HEARING IMPAIRMENT SIMULATION: AN INTERACTIVE MULTIMEDIA PROGRAMME ON THE INTERNET FOR STUDENTS OF SPEECH THERAPY

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ABSTRACT

Students of speech therapy and audiology are often faced with the difficulty of obtaining a realistic view of the speech reception abilities of the hearing impaired. Illustrating speech recognition defects is a demanding task for the teaching staff, too. To improve the students’ awareness of the effects of hearing defects, an interactive multimedia programme allowing simulation of various types of hearing impairment was constructed and placed on an Internet media server for online use. The simulated hearing-impaired speech material was produced using digital signal processing (e.g. mixing and filtering of speech and noise) and multimedia and audio technologies which enable streaming of sound files on the Internet. In the programme, word recognition scores for several degrees and types of hearing impairment in varying conditions of background noise and reverberation time can also be computed.

1. INTRODUCTION

It would appear essential that, to be successful and competent in their studies and subsequent professional career, students of speech therapy learn to combine information from various theoretical courses with skills acquired during practical training. As regards speech production, speech perception and hearing loss, students of speech therapy in Finland take – during their 5.5-year training – several compulsory courses in phonetics and in phoniatrics, a course in audiology and a logopedic therapy course in the rehabilitation of patients suffering from hearing impairment. Integrating knowledge and information from all four disciplines is required to fully understand speech reception problems in different grades and types of hearing impairment.

Traditional classroom techniques lacking the advantages offered by multimedia demonstrations often fall short of the goal of furnishing the students with an adequate hands-on view of the problems of the hearing-impaired, especially of the speech reception abilities of small children with hearing impairment. Word recognition scores and percentages as such tell students very little of the properties and quality of speech received through a defective hearing mechanism.

To enhance the students’ potential for full awareness of the difficulties of the hearing-impaired, an interactive multimedia presentation or programme with speech material simulating a selection of various types of hearing impairment was produced. The programme, intended as an online interactive educational tool on the Internet, allows students and others interested in the effects of hearing defects to simulate various types of hearing impairment, such as hearing loss due to chronic otitis media, noise exposure or aging. In the programme, also differences in listening conditions, i.e. type and level of background noise, reverberation time, and even symptoms such as tinnitus (subjective ringing in the ears) can be adjusted so as to improve the students’ skills in consulting and instructing their clients in the adjustment and optimal use of their hearing aids.

The multimedia programme is supplemented by a 20-page handout explaining the acoustical features of speech, different types and grades of hearing impairment, and the effects of noise and reverberation on the speech reception of the hearing impaired.

2. THE MULTIMEDIA PROGRAMME

The interactive programme incorporates three main functions or modules. In the demonstration section, the student starts by selecting the grade of hearing impairment of interest. For the demonstration, the client is offered four options (mild, moderate, severe or profound hearing loss) each with an audiogram illustrating a particular type of impairment. After selecting the hearing impairment of interest, clients are presented with general information (e.g. definition, prevalence and typical causes) of the selected grade of impairment and, in addition, of its effects on speech reception in general and on language acquisition in children. Using clickable buttons the user can proceed to listen to simulated hearing-impaired (i.e. filtered) speech samples – words and sentences – which are also
presented in written form in the programme window after the sound files have played.

In the simulation section (Fig.1.), the number of options and the degree of interactivity are increased. Users can proceed step-wise by selecting any combination of speech material (5 options), grade of hearing impairment (4 options), audiometric configuration (4 options in each grade of hearing impairment), type (3 options) and level (3 options) of background noise and reverberation time (3 options). The simulation module and its options are illustrated schematically in Figure 2.

Finally, using the test function of the multimedia programme students can compute word recognition scores for Finnish speech audiometry materials for a type of hearing impairment of their own selection (16 options). The maximal speech reception ability is computed by checking the client’s responses – input in an editable response field (see Fig. 1) using the computer keyboard – against a database of standard Finnish audiometric material.

The simulated hearing-impaired speech material of the programme was produced using digital signal processing tools and methods (e.g. digital mixing and filtering of speech and noise). To make the presentation readily available for students and other clients on the Internet interested in the nature and effects of hearing loss, multimedia and audio technologies (Macromedia Director and Shockwave) which enable interactivity and streaming of large sound files on the WWW were employed.

Figure 1. A sample view of the simulation programme window; clickable menus and buttons are used for selecting the speech material (A), grade of hearing impairment (B), individual audiograms (C) and listening conditions (D) as well as for submitting responses to the word recognition task (E).
3. THE WEB PAGE

Full and demonstration versions of the hearing impairment simulation programme adapted to Finnish are available on the WWW server of the Department of Finnish, Saami and Logopedics (University of Oulu, Finland) at the location http://www.oulu.fi/suosalo

Figure 2. Schematic representation of the simulation options of the programme.
Users of the demonstration version can follow the appropriate link from the department home page; the full path to the demo page is

http://www.oulu.fi/suosalo/Hearing/impsimul.html

To run the simulation programme, a Macintosh or a Windows PC connected to the Internet and Netscape Navigator™ 2.0 or later with the Shockwave for Director plug-in (Macromedia Inc.) is required. Power Macs and Pentium PCs with display resolution of 1024*768 or better, 8-bit graphics as well as 16-bit audio hardware are recommended.

4. REFERENCES


