

Distinctive training methods and evaluation of a multilingual, multimodal speech training system

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ABSTRACT

A multilingual, multimodal speech teaching and training system has been developed for 5-10 years old speech handicapped children, in the frame of the SPECO Project, funded by the EU (Contract no. 977126) in 1999. During the training the patients see the speech pictures of the reference speech and listen to the sound of it at the same time. Thus they use the human visual and auditory feedback during their speech learning beside the tactile sensation. A detailed evaluation examination was prepared at the end of the development of the system. Firstly the opinion of speech therapists from different educational field that had been using the SPECO system in their work for a longer period was collected and summarized. Secondly, an objective evaluation was organized to examine the efficiency of the system. It became clear from the objective experiment and from the collection of the opinion of the speech therapists, that the system is a useful and effective teaching aid.

1. INTRODUCTION

Obviously, it is not a simple task to assess the effectiveness of a multimedia teaching system. There are some organizations, which give technique for the evaluation of multimedia teaching software [1, 2, 3]. For example the Evaluation Outline of TEEM [2] is very good, giving detailed questionnaires about the Installation, Content, Design and navigation, Easy of use, Special needs, Courseware etc. These questionnaires are very important, and the answers help the software development, but those are too general and usually concern the usage or outward appearance.

But how can we examine the effectiveness of a speech-training tool? For example how can we decide that the system developed in the frame of SPECO project is better or not, or more effective than the traditional one?

During the development of our system all SPECO partners were keeping close contact with speech therapists from different educational fields and asking them repeatedly for their opinion. We have constructed questionnaires too one is presented in Table 1.

These and similar questionnaires were filled out by the therapists from time to time. The answers gave us information about the occasional problems with the system and facilitated making corrections continuously. Thus the software and database became better and better.

2. SHORT DESCRIPTION OF THE SYSTEM

The SPECO Project was founded by the EU through the INCO-COPERNICUS program (Contract no. 977126) in 1999. In the frame of the project a system has been developed which is an audio-visual pronunciation teaching and training tool for 5-10 years old children. Correction of disordered aspects of speech is progresses by real time visual presentation of the speech parameters, in a way that is understandable and interesting for young children, while remaining correct from the acoustic-phonetic point of view. The development of the speech by our teaching method progress mainly on the base of visual information using the intact visual channel of the hearing impaired child. However during practice we use their limited auditory channel too, by giving auditory information synchronised with the visual one. This multi modal training and

teaching system have been developed for the languages of all SPECO partners; these are English, Swedish, Slovenian and Hungarian [4, 5, 6, 7, 8].

The system is composed of two parts: one is a general language-independent frame program, the so-called Measuring System and Editor and the other is a Language Dependent Reference Database file. These two parts together make up the Teaching and Training Support, which is the program for users. Generally, the frame of the program gives possibility to construct the teaching and training support of any kind of languages using a well-defined database of the language. It measures the different acoustic-phonetic parameters of the speech signal, and helps the user to select the reference speech examples, to place the symbolic pictures and background pictures into their right places. It is possible to build a vocabulary with a special structure, according to the language.

Table 1. *A questionnaire for the evaluation of SPECO project.*

<i>Name:</i>
<i>Job:</i>
<i>How long have you been using the program?</i>
<i>How good do you find this method from pedagogical point of view?</i>
<i>Does the user manual give orientation enough?</i>
<i>Is special skill necessary to the usage of the program?</i>
<i>Is training a pleasure for the children?</i>
<i>Do children understand the feedback in the program?</i>
<i>Are pictures understandable in the exercises "isolated sound"?</i>
<i>Are the speech pictures understandable for children in the exercises of syllables, words and sentences?</i>
<i>Is more training possibility necessary during the exercises?</i>
<i>Is less training possibility enough during the exercises?</i>
<i>Would any other kind of training possibilities be useful?</i>
<i>If yes, which ones?</i>
<i>What is your opinion about the exercises?</i>
<i>Have exercises developed the speech of the children? In what?</i>
<i>Preparation:</i>
<i>Sound development:</i>
<i>Practice in sentences:</i>
<i>Intonation:</i>
<i>Was it difficult to work with the program? If yes, please explain.</i>
<i>How long did it take for a phoneme in isolation to form perfectly?</i>
<i>How long did it take for a phoneme in continuous speech to form perfectly?</i>
<i>What is the difference with traditional therapy?</i>
<i>Did you like this method?</i>
<i>Any other ideas?</i>

3. EVALUATION OF THE DISTINCTIVE TRAINING METHODS

The SPECO system is very flexible. Useful in many cases of speech defects, but the speech therapists must use it in a different way according to the defect. These are for example the different speech defects with normal hearing, with hearing impairment, etc. and in the special therapy of cochlear implants. different training methods have been developed and used in practice.

The SPECO System has been presented to the speech therapists from time to time, and asked for their opinion during the development. Two types of the evaluation were prepared: a qualitative and a quantitative one.

3.1. Qualitative evaluation.

Qualitative evaluation was based on the answers of the therapists that worked with the SPECO System during three months or half a year. They filled in a special questionnaire.

In general, the therapists were very satisfied with this method of learning. The summarised opinion of the teachers in case of all languages was very good. The developed method of learning is very useful, especially as supplement and variegation to classical methods. It is a very welcome modification in the work, pleasant for children and useful in the therapy of many speech and hearing disturbances. The level of good usage depends on the therapists. From pedagogical point of view it is very highly rated.

3.2. *Quantitative evaluation*

Quantitative evaluation was based on the comparison of the intelligibility development of the children trained by the SPECO program, and by the traditional method (control groups). We examined different speech handicapped groups.

3.2.1. *Trained pupils*

40 of 6 to 8 year old children were selected from 240 and grouped according to the degree of impairment. The groups (audiometric pre-examination have been made without hearing aid) were the followings:

- children with normal hearing (H),
- children with small hearing impairment (SMH),
- children with middle hearing impairment (MH),
- children with severally hearing impairment (SH),
- children in the control group, trained only by traditional method.

3.2.2. *Recording of the speech of pupils*

18 well-selected words were recorded pronounced by the pupils in 3 phases:

- 1st phase before the training in October 1999
- 2nd phase after the training in May 2000
- 3rd phase after the summer holiday in October 2000.

Comparing the recorded material of the 1st and the 2nd phases, the result gives information about the effectiveness of the SPECO method and about the quality of speech. Comparison of the speech of pupils in the phases 2 and 3 shows whether the pupils could stay or not at the level they had reached during the training.

3.2.3. *Listening test*

30 non-expert young people took part in the listening test on 28th of October 2000. Word pairs were composed from the same speakers for the same words recorded in different phases. The obtained pairs of 1-2, 1-3 and 2-3 were listened randomly. Listeners were asked to mark a decision about which words were more understandable in the word pairs. It was allowed to mark too if they could not make a decision.

3.2.4. *Result of the listening test*

The listening test gives clear results presented in Table 2. where the decisions of the listeners are given according to the groups.

In SPECO group in the Table we averaged the results obtained in those of 4 groups where teacher used the SPECO system through the training. In control group the teacher did not use any computer-based tools. In general in all groups the listeners found the words after the training much more understandable. More listeners found the intelligibility better in those groups at which the teacher used the SPECO system.

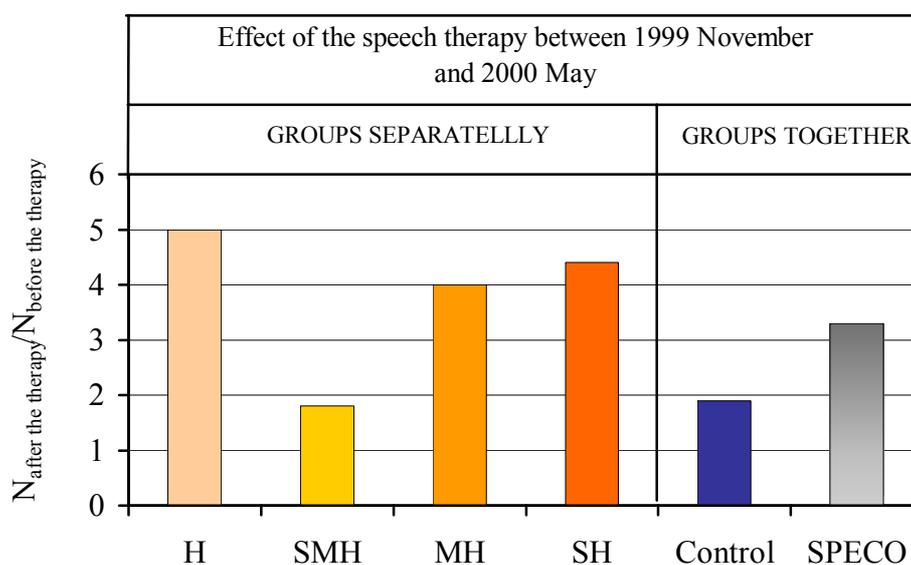
To see the effect of the speech therapy more exactly we examined the word pairs 1-2 separately, and compared the number of the decision to the second word (N after the therapy), with the number of the decision to the first one in the word pair. See the Fig. 1. The effect of the speech therapy is evident.

To see the effect of the summer Holiday we examined the word pairs 2-3 separately. To do this we compared the number of decisions for the second word (N after summer) with the number of the decisions of the first one (N before summer) in the word pairs. Children's speech developed during the summer too in all groups, as you can see in Fig. 2. It is quite natural why the age of 6-8 is the age of linguistic development at these severally impaired children. Here the speech development in the SPECO group and the control group is the same. The children could keep their knowledge, obtained during the therapy and they could develop further.

Table 2. The results of the listening test for the examination of the effectiveness.

Type of the groups	Pairs for listening	Decisions in the listening test		
		The FIRST word in the pairs is better [%]	The SECOND word in the pair is better [%]	Uncertain decision [%]
all groups together	1-2	18	55	26
	1-3	14	66	20
	2-3	22	40	39
control group	1-2	24	45	31
	1-3	14	58	28
	2-3	20	35	44
SPECO group	1-2	17	57	26
	1-3	14	67	19
	2-3	22	40	38
normal hearing (H)	1-2	15	74	11
	1-3	16	73	12
	2-3	24	22	54
small hearing impairment (SMH)	1-2	25	46	29
	1-3	21	64	14
	2-3	24	48	28
middle hearing impairment (MH)	1-2	16	62	22
	1-3	9	78	13
	2-3	20	52	27
severely hearing impairment (SH)	1-2	12	53	35
	1-3	12	57	31
	2-3	22	35	44

Figure 1. The effect of the speech therapy in the word pairs 1-2.



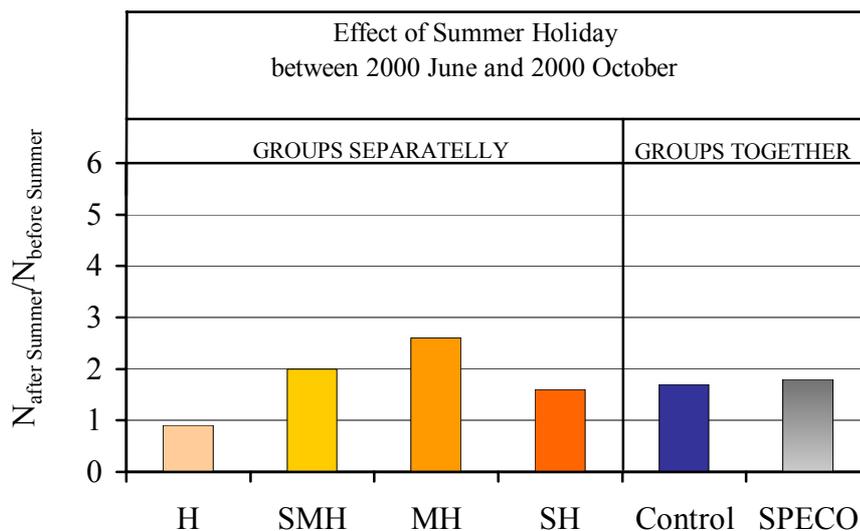


Figure 2. *The effect of the summer holiday in the word pairs 2-3.*

In SPECO groups the result is much better, than in control groups. Number of the decision in the case of SPECO groups is 1,7 times bigger. Comparing the groups with each other, the development of the children was the best with normal hearing. Then the severally hearing impaired children follow.

4. CONCLUSION

The teachers gave a summarised opinion about the SPECO system. The general experiences of the teachers were the following:

1. Children can use this multimodal system by themselves very easily and they use it with pleasure, which is a very important factor from the point of view of efficiency.
2. The visual feedback helps children to see whether their pronunciation is correct or not, and how far it is from the correct one. They are not in need of relying only on the teacher's opinion. In particular, this is very important in case of speech handicapped with hearing loss.
3. In general, sounds were formed sooner, than in control groups where they do not use any computer-based teaching system.

It was found that a consistently shorter time was required for improving a speech sound than was the case with corresponding children of similar mental ability and impairment level who had been instructed by the traditional method. However, it is difficult to express the results in quantitative data because the result depended on many other factors (for example, one highly important factor was how much additional help the child received at home).

4. In those cases when these sounds were very resistant to the traditional therapy, the new method helped to repair these sounds.
5. The system is a useful tool for teachers in the individual linguistic training. It gives possibility to train in small groups too and pupils can use the system themselves and practice alone.

Of course, especially for young children the visual tool itself does not substitute the work of the speech therapist. On the first hand, this tool is a good aid. It helps the work of the therapist and gives a variety to teach. On the other hand, at the automation-phase or in case of elder children, the visual tool itself gives a good possibility to practice alone.

The objective measurement gives the following results:

1. The effectiveness of the SPECO system is essentially better than of the traditional one, with which the teachers do not use any computers or such a visual feedback.

2. After the training pupils can keep the level of their speech product reached by the SPECO system.

It is clear from the objective experiments and from the opinion of the speech therapists, that the system is an effective teaching aid.

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