ENGLISH IN NATIVE AND FOREIGN MOUTH — A LARYNGOGRAPHIC STUDY OF POLISH-ENGLISH CONTRASTS

KATARZYNA DZIUBALSKA-KOŁACZYK

Department of English
Adam Mickiewicz University
Poznań, Poland

ABSTRACT

Lx waveforms and, consequently, fundamental frequency histograms manifest characteristic properties similar for all normal healthy speakers. It has been found out, however, that there exist differences in preferred Fx modes depending on a language. Also, learners of foreign languages may deviate from their Fx patterning when speaking the language learned.

The paper aims at discovering some of those differences and deviations by means of analyzing the data resulting from an experiment conducted with 15 Polish and English speakers, in which an electrical impedance method of observing vocal fold vibration was used.

0. The healthy larynx of any speaker pronouncing e.g. a clear long a sound produces a vibration which, when recorded as a waveform, has a characteristic shape with recognizable and repeatable features (the so-called Lx waveform). Consequently, fundamental frequency (Fx) histograms obtained from Lx waveforms also manifest characteristic properties similar for all normal healthy speakers. This, however, might not be the case when speakers of different languages are involved. Differences have been found out in preferred fundamental frequency modes in particular languages (cf. 10: 126). This, among others, could be the reason for learners of foreign languages to deviate from their characteristic pattern while speaking the language learned.

The paper aims at either discovering or disconfirming the existence of some of those differences and deviations with reference to Polish and English. No matter the nature of the results, the study might prove useful in building up a theory of second language acquisition and, consequently, it may be insightful for theoretical, contrastive and foreign language teaching purposes.

In what follows, first, an electrical impedance method of observing vocal fold vibration will be described; second, the subjects, conditions, apparatus and procedure applied in the experiment will be presented; third, both a statistical and visual analysis of the results will be conducted; finally, a discussion of the results against the background of some other experiments administered by the author will end the paper.

1. An electrical impedance method of observing vocal folds activity possesses several advantages: it is non-invasive and thus relatively easily applicable (although still some speakers are hard to persuade to place the electrodes correctly); a resulting Lx waveform is unaffected by any acoustic noise; and, Lx can be recorded on unsophisticated equipment.

A device used to monitor the varying impedance of vibrating vocal folds is an electrolaryngograph consisting of two electrodes applied superficially to the neck on both sides of the thyroid cartilage. The resulting output waveform is recorded on one track of a tape while the other track is occupied by a speech waveform (Sp) from a microphone.

The Lx waveform manifests characteristic features indicating the voice quality used by the speaker (e.g. normal, breathy, creaky or falsetto) as well as certain pathological deviations from normal speech and individual idiosyncrasies. Lx also provides a basis for the analysis of fundamental frequency patterning (Fx) for particular speakers: periods of vibration of the vocal folds are easily convertible into Fx values so that an Fx histogram is obtained. This frequency distribution of vocal folds vibrations also manifests a characteristic shape with speaker-specific ranges and preferred modes. Fx histograms are obtained from single, double or triple period analysis, increasingly emphasizing the modal values against frequency irregularities indicated by low probability figures. Fx distribution can also be presented in the form of a scattergram showing a correlation between subsequent larynx frequencies (for a better visual presentation a scattergram might be converted into a 3D plot).

2. Fifteen Polish and English speakers (7 Polish, 7 English and 1 bilingual) were asked to read an IPA demonstration passage ("The north wind and the sun...") to the microphone while having laryngograph electrodes on. Polish subjects were asked to read both an English and Polish version of the passage, each of them twice; English subjects read their native text twice. A double reading was elicited in order to: a) obtain a sufficiently long speech sample, b) allow for a degree of text customization through the second reading which was thus performed in a more relaxed manner.

English subjects were all speakers of a broadly defined RP i.e. with, at the most, slight residues of a different accent. Among the Polish subjects, three were formal setting learners (they learned English in Poland), and four — natural setting learners acquiring English in England.

All recordings were done on a professional Marantz cassette recorder with the use of a dynamic microphone and a laryngograph set designed in the Department of Phonetics at University College London. Recorded waveforms were analyzed by means of a waveforms and Lx distribution programme on a BBC Master Series microcomputer with the input coming from an Uher CR 240 filtered through telequipment S61 due to which a visual representation of Lx and Fx could be seen. The analysis was conducted at the UCL phonetics laboratory.

The output of the analysis for each subject consisted of:
- an exemplary speech waveform (Sp) of a selected clear vowel sound
- an Lx waveform
- 1st, 2nd and 3rd order Fx histograms
- a statistical table including calculated mode, mean, variance, standard deviation, median and sample size for each order of distribution
- an Fx scattergram
- an Fx 3D plot

3. The shape of Lx for a healthy larynx is relatively stable. Therefore, its fundamental frequency distribution also possesses characteristic fixed features: modal peaks and sharp edges. The mode values and frequency range are speaker-specific. Irregularities in the overall shape, however, result from some abnormal voice condition like laryngitis or speech pathologies. Can they as well occur as a consequence of difficulties a learner encounters when speaking a foreign language? Still further, is there a possibility of "mode-switching" for the same speaker dependent on a language he is using? What kind of a relationship holds between physiological limitations on the laryngeal apparatus and linguistic structures? The above might be guiding questions to the type of experiment discussed in this paper with reference to Polish and English tongue, and Polish learners of English.

a) In order to verify a null hypothesis about Polish and English demonstrating similar tendencies for preferred fundamental frequency values, the t-test for small independent samples was used. It tests the significance of differences between two means.

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\left(\frac{\Sigma x_1^2 - (\Sigma x_1)^2/N_1 + \Sigma x_2^2 - (\Sigma x_2)^2/N_2}{N_1 + N_2 - 2}\right)\left(\frac{1}{N_1} + \frac{1}{N_2}\right)}}$$

where

$\bar{x}_1$ and $\bar{x}_2$ are sample means

x_1 and x_2 are variables

N_1 and N_2 are sizes of sample 1 and 2

t was calculated three times using different variables: means, modes and medians from Fx histograms for Polish and for English of the Poles and of the English respectively. In all cases it proved non-significant. Thus, the above null hypothesis cannot be rejected: linguistic structures of Polish and English are not distinct enough to introduce significant difference between Lx's (and, consequently, Fx's) of the respective native-speakers of these languages.

b) t-test was also used to compare English of the English subjects with English of the Poles. The null hypothesis this time was that Poles in general do not alter the output of their vocal folds activity when speaking English. Again, there was no significant basis for accepting any alternative hypothesis.

c) A study of correlation between Polish and English of the Polish subjects, however, did show a certain tendency for different Fx patterning for some speakers depending on a language spoken. The assessment of correlation was conducted for three cases: correlation between Polish and English for all Polish subjects together; correlation for Polish formal setting learners, and correlation for natural setting learners. The Pearson product-moment correlation coefficient was calculated with Fx 3rd order mean as a variable.

$$r = \frac{N\Sigma xy - \Sigma x \Sigma y}{\sqrt{\{N\Sigma x^2 - (\Sigma x)^2\}\{N\Sigma y^2 - (\Sigma y)^2\}}}$$

where

x and y are variables

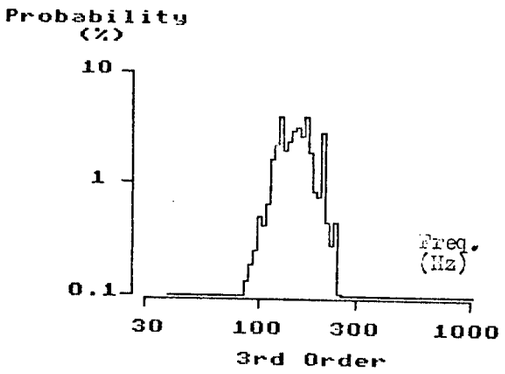
N is a number of pairs of observations

The results are the following:

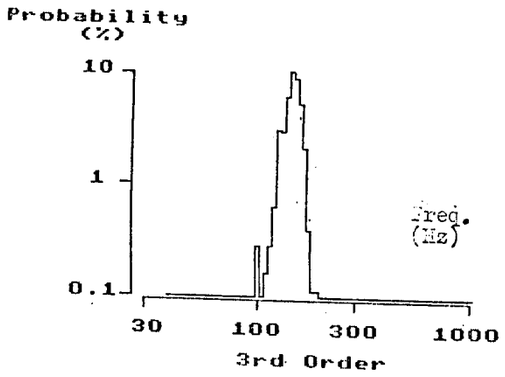
1) r = 0.84 for the whole group of Poles, i.e. a correlation is significant at 0.05 level

2) r = 0.999 for formal setting learners, i.e. shows a strong positive correlation
3) r = 0.879 for natural setting learners - significance at 0.20 level only, i.e. the probability for correlation is almost 20% lower than in 2).

Visually, English Fx histograms for Poles show some minor divergencies from their English counterparts, namely: irregularities in lower frequencies, or higher probabilities for lower frequencies, or a smaller frequency range.
Compare an example:

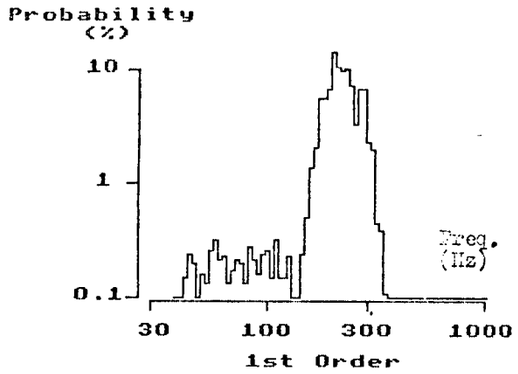


An Fx histogram of a natural setting learner based on the Polish text.

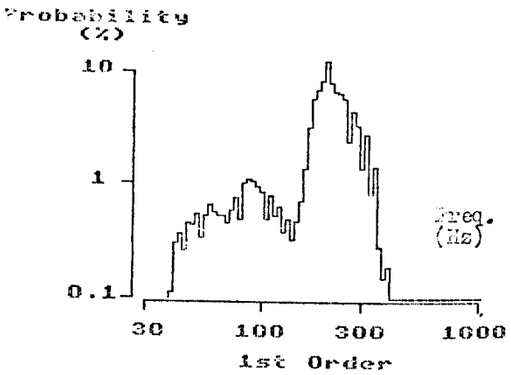


An Fx histogram of the same learner based on the English text.

A bilingual speaker demonstrates a similar tendency. Compare below:



An Fx histogram of a bilingual speaker (born in England) based on the English text.



An Fx histogram of the same speaker based on the Polish text.

4. On the whole, English and Polish turn out to be similar enough to manifest no significant difference between Fx distributions for the native-speakers of the two languages. Particular speakers, however, vary with respect to the amount of irregularity present in their foreign language production. The irregularity itself might be due to natural difficulties faced by the learner in the process of SL acquisition: being limited by his phonatory mechanism he attempts to produce an auditorily acceptable foreign output. There is, therefore, a degree of a conscious control involved in his performance as a recompense for being a non-native speaker. This, together with foreign linguistic structures which themselves require minor (for a Polish-English pair, at least) modification of the native Fx, leads to some deformation of the latter in foreign speech.

It appears that natural setting learners tend to deviate a great deal more from a characteristic to them Fx distribution than formal setting learners do. This suggests that a natural setting learner forces his phonatory mechanism to function appropriately in a foreign tongue without former preparation, which in effect gives a phonetically unsatisfactory output (in terms of segments, segment sequencies and suprasegments) whose only aim is communicativeness. Formal setting learners usually exercise their vocal folds, together with the whole articulatory structure, to let them gradually accommodate to the new, foreign language requirements. Consequently, their Lx patterning remains relatively stable.

The above distinction between formal vs. natural setting learners is confirmed by other experiments conducted by the author which all point out to: firstly, different mechanisms employed by those learners in the process of the acquisition of SL phonology; secondly, formal setting learners being, in general, nearer to success in producing a phonetically acceptable foreign speech.

Naturally, an observation about the lack of statistically significant difference between Polish and English fundamental frequency distributions which would be attributable to language does not presuppose the same state of affairs for any given pair of languages. For instance, one could expect differences in Lx patterning between languages which are typologically distinct, like tone vs. stress languages, especially when the speakers are also anthropologically differentiated. This, however, remains to be investigated.

*I would like to express my gratitude to all speakers who kindly agreed to serve as subjects in the experiment and to the staff of the Department of Phonetics at UCL for supplying me with a necessary equipment.

REFERENCES

1. Borden, G.J., Harris, K.S. 1984. Speech Science Primer. London: Williams and Wilkins.
2. Butler, C. 1985. Statistics in Linguistics. Oxford: Basil Blackwell.
3. Abberton, E., Fourcin, A. 1971. "First applications of a new laryngograph." Medical and Biological Illustration 21, 3. 172-182.
4. Abberton, E., Fourcin, A. 1972. "Laryngographic analysis and intonation." The British Journal of Disorders of Communication 7, 1. 24-29.
5. Abberton, E., Fourcin, A. 1976. "The laryngograph and the voiscope in speech therapy." XVIth International Congress of Logopedics and Phoniatrics, Interlaken 1974. 116-122.
6. Abberton, E., Fourcin, A. 1984. "Electrolaryngography." In: Code, Ch., Ball, M. eds. Experimental Clinical Phonetics. London: Croom Helm. 62-78.
7. Fasold, R. 1985. The Sociolinguistics of Society. Oxford: Basil Blackwell.
8. Fourcin, A. 1974. "Regularity of vocal fold vibration." 8th Internat. Congress on Acoustics. London 1974.
9. Fourcin, A. 1974. "Laryngographic examination of vocal fold vibration." In: Wyke, B. ed. 1974. Ventilatory and Phonatory Control. OUP. 315-333.
10. Fourcin, A. 1981. "Laryngographic assessment of phonatory function." Proceedings of the conference on the assessment of vocal pathology. Maryland 1979. ASHA Reports 11. 116-127.