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On variation and change in diphthongs and long vowels of spoken Dutch

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7. GENERAL SUMMARY, LIMITATIONS AND PROSPECTS

Abstract This final chapter summarizes the main findings of our research on vowel variation in Standard Dutch. The hypotheses as given in the introduction are reconsidered in view of the main findings of the present research, and the limitations. Finally, suggestions for future research are given.

7.1 Hypotheses Reconsidered

In the following we will reconsider the hypotheses of the first chapter (cf. section 1.2).

The general hypothesis of the present research was that in Standard Dutch "... *the realizations of vowel phonemes show sub-phonemic variation that is socially marked.*" The acoustic results of chapter 4 yielded patterns of vowel realization that coincided with the social background of the speakers in terms of 'level of education' and 'age group'. Our general hypothesis on the social structure in sub-phonemic vowel realization was thus supported. In view of our significant results, and unlike previous analyses of larger Dutch vowel corpora, future analyses of Dutch vowels should control the speakers' social background to minimize unwanted variation in the data, and to allow for a better interpretation of the measured acoustics, even more when speaker data are pooled.

The second hypothesis in section 1.2 focused on gender effects in terms of female precursors within the avant-garde speakers: "*While the well-educated (the avant-garde) have lowered /ɛi/, led by the females, the phenomenon is not apparent in other speakers.*" In chapter 4, the results showed that, starting with the mid age generation, /ɛi/ was significantly lowered, longer, and more strongly diphthongized within the group of high educated speakers. Our high or low social classes were defined in terms of 'level of education and occupation', and we did not define avant-garde speakers versus the non-avant-garde. This was due to limitations in the available speaker data and the background attributes gathered within the spontaneous speech part of the CGN. However, we presume that avant-garde speakers are part of the speaker group of high educated and occupied speakers, and that the speaker group that was labeled 'low educated and occupied' does not include speakers of the avant-garde. From this angle, the hypothesis can be supported, though, in view of our results, we would rather name the appearance of the lowered and more strongly diphthongized variant 'higher Dutch' (the Dutch of the high educated and high occupied) than 'avant-garde Dutch' or 'Polder Dutch'. When it comes to the leading role of the females, however, we cannot support the hypothesis, as in our corpus of 35 males and 35 females there were no effects of gender. Due to the latter findings, we have to reject the hypothesis of women leading the change.

Yet, as mentioned in chapter 4, the hypothesis was based on earlier studies of the pronunciation of /ɛi/ which were based on formant values. Though including a logarithmic scale to prevent the unwanted effect of speaker sex contrary to gender, the previously applied normalization procedures probably still carried effects of speaker sex in the formant values which then got entangled in the research results, which led us to our third hypothesis: "*Vowel space sizes differ, and gender differences might be caused by anatomical differences between the sexes. When comparing realizations of various speakers and sexes, a speaker's realized vowel quality needs to be defined in relation to the size of his or her individual vowel space.*" In chapter 4, the acoustic analysis of all speakers' /a/-i/-u/

vowel triangle spaces yielded significant effects of speaker sex when the acoustics were measured in terms of formants in Bark. For the triangle space size in pc's based on a PCA on barkfilter output, the differences between the sexes were not significant and speakers could be pooled. For formants, our data support the first part of the hypothesis considering the disentanglement of gender and sex effects in vowel variation research. This underlines the second part of the hypothesis; the need for a definition of vowel quality in relation to the speakers' individual vowel space size, which was indicated by the results of the preliminary study in chapter 3. A sophisticated procedure to compare vowel data of various speakers and independent of speaker-sex was developed in chapter 4. As shown in chapter 4, the sex-specific vowel space attributes could be normalized when our normalization procedure was applied to the outcome of pc's derived from a PCA on barkfiltered /a/, /i/, and /u/ spectra. In contrast, sex-specific vowel space attributes could not be normalized when the normalization procedure was applied to formant measurements in Bark.

Our next, more methodologically oriented hypothesis stated the following: "*Principal component analysis on barkfiltered spectra are a more objective method of measurement in vowel variation research than formant analysis.*" Given the results of the PCA on all speakers' barkfiltered /a/, /i/, /u/ mean spectra, and the lack of significant sex effects in the analysis of the resulting various speakers' vowel space sizes in the pc dimensions, we assume that this method is reliable in vowel variation research. Furthermore, and contrary to formant analysis, this method can be reliably automated and needs no hand correction. The effect of noise in the vowel space sizes could be normalized by relating all vowels to the speaker-specific /a/-/i/ values. Contrary to our pc's, the vowel space size in formants in Bark did yield significant sex differences. Since we were analyzing degrees of lowering and diphthongization under aspects of social pronunciation constructs, effects of speaker sex need to be disentangled from effects of gender in this variation research. We thus assume that principal components on barkfiltered spectra are more objective and reliable in vowel variation research.

Having proven the socially marked diphthongization and lowering of /*ei*/, we now consider the last hypothesis stated in the introduction that deals with the interdependence of the Dutch diphthongs next to /*ei*/, and the long vowels: "*The long vowels and diphthongs of Dutch vary interdependently. If the pronunciation of /*ei*/ is changing, the diphthongs /*æy*/ and /*au*/, and the long vowels /*e:*/, /*ø:*/, and /*o:*/ are, too.*" Due to its low frequency of occurrence we omitted the vowel phoneme /*ø:*/ from our analysis. The results of chapter 4 indicate indeed a lowering and diphthongization pattern. This pattern was found for all of the vowels mentioned, and not merely for /*ei*/ . Moreover, the lowering and stronger diphthongization were most apparent in the phonemes /*e:*/ and /*o:*/ . The limited amount of data do not allow us to determine which of the vowel phonemes was first in the process of lowering and stronger diphthongization, but we speculated that /*ou*/ and /*æy*/ were the first to have moved. In general the outcome of this study suggests that, unlike previous Dutch

vowel analyses in larger corpora, future vowel analyses should control the social speaker background before generalizing pronunciation patterns.

7.2 *Limitations and Future Prospects*

Though most parts of our initial hypotheses could be clarified or even supported by our research, the results of our corpus analysis can only be generalized under reserve. Given the number of attributes in the 70 speakers' meta data that could be related to the realization behavior, there is a need for the analysis of even larger corpora with a more even spread of these attributes.

Although we are satisfied with the reliability of our pc's in our variation research compared to the analysis by formants, the fact that the pc's were sensitive to background noise, whereas the formant values were affected by sex differences, would suggest the benefit when both could be combined. Vowel variation analysis by a PCA on barkfilters could be improved by a combination with e.g. the stronger weighing of spectral peaks in the barkfiltered spectra, reducing the effects of noise that were apparent in the principal components.

Our study should represent diachronic changes in pronunciation from generation to generation. However, only a longitudinal study could confirm that the effects found in our apparent-time study are not the effects of age grading. In the summary of chapter 6 we speculated that our young speaker group is probably the least settled generation of our speakers, and therewith they are the speakers who are most likely to show changes in pronunciation, were they measured again at a later point in time. Longitudinal studies on pronunciation are lacking for Dutch, and measuring speakers and reporting on their social background at different points in their lives would help to disentangle the various background effects.

Considering social background effects we would also suggest more sophisticated investigations on the listeners' backgrounds. Although the interpretability of our perception experiment is limited, given the literature on social behavior and perception, we nonetheless assume that, parallel to the social effects found in sub-phonemic vowel realization, comparable effects can be found in sub-phonemic vowel perception. This is due to the individual acoustic input a speaker is confronted with, and which tunes his or her perception of sub-phonemic (social) variation and the production behavior as well. Referring to the strong ties between perception and production, we could have suggested another hypothesis: *"If the speakers' productions can be related to their social background, and thus to different speech communities, their perception might show traces of these effects as well."* We would thus claim that not only a speaker's production but also his or her perception is socially marked. The results of our perception experiment suggest that both are affected or formed by social behavior in the same way. Chapter 6 underlined the de-

pendence of acoustics and articulation and the large impact of social behavior on both. However, though it showed some effects of listener age in the same-different judgments of pairs of sub-phonemic vowel realizations, our perception experiment in chapter 5 was originally set up to prove the perceptibility of the acoustic variation as found in chapter 4. Given the indications of participant-related effects on the perception of acoustic distances, the listeners should have been chosen more carefully with an even spread of attributes such as the listener's age that turned out to have affected the judgments. Only then the suggested hypothesis could have been tested properly. Next to controlling the listener background, we would have chosen other stimuli. Major difficulties in mapping articulation, acoustics and the perception of vowels arise from the circumstance that different sounds or articulations can evoke the same perception, and thus equidistant articulatory or acoustic steps do not lead to equidistant perceptual categories (see for instance Peterson & Barney, 1952 [115], Miller, 1953 [98], Traunmüller, 1981 [147], Assmann et al., 1982[4], Miller, 1989 [97], Hoemke & Diehl, 1994 [51], Stevens, 1996 [136]). Restricting ourselves to the spontaneous speech data that have been analyzed in our study of 70 speakers made the choice of stimuli and controlling various stimulus attributes difficult. Including psychoacoustic, syntactic, semantic, lexical and pragmatic effects, human speech processing is very complex, and due to the interaction of the various layers of speech, the relation between perceived features and the acoustic signal is not biunique. Many more aspects of the chosen stimuli probably affected the listeners judgments than the ones we could consider, and synthesized stimuli might help in controlling these aspects.

To test the social effects in listeners we would suggest to use stimuli with synthesized vowel qualities from various parts of the vowel continuum, representing the sub-phonemic vowel variation. A perception task including synthetic stimuli with variously diphthongized and lowered vowel phonemes for comparison could clarify to what extent listeners can be differentiated in their judgment of acoustic differences, and whether the differences can be related to social attributes of the listener background. Were the vowel realizations of the same participants' acoustically analyzed as a function of their social background, a direct link could be established between effects of social background on production and perception behavior.