/U/-FRONTING IN RP: A LINK BETWEEN SOUND CHANGE AND DIMINISHED PERCEPTUAL COMPENSATION FOR COARTICULATION?

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ABSTRACT

The present study is concerned with a perceptual analysis of /u/-fronting in Southern British English, Received Pronunciation and with whether there is an age-dependent difference in perceptual judgments to synthetic /i-u/ continua. A second aim was to test the hypothesis that younger listeners would be less likely to attribute a fronted /u/ perceptually to the coarticulatory fronting effects of the left context. We synthesized /i-u/ continua and embedded them in two contexts: firstly, 'yeast-used', in which the initial /j/ exerts a marked effect on /u/-fronting; and secondly 'sweep-swoop' in which the preceding /w/ is likely to induce /u/-backing. Taken together, the results of responses to these continua so far suggest that young and old listeners respond differently to a sound change in progress and also that /u/-fronting in RP may be related to a perceptual reinterpration of coarticulatory-induced /u/-fronting.

1. INTRODUCTION

Several studies both impressionistic and acoustic have provided evidence that /u/ has become fronted in the last 50 years [1,2,3,4,8,13] in Southern British English, Received Pronunciation (we follow [13] in his definition of RP). In an acoustic analysis of the vowels from the Queen's Christmas broadcasts [5,6,7], Harrington showed not only that the Queen's /u/ from broadcasts later than 1980 was fronted relative to /u/ in her 1950s broadcasts, but also that this change may be a hypoarticulation induced sound change related to the prevalence with which /u/ in RP follows /j/ (e.g. 'few') and consonants such as alveolars (e.g., 'noon') that have a high F2 locus [7]. Compatibly, the acoustic analysis in [7] showed that the distance between the F2-locus of the preceding consonant and the F2-target of /u/ has progressively diminished from earlier to later years.

According to Ohala [11,12], many sound changes arise not only as a consequence of this type of context-dependent hypoarticulation, but also because of the listener's failure to compensate for the effects of coarticulation. More specifically, although /u/ may be fronted between flanking alveolars, listeners do not necessarily perceive a front vowel because they attribute the vowel-fronting to the effects of context (and so factor it out from the vowel). However, if according to Ohala listeners fail to undo perceptually the effects of coarticulation, then a mini sound change will take place: the listener will interpret the fronting as intended i.e., as part of the speaker's phonological plan.

One of the aims of the present study was to investigate whether there was any evidence for this relationship between the failure to compensate for coarticulation and a sound change that has been taking place in RP over the last 50-60 years. We reasoned that if young listeners are more likely to interpret a fronted /u/ as intended, then they should show less evidence of compensation for the coarticulatory effects of fronting compared with older listeners from the same RP-speaking community. A second and related aim was to assess whether, commensurate with the studies cited earlier showing /u/-fronting as a change in progress in RP, the categorical perceptual boundary along an /i-u/ continuum is shifted to the left for younger listeners – that is, whether young listeners are more likely to label a given token from an /i-u/ continuum as /u/ compared with older listeners from the same community.

In the present study, the effects of contexts were investigated by embedding /i-u/ continua in two

sets of minimal pairs: 'yeast-used' ('used' as in the past tense sense, e.g., 'they used to study'), /jist-just/; and 'sweep-swoop', /swip-swup/.

Based on the foregoing discussion, we made the following predictions. (1) the /i-u/ boundary should be left-shifted (greater proportion of /u/-responses) for younger listeners in both contexts. This is because if young listeners' perceptual /u/ category has fronted, then it is likely that they will interpret a greater number of stimuli with high F2 on an /i-u/ continuum as /u/. (2) the /i-u/ boundary should be left-shifted for 'yeast-used' compared with 'sweep-swoop' for all age groups, if a certain degree of /u/-fronting in the former and /u/-backing in the latter are perceptually interpreted as due to coarticulation. This is entirely predictable from the theory of perceptual compensation for coarticulation, in the way shown in Mann & Repp's [10] classic study. (3) the difference in the responses between these two sets of minimal pairs should be less for the younger listeners. This is perhaps the most important prediction from the present study, and the reasoning that underlies it is as follows. If /u/-fronting in RP as a sound change in progress has come about because young listeners fail to undo perceptually the effects of /j/-on-/u/ perseverative coarticulation, then the /i-u/ boundary will be slightly right-shifted (more /i/ responses) in 'yeast-used' for younger listeners. Thus although following prediction (1) above, the /i-u/ boundary should, in general, be left-shifted in younger compared with older listeners for *all* comparable contexts, the implication of prediction (3) is that it will not be quite as left-shifted in 'yeast-used' as in 'sweep-swoop'. But this is equivalent to predicting that the difference in the location of the cross-over boundary from /i/ to /u/ in 'yeast-used' compared with that in 'sweep-swoop' should be slightly less in younger than in older listeners.

2. METHOD

2.1. Stimuli

HLSyn (High Level Parameter Speech Synthesis System [9]) was used for creating the synthetic stimuli in all cases. We carried out pretests with trained L1-English phoneticians to obtain naturalness judgments to various continua in the two contexts, firstly in order to guarantee that our synthesized endpoints were intelligible as the intended words; and secondly to determine the perceptually most natural continuum as far as F2 changes were concerned. We used two 13-step synthetic continua in which F2 was varied as follows: for 'yeast-used' F2 varied from 2428 Hz to 1278 Hz in equal 0.45 Bark-size steps; the F2-locus of the preceding /j/ was 2450 Hz, and the transition phase of 90 ms was followed by a 120 ms steady-state part of the vowel (F1 = 280 Hz, F3 = 2700 Hz). For 'sweep-swoop', F2 varied from 2320 Hz to 1014 Hz in 0.35 Bark steps; the duration of the steady-state part of the vowel that followed /w/ (F2-locus = 600 Hz) and a transition phase of 45 ms was 140 ms; F1 and F3 of the steady-state were 280 Hz and 2544 Hz respectively.

2.2. Experiment and Subjects

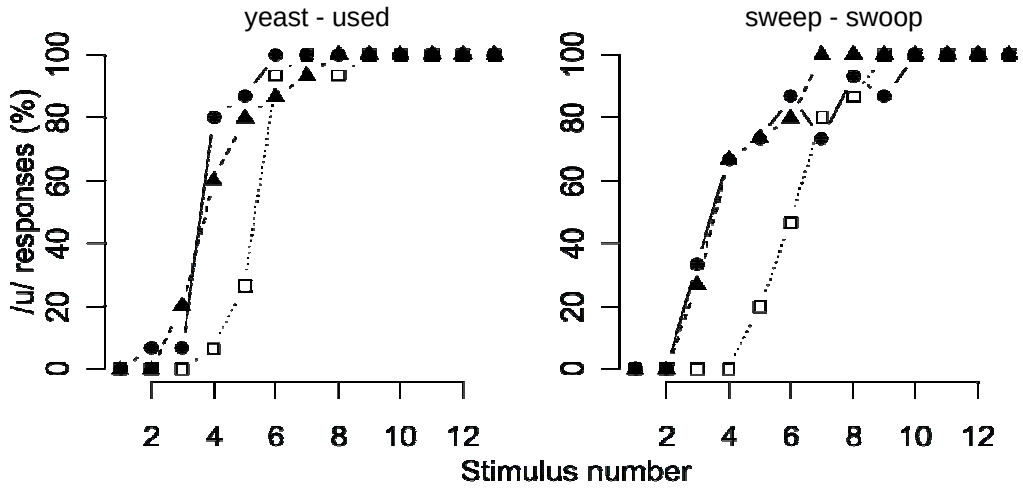
Nine male RP speakers, students or staff of Cambridge University participated in the experiment. The subjects were chosen according to three age groups: Y(oung), born between 1987-88 and with an average age of 18.3 years; M(id), born between 1946 and 1951 and with an average age of 57.3; and O(ld) born between 1928 and 1934 and with an average age of 76.3 years. Each group consisted of three subjects. The M- and O-group subjects had already taken part in the 2001 production experiments of [4], in which both groups showed a rather ‘conservative’ /u/: M’s /u/ was marginally fronted compared with O’s.

The experiment took place in a quiet booth in the Dept. of Linguistics, University of Cambridge. The stimuli (five repetitions in randomized order) were presented to the subjects via headsets, and the subjects were asked to label the perceived synthetic stimulus with one of *sweep*, *swoop*, *yeast*, or *used* on prepared answer sheets.

3. RESULTS

The responses of the three subject groups to the two continua are shown in Fig.1. As far as hypothesis (1) is concerned, Fig. 1 shows that the cross-over boundaries are shifted to the left for both the 'young' and 'mid' compared with the 'old' groups: that is, there seems to be a greater likelihood that 'young/mid' listeners hear more /u/ vowels than 'old' listeners. However, the results of a repeated measures ANOVA with independent variable Age (Y/M/O) and dependent variable the

Figure 1: /u/ responses to 'yeast-used' (left) and to 'sweep-swoop' (right) for 'young' (filled circles), 'mid' (filled triangles), and 'old' (open squares) listeners. The stimulus numbers are arranged according to decreasing F2 in the synthesized stimuli from left to right.

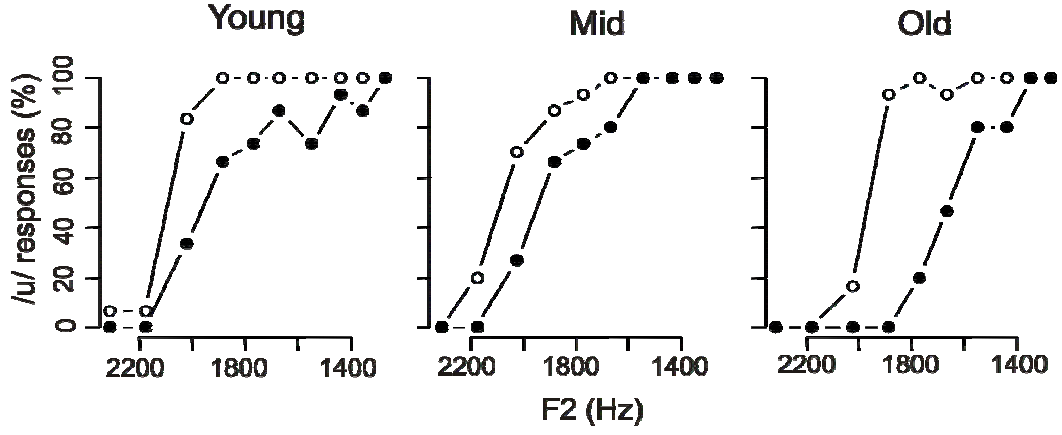


Stimulus Number showed no significant differences as a function of age group.

Comparing now between the panels (hypothesis (2)), the same figure shows that responses to 'yeast-used' is left-shifted relative to 'sweep-swoop'. Results of a repeated measures ANOVA showed a significant effect of context ($F=15.3$, $df=1, 6$, $p < 0.01$). These results are therefore compatible with hypothesis (2) that the 'yeast-used' boundary is left-shifted relative to 'sweep-swoop'.

Finally, we come to hypothesis (3): is the difference between contexts less for younger listeners? In Fig. 2, we have plotted the same data as in Fig. 1, but this time separately for the three age groups. We have also plotted the data as a function of F2 in order to be able to better compare the responses across contexts as a function of changing F2. The data show again clearly support for hypothesis (2) that the 'yeast-used' boundary is left-shifted relative to that of 'sweep-swoop'. The data also show some evidence that the responses in the two contexts are more divergent for the 'old' group (right panel). In particular, the extent of divergence (of left-shift of 'yeast-used' relative to 'sweep-swoop') is greater for the 'old' than for either the 'mid' or for the 'young' listeners. However, the results of a repeated measures ANOVA with factors Age and Context showed no significant interaction between age-group and context.

Figure 2: /u/-reponses to 'yeast-used' (open circles) and 'sweep-swoop' (closed circles) for the three age groups as a function of the second formant frequency of the stimuli.



4. DISCUSSION AND CONCLUSION

Since we have so far analyzed the perceptual responses of only 9 subjects, the results are tentative at best. Nevertheless there are some trends which are not inconsistent with the predictions made about the perception of /u/-fronting in the earlier part of this paper. These are as follows. Firstly, the younger and older groups differ in their location of the perceptual boundary between /i/ and /u/ such that the younger listeners are more inclined to accept tokens with a higher F2 as /u/. There seems therefore to have been a shift in the category boundary for /u/ that may be consistent with various studies showing a fronter realization of /u/ in younger speakers. Secondly, and compatibly with Mann & Repp [10], we have provided further evidence that listeners compensate for coarticulation. Finally, there is some evidence that younger listeners are less inclined to compensate perceptually for coarticulation when /u/ follows a fronting context such as /j/. This third finding, if supported by responses from a greater number of subjects, would be consistent with the acoustic analysis in [7] that /u/-fronting in RP is a hypoarticulation-induced sound change that is related to the prevalence with which /u/ follows a fronting context. Moreover the results are consistent with the idea that there is a link between sound change and perceptual non-compensation for coarticulation: younger listeners may well be less inclined to undo the coarticulatory fronting effects of context on F2 in /u/ compared with older listeners; and the waning of perceptual compensation could be related to their left-shifted perceptual category boundary of /u/ along an /i-u/ continuum.

Further data are needed to substantiate these points, not only from more listeners but also from a further analysis in which perceptual responses are correlated with the positions in an acoustic space of /u/ vowels produced by the same subjects that have taken part in this listening experiment.

ACKNOWLEDGMENTS

This research is funded by the German Research Council Foundation (DFG). Many thanks to the Dept. of Linguistics University of Cambridge, especially Sarah Hawkins, for giving us the opportunity to carry out the perception experiments in their lab.

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