AN ACOUSTIC DESCRIPTION OF THE MONOPHTHONGS OF EAST ANGLIA

Emmanuel Ferragne, François Pellegrino

Laboratoire Dynamique Du Langage, UMR 5596 CNRS Université Lyon 2
Emmanuel.Ferragne@univ-lyon2.fr

ABSTRACT

This study is a description of the monophthongs of East Anglia speech, an area in the south east of England. Formant measurements were computed on 11 vowels in /hVd/ contexts. The results are compared with those of previously published works on standard British English. Our findings highlight the similarities and differences between the two systems. Particular attention is paid to age-related issues and speaker normalization.

Keywords: Dialect speech, British Isles, vowel system, formants.

RÉSUMÉ

Cette étude est une description des monophtongues de l'accent de l'Est Anglie, région du sud-est de l'Angleterre. Des mesures de formants ont été effectuées sur 11 voyelles dans des contextes /hVd/. Les résultats sont comparés à ceux de travaux antérieurs sur l'anglais britannique standard. Nos résultats montrent les similitudes et les différences entre les deux systèmes. Une attention particulière est donnée à l'âge des locuteurs ainsi qu'à la normalisation du locuteur.

1. INTRODUCTION

East Anglia is an area in the south east of England whose accent is distinctive enough from other regions in the British Isles to qualify, to all intents and purposes, as a single dialectal area (although some variation occurs within it). According to sociolinguist Peter Trudgill, who has carried out dialectological research in the area since the late 1960s, it includes most of Suffolk and Norfolk, and portions of surrounding counties are regarded as transition zones ([9], 163-164). In typological parlance, the phonological system of East Anglia is typical of the south of England in that, unlike in northern varieties, FOOT does not rhyme with STRUT; and, within the south, it is clearly eastern since it is not rhotic. Specific pronunciation features include comparatively great duration differences between stressed and unstressed vowels ([9], 176) (this is confirmed in a study on the rhythm of British dialects: on the vocalic PVI dimension, East Anglian falls at the most stress-timed end of a continuum [4]). Systematic yod-dropping (e.g. <dew> and <do> are homophones) is also a distinctive feature of this area. Closing diphthongs have a remarkably close second element, triphthong smoothing (for some speakers, <tower> and <tar> can be homophones) frequently occurs, and /l/ is vocalized in most speakers, etc.
The dialect of East Anglia is considered by most linguists to have been instrumental in the development of standard British English (sometimes referred to as "RP"; denominations will regrettably not be commented upon in detail here, suffice it to say that, despite possible differences, the two terms will be used as synonyms in this paper). It will therefore be instructive to compare data from a recent corpus of East Anglia speech with published data on the vowel system of standard British English ([10, 7, 3, 6]).

The aim of this study is to characterize the vowel system of a group of speakers from East Anglia using formant measurements. F1 and F2 values were computed from 19 speakers producing vowels in /hVd/ contexts. We first describe our method and then comment on the data, with particular focus on a comparison with standard British English, speaker normalization, and between-speaker homogeneity. This work is preliminary to a further study that will encompass 13 dialects of the British Isles.

2. METHOD

In this section, we describe the speech data and the method employed for the analysis.

2.1. Speech material

The data analyzed here comes from the Accents of the British Isles (ABI) corpus (see [2] for a thorough description). Nineteen speakers (ten women, nine men) from Lowestoft, a town in

Suffolk, produced five series of nineteen vowels in /hVd/ contexts in random order: *heed, hid, head, had, hard, hod, hoard, hood, Hudd, heard*, *who'd*. The data were recorded at the beginning of 2003.

Unfortunately, very little is known about the speakers: they had to have lived in the area all their lives, and their parents should have lived there too. The ideal target age range was 18 to 50 years old, but the documentation indicates that two male speakers, who happen to be brothers, fall well outside this range. Besides, this range is clearly too large to constitute a single accent entity: it is well-known that age is an important factor in language variation (see, for instance [6]).

Words in /hVd/ contexts have often been used in phonetic studies; and although their ecological validity is questionable, as can be inferred by the important number of hesitations in our data, it has been shown in ([5]) that they were quite adequate for research on accents.

2.2. Data Analysis

The ABI database comes complete with a word-level segmentation. In order to extract formant values, a semi-automatic procedure was adopted. Vowel boundaries were estimated using automatic pitch detection with the Snack toolkit. The values of F1 and F2 were computed with the Burg algorithm implemented in the Praat program set to default values. Given the poor reliability of automatic formant extraction in general, the following method was adopted: a shell script was written to have Praat display a spectrogram of each vowel with the estimated formant tracks superimposed, and the script waited for the user to accept or reject the vowel in question. As a general rule, vowels were rejected when a formant was skipped, which happens quite often for back vowels (especially *hoard*), where F1 and F2 are so close that the algorithm misses one of them. When formant tracks were particularly jagged, the vowel was discarded too. Due to formant errors and poor spectrogram legibility, we did not manage to complete the whole set of 11 vowels in 4 speakers; these speakers (two women and two men) were left out for the rest of the analysis.

Given the coarse method employed to determine vowel boundaries (i.e. pitch detection), which led to include parts of adjacent segments with the vowel (hence erratic values towards the beginning and the end of the segment of interest), four frames (successive frames were 5 ms apart) were discarded on each side of the vowel, and the median over all vowel tokens of one type for one speaker was calculated. The median was meant to play down the influence of possible formant estimation errors near vowel boundaries.

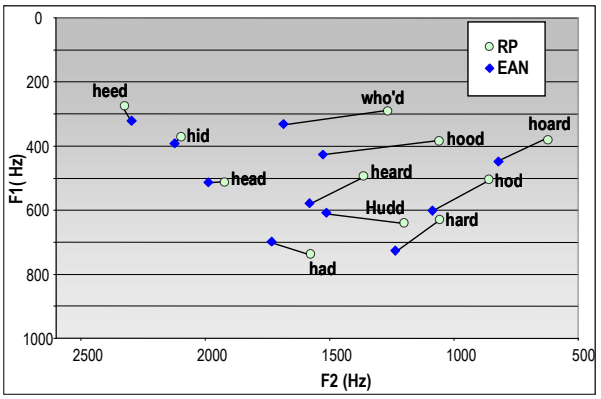
The choice of a unit was made with reference to previous classical studies on the "monophthongs" (we will return to the use of this term further below) of British English ([10, 7, 3, 6]): both Bark and Hertz values were computed. In addition, following [1], z-scored Hz values are also presented in this paper.

3. RESULTS

3.1. Comparison between dialects

Figure 1 plots the mean values from [6] (RP, henceforth) and the male speakers in the present study (EAN). Corresponding vowels are connected by a line. The overall picture shows that the back and central vowels in our study are relatively fronted, and more open (except for *Hudd*), while front vowels tend to be similar. The relative fronting of *hood* and *who'd* is particularly noticeable. The conspicuous proximity of *Hudd* and *heard* deserves further investigation (see below).

Figure 1: Mean F1 and F2 (Hz) values from [6] (dots) and the male subjects study (diamonds).



3.2. Between-speaker variability

The system of EAN monophthongs is reproduced in Figure 2 and Figure 3. [1] have shown that the best way of factoring out between speaker physiological differences while preserving accent information was the method proposed by Lobanov in the early 1970s: for all the vowels of a given speaker, the values of each formant (separately) are z-scored, e.g. the mean F1 is subtracted from each

F1 value, and the result is divided by the standard deviation of the F1 distribution. Although our dataset is too small to assess the benefits of this method with, for example, an automatic vowel classification task, visual displays suggest that between-speaker variation decreases indeed when z-scores, instead of raw Hz values, are plotted.

Figure 2: F1 and F2 and one standard deviation bars for the 16 EAN speakers (Hz).

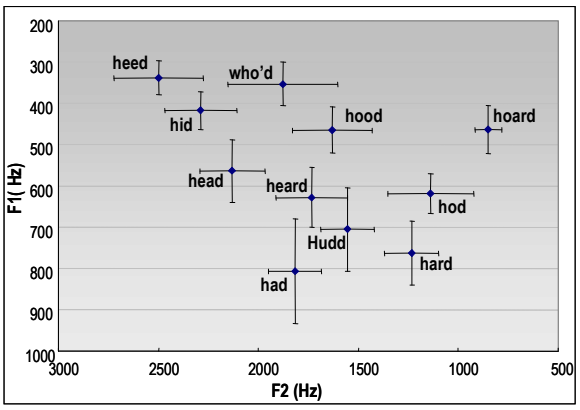
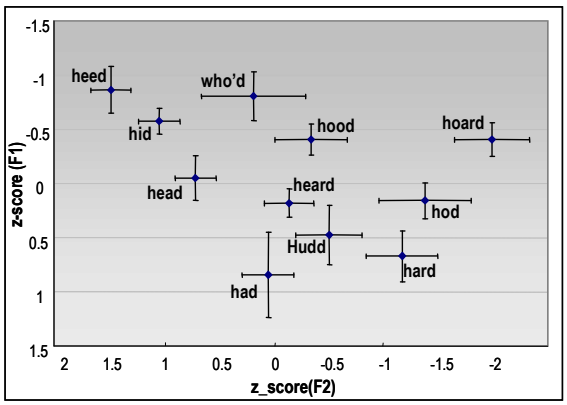
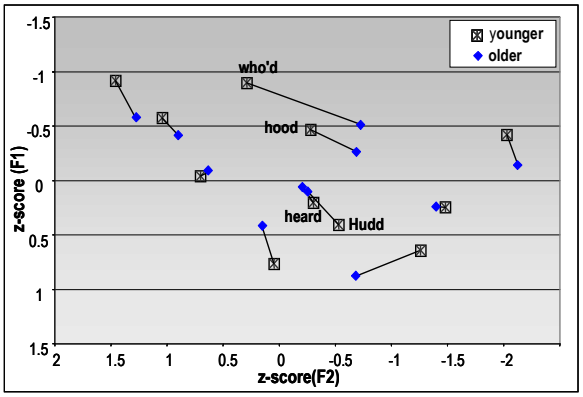


Figure 3: Mean z-scored F1 and F2 and one standard deviation bars for the 16 EAN speakers.



The main difference, in terms of phoneme proximity, between EAN and RP being the relative nearness of *heard* and *Hudd* in EAN, we inspected individual F1/F2 plots to check whether this pattern was shared by all speakers. The only information available was that two of the male speakers were much older than the others. So we set out to analyze potential generational differences with particular focus on the *heard*/*Hudd* pair. The results are shown in Figure 4. Statistical analysis on such a small sample of uncontrolled, observational data would be meaningless. The data nevertheless indicate that *heard* and *Hudd* are closer together in the two older speakers. In addition, *who'd* and *hood* are more back. The fronting of these two vowels is a well-known trend in southern British English.

Figure 4: Mean z-scored F1 and F2 for the 2 older male speakers (diamonds) and the other EAN male speakers (stars).



4. DISCUSSION

Although caution is always necessary when comparing data from different studies, the parallel between our results and those of [6] is justified on the grounds that the age range is fairly similar, the speech material matches (however some test words differ slightly), and the times of recordings are all but identical. One remarkable difference lies in that [6] made measurements at the steady state, near the middle of the vowel whenever possible.

The vowel system of EAN is typically southern: *hood* and *Hudd* are clearly separated; it seems to be, systematically speaking, identical to that of what [6] have labeled RP. Yet, one of the limitations of /hVd/ words is that some phonological contrasts may be missed. The set of 11 vowels used here exemplifies part of the system of standard British English, but it is only with extra care that it can be applied to other varieties. For instance, [9], 167-168, mentions the fact that in an older form of East Anglia dialect, the lexical set NURSE (which is supposed to be exemplified by *heard*, here) was further subdivided into two sets, e.g. *hurl* and *fur* did not have the same phonological vowel. If this contrast was still in use, the present study would have missed it. In addition to that, differences in lexical incidence cannot be elicited.

There is no clear explanation for the observed fronting of back vowels (relative to RP) in the literature. We suggest that our method favours higher formant values than would be expected, had

the measurements been made at vowel steady-state. Yet, the notion of steady-state is hardly tenable in some cases. Firstly, close vowels (in *heed* and *who'd*) have been know for decades to be diphthongized to a certain extent in southern British English ([8], 65, 85); and therefore it may be inadequate to describe them with one single F1 and F2 value. Incidentally, [9], 169, chose to refer to these two vowels as diphthongs; this label would probably be more adequate for most English dialects of the south east. A follow-up study will tackle the issue of the dynamics of formant trajectories. Secondly, steady-states are particularly difficult to locate in some very short vowels (e.g *hod* and *Hudd*): in some cases, the transition to the following consonant begins right after the inception of the vowel. In summary, our method to extract formant values may have had a greater bias than we had expected.

Returning to back vowel fronting, we have shown that, beside a possible methodological bias, the older speakers tend to produce variants of *hood* and *who'd* that are not as front as in the younger subjects. This is a widely acknowledged fact in RP, as [6] remarks, and it may well be a general trend in southern British English and other accents, since, as [11] (133, 148) points out, generally speaking, a comparatively back quality in *hood* and *who'd* is indicative of conservative, or old-fashioned accents.

The comparison between older and younger speakers shows that in the younger speakers the vowel of *Hudd* tends to be more open, and therefore further away from *heard*. This fact has been mentionned on several occasions in descriptions of RP (e.g. [6]).

5. CONCLUSION

We have provided F1/F2 plots representing the system of East Anglian monophthongs. A parallel has been drawn between our data and previously published comparable data on standard British English. This shows that our back vowels are comparatively more front. It also sheds light on the difference in the proximity of *heard* and *Hudd*. After confirming that z-scored formant values in Hertz provide good between-speaker normalization, we found that the older speakers had variants of *who'd* and *hood* that were more back, and variants of *heard* and *Hudd* closer to each other than in younger speakers, which can be accounted for by a general trend, in southern British English. Further work will include more accents and deal with the dynamics of vowels.

6. REFERENCES

[1] Adank, P., Smits, R., van Hout, R. 2004. A comparison of vowel normalization procedures for language variation research. *J. Acoust. Soc. Am*. 116 (5), 3099-3107.

[2] D'Arcy, S.M., Russell, M.J., Browning, S.R., Tomlinson, M.J. 2004. The Accents of the British Isles (ABI) corpus. *Proc. MIDL*, Paris, 115-119.

[3] Deterding, D., 1997. The formants of monophthong vowels in standard southern British English pronunciation. *J. Inter. Phon. Assoc*. 27, 47-55.

[4] Ferragne, E., Pellegrino, F. 2004. Rhythm in read British English: interdialect variability. *Proc. 8th ICSLP*, Jeju, Korea, 1573-76.

[5] Ferragne, E., Pellegrino, F. *in press*. Automatic dialect identification: a study of British English. In: Müller C., Schötz, S. (eds), *Speaker Classification*, Heidelberg, Springer.

[6] Hawkins, S., Midgley, J. 2005. Formant frequencies of RP monophthongs in four age groups of speakers. *J. Inter. Phon. Assoc*. 35 (2), 183-199.

[7] Henton, C.G. 1983. Changes in the vowels of received pronunciation. *Journal of Phonetics*.11, 353-371.

[8] Jones, D. 1967. *An outline of English phonetics*. Cambridge, Heffer.

[9] Trudgill, P. 2004. The dialect of East Anglia: phonology. In: Schneider, E.W., Burridge, K., Kortmann, B., Mesthrie, R., Upton C. (eds), *A Handbook of Varieties of English. Volume 1: Phonology*. Berlin: Mouton de Gruyter, 163-177.

[10] Wells, J.C. 1962. *A study of the formants of the pure vowels of British English*. Unpublished MA dissertation, London, University College.

[11] Wells, J.C. 1982. *Accents of English*. Cambridge, Cambridge University Press.