STATISTIC RESEARCH ON CHANGES IN SPEECH DUE TO PEDAGOGIC TREATMENT (THE ACCENT METHOD)

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1. Introduction

The accent-method is a pedagogic method for improving speech and language.

It has come to its final shape through practical work and theoretical study within the last 40 years.

Physiologically it aims at introducing elasticity in the speech function.

By means of rhythmic exercises based on active contraction of abdominal muscles and consisting of accentuated and non-accentuated vocalization, the vibratory pattern of the vocal cords is being changed, so as to produce stronger harmonics.

The filtering process of the vocal tract is improved presumably as a result of a longer duration of the vocal cord contact within one single period and a higher flow through the glottis in the opening phase, which together counteracts the damping effect of the resonances in the vocal tract.

The acoustic effect of treatment along this line has been studied to some extent by different persons, as mentioned in this paper.

The accent method implies a linguistic approach which has been tried out in practice for several years and will be commented on in future papers.

The method has been used in the treatment of insufficient voices and blurred articulation as well as for pure pathological cases (pareses of vocal muscles). It is also part of the treatment of other speech defects, primarily stuttering and cluttering.

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The present paper deals with some analyses of changes in timbre and intensity resulting from short-time treatment of insufficient voices according to the method mentioned above.

The background was the following: 80 persons received voice training in groups of 10. They received 10 consecutive lessons. This material constituted our first material for research.

Recordings of voices, before and after treatment, were carried out under identical circumstances. Students eventually listened to the 80 cases mentioned and delivered a written description of their impression of improvement or non-improvement.

30% of the patients (i.e. 24 cases) were found to exhibit some improvement. The information derived from this listening test showed 20 cases of stronger voice and 16 cases of higher intelligibility (i.e. 65% and 80%, respectively). This subjective result led us to a new plan of objective investigation, see section 2 below.

Former acoustic research on the effect of the accent method on pathological voices (B. Frøkjær-Jensen, K. Lauritzen and Svend Smith) pointed to the F2 region (above some 1000 Hz) as being the one which was characteristically developed. Several colleagues, on the other hand, had the impression that the development of voice as treated by means of the accent method first took place in a deeper formant region, the F2 region being one which did not develop until a development of "fullness" (roundness) had taken place. This would mean that harmonics below 1000 Hz (primarily F1) are first enhanced.[1]

The present investigation has been carried through exclusively by means of quantitative methods. The intensity has been investigated, and we have taken a special interest in trying to figure out whether certain time-factors (duration) have changed.

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1) Also cf. the paper by Børge Frøkjær-Jensen and Svend Prytz in this volume, in which they propose a new method which should demonstrate intensity relations in the higher and lower parts of the speech spectrum.

2. Material and method

Additional 220 students at a teachers' college (Jonstrup) were treated in the above mentioned way, i.e., they were subject to a treatment of a very short duration.

All voices were recorded before and after this short-time treatment.

A random choice of 30 now became our material of research. Care had been taken that all recordings of voices before and after treatment were carried out under identical circumstances, i.e. in the same room, and with the same recording machine, recording level, and microphone.[1] A short sentence in the middle of the story used for all recordings was chosen for the analysis: "Den ene efter den anden prøvede på at få ham til at forstå, at han ikke ville få lov til at forlade retten, før han havde betalt et pund."

The recordings of "before" and "after" were all recorded on a mingograph within one research session in order to avoid deviating settings of the gain controls of the various instruments used for the analysis. 7 channels on the mingograph were used (see fig. 1).

The curves were digitalized by means of a semi-automatic curve follower attached to a computer (IBM 1800). On the basis of these numbers stored in the computer, factors of duration and intensity were dealt with.

2.1. Durational investigation

The factors investigated were:

(D_i) The duration of the whole sentence before and after treatment.

(D_{ii}) The total duration of the fundamental (vocal cord vibrations) within the sentence. Band-pass filtering around the F_o-region.

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1) The microphone distance was measured out to be within the range 70-80 cm for all recordings, "before" and "after".

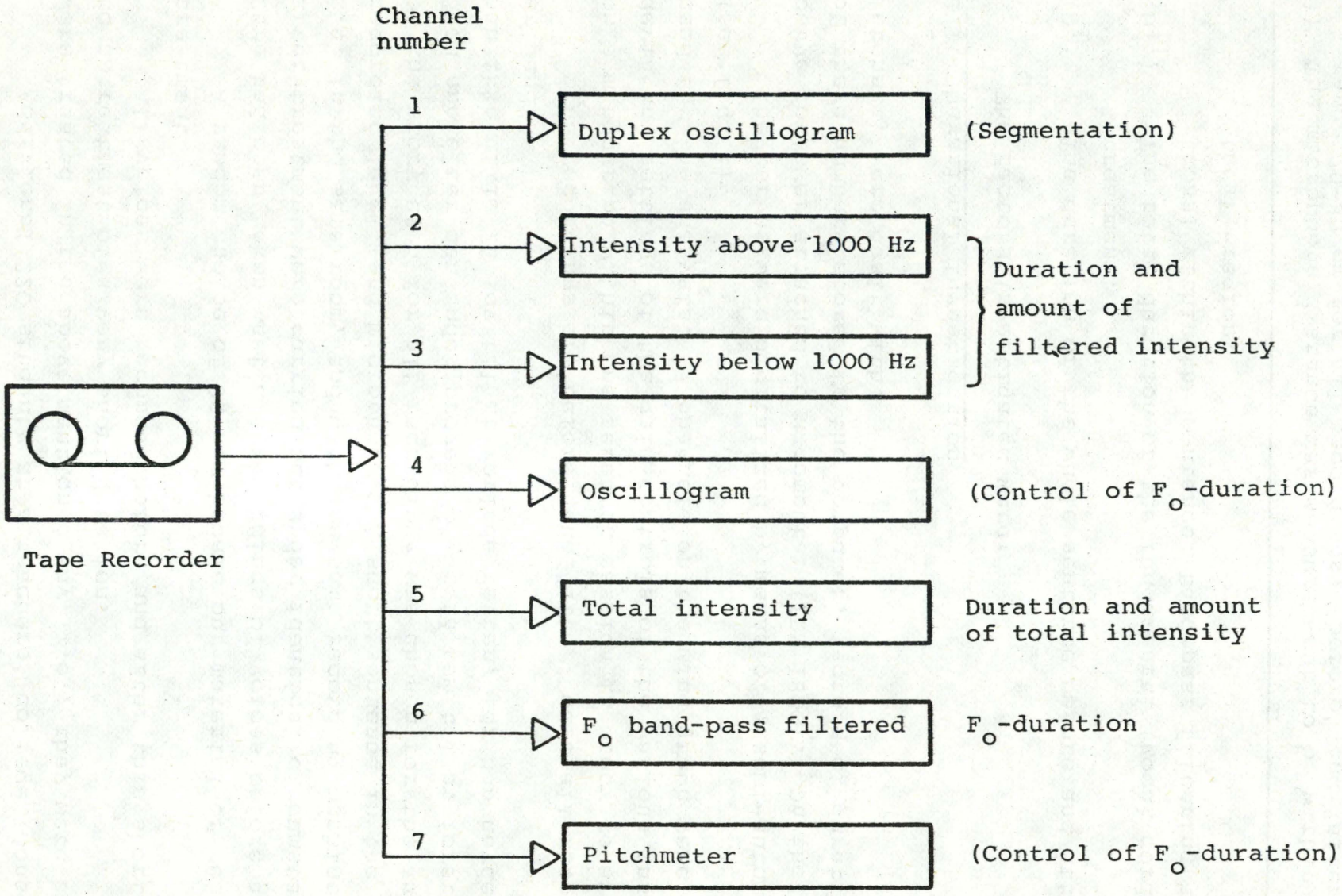

Figure 1

Schematic drawing contents of mingograph channels and the parameters that were measured from the different channels.

(D_{iii}) The total duration of intensity above 1000 Hz. High-pass filtering.

(D_{iv}) The total duration of intensity below 1000 Hz. Low-pass filtering.

2.2. Intensity investigation

The factors investigated were:

(I_i) The mean intensity in the total frequency range.

(I_{ii}) The mean intensity above 1000 Hz.

(I_{iii}) The mean intensity below 1000 Hz.

In order to be able to decide on the statistic significance of results to be expected, the Wilcoxon rank sum test for matched pairs was used.

The level of significance was fixed in advance (95%).

3. Results

3.1. Duration

see figs. 2 and 3.

(D_i) No statistically significant change was found with regard to the length of the whole sentence. The length of pauses was left out of consideration.

(D_{ii}) Likewise, the duration below 1000 Hz showed no statistically significant change, presumably on account of the exclusion from measurement of signals that were more than 40 dB below the maximum reference level.

(D_{iii}) However, above 1000 Hz (corresponding to the F2 and F3 region of vowels and the high frequency consonants), a 6% augmentation in length was found ($p \lesssim 0.003$) after treatment.

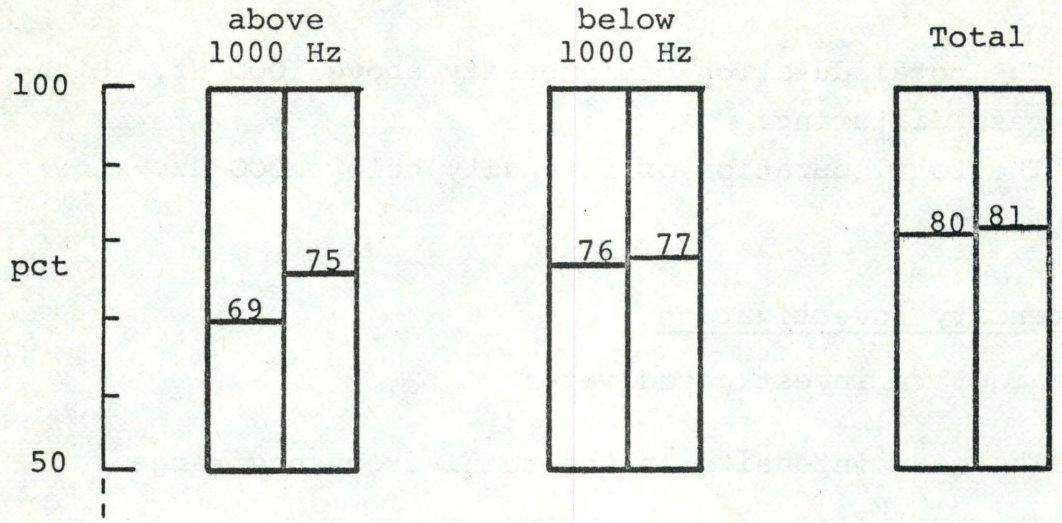

Figure 2

Duration of phonatory intensity in different frequency regions. Left columns show percentage intensity before treatment. Right columns show percentage intensity after treatment.

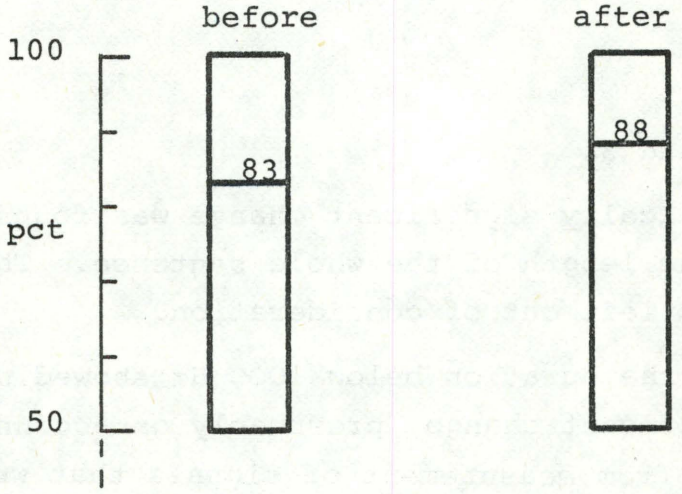

Figure 3

Duration of F_o shown as percentage of total utterance duration before and after treatment.

(D_{iv}) Even if the duration of the whole sentence did not change statistically, the duration of the fundamental was augmented by 5%, this result being statistically highly significant ($p \lesssim 0.001$). This change demonstrates an improved mobility of the vocal cords. Duration of phonatory intensity (D_{ii} above) cannot be compared to the measurement of duration of F_o, which is based on an observation of F_o (sinewave) on the band-pass curve.

3.2. Intensity

(I_i) The intensity within the whole frequency spectrum was augmented (+1.4 dB). The change was significant ($p. \lesssim 0.007$).

(I_{ii}) Below 1000 Hz the change was +1.6 dB, i.e. likewise significant ($p. \lesssim 0.007$).

(I_{iii}) A change in the intensity above 1000 Hz was, on the other hand, just significant ($p. \lesssim 0.04$).

4. Discussion and conclusion

A short-time treatment results in a greater amount of acoustic information transmitted to the environments. This information may involve:

(i) Increased duration of the fundamental.

(ii) Increased duration of sounds characterized by energy above 1000 Hz, so that these are more easily distinguishable (u, y, i - o, ø, e and high frequency consonants).

(iii) An increase of intensity below 1000 Hz (primarily the F1 region).

The latter result is interesting on account of the objective proof of a hypothesis which was formerly expressed on the basis of subjective judgments.

The higher energy below 1000 Hz would be expected to contribute to an improvement in intelligibility (information on the degree of openness in vowels), and to convey the impression of a fuller voice. To which degree a stronger fundamental adds to the fullness of the voice is not as yet clear.

Likewise it is possible that a smoother pitch curve results from short-time treatment.

A gross impression of spectrographic recordings (cross-sections) supports the above results, viz. that even a short-time treatment will

(iv) improve the mobility of the vocal cords,
(v) make the timbre rounder and to some extent more "light-coloured",
(vi) result in a stronger voice, and
(vii) enhance factors that are important for a higher intelligibility without slowing down the speed of articulation.

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