5 Accent Reversion in Older Adults

Evidence from the Queen's Christmas Broadcasts

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5.1 Introduction

In recent years, there has been an increased interest in investigating the lifespan i.e., linguistic and phonetic changes during adulthood (see Bowie and Yaeger-Dror 2015; Sankoff 2018 for reviews). Some of these changes, such as a decrease and possible subsequent increase in the fundamental frequency (Linville 2001) and first formant frequency (Linville and Fisher 1985; Reubold and Harrington 2015; Xue and Hao 2003) with increasing age are a consequence of the physiological maturation to the vocal tract (Reubold et al. 2010).

But other lifespan changes can be phonetic and caused by adaptation to the community to which a speaker is exposed. This was demonstrated in a study of a bilingual English-Portuguese adult speaker in Sancier and Fowler (1997). Her English voiceless stops had shifted acoustically in the direction of their Portuguese counterparts after she had spent several months in Brazil. More recently, in a longitudinal study of the famous tennis player and late German-English bilingual Stefanie Graf (de Leeuw 2019), the phonetic characteristics of Graf's L2-English had over several years influenced her L1-German.

Long-term change in adulthood can also be brought about by exposure to a new dialect (Chambers 1992). Kwon (2018) has shown significant non-categorical shifts in Noam Chomsky's native Philadelphian vowel system towards the new dialect features after his relocation to Boston. In Reubold and Harrington (2018), it was shown how the vowels of the broadcaster Alistair Cooke shifted away from his standard British English accent, Received Pronunciation (RP) that he spoke at the age of 25 years and towards American English as a consequence of moving permanently to America in 1937 at the age of 29 years.

For several decades, an analytical device for the examination of diachronic development in a language was the apparent-time construct (Bailey et al. 1991; Weinreich et al. 1968), which was based on the idea that differences among generations of similar adults can be used to measure a sound change in progress because language was assumed to become more or less stable after the critical age of language acquisition. There are indeed many longitudinal studies demonstrating adult stability rather than change in the direction of (or against) the community (e.g., Bowie 2015; Brink and Lund 1975, cited in Labov 2006; Labov and Auger 1998), and stability has been reported in Sankoff's (2018) overview to be the most common trajectory in post-adolescence. However, there are also studies showing that phonetic shifts in adulthood are triggered by sound changes sweeping through the community (Sankoff and Blondeau 2007). According to Sankoff (2018), the second most common trajectory of change within an individual adult (after stability) is a so-called *lifespan change*, defined in Sankoff (2005) as an individual's modifications *in the direction of* ongoing community-wide change. Buchstaller et al.'s (2017) longitudinal analysis showed that some but not all of the six adult speakers from Tyneside, England, recorded in 1971 and in 2013, had followed the community changes by which the FACE diphthong has become more monophthongal and phonetically closer in this Tyneside variety. A longitudinal analysis by Quené (2013) showed that Queen Beatrix of the Netherlands increased her speech rate between the ages of 42 and 74 years, compatibly with the more recent tendency to produce speech at a faster rate in the Dutch language community. Based on an analysis of the annually produced Christmas broadcasts, Harrington et al. (2000a) showed how the accent of Queen Elizabeth II had shifted over a 30-year period from a conservative towards a more mainstream form of RP (Received Pronunciation). An uncommon trajectory in post-adolescent language users is a so-called *retrograde change* (Sankoff and Wagner 2006, 2011; Buchstaller 2016) in which adults revert to more conservative language forms that were used at an earlier time in the community. Retrograde change can apply to linguistic categories in e.g., the use of two different kinds of future tense in Québécois French (Sankoff and Wagner 2011). Only three studies have to our knowledge demonstrated retrograde phonetic/phonological change in older adults' speech. Shapp et al. (2014) showed that the Justice of the Supreme Court of the United States, Ruth Bader Ginsberg, increasingly used in late adulthood older (and now outdated) New York City (NYC) vernacular variants including a raised vowel in THOUGHT and vocalized rhotics. MacKenzie (2017) analysed longitudinally the frequency of intervocalic /r/-tapping in the natural historian and broadcaster David Attenborough, a speaker of RP. Although /r/-tapping has waned in this variety in the last 50 years, David Attenborough exhibited beyond the age of 74 years a retrograde change and increased /r/-tapping in later life. Reubold and Harrington (2015, 2018) showed a case of "accent reversion" in the aforementioned broadcaster Alistair Cooke who, having shifted his RP accent towards American English for certain vowels, then reverted his accent beyond the age of 68 years back in the direction of RP even though he remained domiciled in the United States during the period of accent reversion.

Shapp et al. (2014) attribute their finding of a retrograde change to Ginsberg's positions (lawyer vs. judge) at the Supreme Court which were reflected in the different ways that she accommodated to non-NYC English speakers. MacKenzie's (2017) explanation for Attenborough's retrograde retention of intervocalic flaps is that these have been lexicalised within frequently occurring collocations such as "for a" and "their own". In Reubold and Harrington (2018), the accent reversion in Alistair Cooke's late adulthood was found to be led by high-frequency words. Their tentative explanation for this finding is that more recently learned exemplars of words, as well as those of low frequency (Bybee 2006), are less entrenched in memory; and, in very late adulthood, it is the less entrenched exemplars that are deleted first. However, this conclusion is highly speculative, being based on evidence from one person (Alistair Cooke) and for one vowel change (in which an RP-like BATH vowel with a back quality close to cardinal vowel (CV) 5 shifted due to exposure to American English towards the front of the vowel space but then back again towards CV 5 in late adulthood).

In the present study, we seek to shed more light on the issue of *retrograde change* and its possible interaction with lexical frequency through a reanalysis of the Christmas broadcasts that have been delivered annually by Queen Elizabeth II. The focus is on three vowels for which we had earlier found evidence of a phonetic change in the direction of a more modern, mainstream RP (Harrington et al. 2000b; Harrington 2006). These include the /u/ as exemplified by the lexical set GOOSE, the /æ/ of TRAP, and the /ɪː/ of HAPPY which were found to be phonetically more front, lowered, and more peripheral in the later decades (in the 1980s for /u, a/; up to 2002 for /ɪː/) compared with recordings obtained from the 1950s. The main issue to be considered in the present study is whether in later years up to 2017 these vowels of the Queen's Christmas broadcasts have remained stable, or whether there is evidence of a retrograde change towards those qualities from the 1950s combined with an interaction with lexical frequency.

5.2 Methods

5.2.1 Materials

We analysed 35 Christmas broadcasts of Queen Elizabeth II (recorded in 1952, 1954–1961, 1963–1966, 1968, 1970–1973, 1983, 1985, 1988, and 1994, 1996–2002, 2008, 2010, 2014, 2015, 2016, and 2017). Their mean duration was 5 minutes with a range between 59 seconds in 1959 and just over 8 minutes in 1956. These recordings span the age range of 26–91 years. We selected and analysed target vowels that (a) formed the

Table 5.1 Number of occurrences of each vowel type selected as either an anchor (left) or target (right) vowel

	Anchor vowels				*Target vowels*			
	FLEECE	DRESS	PALM	THOUGHT	HAPPY	TRAP	GOOSE	
							WHO'D	HEWED
	/iː/	/e/	/ɑː/	/ɔː/	/ɪː/	/æ/	/uː/	/juː/
1950s	229	462	115	217	153	66	38	24
1960s	173	360	59	133	120	20	25	24
1970s	106	223	34	90	86	14	14	27
1980s	102	244	43	100	55	47	19	26
1990s	198	314	96	152	128	36	30	29
2000s	121	224	44	106	74	14	22	17
2010s	166	269	70	147	118	57	29	28
Σ(= 5928)	1095	2096	452	945	734	254	177	175
							352	

nuclei of stressed syllables of nuclear accented words in the lexical sets TRAP (/æ/) and GOOSE (/uː/) and (b) vowels in lexically unstressed syllables of words in the lexical set HAPPY (annotated as /ɪː/, as in Harrington 2006). Additionally, we selected (c) so-called anchor vowels (see below) in lexically stressed syllables from the lexical sets FLEECE (/iː/), DRESS (/e/), PALM (/ɑː/), and THOUGHT (/ɔː/). Altogether, 5928 vowels were selected (of which 1340 were target vowels); their distribution by decade is shown in Table 5.1.

Following our own earlier practice (e.g., Harrington et al. 2000b), we separated words of the lexical set GOOSE depending on the absence (e.g., WHO'D, COOED) or presence (e.g., HEWED, QUEUED) of a preceding /j/ context. In the latter cases, the segment of interest then was the entire /juː/ sequence.

5.2.2 Data Preparation and Analysis

Using the transcripts of the Christmas broadcasts (which can be downloaded from https://www.royal.uk/history-christmas-broadcast?ch=5#bio-section-4), we applied grapheme-to-phoneme conversion and forced-alignment (within the Munich Automatic Segmentation System for British English, Kisler et al. 2017) for the automatic segmentation and labelling of the audio recordings. Any necessary manual readjustment of the target and anchor vowels were carried out in the EMU-Speech Database Management System (Winkelmann et al. 2017).

The frequencies of the first five formants (F1–F5) were calculated from the audio signals (sampling rate 16 kHz) in the frequency range 0 to 5500 Hz with a frame shift of 6.25 ms and a window length of 25 ms by means of *PRAAT*s (Boersma and Weenink 2018) built-in standard formant tracker using the Burg method (cf. Childers 1978: 252–255). Obvious errors in the first two formants of the target vowels, such as when F1 was mistracked as F2, were manually corrected.

The linearly time-normalized (to 11 points) F1 and F2 trajectories were smoothed using a 5-point median filter. In order to preserve the dynamic information, the discrete cosine transformation (DCT) was applied to these time-normalized trajectories of F1 and F2 (Watson and Harrington 1999). For this purpose, we extracted the first three DCT coefficients, k_0, k_1, k_2, which are proportional to the mean, the linear slope, and the curvature and thereby encode the salient aspects of a vowel's dynamics with just three values per formant (Watson and Harrington 1999).

We tested our hypotheses by calculating the relative distance between the target vowel and two anchor vowels (see Table 5.2) in a space formed from the DCT-transformation of either one or both formants. This method of relative distances was used in order to normalize for possible changes to vowels' formants that are a consequence of

Table 5.2 The target vowel, anchor vowels and the DCT-space in which the relative position of the target vowel between the anchors was calculated

Target vowel	*Anchor vowel 1*	*Anchor vowel 2*	*Space (dimensions)*
TRAP	FLEECE	PALM	*DCT-F1* (= 3D)
GOOSE	FLEECE	THOUGHT	*DCT-F2* (= 3D)
HAPPY	FLEECE	DRESS	*DCT-F1 and F2* (= 6D)

(physiologically induced) age-related changes to the vocal tract (cf. Reubold and Harrington 2015, 2018). More specifically, since the sound change to TRAP involves changes in phonetic height, the position of TRAP was calculated in relation to the phonetically high FLEECE and phonetically low PALM vowels in an F1-space (which indexes phonetic height). Since the sound change to GOOSE involves /u/-fronting, its position was calculated in an F2-space relative to the phonetically front and back vowels respectively FLEECE and THOUGHT. Finally, given that tensing of the final vowel in HAPPY involves both fronting and raising, its position was calculated in relation to the high front FLEECE and phonetically lower and more central DRESS vowels in a combined F1 and F2 space. In all cases, the spaces were created from the DCT-coefficients (thus e.g., a three-dimensional DCT-F1 space in the case of TRAP – see Table 5.2).

This relative distance of the target vowel to the two anchor vowels was calculated from *op*, the orthogonal projection ratio (Stevens et al. 2019) using (1):

$$op(\vec{x}) = 1 - 2\frac{(\vec{x} - \vec{c}_{A1}) \odot (\vec{c}_{A1} - \vec{c}_{A2})}{(\vec{c}_{A1} - \vec{c}_{A2}) \odot (\vec{c}_{A1} - \vec{c}_{A2})} \quad (1)$$

in which in a DCT-space (formed from the DCT-coefficients of F1, F2 or both formants, see Table 5.2), $\vec{x}$ is the position of a given target vowel, $\vec{c}_{A1}$ and $\vec{c}_{A2}$ are the centroids (means) of the two anchors respectively, and $\odot$ is the scalar (inner) product of two vectors. When $op = 0$, then the target is equidistant between the two anchors and when $op = +1$ or -1, then the target is positioned at one of the two anchors respectively. If *op* is outside these ranges, then the target is beyond either anchor (see Stevens et al. 2019, for further details).

As in Reubold and Harrington (2018), we wanted to test for possible effects of lexical frequency by using so-called *Zipf* values (Van Heuven et al. 2014), i.e., standardized measures of word frequencies, taken from a database that is based on subtitles of British TV programs (SUBTLEX-UK, cf. Van Heuven et al. 2014), thereby aiming at representative frequency measures of spoken language (as opposed to written language resources). The *Zipf* value of a given word, $Zipf_{word}$, could vary between 0 and 9 and was calculated from (2):

$$Zipf_{word} = -\log_{10}(n/10^9) \quad (2)$$

in which n is the number occurrences of a particular word in the SUBTLEX-UK database.

Elizabeth II often uses quite frequent words in the Christmas broadcasts: the mean of $Zipf_{word}$ in the selected target words was 5.07 (median = 5.25, SD = 1.01, range: 1.81 to 7.32). Usually, the cut-off between "infrequent" and "frequent" words is chosen at $Zipf_{word} \geq 4$ (Van Heuven et al. 2014). Since, however, only 201/1340 of the selected words were labelled "infrequent" by this measure, we instead selected a cut-off of $Zipf_{word} \geq 5$ resulting in 755 *frequent* and 585 *less frequent* words.

We ran three separate mixed models (one for each of the HAPPY, TRAP, and GOOSE targets) in the *R* package *lmerTest*, version 3.1-0 (Kuznetsova et al. 2017), which makes use of the techniques in the package *lme4*, version 1.1–21 (Bates et al. 2015). For plotting the fixed effects (see Figure 5.2), we used the package *effects*, version 4.1-0 (Fox and Weisberg 2018). The dependent variable was always *op* in (1) and the independent variables were *Age* (in years) and the quadratic term Age^2 as a numerical regressor and a binary fixed factor *Lexical Frequency* (with levels *frequent* and *less frequent*). The quadratic term Age^2 was included in order to test for a retrograde change, i.e., to test whether the change was initially towards, and then in late adulthood against, the direction of community change. The word types were the levels of the random factor *Word*. In order to obtain p-values, Satterthwaite's method was used to calculate an approximation to the effective degrees of freedom.

5.3 Results

Figure 5.1 shows the positions of the centroids (averaged by decade) of the Queen's vowels in HAPPY, TRAP, and GOOSE (the latter separated into WHO'D and HEWED, i.e., with and without preceding /j/) in the F2 × F1 plane as trajectories over time, with the trajectories' beginnings representing the centroids during the 1950s, the turning point representing the 1990s, and the arrow head representing the 2010s. The most relevant age-related changes can be attributed to F1 for HAPPY, to F2 for GOOSE, and to both F1 and F2 for TRAP, i.e., HAPPY varies in phonetic height, GOOSE mainly in phonetic backness, and TRAP in both height and backness.

Figure 5.2 shows *op* values for the target vowels together with fitted trajectories for *frequent* and *less frequent* words derived from mixed

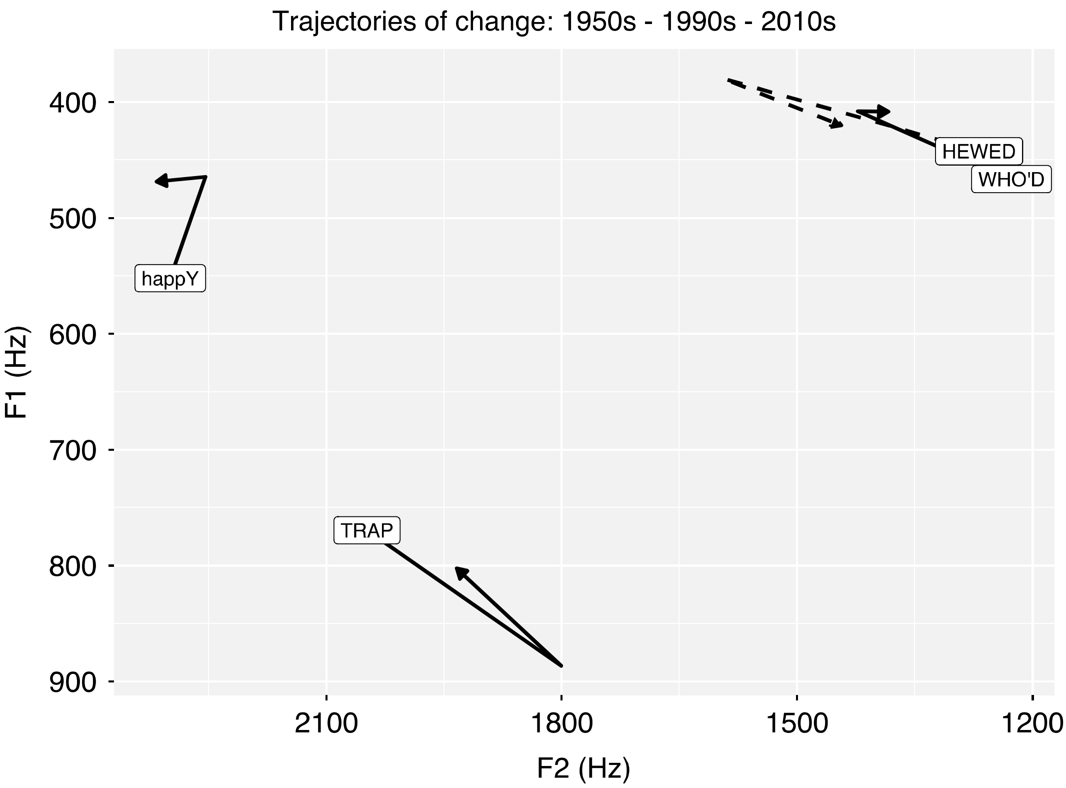

Figure 5.1 HAPPY, TRAP, AND GOOSE VOWELS (the latter divided into WHO'D (solid) and HEWED (dashed) in the 1950s (position of the labels), in the 1990s (turning point of the trajectories), and in the 2010s (position of the arrow heads) in the F2 × F1 space. The plot for HAPPY, TRAP, and WHO'D are aggregates of the F1 and F2 centroids extracted at the temporal midpoint; for HEWED, the aggregated plots are of F1 and F2 centroids measured at 80% of the /juː/-segments' durations.

models (with *Age* and *Age*^{2} as regressors). There is some evidence from all three panels of Figure 5.2 (as well as from Figure 5.1) for a partial reversion of the sound change in progress, that is, of a change from the 1950s in the direction of community changes that reached its peak around 1990 (i.e., in the Queen's mid-sixties), and then changed direction back towards the values of earlier decades. There seems to be no clear patterning as far as lexical frequency is concerned: thus, in HAPPY and GOOSE, there is some evidence that this reversion is marginally greater in more frequent words but there is no such pattern for TRAP.

The results of the mixed models with dependent variable *op* are summarized in Table 5.3. Compatibly with Figure 5.2, both the linear and quadratic terms of *Age* had a significant influence on *op*: the significant effect of the quadratic term *Age*^{2} provides the evidence that the sound change in later years (beyond 1990) has changed back in the direction of the 1950s. The effect of this reversal is evidently much stronger for TRAP than for the other two vowels in which the retrograde change, while associated with a significant quadratic term, is marginal.

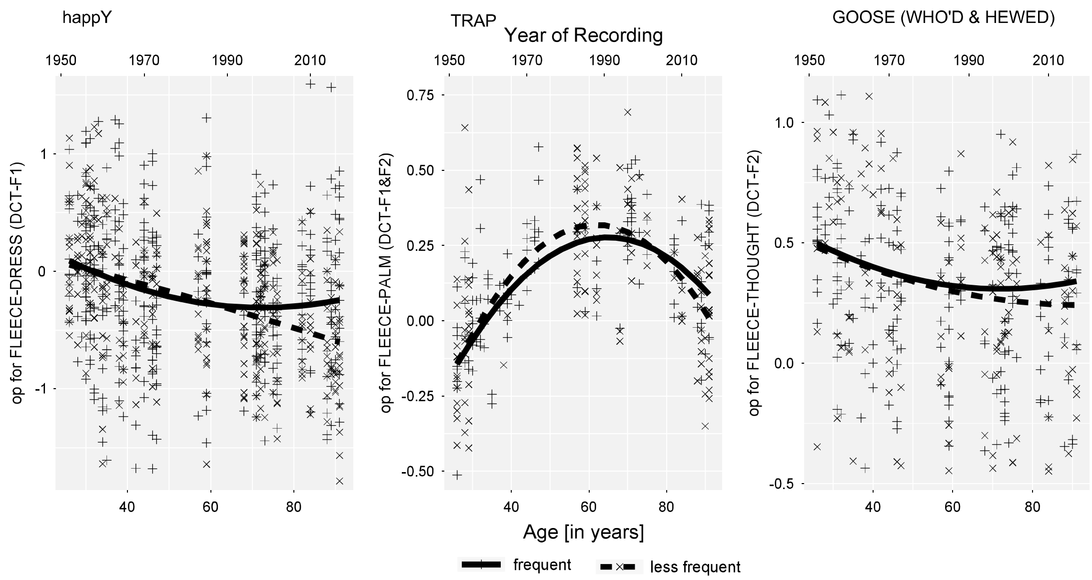

Figure 5.2 *op* for the target vowels in frequent (+) and less frequent (×) words of the lexical sets HAPPY (left panel; *n* = 734), TRAP (centre; *n* = 254), and GOOSE (right panel; *n* = 352), measured in different spaces (see in METHODS section), as a function of biological age. Superimposed are modelled quadratic trajectories for frequent (solid) and less frequent (dashed) words resulting from the mixed models.

The results also show that, independently of the sound change in progress, the target vowels were unaffected by lexical frequency. The only evidence of an interaction between age and lexical frequency was for HAPPY: in this vowel alone, the reversion i.e., change back towards positions characteristic of the 1950s vowels was more marked in frequent than in less frequent words.

5.4 Discussion

Queen Elizabeth II follows the sound changes that have taken place in RP since 1950 in three vowels until around 60–65 years of age that is, until the turn of the decade from the 1980s to the 1990s. The new finding is that beyond this period until the age of 91 years in 2017, there is evidence of a retrograde change in the direction of the vowel qualities from the 1950s. The retrograde change was small (but significant) so that the vowels nevertheless remain more "modern" than they were in the 1950s. The size of the retrograde changes was greater for TRAP than for HAPPY or for GOOSE. We speculate that this might be so because the magnitude of the sound change in progress from the 1950s to the 1980s (up to the age of 60 years) was itself much larger for TRAP than for the other two vowels, as Figure 5.2 shows. But Figure 5.2 also suggests that the size of the reversion (beyond the age of 60 years) was around half the actual change, at least in high-frequency words in all three cases. The first stage in the changes to the Queen Elizabeth II's accent until around 1985–1990 that were in the direction of community changes can be explained in terms of contact and memory. As far as contact is concerned, it is probable that Queen Elizabeth increasingly came into contact with middle-class speakers in the period 1950–1970. This greater contact across the classes in these decades is a likely consequence of a social revolution in Britain during that period (Cannadine 1998) in which the marked separation between the classes was becoming increasingly blurred and above all in which persons from the lower and middle classes were finding their way into the establishment. The prime ministers, with whom the Queen holds a weekly audience, were undeniably of the establishment in the 1950s (and spoke a conservative or upper-class form of the standard sometimes known as U-RP, see Wells 1982), but from the 1960s until the coalition government of 2010 this was no longer so, and none of them during this period – with the possible exception of Edward Heath – could be described as a U-RP speaker.

As far as memory is concerned, the computational model of sound change in Stevens et al. (2019) and Harrington and Schiel (2017) takes over the idea from episodic models of speech (Pierrehumbert 2016) that speakers are also listeners and that passive listening can cause the mapping between words, their phonological representation and speech signals to be updated (see also Todd et al. 2019 for a computational implementation). The gradual approximation of the Queen in the direction of (but without attaining) a more middle-class accent in this model is interpreted as a consequence of incrementally updated memory-rich representations of speech brought about by contact with middle-class speakers, rather than, e.g., a strategy initiated by the Queen to sound more like one of the people.

This type of memory-rich model of sound change with a production-perception feedback loop (Stevens et al. 2019; Todd et al. 2019; Wedel 2004, 2006) can explain why there are marked differences in the extent to which adults participate in community sound changes or adapt to a new dialect (Buchstaller et al. 2017; Sankoff 2018). Firstly, no two persons come into contact (and hold conversations) with the same set of interlocutors. There is, for example, no reason to expect that an adult speaker should be swept along in community changes, if that speaker happens not to keep company with the, often younger, speakers who might be at the forefront of a phonetic change. Secondly, as detailed in the computational model of sound change in Stevens et al. (2019), even if such a speaker does regularly contact phonetically innovative interlocutors, change is not inevitable because it also depends on how the speaker's phonological categories happen to be aligned with respect to each other and in relation to those of the community in an acoustic space (so that, e.g., an adult with a retracted /u/ which is skewed towards the

Table 5.3 Results of the mixed models by target vowel (rows) for the linear and quadratic terms of age (columns 2 and 3), lexical frequency (column 4) and the interactions between (the linear and quadratic) terms of age with lexical frequency (final two columns)

	Age	*Age*^{2}	*Lexfreq*	*Lexfreq*Age*	*Lexfreq*Age*^{2}
HAPPY	t[670.1] = 4.4, $p < 0.001$ ***	t[673.0] = 2.3, $p < 0.05$ *	NS	(t[715.7] = 2.5, $p < 0.05$) *	t[727.9] = 1.7, $p < 0.1$
GOOSE	t[241.7] = 3.7, $p < 0.001$ ***	t[244.7] = 2.1, $p < 0.05$ *	NS	NS	NS
TRAP	(t[165.7] = 6.4, $p < 0.001$) ***	(t[175.0] = 7.3, $p < 0.001$) ***	NS	NS	NS

front of the vowel space is especially likely to change over the years if there is contact with speakers with a fronted /u/, see Harrington and Schiel 2018 for further details).

The present study of Queen Elizabeth II as well as three other studies (Shapp et al. 2014; MacKenzie 2017; Reubold and Harrington 2018) show that there can be a change towards the type of accent spoken by the same individuals earlier in their lifespan. Reubold and Harrington (2018) suggested that there might be a relationship between their finding of accent reversion in Alistair Cooke and those from second language acquisition in which there can be a decrease in L2-proficiency and increase in L1-usage that can happen in a similar age range of around 60 years of age (De Bot and Clyne 1989; Clyne 2011). There may be a further commonality between the accent reversion in Reubold and Harrington (2018) and the change in accent observed by Roth et al. (1997) in a 48-year-old L1-English speaker after he had had a stroke. After recovering some spontaneous speech, Roth et al. (1997) found that their patient's speech was characterized both by Broca's aphasia and exhibited various characteristics of a Dutch accent. Prior to the stroke, the patient had no Dutch accent as an adult but was born in the Netherlands and had lived there until the age of 5 years, after which he moved to the United States with his family: the suggestion in Roth et al. (1997) is that their patient had reverted to the characteristics of an accent he had spoken in early childhood.

We now sketch some possible explanations for the retrograde change we have found in Queen Elizabeth II, building upon some of the very preliminary ideas in Reubold and Harrington (2018). The explanation advanced in Reubold and Harrington (2018) for the accent reversion of Alistair Cooke away from his acquired American English towards his former RP accent is once again couched in terms of contact and memory. As far as contact is concerned, there is evidence that Cooke interacted far more with American English speakers in his middle compared with his later years. In an exemplar type model, this would mean that his internal model of American English would be updated less often in late than in middle adulthood. As far as memory is concerned, it is possible that remembered exemplars learned in the early stages of life are more entrenched than in late adulthood. There is experimental evidence in Hay and Foulkes (2016) that exemplars are stored in relation to the time at which they were acquired with the consequence that "older" words, i.e., ones that would typically occur in discussing issues in the distant past are also produced with more conservative pronunciations. Although there is no direct evidence from the study by Hay et al. (2015) that older exemplars are more entrenched, such older and earlier remembered exemplars must nevertheless be very robust, given that they are not only memorized over a long lifespan but also seem to exert an influence on speech production in later life. A waning of Cooke's internal cognitive model of American English, coupled with an entrenched and robust model of RP, might explain why RP began to exert a greater influence on Cooke's Americanized vowels in late adulthood.

This tentative explanation for Cooke's accent reversion does not, however, easily carry over to accounting for the retrograde change in Queen Elizabeth II, given that (to our knowledge) there is no evidence for a diminished contact of Queen Elizabeth II to the public in Britain in the last 20 years. An alternative explanation, which could also account for Cooke's accent reversion, might instead be based on the age-related deteriorations of several perceptual and cognitive processes that might well be detrimental to the updating of memory-rich representations of speech. With regard to perception, it is clear that the very common age-related presbycusis (Huang and Tang 2010) diminishes the sensory acuity needed for (detail-rich) speech perception; decreases in hearing ability also increase the workload due to a higher experienced listening effort, which has been shown to impact functional brain connectivity (Rosemann and Thiel 2019). On the other hand, older adults show declines in speech perception even if presbycusis is factored out (Füllgrabe et al. 2015), which suggests that age-related deteriorations to speech perception are at least partly caused also by cognitive changes separate from age-related changes in audiometric sensitivity. Bidelman et al.'s (2014) study compared speech-evoked brainstem and cortical Event Related Potentials in older and younger adults and concluded that age-related changes in brain physiology "distort the hierarchy of speech representations along the auditory pathway" and "reduce neural flexibility in the speech network" (Bidelman et al. 2014: 2538).

Additionally, there is quite considerable evidence for a deterioration in episodic memory in later life (Tulving 2002). Episodic memory (Tulving 1972) includes remembered events that are experienced in a particular context and setting (Cansino 2009; Rosenbaum 2017) and are distinct from semantic memory which stores context-independent and factual information. Thus, remembering that a person said a certain word or expression at a particular time and place forms part of episodic memory, whereas the knowledge that the word has particular properties, such as its grammatical class, belongs to semantic memory. Whereas contextual information in episodic memory decays in later life (Levine et al. 2002; Cansino et al. 2018), semantic memory is thought to remain relatively intact (Rosenbaum et al. 2017) or to be even facilitated (Levine et al. 2002). Perhaps then the age-related decline of episodic memory has a progressively greater influence on those word exemplars that are remembered in later adulthood. If so, then more recently experienced word exemplars would tend to be deleted, which is perhaps just another way of saying that exemplars remembered earlier in life are more entrenched or are more robust relative to more recently encountered ones. The idea is nevertheless speculative. Although some empirical studies of source memory suggest that the decline in episodic memory is especially marked beyond the age of around 50–55 years (Verhaeghen and Salthouse 1997), other studies (Cansino 2009; Cansino et al. 2018) point to a fairly gradual decline beyond the age of around 30 years. Only the evidence of a late (but not early and linear) decline in episodic memory could be taken to be compatible with the findings here of Queen Elizabeth II of a retrograde change at around the age of 60 years.

Finally, there is a discrepancy between our findings for Alistair Cooke and Queen Elizabeth II as far as the interaction in retrograde/accent reversion changes and lexical frequency is concerned. In Cooke, the accent reversion in late adulthood was greater in BATH vowels of high than low frequency. While we do find that high-frequency words lead the retrograde change of HAPPY away from FLEECE in Queen Elizabeth II, there was no evidence for an influence of lexical frequency on the retrograde shifts in GOOSE and TRAP. Perhaps these mixed results have come about because whether or not lexical frequency and sound change interact seems to depend on several factors. Thus, neither Dinkin (2008) nor Labov (2010) find any influence of lexical frequency on the gradual sound changes of American English vowels, Hay et al. (2015) find that high-frequency words lead sound change in the case of New Zealand English /t/-glottalisation, and Hay et al. (2015) show that low-frequency words lead the raising of the New Zealand English DRESS vowel which is in a push-chain relationship with TRAP. As modelled in Todd et al. (2019), the influence of lexical frequency on sound change is likely to depend on whether or not the sound change encroaches on the space of any neighbouring phonemes, and this might be one of the factors that contributes to these mixed results within the Queen and between Cooke and the Queen.

5.5 Summary and Conclusions

Between the 1950s and 1980s, Queen Elizabeth II shifted her vowels in the direction of changes that were taking place to the standard accent of England, British English Received Pronunciation. Since around 1990 at the age of 64 years, there is evidence for a retrograde phonetic change back in the direction of the Queen's vowels of the 1950s. This finding of retrograde change is consistent with accent reversion involving a waning of American English towards RP for the broadcaster Alistair Cooke (Reubold and Harrington 2018) and with the evidence that conservative forms of /r/-tapping are preserved in Richard Attenborough (MacKenzie 2017). We tentatively conclude that these retrograde changes may be linked firstly to a decline in the functioning of episodic memory in late adulthood which causes the attrition of more recently stored word exemplars, and secondly to an entrenchment (and therefore protection from deletion) of exemplars of remembered words and their associated episodes that were stored in the distant past.

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