conservative or mainstream RP have shaped the direction of any changes in the Queen's pronunciation in the last forty years, then we might expect to find evidence that some of the changes in the Christmas broadcast monophthongs from the 1950's to the 1980's are in the direction of the vowel positions of Standard Southern British of the 1980's. This MARSEC data is additionally an appropriate resource for such an investigation because it is (the only) available data of continuous speech, female RP vowels.

2. Method

We selected nine Christmas broadcasts from three year groups: the 1950's (1952, 1954, 1957); the late 1960's/early 1970's (1967, 1968, 1972); and the 1980's (1983, 1985, 1988). The average duration of each passage was 5 minutes 55 seconds ranging from 3 minutes 30 seconds (1968) to 7 minutes 32 seconds (1967). Each passage was transcribed orthographically and the accented words and prosodic boundaries were identified by one of the authors of this paper (JH). This prosodic annotation was accomplished by listening repeatedly to short sections (of about 10-15 seconds) from each passage and identifying words that were judged to be accented. Prosodic boundaries corresponding to a break index of three or more in the tones and break indices system (Beckman & Ayers-Elam, 1994/7) were also identified but they were not further classified as intermediate or full intonational boundaries. The fundamental frequency contour and time-aligned waveform were occasionally inspected for those words whose accentual status was not easy to judge from an auditory analysis alone. If there was still uncertainty about whether a word was accented or not, it was marked as unaccented.

For all words that were judged to be accented, a combination of the acoustic waveform, a time-aligned broadband spectrogram, and formant tracks automatically calculated using Entropic's ESPS system were displayed in order to mark both the acoustic vowel boundaries and the acoustic vowel target. The vowel target was usually marked where F1 reached a maximum value in open vowels and where F2 reached a maximum/minimum value in front/back vowels (Harrington & Cassidy, 1999). If the formants showed either little change or no evidence of reaching an asymptote within the vowel, an intensity peak was sometimes used to position the vowel target; if there was no evidence of an intensity peak, then the vowel target was positioned at the vowel's acoustic midpoint. Vowel labelling was carried out by a team of up to three transcribers in the Speech Hearing and Language Research Centre, Macquarie University. All annotations were checked by SP (the second author of this paper) and adjusted if necessary. SP also checked all the formant tracks of all accented vowels and made hand corrections to these, if there was evidence that they had been mistracked (for example,

such as when, due to nasalisation of open vowels in a nasal context, F1 was mistracked as the nasal formant). Although we labelled all accented vowels in this way, only monophthongs (Table 1) were analysed in this study.

The accented vowels were pooled according to the three time periods that we wished to examine, i.e., 1950's vowels (from the 1952, 1954, 1957 passages), 1960's/70's vowels (from the 1967, 1968, 1972 passages), and 1980's vowels (from the 1983, 1985, 1988 passages). Henceforth, the three time periods will be referred to as 50's, 60's, and 80's. We displayed the word tokens separately for each vowel and for each of these time periods in the plane of the first two formant frequencies in order to remove any outliers. We also removed all [ɪ] and [ɛ] tokens that preceded a 'dark' (velarised) realisation of /l/ (e.g., 'still', 'fell') because of the substantial anticipatory influence of this consonant on these vowel targets (Lehiste, 1964). [u] was also evidently affected by a preceding [j] context (e.g., 'new', 'few') but since [u]-fronting was one of the central areas of investigation, we relabelled these tokens as [ju] to differentiate them from [u] preceded by other contexts.

After removing all outliers as well as [ɪ] and [ɛ] from the velarised /l/ contexts, 2337 monophthongal vowels remained. Their distribution according to the time period and vowel type is shown in Table 1. The terms 'lax' and 'tense' are intended as phonological labels (lax vowels are prohibited from occurring in open, prosodically accented monosyllabic words in English). They are used for convenience in presenting the data and no phonetic distinction between these vowel groups is implied by the use of these labels.

Table 1. The number of accented vowel tokens analysed in the three year groups.

year group	50s	60s	80s
lax vowels			
ɪ	103	105	123
ɛ	138	139	156
æ	96	94	77
ʌ	80	80	83
ɒ	62	65	64
ʊ	8	6	21
tense vowels			
i	82	85	82
ɜ	37	28	33
ɑ	35	26	42
ɔ	78	74	82
u	24	12	17
ju	31	32	37

The results of a formant analysis are presented in two main sections. Firstly, we compared the positions of the first two formant frequencies for each vowel across the three time groups. We then compared the Queen's vowels with continuous speech formant data from 1980's Standard Southern British (SSB) speakers are taken from the MARSEC database (Roach, Knowles, Varadi, Arnfield, 1994) and from the data reported in Deterding (1997) The formant data for the SSB speakers was downloaded from David Deterding's webpage: http://www.soa.ntu.edu.sg:8080/ell/DavidD/Personal/david.htm).

These five speakers are described by Deterding (1997) as having a 'Standard Southern British accent', a style of speech that 'may be familiar...through listening to the BBC World Service'.

All the formant values in Hz were converted to an auditory, Bark scale (Zwicker, 1961) using the formula:

$$^{f}\text{Bark} = 13\tan^{-1}(0.0076\,{}^{f}\text{Hz}) + 3.5\tan^{-1}({}^{f}\text{Hz}^2 / 7500)$$

where ^{f}Bark and ^{f}Hz are the frequencies in Bark and Hz respectively and $\tan^{-1}$ is the arctangent in radians. The statistical analyses are applied to the Bark values and the formant plots are presented in Bark with superimposed Hz values at suitable frequency intervals.

3. Results

Vowel formants in the 50's, 60's, and 80's

Ellipse plots in the formant plane for the monophthongs in the three different year groups are shown in Figure. 1.

The lax vowels showed considerable changes from the 1950's to the 1980's data in terms of an overall vertical expansion of the vowel space which is brought about by a raising of F1 of [æ] and [ʌ] and a lowering of F1 for[ɪ] and [ʊ]. These F1 changes were most pronounced between the 50's and 60's, and there was far less evidence of change from the 60's to the 80's data. The overall effect of these 'vertical' differences is that the [ɪ ɛ ʌ] spaces overlap extensively with each other in the 50's data, but much less so in the 60's or 80's data. Similarly, while [ʊ] overlapped substantially with [ɒ] and even with [ʌ] in the 50's data, the separation of these vowels was considerably greater in the 80's data. Figure 1 also shows a slight lowering of F1 for [ɛ] between the 50's and 80's and an even smaller F1 raising in [ɒ] over the same time period. The combined effect of these shifts is to alter the height relationship between these two vowels: whereas in the 50's data, the F1 values for [ɛ] and [ɒ] were quite similar, the mean F1 for [ɒ] was a good deal lower than that of [ɛ] in the 80's data. It is likely that these acoustic changes are due to an increased phonetic height difference between [ɛ] and [ɒ]; the other possibility, that [ɒ] was produced with less rounded lips in the 80's data, is a less probable explanation, because decreased lip rounding would result in an increase in F2 of [ɒ] (for which there is no evidence). Another change within the lax vowel set was in the relationship of [æ] and [ʌ]: in the 50's data, [æ] had a lower F1 than [ʌ], but in the other data sets, F1 of [æ] and [ʌ] had much more similar average positions. Since these F1 changes were also accompanied by a marked F2 lowering in [æ], the [æ] and [ʌ] spaces were closer to each other in the 60's and 80's data than in the 50's data.

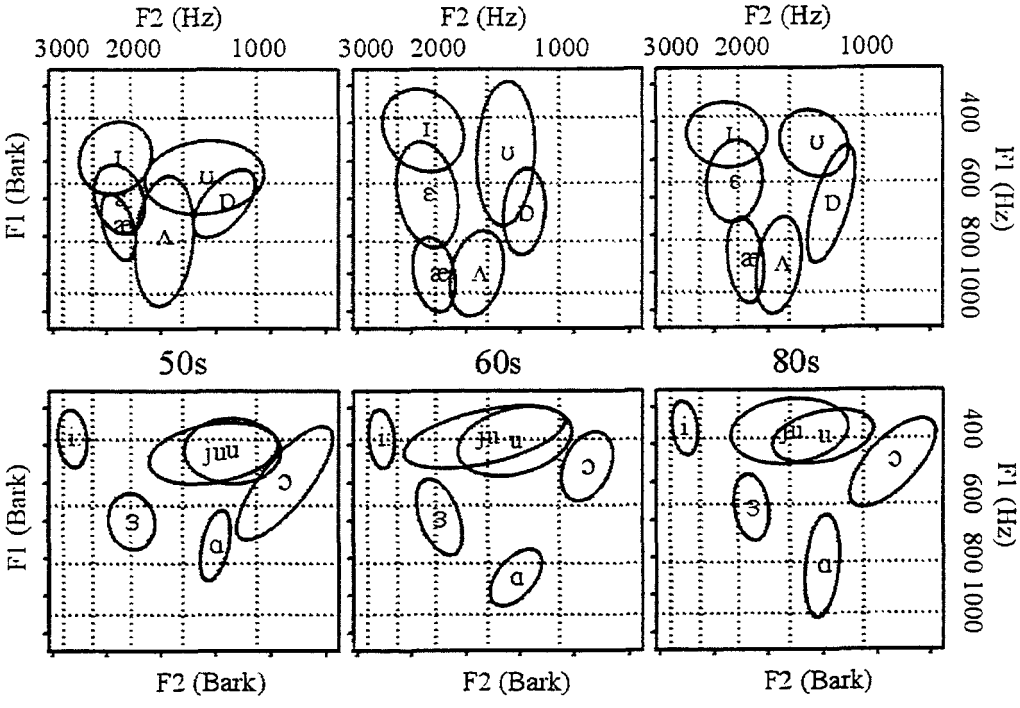

Figure 1. Ellipses in the formant plane for lax (*top row*) and tense (*bottom row*) vowels in the 50's data (*left*), 60's data (*middle*), and 80's data (*right*). The ellipses include data points within two standard deviations of the mean.

There is also evidence in the tense vowel set for a decrease in F1 in the mid-high and high vowels [i ɔ ju u] and an increase in F1 in the open vowel [ɑ] from the 50's to the 60's/80's data. The same figure shows a raising of F2 in [ju] and [u] in later years and a slight lowering of F2 in [i], as a result of which the [i] and [ju]/[u] vowel spaces are closer in the 60's/80's than in the 50's data. F1 and F2 of [ɜ] showed a progressive lowering; because of the opposite direction of F2 changes in [ɜ] and [ju]/[u], the [ɜ] and [ju]/[u] spaces were more clearly separated in F2 in the 50's than in the 80's data.

The results of an analysis of variance applied separately to each vowel with YEAR (50's or 60's or 80's) as the single factor are shown in Table 2. The results show that there was a significant increase in F1 from the earlier to the later data for [æ ɑ ʌ ɒ] and a significant decrease in F1 for all of the other vowels, which confirms the general trend shown in Figure 1 that the open vowels have moved further away from the mid and high vowels on F1 in the 60's and 80's data. As far as F2 is concerned, there were fewer significant changes compared with F1. The significant changes include an F2 decrease in later years for [i ɛ æ ʌ ɜ] and an F2 increase for [ju] and [u]. Table 2 also shows the results of post-hoc *t*-tests in order to investigate over which years the changes were significant. As Figure 1 suggests, these results show many more significant differences from the 50's to the 60's and to the 80's, than from the 60's to the 80's.

FIRST FORMANT

Vowel	50s	60s	80s	df	F	p	5/6	5/8	6/8
i	3.82	3.82	3.57	2,246	11.97	***	NS	***	***
ɪ	4.91	4.19	4.34	2,328	64.47	***	***	***	NS
ɛ	6.01	5.91	5.58	2,430	22.63	***	NS	***	***
æ	6.74	8.03	7.67	2,264	168.29	***	***	***	***
ɑ	6.64	7.53	7.25	2,101	21.63	***	***	***	NS
ʌ	7.12	8.00	7.81	2,240	17.21	***	***	***	NS
ɒ	6.12	6.42	6.28	2,187	3.29	*	**	NS	NS
ɔ	5.01	4.57	4.51	2,231	15.43	***	***	***	NS
ʊ	5.44	4.82	4.58	2,32	6.87	**	NS	***	NS
ju	4.22	3.79	3.66	2,97	15.51	***	***	***	NS
u	4.16	3.90	3.81	2,50	3.82	*	NS	**	NS
ɜ	6.02	5.92	5.68	2,95	5.39	**	NS	**	NS
SECOND FORMANT									
Vowel	50s	60s	80s	df	F	p	5/6	5/8	6/8
i	15.26	15.09	15.08	2,246	13.24	***	***	***	NS
ɪ	13.67	13.56	13.52	2,328	1.23	NS			
ɛ	13.53	13.41	13.23	2,430	12.11	***	NS	***	**
æ	13.55	13.16	12.82	2,264	95.93	***	***	***	***
ɑ	10.00	10.16	10.04	2,101	1.52	NS			
ʌ	11.87	11.59	11.59	2,240	8.89	***	***	***	NS
ɒ	9.71	9.83	9.76	2,187	0.92	NS			
ɔ	7.49	7.52	7.40	2,231	0.51	NS			
ʊ	10.41	10.52	10.31	2,32	0.20	NS			
ju	10.08	11.29	11.23	2,97	9.54	***	***	***	NS
u	9.39	10.18	9.97	2,50	3.52	*	NS	NS	NS
ɜ	13.06	12.97	12.61	2,95	12.94	***	NS	***	***

Table 2. The results of ANOVAs and post-hoc t-tests applied separately to each vowel. The post-hoc tests are applied only if the ANOVA is significant. Column 1: vowel type. Columns 2-4: mean F1 and F2 (Bark) for the 50's, 60's, and 80's data. Column 5(p): the results of the ANOVA. Columns 6-8: post-hoc t-tests comparing the 50's with 60's (5/6), 50's with 80's (5/8), and 60's with 80's (6/8) data. ***, $p < 0.001$; **, $p < 0.01$; *, $p < 0.05$; NS, non-significant ($p > 0.05$ for the ANOVA and $p > 0.05/3 = 0.017$ for the alpha-adjusted post-hoc t-tests).Comparison with 1980's Standard Southern British (SSB)

Figure. 2 shows the average positions of the lax (top row) and tense (bottom row) vowels from the 1950's and 1980's data, together with the average positions of the same vowel types from Deterding's (1997) analysis of 1980's Standard Southern British English. We show the average positions of the five female speakers in Deterding's data separately, since it is evident that there is a fair degree of speaker variation for some vowels. Nevertheless, the vowels from these speakers generally cluster together quite well so that comparisons between this group of speakers and the Queen's vowel positions are certainly possible. Recall that in such a comparison, we are looking for evidence of a progression or change in vowel formants from the 50's to the 80's data and then to those of the SSB speakers.

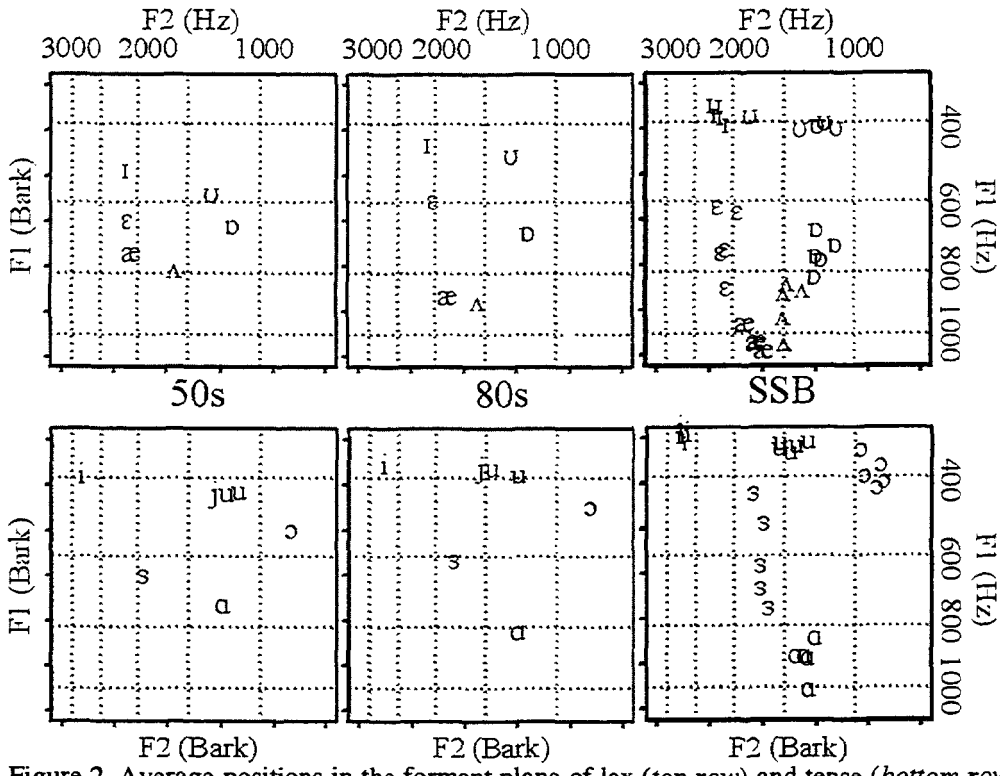

Figure 2. Average positions in the formant plane of lax (*top row*) and tense (*bottom row*) vowels in the 50's data (*left*), 80's data (*middle*) and from the five SSB speakers in Deterding (1997) (*right*).

Figure 2 shows that there is evidence for such a trend in many of the vowels. Consider for example the mid-high and high vowels [ɪ ʊ i u ɔ]. For all these vowels, F1 has decreased from the 50's to the 80's and all five SSB speakers have even lower first formant frequencies for all these vowels relative to the 1980's data. Secondly, F1 has risen in [æ ʌ ɑ] from the 50's the 80's data. In the SSB data, F1 is higher than in the 80's data for [æ ɑ] in all five speakers, and higher than in the 80's data for 2/5 speakers for [ʌ]. On the other hand, there is an F1 *decrease* in [ɛ] in the Queen's vowels from the 50's to the 80's, whereas the SSB speakers have a *higher* F1 than in the 80's data; however, the variation in F1 of [ɛ] for the SSB speakers is considerable (more than 200 Hz) and so it is difficult to be conclusive about whether or not there is any pattern to the formant differences. For the same reason, we cannot make any conclusive statements about the pattern of F1 vowel changes in [ɜ] which show an almost 400 Hz variation in mean F1 positions for the five SSB speakers.

As far as F2 is concerned, there were significant decreases from earlier to later years for [i ɛ æ ʌ ɜ] (Table 2). For 4/5 of these vowels, the F2 difference between the 1980's and the SSB vowels is in the same direction, i.e., a decrease in F2. This is shown in Table 3 which gives the mean values in Hz for each of these vowels from the 50's data, the 80's

data, and then from the two SSB speakers who had the highest and lowest F2 mean for the same vowel.

Table 3. F2 means (Hz) for the 50's data, the 80's data and for SSB speakers on those vowels which showed a significant ANOVA difference (Table 2). Columns 4 and 5 show the means of those SSB speakers who had the highest and lowest F2 means respectively (see also Figure 2).

vowel	50s	80s	SSB(max)	SSB(min)
i	2833	2748	2694(2)	2582(3)
ɛ	2144	2049	2157(2)	1926(3)
æ	214	1917	1892(2)	1690(1)
ʌ	1664	1596	1512(2)	1335(5)
ɜ	1991	1856	1762(1)	1627(2)
u	1151	1259	1529(1)	1302(5)

The table shows that for each vowel, the 80's F2 means are less than the 50's F2 means and that the SSB means are less than the 80's means for all five speakers for all vowels except [ɛ]. The other significant F2 difference in the Queen's data was for [u] which had a (marginally) higher F2 mean in the 80's data than in the 50's data. Table 3 shows that all SSB speakers had a higher F2 for [u] than that of the 80's data. These F2 data, together with the F1 data discussed in the preceding paragraph, show that many of the vowel changes from the 50's to the 80's data are in the direction of the vowel positions of the SSB speakers.

4. Discussion

The acoustic analysis of these Christmas broadcasts shows that there has been a 'vertical' expansion of the vowel space from the 1950's to the 1980's and, to a lesser extent, a 'horizontal' compression. The vertical expansion is due to an F1 raising of the open vowels [ɑ ʌ æ ɒ], which suggests that they are phonetically more open in the 1980's than in the 1950's broadcasts, and an F1 lowering of all the other vowels, in particular of [ɪ ʊ ɔ]. Interestingly, Gimson (1966) commented that a "compression of the front phonemes is a characteristic of RP". In his 1994 revision of Gimson's *Introduction to the Pronunciation of English* (Gimson & Cruttenden, 1994), this comment is removed, although whether this was done because Cruttenden felt that 1990's RP front vowels were less compressed than in the 1960's is not stated. The more modest horizontal compression of the vowel space is brought about by an F2 raising of [u] and [ju] and an F2 lowering of [i ɛ æ ɜ ʌ]. Since there is no significant change in F2 of the back vowels [ɑ ɒ ɔ ʊ], they must be somewhat less differentiated in F2 from the front vowels in the 1980's than in the 1950's data. We also showed that these F1 and F2 shifts from the 1950's to the 1980's data were in the direction of the vowels from 1980's Southern British English female broadcasters from the MARSEC database analysed recently by Deterding (1997). For example, F1 of open vowels has increased from the Queen's 1950's to the 1980's data and in the SSB data, F1 was even higher for these vowels; F1 of the mid-high and high vowels showed a decrease from the 1950's to the 1980's and in the SSB data it was even lower for these vowels; finally F2 of most front vowels had decreased, and F2 of [u] had increased, and in the SSB data, F2 of these front vowels was lower and F2 of [u] was higher than in the Queen's 1980's data. The conclusion that can

be drawn from these results is that changes in the Queen's vowels between the 1950's and 1980's have been in the direction of a more mainstream RP. If this theory is correct, and if the vowel positions have continued to change beyond the 1980's, then the present-day Queen's vowel positions might have shifted even further in the direction of a vertical expansion and horizontal compression. On the other hand, the Queen's vowel positions may well have stabilized by the 1980's; our results show very clearly that there has been a fairly dramatic change from the 1950's to the late 1960's/early 1970's with very little change thereafter to the mid-late 1980's.

We consider now how far the changes we have reported to the Queen's vowels are consistent with other previous acoustic and impressionistic analyses of changes in RP. Firstly, there is widespread agreement (Bauer, 1985, 1992; Gimson, 1966; Wells, 1982), that [æ] has become more open in the 20th century and the present results, showing a considerable increase in F1 in a 30 year period are consistent with this view. Many authors report that [u] has fronted and Henton (1983) also presents acoustic data in support of [ʊ]-fronting. We find no evidence for [ʊ]-fronting, although this may be because there were so few [ʊ] tokens in our corpora. On the other hand, [u], particularly when it is preceded by [j], has a higher F2 in the 1960's and 1980's data than in the 1950's data. As far as [ʌ] is concerned, the data are consistent with earlier accounts that this vowel is phonetically closer to [æ] in the later, than in the earlier part of the 20th Century (Gimson, 1966), but like Bauer (1985), we find no evidence that it has fronted. However, our data showing that the [æ] and [ʌ] formant spaces are closer together in the 80's data is consistent with the view that they are less differentiated in the later than in the earlier part of the 20th Century. The other reported vowel changes with which our data are consistent include the raising of [ɔ] (Gimson, 1966; Wells, 1982) and Bauer's (1985) impression that RP [ɪ] has become a higher vowel. On the other hand, our data suggest various vowel changes that have not been documented to our knowledge including: the phonetic raising and retraction of [i]; the phonetic lowering of the open vowels [ʌ ɒ ɑ], and the phonetic raising of [ʊ] (assuming that F2 and F1 changes imply changes to phonetic height and backness respectively). Finally, although some SSB speakers seem to have a phonetically lower [ɛ] (as judged by F2), there is no evidence that [ɛ] has lowered phonetically in later years in our data.

Our analysis has shown that vowels of the same adult can change in quality. Moreover, it is clear that for this speaker, these vowel changes cannot have anything to do with geographical influences (as they do for some speakers who emigrate or live outside the region of their dialect for long periods of time). Since the speaking materials and the purpose of the delivery (a Christmas message to Britain and the Commonwealth) have not really varied (with the exception that the 1952 and 1954 speeches were not televised), and given that our data show directional changes towards the 1980's SSB speakers, we conclude that there is strong evidence that an adult's vowel changes can be quite considerably influenced by community vowel changes. When Bauer (1985) re-recorded the same RP speakers 20 years apart, he also found marked changes to vowel pronunciation noting in particular a general tendency for F1 to be lower in later years (which we only find for the non-low vowels). Leaving aside the details of the changes themselves, we agree with Bauer (1985) that these adjustments to an adult's vowel space

have implications for studies that view diachronic change in terms of apparent, rather than real time: that is, the results of apparent time studies (in which matched young and old speakers are compared, and from which community pronunciation changes are inferred) may well be distorted by underestimating the influences of community changes on an adult's vowel space.

Although we believe that our results provide empirical evidence both for vowel changes in RP and that the Queen's vowels have changed in the direction towards a more 'mainstream' RP, we need to consider some other possible non-phonetic explanations of these data. The most obvious is that a person's vowels may change as a result of the physiological processes of aging. There are very few studies of this to our knowledge, but those that are available suggest that, if there are age-related formant changes, they are generally in the other direction from the vowel changes that have taken place in our study. For example, in a comparison between the vowel spaces of a young (mean age 21 years) and an old (mean age 75 years) group, Rastatter, McGuire, Kalinowski, Stuart (1997) found some formant differences between the two age groups in the male speakers, but very few in the female speakers. But those few formant differences that were found for the female group were generally in the other direction from our formant changes from the 50's to the 60's/80's data groups. For example, Rastatter et al. (1997) found that the older female group had a lower F1 in their open unrounded vowels compared with the young group and that the older females had a higher F2 in /æ/ than the younger females. Although they do find that F2 of /u/ is higher in older than younger females (which is consistent with the change in the Queen's data from the 50's to the 80's), they find the opposite trend in their male speakers (older males have a lower F2 in /u/ than younger males). So it seems then that there is no evidence to suggest that the formant changes for the Queen can be attributed to physiological changes to the vocal tract with age.

Another more plausible alternative to the explanation that we are proposing is that there has been a change in the style of delivery in the Queen's Christmas broadcast messages. For example, it is possible that the Queen has learned to produce a perceptually clearer delivery of broadcasts in later years; the vowel changes that we are seeing would, under this interpretation, have little to do with phonetic changes to RP, or a phonetic shift in the Queen's vowel space towards a more mainstream version of RP, but would instead be explicable in terms of hyperarticulation effects (de Jong, 1995; Harrington, Fletcher, Beckman, 2000; Lindblom, 1990; Moon & Lindblom, 1994). Under this theory, we might propose that the Queen's accented vowels are hyperarticulated in later broadcasts, which would in turn imply a greater deviation of vowels from a central position (i.e., a greater approximation of vowels towards canonical vowel targets). The F1 data might certainly be compatible with this view. The 1950's data shows that the lax vowels, in particular, are compressed on this dimension relative to the 1980's data; it is therefore possible that the 1980's data are vertically hyperarticulated relative to the 1950's data (high vowels are higher, low vowels are more open). However, while this cannot be ruled out as a possible explanation, it seems difficult to reconcile this theory with the results of the F2 data which show no evidence of 'horizontal' hyperarticulation: that is, if vowels in general were hyperarticulated to increase their clarity, then there should also be an expansion on the backness dimension (front vowels become fronted as

in Harrington, Fletcher, Beckman, 2000; back vowels are more retracted as in de Jong, 1995) and there is no evidence from the data that this has happened (quite the opposite, in fact, given that F2 of the front vowels has decreased and F2 of [u] has increased from the 50's to the 80's). The evidence therefore does not seem to point to a speaking style variation as an explanation of the vowel changes from earlier to later years.

Our conclusions, then, are that many of the Queen's vowels have changed in phonetic quality over a forty year period as shown by changes in the first two formant frequency values; that these changes have taken place primarily in the period from the mid-fifties to the early seventies with little comparable change from the mid-seventies to the mid-late eighties; and that these changes are in the direction of those of Standard Southern British vowels.

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