Vowel Changes in Two RP Speakers with Different Social Status: A Sociophonetic Study of TRAP/STRUT Vowels

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پوختە

ئەم توێژینەوە هەوڵ ئەدات شوێن پێی ئەو گۆڕانکاریانە هەڵ بگرێت کە لە هەردوو دەنگی بزوێنی /æ/ و /ʌ/ ڕوویانداوە لە ساڵەکانی پەنجاکان و هەشتاکانی سەدەی ڕابوردوو وە هەروەها ساڵی ٢٠١٢. گۆڕانی ئەو دوو دەنگە بزوینە لە ئاخاوتنی شازنی بەریتانیا و دەیقید ئەتینبەرە شیکراونەتەوەو بەراورد کراون لە بەر دوو هۆکار. یەکەم، بۆ بە دواداچون و دۆزینەوەی گۆڕانکاری لە پێگەی دەنگە بزوینەکانی شێوەزاری ستانداردی ئینگلیزی ناسراو بە (ئار پی) دووەم، بۆ ئەوەی بزانرێت تا چ ڕادەیەک هەردوو قسەکەری تۆێژینەوەکە شێوە ئاخاوتنی دەنگە بزوێنەکانیان دەگونجێنن لەگەڵ شێوە ئاخاوتنی (ئار پی). بۆ ئەم مەبەستە فۆرمانتی هەردوو دەنگە بزوینی /æ/ و /ʌ/ بۆ هەر سەردەمێک و بۆ هەر بەشداربوویەک دەرهێنراوە بە بەکارهێنانی پرۆگرامی کۆمپیوتەری پرات.

جیاواز لە هارینگتۆن و ئەوانی دیکە کە تەنها شیکردنەوەیان بۆ وتارەکانی شازن کردوە بە بۆنەی لەدایک بونی مەسیحەوە، ئەم توێژینەوە لە دەنگە بزوێنەکانی شازن دەکۆڵێتەوە لە سێ سەردەمی جیاوازدا و بەراوردی دەکات بە ئاخێوەرێکی دیکەی (ئار پی). بە بەشداری پێ کردنی دوو ئاخێوەری (ئار پی) کە ڕەگەز و پێگەی کۆمەڵایەتیان جیاوازە، بەشێکی دیکەی دەرەنجامەکانی ئەم تویژینەوە گۆڕاوە کۆمەڵایەتیەکانی وەک پێگەی کۆمەڵایەتی و ڕەگەزە.

الخلاصة

هذه الدراسة تحاول ان تقارن و ان تجد التغيرات التي تحصل على اصوات في ثلاث ازمنة: (الخمسينات, الثمانينات وسنة ٢٠١٢). تغيرات الأصوات التي مقتسبة من كل من جلالة ملكة انكلترا و السيد ديفد اتنبرة درست و قرنت لسببين. الاول, لمتابعة وايجاد اي تغير في ابعاد اصوات العللة في لهجة اربى. ثانيا, لنجد الى اي حد المشاركين في هذة الدراسة يكيفون اصواتهم العلة مع اربى. لهذا القصد استخدمت برنامج كمبيوتر برات لاقتباس اصوات العلة/æ/ و /ʌ/ .

خلافا لهارينكتون و اخرون الذين درسوا خطابات الملكة في اعياد المسيح, هذة الدراسة تدرس التغيرات في ابعاد الاصوات العللة للملكة وتقارنها بمتحدث اخر. بوجود متحدثين من لهجة اربي و من طبقتين اجتماعيتين مختلفتين, استنتاج اخر لهذة الدراسة ممكن ان تكون في مجال المتغيرات الاجتماعية مثل الجنس و المنزلةالاجتماعية

Abstract

This study tries to track and compare changes of TRAP/STRUT vowels in three time periods (1950s; 1980s and 2012). The vowel changes, from the Queen of England and David Attenborough, are analysed and compared for two reasons. First, to track and discover changes in RP vowel formants. Second, to see to what extent, if any, the two speakers of the study adapt their vowel formants to that of RP. To this end, Formant frequencies of TRAP/STRUT vowels for each speaker in each time period is extracted using PRAAT. Unlike Harrington et al (2000) who acoustically

analyse The Queen's Christmas speech, this study analyses and compares The Queen's vowel formant changes with another RP speaker. By having two RP speakers with different social status and different gender (male and female), this study reports findings of social variables such as social class and gender.

1. Introduction

This study tries to analyse and compare the vowel changes of two speakers with distinct social affiliation. The two speakers are the Queen Elizabeth II and David Attenborough, a BBC broadcaster. To do so, changes in the TRAP/STRUT vowels of the Queen and Attenborough are analysed and compared in three time periods: (1950s; 1980s; and 2012). TRAP and STRUT vowels are two lexical sets (Wells 1982) who proposes common words to represent RP vowels. TRAP stands for /æ/ and STRUT stands for /ʌ/. Attenborough, an adult male with the same age as the Queen (both born 1926), is utilised to track changes in RP in the three different time periods. He is assumed to be a proper RP speaker as he is a BBC broadcaster for 60 years, and until the early 1970's, BBC announcers were required to be RP speakers. Moreover, his recording in different time periods are available. The inclusion of the male RP speaker with the same age as the Queen can help measuring different variables.

As the pronunciation of all languages change subtly over time (Aitcheson 2004, p. 201), this paper accounts for the changes of RP accent by comparing the vowels of the two speakers to RP in different time periods. Thus, unlike Harrington et al (2000, p.63) who compared the Queen's speech to one period (1980s) of RP, this paper compares the vowel formant frequency of the speakers in three different time periods: 1950s; 1980s and 2012. The vowels of these three different time periods are compared to the MARSEC data base (Roach et al 1993 reported in Deterding 1997, p. 50). This database consists of monologue broadcasts from BBC recorded during the 1980s.

The goals of the study can be summarised as follows: Tracking the changes of TRAP/STRUT vowels of the two speakers in different periods, i.e. to find any age-related variation between the two speakers and as compared to each other. Further to this, the two speakers' patterns of change will be compared to mainstream RP. The comparison of the two speakers with main stream RP in different time periods is made by reporting to Deterding (1997, p. 51). To find shifting vowel quality of individual speakers, it is essential to look for how far a vowel has moved in F1/F2 space. Thus, using a new version of Praat software, the F1/F2 values for each of the speakers are acquired starting from the 1950s audio files.

The comparison between the Queen and Attenborough's TRAP/STRUT vowels explains two distinct but relevant aspects of vowel change: first, the extent to which the Queen's vowels are affected by vowel changes to the community in which she lives. Second, whether the male RP speaker follows the changes that happen in his accent. Thus, gender variable to vowel changes can be obtained. As the Queen and Attenborough have two different social classes, their reaction to vowel change can be another measurable variable. However, the main goal of the paper is to find out whether the changes, if any, of the speakers TRAP/STRUT vowels are the result of ageing, and hence, in the direction of lowering F1 (biophysical) (see Rastatter et al 1997, p. 5) or changing in the direction of mainstream RP and hence, raising F1 (Bauer 1992, pp. 255-260). Acoustic and auditory analysis is used to find out the nature of the vowels for the speakers in different time periods.

2. Method

Three Christmas broadcasts of the Queen from three different time periods (1957; 1984 and 2012) are selected. The average duration of each speech is almost 4 minutes and 48 seconds ranging from 6 minutes 53 seconds (1957) to 4 minutes for ((1984). The orthographic form of each audio file, available in the Official website of the British Monarchy, is also used to help in transcribing the audio files (retrieved from https://www.royal.uk/her-majesty-the-queen). On the other hand, three

different BBC programmes of David Attenborough are used from three different time periods 1959; 1987 and 2012 (retrieved from https://www.youtube.com/channel/UC3p3WtGCfeVRvt3ytWNHQAg/videos.) The average duration of the excerpts of the programmes is 3 minutes and 61 seconds ranging from 4 minutes 30 seconds to 2 minutes 33 seconds. These excerpts are part of a long programme of 59 minutes. The recordings are obtained from video files which are transferred to WAV audio files to be compatible with PRAAT software.

For both speakers, the vowel tokens are chosen in a neutral consonantal context to avoid changing the real value of formants such as coarticulation, lip protrusion. Moreover, attempts are made to exclude vowels adjacent to liquids as they often cause lowering of F2 in front vowels (Ladegoged and Johnson 2011, p. 68). Some similar words in different periods are chosen to minimise the effect of neighbouring sounds on the TRAP/STRUT vowels see appendices 1 and 2). However, it is not always possible to find similar words in different time periods and enough tokens are not found if certain environments are avoided. Wherever possible, the stressed vowels are used and also chosen syllable initially, medially and finally to get their values in different contexts (See appendices for the list of words and their frequencies). For each speaker in every time period, the target is to have ten tokens for TRAP vowel and ten tokens for STRUT vowel. The tokens are used to compare the F1/F2 value changes of the vowels in different periods for the two speakers on one hand, and to the changes in RP on the other.

The phonological variables selected in this paper are TRAP/STRUT vowels lexical set. As Wells (1982, pp. 127-163) points out, with a certain degree of interrelatedness, they shift in particular directions in RP during the course of the 20th century in such a way that they form a merger due to perceptual similarity between the newly current [a] of TRAP and the fronted realisations of STRUT. Wells associates the movement of /æ/ in the vowel quadrilateral with that of /ɪ/ and /e/ in a *chain shift* process. It seems that TRAP lowering is established in literature of RP vowels: Kerswill (2007, p. 49) includes TRAP lowering as one of the eight phonological parameters that has changed in RP in the last 50 years. Moreover, Hawkins and Midgley (2005, p.187) report that, F1 value is bigger in younger generations than the elders.

Most researchers recommend using dynamic information (more than a point) in determining the measurement of sounds (see Di Paolo et al 2010, pp87-95). However, this paper uses a midpoint of a steady-state area of the vowel spectrogram for acquiring the F1/F2 values. The justification for using only one point is the fact that this study deals with short monophthongs where the movement within a vowel is less possible than diphthongs and longer vowels. Further, measuring the average value of ten tokens help the measurement to be more representative for the formants than looking for individual formant value. Another reason for choosing single point is that, as Di Paolo et al (2010) point out, multiple-point formant measurements may sometimes be misleading by misrepresenting a monophthong as a diphthong vowel.

The choice of the two speakers and the context of their utterances can be regarded as an ideal experimental analysis of diachronic vowel change for two reasons: First, confounding variables such as speaking style and tempo can be eliminated as both speakers speak in a similar situation (Christmas broadcast for the Queen and BBC programmes for Attenborough). So, variation in the vowel quality due to prosodic structure, speaking style and tempo is eliminated without the speakers producing the same material. Second, the material and the production of the speakers represent 'real time' as the same speakers are compared in three different time periods with almost 50 year difference rather than the 'apparent time' in which, as Meyerhoff (2006, p.135) states, speakers of different ages are compared in a single-speech community at a single time.

3. Results

The two vowels for the two speakers show considerable change from the 1950s to 1980s and then from this period to 2012. This change covers both vertical and horizontal dimensions of the

two vowels in the vowel chart. The vertical shift of the vowels in the vowel space is brought about by raising F1 while the horizontal movement is done through changes in F2 value. However, one exception to this is the lack of significant change in the Queen's STRUT vowel especially between 1980s and 2012 data.

The F1 changes are more noticeable for TRAP vowels for both speakers but the direction of change for both speakers is opposite with the same purpose, i.e. moving towards RP. The Queen's vowels especially TRAP vowel lowers by increasing F1 value while Attenborough's vowels (both TRAP and STRUT) rise in the vowel shift by decreasing F1 value. As the Queen's TRAP vowel in the 1950s had a lower F1 value than the mainstream RP, the F1 of TRAP vowel increases in the 1980s data and then in 2012 moves towards filling the gap between her accent and mainstream RP. As for her STRUT vowel, F1 is in rather similar position to RP in the three periods while F2 undergoes a noticeable change towards RP by increasing its value, but this change understandably is not as big as the TRAP vowel.

As for Attenborough's vowels (both TRAP and STRUT) in the 1950s, it is much more open and forward than mainstream male RP. In the 1980s data, Attenborough's TRAP/STRUT vowels became much closer by lowering F1 value and more backward by lowering F2 value. This trend continues in the 2012 data until it becomes very similar to RP vowels. However, the movement of TRAP and STRUT are not exactly similar. As the gap between his TRAP vowel in the 1950s and RP TRAP in the 1980s is very big, F1 value decreases intensely. The reduction of F1 value from 1980s to 2012 continues until it becomes smaller than mainstream RP. The change of TRAP vowel involves F2 by compressing it. This compression again is a movement towards mainstream RP (see the appendices for the value of the formants).

The shifts of the vowels in different periods are compared to the mean formant frequencies of BBC male and female broadcasters reported in Deterding (1997, p.50). The fact that the measurements of Deterding's study are taken from connected speech and supported by improved formant tracking software makes it more comparable to the formant frequency of the vowels of this paper. Moreover, Deterding's use of two different gender groups (male female) makes it possible to compare the two speakers of this paper to average RP speakers in 1980s without hindrance to comparison due to speaker gender determinant of vocal tract length. The other determinant of vocal tract length, age, is not given in Deterdin's (1997) study where TRAP and STRUT vowels have (690/1550/2463 Hz) and (644/1259/2551Hz) for (F1/F2/F3) respectively.

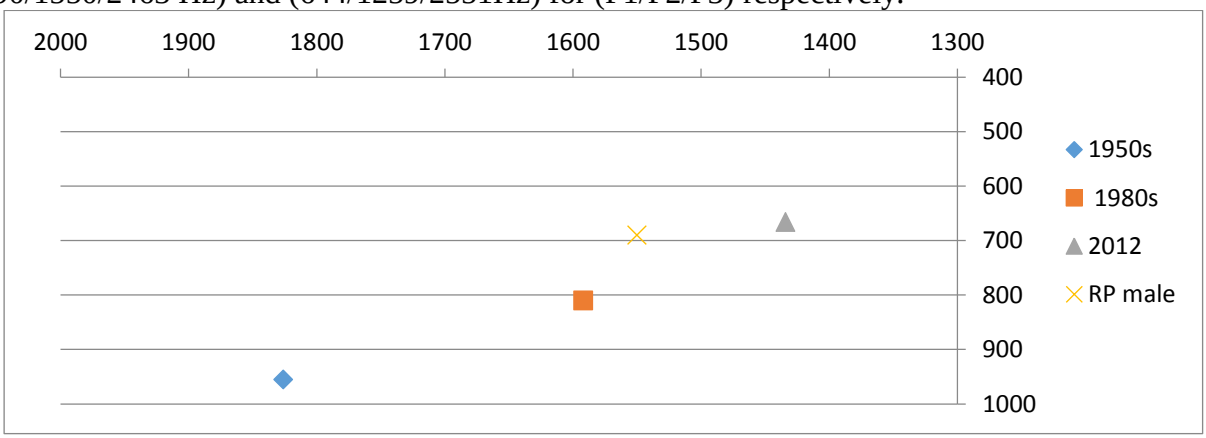

Figure 1: Attenborough's TRAP vowel in (1959, 1987 and 2012) vs. Deterdin's RP male in 1997

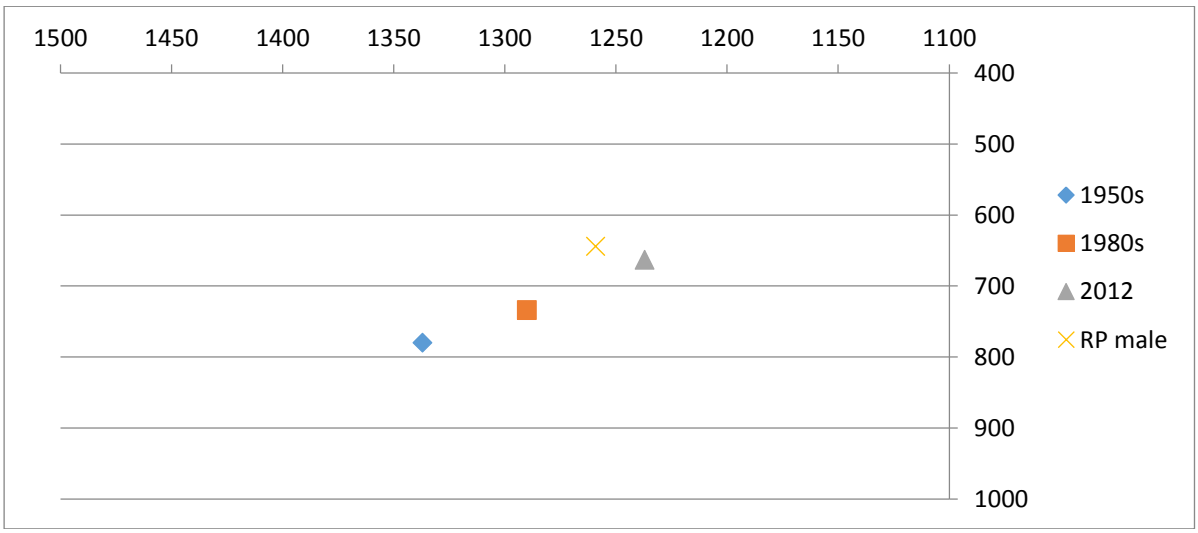

Figure 2: Attenborough's STRUT vowel in (1959, 1987 and 2012) vs. Deterdin's RP male in 1997

As mentioned above, the Queen's TRAP/STRUT formant frequencies change or (lack thereof) shifts in the direction of a more mainstream form of RP. This shift includes both F1 expansion and F2 compression. While the Queen's F1 frequency for TRAP was (796 Hz) in 1957, it increases significantly until it became (949 Hz) in 1984 coming closer towards mainstream RP which was (1018 Hz) for female speakers. From1984 to 2012, the Queen's F1 for TRAP vowel moving in a reverse order from (949 Hz) to (892 Hz). As for the Queen's F2 frequency shift, it has a reverse trend to F1 movement. The Queen's F2 compressed from 1957 to 1984 to become close to the main stream RP then increases again from 1984 to 2012 (See the discussion section for interpretation of this opposite direction). While the Queen's F2 frequency for TRAP was (2039 Hz) in 1957, it decreases significantly until it became (1731 Hz) in 1984 coming closer towards mainstream RP which was (1799 Hz) for middle-age female speakers.

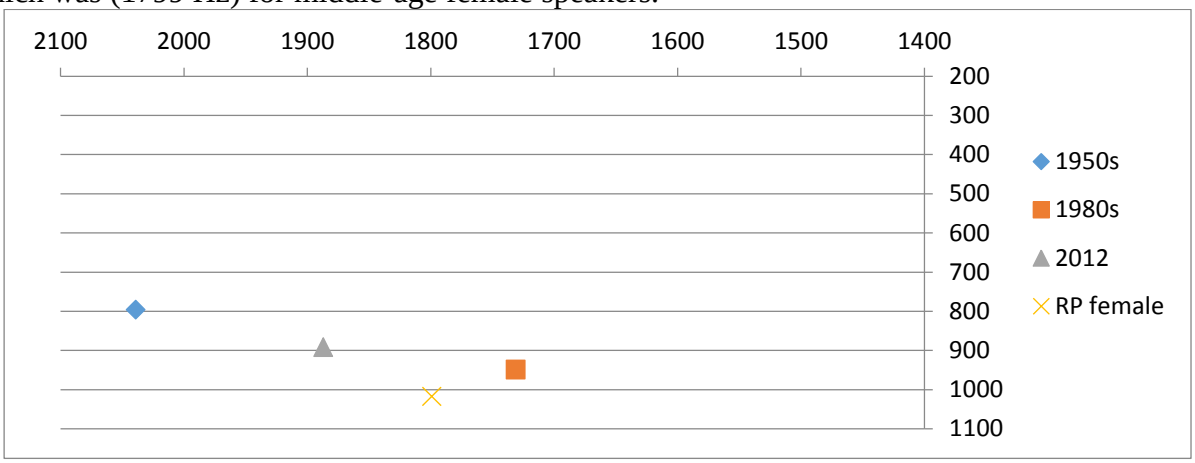

Figure 3: The Queen's TRAP vowel in (1959, 1987 and 2012) vs. Deterdin's RP female in 1997

As for The Queen's STRUT vowel formant frequencies, for both F1 and F2, a considerable shift towards mainstream RP from 1957 to 1984 can be seen. The Queen's F1 frequency increased from (863 Hz) in 1957 to become (899 Hz) in 1984. Thus, moving towards RP which was (914 Hz) for a middle-age female speaker. In contrast to TRAP vowel, from 1984 to 2012, STRUT vowel's F1 frequency decreased from (899 Hz) in 1984 to (870.8 Hz) in 2012. As for F2, it follows the same line as F1 by decreasing its value to become similar to mainstream RP from 1957 to 1984 then to decrease its value from 1984 to 2012. Thus, the Queen's F1 and F2 have moved in the same direction in different time periods.

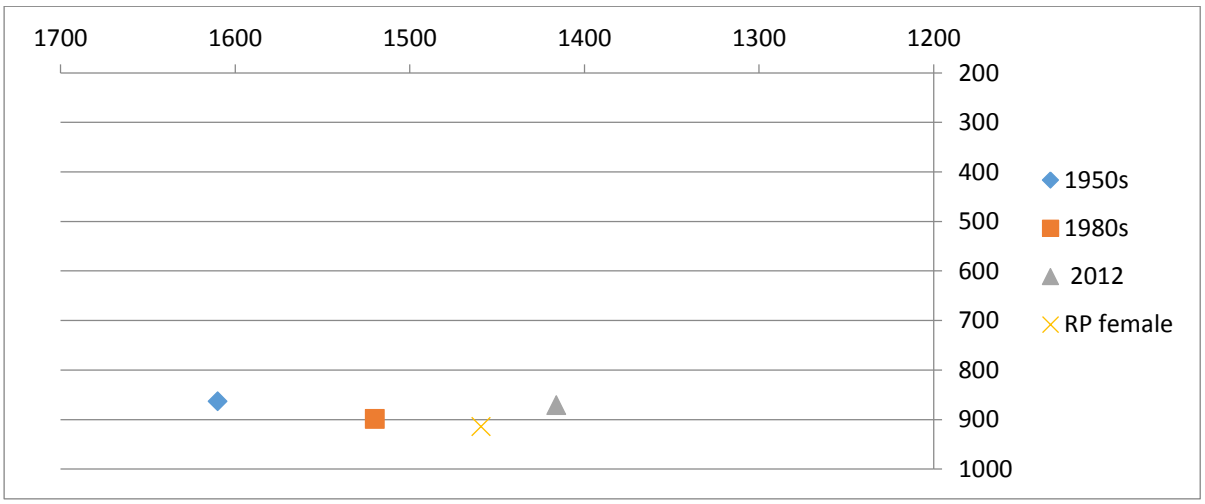

Figure 4: The Queen's STRUT vowel in (1959, 1987 and 2012) vs. Deterdin's RP female in 1997

As Wells (1982, p.129) remarks, RP TRAP and STRUT vowels are phonetically closer than it had been in the early part of the century. In a later work by Kamata (2008), the same trend can be seen for both working class and upper middle class speakers in London. Similarly, for both speakers in this paper, the Queen and Attenborough, TRAP/ STRUT vowel come closer especially in the vertical axis of the vowel quadrilateral by lowering F1 of TRAP vowel and a relatively stable F1 for STRUT vowel. In 2012 data set for Attenborough, TRAP and STRUT vowels have much more similar positions in both F1 and F2 frequency values.

4. Discussions

The acoustic analysis of the two speakers shows that both speakers change their realisation of both TRAP/ STRUT vowels both vertically and horizontally from the 1950s to 2012. However, this shift moves in two opposite directions in the vowel quadrilateral, but for both speakers and for both vowels the movements are towards becoming more similar to mainstream RP. One exception to this drift is the Queen's formant frequency from 1984 to 2012. As discussed in the introduction, any reduction in formant values in later periods can be attributed to age factor that cause lengthening the vocal tract. Expansion of the formant frequency values, on the other hand, can have a sociophonetic motivation. Another reason for this explanation is the fact that the shift is consistent with the changes in RP, i.e. opening of TRAP vowel and becoming closer to STRUT vowel than it used to be earlier in the 20th century.

The Queen's different formant frequency values from mainstream RP in 1950s, as Harrington et al (2000, p.70) report, may be rooted in the Queen's different accent from the RP accent in the 1950s. The Queen's lowering of F1 and compression of F2 for both vowels from 1950s to 1980s can be interpreted as a case in which an individual's vowel change may be influenced by vowel change of her community. These vowel changes cannot be caused by geographical or profession influences as they do for some speakers who move to live outside the region of their dialect or pick up a new job that affect their original dialect. Further, the speaking material and the purpose of delivery is the same in different periods, i.e. Christmas message to Britain and Commonwealth countries.

Although Harrington et al (2000) predict that the Queen's accent will not undergo any changes after 1980s. However, if, as Labov (2010, p. 350) argues, older speakers show a tendency towards communal change, then, it is a feasible argument to look for any changes in the last 30 years of the two speakers. In contrast to what Harrington et al (2000) suggest, the Queen's vowel frequencies from 1980s to 2012, undergo changes but not as dramatic as the changes from 1950s to 1980s. F1 value for both vowels is relatively stable and small reduction in its value can be attributed to physiological processes of aging. However, changes in F2 of TRAP/STRUT Vowels from 1984 to

2012 are significant and in two different directions: Increase in F2 of TRAP vowel and decrease of F2 of STRUT vowel. This drift can be attributed to both the changes in mainstream RP in the last 30 years and physiological processes of aging. Since ageing results in having a longer vocal tract, it causes having a smaller F1 value.

On the other hand, Attenborough's formant frequency for both vowels shows consistency by increasingly following the mainstream RP in different periods. While his 1950s vowels was significantly different from RP, the gap reduced dramatically until his vowels have become almost identical to mainstream older speakers of RP reported in Hawkins and Midgley (2005, p. 189). This shift can be simply explained as an adult's vowel change that was influenced by his community's vowel change. Similar to the Queen, geographical or profession influences cannot cause the vowel shift for Attenborough as he has stayed in the same profession and the same place in the last 60 years.

The fact that the Formant frequency shift of TRAP/STRUT vowel for the Queen and to a lesser degree to Attenborough is different in different time periods underlies the role of community customs on the rate of sound change. As Wassink and Riebold (2013) observe, to understand motivation of sound change, modelling exposure to a sound change is not enough, but also the community norms at the time of the actuation should be accounted for. So, different community norms in the (1950s to 1980s) as compared to (1980s to 2012) can be the reason for distinct vowel shift in these two periods. Similarly, Burridge (1998) points to the influence of community norms on following RP saying that many people no longer try to modify their accent towards RP. Instead, they are now trying to speak more 'down to earth' and more 'ordinary', avoiding the replication of RP. Nonetheless, to analyse the community norms in the three different time periods and scrutinise its role in the actuation of sound change is beyond the scope of this short paper.

5. Conclusions

The formant value of TRAP/STRUT vowels for both speakers have changed noticeably over more than six periods. The shift in the formants is consistent and towards a certain point. The shift in formants can be attributed to two triggers: First, the shift from 1950s to 1980s can be explained as an adult's vowel is influenced by his community. Although the Queen had different accent from the mainstream RP speakers in the 1950s, she changed her accent towards mainstream RP. Whereas Attenborough followed the changes in RP to fit in with the accent of his community. Second, the change from 1980s to 2012 can be attributed to the physiology in the vocal tract of the speakers due to ageing. As the vocal tract becomes longer through time, the F1 value becomes smaller as it can be seen in (figures 1 and 3).

References

1. Aitchison, J., 2004. 'Language change: progress or decay'. 3rd ed., Cambridge University Press, Cambridge.
2. Bauer, L., 1992. 'The second great vowel shift revisited.' English World-Wide. 13: pp. 253-268.
3. Burridge, K., 1998. 'English in Australia and New Zealand: An Introduction'. Oxford University Press, Melbourne.
4. Deterding, D., 1997. 'The formants of monophthong vowels in standard southern British English Pronunciation.' *Journal of the International Phonetic Association.* 27: pp. 47-55.
5. Di Paolo, M., Yaeger-Dror, M. and Wassink, A. B., 2010. 'Analysing Vowels' in M. Di Paolo and M. Yaeger-Dror (eds.) '*Sociophonetics: A Students Guide*.' Routledge. London and Newyork.
6. Harrington, J., Palethorpe, S. and Watson, C., 2000. 'Monophthongal vowel changes in Received pronunciation: an acoustic analysis of the Queen's Christmas broadcasts.' *Journal of the International Phonetic Association.* 30: pp. 63-78.
7. Hawkins, S. and J. Midgley. 'Formant frequencies of RP monophthongs in four age group of speakers.' 2005. *Journal of the International Phonetic Association.* 35: pp.183-199.
8. Kamata, M., 2008. '*A sociophonetic study of the DRESS, TRAP and STRUT vowels in London English.'* Unpublished Ph.D. thesis, University of Leeds.

9. Kerswill, P., 2007. 'Standard and non-standard English' in D. Britain (ed.) '*Language in the British Isles*.' Cambridge University Press. Cambridge. PP. 34-52.
10. Labov, W., 2010. 'Principles of Linguistic Change: Cognitive and cultural factors.' Volume 3. Wiley-Blackwell. Oxford.
11. Ladefoged, P. and K. Johnson., 2011. 'A course in phonetics.' 6th ed. Wadsworth. Boston.
12. Meyerhoff, M., 2006. 'Introducing Sociolinguistics.' *2nd ed.,* Routledge. London and Newyork.
13. Rastatter, M., R. Mcguire, J. Kalinowski, and A. Stuart., 1997. 'Formant frequency characteristics of elderly speakers in contextual speech.'.Folia Phoniatrica, 49: 1-8.
14. Wassink, A. and J. Riebold,. 2013. **'**Individual variation and linguistic innovation in the American Pacific Northwest.' Paper presented at Workshop on Sound Change Actuation, University of Chicago, April 2013.
15. Wells, J.C., 1982. 'Accents of English.' Cambridge University Press. Cambridge and New York.

Appendix (1) Attenborough's word list with their formant frequencies

TRAP	F1	F2	F3	STRUT	F1	F2	F3
Viscacha1	999	1270	2197	cousin	790	1302	2236
Galleries	920	1750	2435	Lucky	793	1390	2524
Passages	1077	2158	2373	enough	782	1328	2484
Families1	946	1761	2679	another	739	1230	2560
National	788	1854	2359	undetected	749	1386	2383
Family2	928	1759	2678	one	684	1286	2733
Had	976	2218	2613	sun	834	1383	2519
Paraguay1	953	1881	2414	something	832	1344	2430
Paraguay2	883	1815	2501	but	718	1345	2461
Viscacha2	1076	1797	2782	up	877	1375	2303
Average	955	1826	2503	**Average**	780	1337	2463

Table (1) Formant Frequency values Attenborough in 1959

TRAP	F1	F2	F3	STRUT	F1	F2	F3
Comparison	772	1551	2474	other	686	1192	2215
Land	705	1576	2431	Cultivation	640	1241	2204
Rabbit	708	1508	2095	One	706	1373	2320
Crab	796	1568	2052	Unknown	873	1199	2932
Fact	724	1607	1802	hundred	832	1325	2087
Canal	948	1563	2748	cut	810	1400	2288
Diplomat	860	1611	2512	another	614	1246	2681
Travel	932	1683	2740	number	754	1323	2744
Back	813	1587	2253	sulking	794	1264	3117
Began	844	1663	2506	just	636	1344	2189
Average	810	1591.7	2361.3	**Average**	734	1290	2477.7

Table (2) Formant Frequency values for Attenborough in 1987

TRAP	F1	F2	F3	STRUT	F1	F2	F3
national	685	1377	2393	London	702	1310	2371
animal	822	1373	2370	wonderful	508	1169	2628
planet	651	1397	2486	trouble	683	1106	2303
spectacular	542	1555	2251	others	683	1202	3020
fascinating	639	1389	2364	done	681	1233	2220
grab	630	1433	2371	monkey	679	1202	2593
magnificent	761	1405	2499	one	601	1198	2367
hand	646	1281	2701	unlike	731	1228	2764
latin	533	1545	2666	grub	665	1287	2435
black	752	1590	2544	gut	698	1439	2583
Average	666	1434	2464.5	**Average**	663	1237	2528

Table (3) Formant Frequency values for Attenborough in 2012

Appendix (2) The Queen's word list with their formant frequencies

TRAP	F1	F2	F3	STRUT	F1	F2	F3
Family	803	2038	2831	Much	903	1665	2984
Landmark	754	2133	2693	touch	777	1774	2003
Gather	762	1949	2852	another	949	1585	2993
Battle	821	1834	2949	Trouble	953	1421	3073
amicably	776	2291	2971	Courage	733	1707	3055
Happy	698	2035	2739	someone	909	1652	2974
abandon	742	2247	3175	someone	866	1533	2351
grandfather	779	2014	2471	unable	946	1676	3092
valiant	807	1985	2497	trust	853	1620	2820
manage	831	2203	3161	unthinking	914	1666	2572
Average	796	2039	2833.9	**Average**	863	1609.7	2791.7

Table (4) Formant Frequency values for the Queen in 1957

TRAP	F1	F2	F3	STRUT	F1	F2	F3
sadness	926	1615	2843	Much	824	1409	2678
perhaps	1066	1684	2909	culture	927	1279	2727
Battle	901	1601	2796	trust	959	1409	2573
National	942	1916	3164	other	888	1577	3032
families	923	1764	2380	one	822	1398	2460
Thankfulness	1010	1858	2948	Understanding	870	1816	2953
comparative	896	1732	2750	Unheeded	931	1652	2687
standard	993	1890	3289	Up	939	1414	2940
managed	927	1279	2727	Trust	992	1439	2489
abandon	972	1786	2923	Until	797	1542	3257
Average	949	1731	2872.9	**Average**	899	1520	2779.6

Table (5) Formant Frequency values for the Queen in 1984

TRAP	F1	F2	F3	STRUT	F1	F2	F3
Family1	954	1737	2691	wonderful	885	1400	2455
Has	872	1706	2783	Trouble	832	1360	2863
Gather	784	1927	2894	Courage	759	1385	2529
Bank	966	2293	2894	Public	828	1391	2899
maritime	943	1916	2911	Others	893	1481	2974
perhaps	1005	2044	3038	London	950	1520	3255
That1	833	1787	3159	mother	934	1342	2245
Family2	898	1745	2759	young	908	1509	2654
That2	833	1787	3159	Comfort	798	1332	2683
athlete	838	1930	2778	hundreds	921	1437	2687
Average	892	1887	2906.6	**Average**	870.8	1415.7	2724.4

Table (6) Formant Frequency values for The Queen in 2012