

5) The current medication of the subject was noted and correlation could be seen between low performance on verbal expression and administration of phenytoin. There was also a tendency to lowered performance in many language skills for the group of people taking a combination of carbamazepine and sodium valproate.

#### 4. Recommendations

This study has generated information about potential areas of language difficulty which some people with epilepsy may experience. It has indicated possible factors which may have a bearing on language impairment, and it indicates that a follow up study would be valuable to investigate the effect of some anti-epileptic medication on language performance.

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### **The Visual Speech Apparatus: An aid for speech-training of the hearing impaired**

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#### 1. Problem and objectives

The central problem in speech-training of the hearing-impaired is the lack of sufficient information, normally supplied through the ear, about the characteristics of the speech in the child's environment on the one hand, and about the child's attempts to produce that speech on the other. Therefore, we believe that substantial improvement of speech of the hearing-impaired can only be obtained if we can provide the necessary information about speech through other than auditory channels.

The purpose of the project, started March 1985, is to develop a computerbased system that transforms the acoustic speech signal to the visual domain in such a way that aspects relevant to speech training are visualized using the visual dimensions available on a computer screen.

In developing the system we aim at:

- a) Mapping each relevant acoustic dimension uniquely on an appropriate visual dimension; dimensions used are size, form, color, texture, blurring of contours, location etc.
- b) Developing parallel or integrated (multi-dimensional) visual displays that provide information about several relevant aspects at the same time (as far as feasible);
- c) Giving the displays the form of attractive voice- and speech-controlled games that motivate the child to develop systematically different aspects of speech production.

#### 2. Method

Basically the method followed in the project consists in the following steps:

- a) Define components of speech behavior that can be trained independently;
- b) Find the acoustic parameters in the speech signal that are correlated with these components;
- c) Extract the parameters from the speech signal and apply transformations to make them suited for visual displaying;
- d) Form appropriate visual representations that can be used in voice and speech training;
- e) Develop a training program in which the components are introduced according to current principles of speech training of the hearing-impaired.

### 3. Current status and future developments

The project has gone through some phases in which different systems were developed. The current system is based on the Amiga-2000 of Commodore, which is a personal computer containing two processors operating in parallel: a MC 68000 and a 80286 (used in the IBM-PC) that interact via dual-ported memory on DMA basis. The Amiga has special processors for high-quality graphics. A special-purpose digital signal processing board has been added: the DSP-16 from Ariel based on the TMS320C25 processor. The DSP is programmed in assembler, the PC in Pascal and the Amiga in C. Thus we have now a system that combines parallel processing, ensuring sufficient computational power necessary for the on-line extraction of speech parameters, with excellent graphics needed for developing attractive games.

So far we have programmed exercises for developing control of basic voice characteristics: timing, loudness and pitch. Two 8-week evaluations performed by 2 speech therapists of the Instituut voor Doven at St. Michielsgestel showed positive results and yielded suggestions for improvements and extensions of the exercises. This interaction between system designers and therapists guarantees the flexibility necessary for developing a versatile visual aid.

Currently we are designing exercises that supply information about voice quality and about the identity of vowels. The latter is based on earlier work by Povel & Wansink (1985). In the future we will work on developing multidimensional displays and we will attempt to design a flexible system that allows the speech therapist to define on the spot special exercises adjusted to the needs of the pupil. More details about different aspects of the project can be found in the references mentioned below.

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## Eye communication aids: III. Development of an optic-RAM eye communicator

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### 1. Problem and objectives

For the replacement of the voice the speechless needs the highest possible communication speed via their aids in the conversation with vocal individuals. This need is experienced especially, when artificial speech is the output of the aid. The question is put, how can an eye recorder system most effectively use the eye motor system for this purpose?

The eye-positions on a communication board have to be determined by the broad-band eye recorder system without delay as the end position of saccades (at least in vertical and horizontal directions) can be predicted half way by the maximal saccade velocity (ten Kate