RAISING OF /A/ IN COPENHAGEN DANISH – PERCEPTUAL CONSEQUENCES ACROSS TWO GENERATIONS

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ABSTRACT

This study concerns differences in the perception of phonemes that have undergone near merger within the past few generations in the Copenhagen speech community. It is hypothesized that this process can lead to a difference in phoneme boundaries across generations. We studied the effect of speaker and listener age on the placement of the phoneme boundary between /ɛ/ and /a/ in Copenhagen Danish using a forced choice word identification task. The results show that younger listeners accept a greater range of vowels as tokens of /a/ in accordance with the changes in production of this phoneme.

Keywords: phoneme categorization, listener age, sound change, sociophonetics.

1. INTRODUCTION

Recent changes in the vowels in Copenhagen Danish have led to a difference in the realization of the short /a/ phoneme: younger speakers tend to realize /a/ with a lower F1 (and higher F2) than older speakers, meaning that younger speakers' realizations of /a/ are closer to and often overlaps with older speakers' realizations of /ɛ/. Previously, this raising of the vowel /a/ was overtly stigmatized, but no longer appears to be noticed by younger listeners [1].

In this study, we investigate whether this change in production and the concomitant loss of overt social evaluation has affected the placement of the boundary between /ɛ/ and /a/ across two generations. Since younger language users are more likely to produce /a/ with acoustic qualities that place it higher in the front vowel space, we hypothesize that they also accept acoustically higher (and fronter) vowels as tokens of /a/ when their classifications are compared to those of older listeners.

Previous studies have found an effect of listener age on the placement of the boundary between vowel phonemes whose allophones are adjacent in the acoustic vowel space. Harrington et al. [4] found that younger listeners accepted fronter tokens in an /i/ - /u/ continuum in RP English as tokens of /u/ than older listeners did. Drager [3] found a similar effect in a study of the /ɛ/ - /a/ continuum in New Zealand English. Here, older listeners classified higher vowel tokens as /a/ in a forced word choice task, when they had been primed to believe that the speaker was a younger male. When they had been primed to think that the speaker was an older male, the boundary between /ɛ/ and /a/ was lower in the acoustic vowel space. This effect did not obtain for the younger listeners in [3], who always placed the boundary at approximately the same point as the older listeners did when primed to believe that the speaker was young.

The /i/ - /u/ distinction in RP English and the /ɛ/ - /a/ distinction in New Zealand English are similar to the /ɛ/ - /a/ distinction in Copenhagen Danish, in that they both involve a vowel change in progress: /u/ is produced with a more fronted articulation by young speakers of RP [4] and /a/ is produced with a more closed articulation by young speakers of New Zealand English [3].

Given the circumstances of the production of /a/ in Copenhagen Danish and based on the previous findings of [3] and [4] we hypothesized that:

- younger listeners would place the boundary between /ɛ/ and /a/ higher in the acoustic vowel space than older listeners
- older listeners would be sensitive to the age of the speaker in their phonemic categorizations, whereas younger listeners would not

2. METHOD

To test the hypothesis that speaker age and listener age would affect placement of the phoneme boundary between /ɛ/ and /a/, we conducted a forced choice word identification task using resynthesized stimuli. Six minimal pairs were spoken by four speakers and recorded in a sound proof room at the Linguistics Laboratory at the University of Copenhagen with a sampling rate of 44.1 kHz. For each minimal pair an eight step continuum between /ɛ/ and /a/ was created using Praat [2]. Each word in a minimal pair was matched for frequency and the 12 words were matched for overall frequency. The phoneme /ɛ/ was always represented by the letter 'æ' orthographically and the phoneme /a/ was represented with 'a'. Thus word frequency and orthography were controlled for in the design, maximising the likelihood that any observed effects could be ascribed to the age of the listner and/or speaker.

A younger and an older female speaker and a younger and an older male speaker each recorded all of the twelve words spoken in a carrier sentence. The recordings with /ɛ/ constituted one endpoint of the continuum, and the recordings with /a/ constituted the other endpoint. The vowels were resynthesized with the /ɛ/ point of the continuum having an F1 of 350 Hz and F2 of 2220 Hz. The eight steps were created by increasing F1 by 50 Hz for each step and decreasing F2 by 55 Hz for each step resulting in an endpoint corresponding to the vowel /a/ with an F1 of 700 Hz and an F2 of 1780 Hz. 12 words x 4 speakers x 8 steps yielded a total of 384 items.

The ages of the four voices used for the stimuli were judged in a pre-test, where 13 participants were asked to write down the age of each voice based on the words they had spoken in isolation. The young male voice was judged to have a mean age of 20.8, the young female voice had a mean age of 24.3, the older male voice had a mean age of 57.5 and the older female voice was judged to have a mean age of 48.8. While the age span for the two older voices was larger than for the two younger voices, the results of the pre-test indicated that the voices alone were sufficiently different to be able to prime two different age groups for the listeners.

The stimuli were presented to listeners over headphones using E-Prime to administer the task. A set of three minimal pairs of the vowels /i:/ and /e:/ spoken by two younger female speakers were used for the training phase of the experiment.

Two groups of listeners participated in the experiment: 16 younger listeners (aged between 19 and 41 years old, mean age 22.8) and 17 older listeners (aged between 58 and 72 years old, mean age 65.8). All listeners were born and lived in the Greater Copenhagen area.

Stimuli were blocked by gender and speaker but randomized within blocks. For each item, listeners had to pick which of the members of a minimal pair they heard. The order of options was fixed within listener but varied between listeners, i.e. half of the listeners in each group either always had the /ɛ/ option on the left and the /a/ option on the right, whereas the order was the opposite for the other half.

2. RESULTS

To find out whether there was an effect of listener age on the placement of the perceptual boundary between /ɛ/ and /a/, a generalized linear mixed-effects model with subject as random effect was fit to all 6330 responses to the resynthesized vowel continua. Step and Voice were included as fixed factors to control for the contribution of the changes in F1 and F2 and to see if the effect of listener age was different depending on either the sex or age of the voice or both. Listener Age was entered as a binary factor with the levels "young" and "old", and the model predicted response to the stimuli as /a/. Only step and listener group emerged as significant ($p = 0.09$ for voice). There were no significant interactions. The summary of the final model including only significant factors is shown in Table 1 below.

Table 1: Model summary for word choice task.

Factor	Estimate	Std. Error	z value	p
Intercept	-1.586	0.095	-16.65	< .001
Young listeners	0.377	0.109	3.45	< .001
Step	0.269	0.012	22.34	< .001

The model summary shows positive estimates for both Listener Age and Step in the vowel continuum, meaning that an increase in both yielded an increased tendency for listeners to categorize a stimulus as containing /a/ when F1 increased and F2 decreased, as predicted.

The younger listeners were more likely overall to categorize stimuli as containing /a/. The effects of the two factors are shown together in Figure 1. The x axis shows the value for the factor Step and the y axis gives the probability that listeners responded /a/. The black line gives the predicted responses for older listeners, and the grey line gives the predicted responses for the younger listeners.

Figure 1: The simple main effects of Listener Age and Step in the forced word choice task

Perception of [a] in Copenhagen
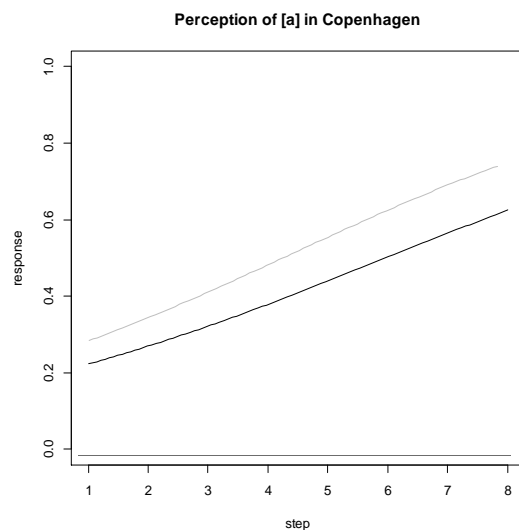
As can be seen from the figure, the 50 % cross over point is different for the two groups of listeners: it occurs at step 4 for the younger listeners, but at step 6 for the older listeners. In other words younger listeners tend to classify a vowel with an F1 of 550 Hz or higher and an F2 of 2000 Hz or lower as /a/, whereas older listeners only start to prefer the response /a/ once the vowel has an F1 of 600 Hz or higher and an F2 of 1890 or lower.

3. DISCUSSION

The results of the forced word choice task show that listeners of different ages classify acoustically identical vowels as allophones of different phonemes, confirming the first hypothesis. This is reminiscent of the results presented in [3] and [4]. However, the results differ from those of [4] in that the responses were not as categorical as those found for the /i/ - /u/ continuum in RP English. This is most likely due to the fact that the present experiment used a smaller range of the F1 and F2 continua, meaning that the extremes of the /ɛ/ - /a/ vowel continuum were not represented in the test. The results also differ from [3] since we did not find an effect of the age of the voice, thus not confirming the second hypothesis. This is surprising, since the variation in the realization of the phoneme /a/ is known to have moved in the direction of /ɛ/ in the speech community where we sampled our listeners from. In [3] the effect of presumed age of the speaker was found for the older listeners, but here we do not find an effect for either age group of listeners. This could be due to the fact that we relied on characteristics of the voice itself to prime speaker age, whereas in [3] speaker age was primed by presenting subjects with a visual prime while the voice remained the same. It is possible that priming of speaker age requires activation of stereotypically younger and older speakers in order to influence vowel perception, and that such activation does not occur when priming only with voice characteristics. The main result, however, remains. Younger listeners classify vowels as allophones of /a/ which older listeners classify as /ɛ/, indicating a shift in the perceptual boundary for the two phonemes between the two generations. Thus, the present study adds to the findings of [3] and [4] in showing evidence for a perceptual change in apparent time.

7. REFERENCES

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