ON THE PERCEPTION OF DURATION OF THE CZECH VOWELS

Jevgenij Timofejev

Pedagogická fakulta
Hradec Králové, Czechoslovakia

ABSTRACT

An experiment concerning the perception of the Czech phonological duration is described in this paper. All Czech vowels synthesized by HV 02 synthesizer have been used in the experiment. The results have been compared with natural speech signals statistics.

1. INTRODUCTION

The Czech phonological duration has been studied from various points of vew /J. Chlumský [3], P. Janota [4], B. Hála [1]/. The des cribed experiment is aimed at physical relevance of Czech duration. The experiment does not include wider language parameters and has been limited with isolated words synthesized by HV 02 peripherals /Tesla Electronic Research Institute in Prague/. It is one of the possible ways for studying subject and it is based upon the precise quantity of the synthesized speech signal.

2. PROCEDURE

A list of Czech meaningful words has been prepared and synthesized by HV 02. There were two criteria for the words preparation. All the Czech vowel were taken into consideration their duration covering the range of 30 to 240 msec with 20 msec stepping:

a ... 240 - 60
e ... 190 - 30
u ... 180 - 20
o ... 200 - 40
i ... 170 - 10

The perception test has been aimed at two specific spheres of interest. First there was an attempt to define the boundary where the phonological duration changes the meaning of the word: pás /"belt" with a long vowel "á"/ and pas /"passport" with short vowel "a"/.
A list of words presenting the entire range of temporal realisation has been listned a evaluated both in gradually descending and gradually increasing scale. Secondly there was an attempt to determine the relative temporal differences in physical realisation of vowels, which can be percepted by native Czechs as phonological temporal difference. Pairs of words with temporal contrast have been listened and estimated by respondents. The temporal contrast was both gradually descending and gradually increasing in the range of 20 to 180 msec with stepping of 20 msec, for example bór - bor /200 - 40/. The pause between the words was 1 sec and 3 sec between pairs of words. All the synthesized Czech words have been tested in such a way. There were more than 70 respondents, native Czechs, involved into perception experiment. They were requested to write the words.

3. SOME RESULTS

3.1. Within the range of temporal parameters of the tested words the results cannot be regarded as a compact value. The boundaries between long and short vowels are rather dispersed and are percepted for various vowels as follows:

á - a : 200 - 100 msec
é - e : 170 - 70 msec
ú - u : 180 - 60 msec
ó - o : 180 - 80 msec
í - i : 150 - 50 msec

The percentage of boundary identification may be presented by following data:

á - a
200 - 180 : 2,6 %
180 - 160 : 16,0 %
160 - 140 : 56,0 %
140 - 120 : 20,0 %
120 - 100 : 5,3 %

é - e
170 - 150 : 2,6 %
150 - 130 : 14,6 %
130 - 110 : 54,6 %
110 - 90 : 26,6 %
90 - 70 : 1,3 %

ú - u
160 - 140 : 8,0 %
140 - 120 : 32,0 %
120 - 100 : 49,2 %
100 - 80 : 9,2 %
80 - 60 : 1,3 %

ó - o
180 - 160 : 2,6 %
160 - 140 : 22,0 %
140 - 120 : 40,0 %
120 - 100 : 29,2 %
100 - 80 : 4,0 %

í - i
150 - 130 : 4,0 %
130 - 110 : 20,0 %
110 - 90 : 29,2 %
90 - 70 : 44,0 %
70 - 50 : 2,6 %

The verification tests have shown upon no significant differences. The percentage of identification during two various ways of words presentation /first in gradually descending scale and then in gradually increasing one/has been the same. These data and results have been compared with prof. B. Hála statistics [2]. The results of the comparison have indicated upon the narrow correlation between the perception test results from one side and highly reliable statistics of Czechs vowels lenhtg as presented by prof. B. Hála from the other side. We shall first discuss the temporal parameters of long vowels.

3.2. There were no responda which showed that the results of the listening test were not in any way in accordance with existing knowledge of the Czech long vowels parameters [2]. This remark is valuable for all Czech long vowels. We have not registered any word with "long" vowel, which exceeds the down limit of duration valuable for long vowels.
These results are illustrated with figure 1.

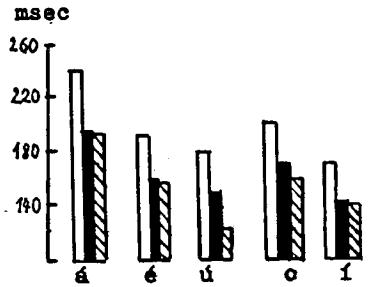

Fig. 1

the mean value of long vowels statistics

the results of the perception test

the down limit of long vowels statistics

As the "short" vowels are concerned, we have registered no word with vowel, which is longer than the upper limit of short vowel statistics available in 2 - figure 2:

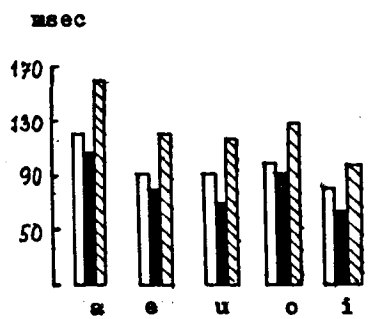

Fig. 2

The figure 2 illustrates the correlation between the mean values for long and f for short Czech vowels on the one hand and the most contrastive span of duration /from 30 to 56 % of responds/ evaluated as a boundary during the perception experiment on the other hand:

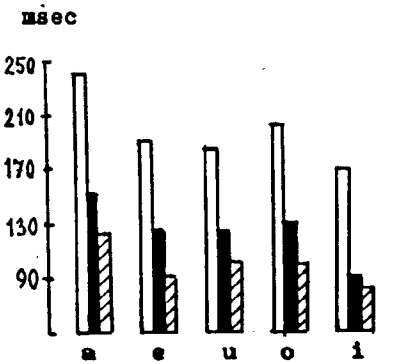

Fig. 3

the mean value of long vowels statistics

the results of the perception test

the mean value of short vowels statistics

3.3. The above discussion covers the absolute values of Czech vocal duration. The relative values have been estimated on the bases of the second part of our listening test, where the pairs of two words were evaluated. We have gained rather stable results showing that the span of 100 msec is the most important for phonological quantity identification - figure 4:

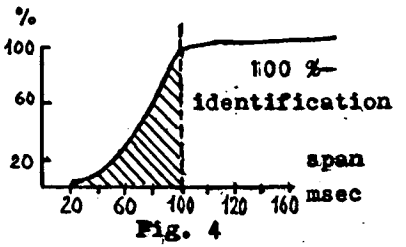

Fig. 4

4. CONCLUSION

There is no simple correlation between the natural and synthetic speech signal, neither isolated words can simulate the real language realisation. We have presented one of the possible ways of problem presentation. The results may be of interest both for natural and synthetic speech investigation.

5. REFERENCES

[1] HÁLA, B. /1941/, "Akustická podstata samohlásek", Praha

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[4] JANOTA, P. /1967/, "An experiment concerning the perception of stress by Czech listeners", Praha