

COMPUTER-BASED MULTIMEDIA SPEECH TRAINING TOOL FOR DYSPRAXIC CLIENTS

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ABSTRACT - Currently, there is a shortage of speech therapy services available to match the number of adult clients who require speech therapy. Consequently, we have developed a computer-based therapeutic tool, *Articulator*, to assist speech therapy services with the aim of reducing time in therapy and improving practise/access to treatment programs.

Most research in the area of computer assisted speech rehabilitation addresses language problems with only very occasional reference to motor speech disorders. Motor speech disorders may be caused by various factors with stroke being the most common. Computer-based therapy is interesting and visually stimulating to the patient and costs of therapy may be reduced. Time is saved, and the problem of shortage of speech therapists is alleviated. Further advantages are that patients can learn at their own pace, perhaps in the comfort of their own home.

Articulator is a computer-based therapeutic tool developed for use in both the hospital setting and at home by those with motor speech disorders. It is based on current methods with full adaptability and utilization to a range of speech clinics. This user interface is simple to use so care-givers can also use it easily. The use of different levels of cues allows the patient to determine the level of difficulty to match their abilities.

Articulator is a personal computer multimedia Windows application. It consists of natural sound output, high quality graphics, animation of air-flow and tongue position, and a user-friendly graphical interface. There are two levels of training available, single consonant training and consonant-vowel combination training.

Although the emphasis is on stroke patients, it is useful for all patients with motor speech disorders.

Developed in association with speech therapists at Royal Perth (Rehabilitation) Hospital, the system is about to undergo further level trials prior to general release. This paper addresses the problems faced in developing user interfaces of the system and the associated problems of integrating current therapeutic treatments with computer technologies.

INTRODUCTION

Currently, there is a shortage of speech therapy services available to match the number of adult clients who require speech therapy. Consequently, we have developed a computer-based therapeutic tool, to assist speech therapy services with the aim of decreasing the time therapists have to spend with each patient for the rehabilitation of motor speech disorders.

CONVENTIONAL VERSUS COMPUTER-BASED THERAPY

Conventional Therapy System

Conventional therapy focuses on the production of individual phonemes and this may cause several disadvantages. The patient may find it difficult to concentrate on many things at once, such as watching the therapist's face for cues, looking at the letter being presented, and listening to her voice.

The tools used are graphemes displayed on flash cards (Figure 1.0), phrase cues and description cues presented verbally, and on paper, and most important are the facial cues given by the therapist.

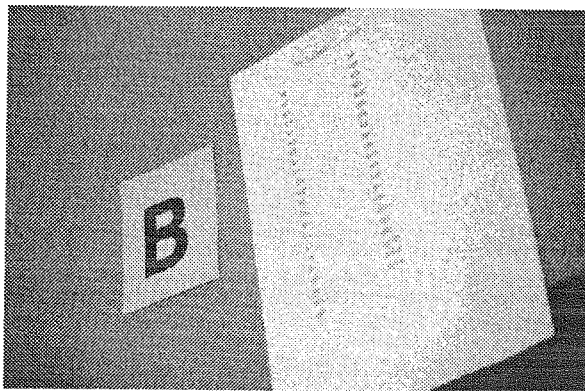


Figure 1.0 Conventional paper-based speech therapy aids.

Speech therapy provided at home has the advantage that families are actively involved in encouraging the patient to do his/her exercises between sessions with the therapist, speaking with and trying to understand him/her. This both facilitates and encourages communication within the family, with the family being an important source of rehabilitation. By doing this, it can also reduce the high cost of therapy (Seidl 1977). Instead of standing by helplessly, families are taught techniques of speech therapy. Active involvement provides the members of the family with the opportunity to learn and accept the limitations of the patient as well as to avoid from becoming over-protective (Alkalay and Asserman 1983).

However, it should be pointed out that while most family members tend to be very motivated in their involvement in Therapy at the beginning, as time passes, many tend to lose interest and unfortunately, do not keep up therapy practice. Therefore, by using computer-based therapy, such loss of interest within the family may be prevented. A computer is always available for therapy and never loses patience!

Computer Based Therapy System

Assists with Speech Therapy - Articulator aims to relieve therapist supervision of drill work. Carers may help to monitor the accuracy of the patient's productions. In this way, therapists can use their time more efficiently to plan new target goals. Therapists no longer have to organise cards and sheets of paper for drill work. Traditionally, each session the therapist has to sort through several cards and pieces of paper with facilitating cues, or use a more time consuming process of writing down the cues. With Articulator, the therapy process is able to run more smoothly and efficiently, as all the cues are presented on the screen (Figure 2.0).

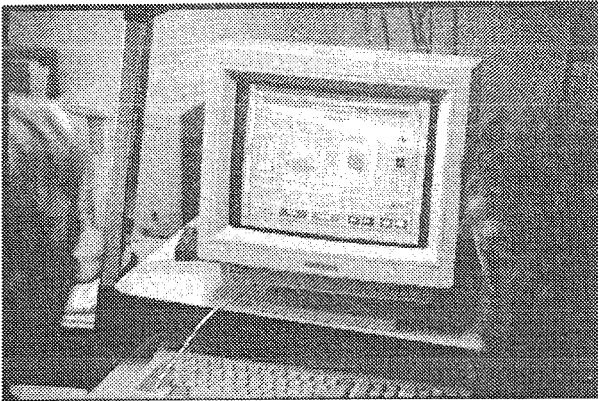


Figure 2.0 A patient using Articulator with a speech therapist.

Relieves shortage of speech therapy services available for patients - Since Articulator saves clinician time, it may also help to relieve the shortage of speech therapy services available to patients by reducing the amount of time the clinician has to spend with each patient. Each clinician can therefore take on a greater case load.

Patients can learn at their own pace - Patients can progress through the various sounds independently and take control of their own learning without the need of a supervising clinician (Figure 3.0). Though the clinician, may be a source of motivation, patients may tend to rely too much on clinicians to support and guide their learning. One of the aims of rehabilitation is for patients to develop or retain as much independence as possible, and allowing them to learn at their own pace is a step towards such a goal.



Figure 3.0 Patient using Articulator 1.0 independently.

Articulator is Interesting and Visually Stimulating for the Patient - Large, colour graphics and recorded natural speech make the program interesting and more stimulating for the patient (Figure 4.0). The use of recorded natural speech promotes more interaction and facilitates learning better than digitized speech.

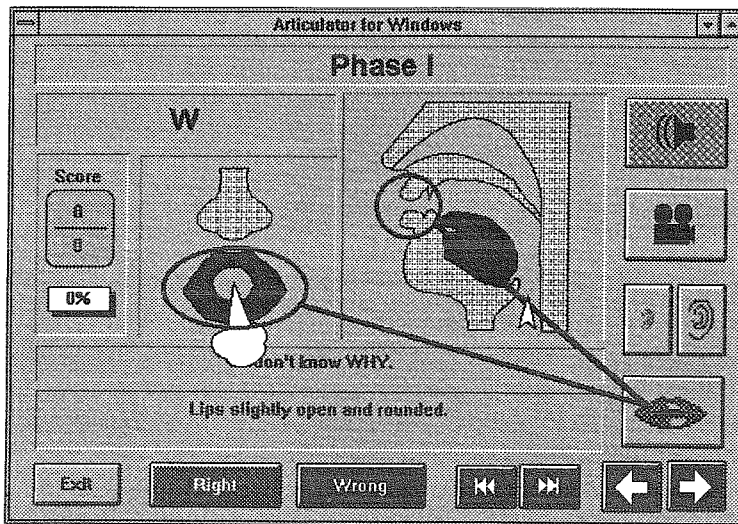


Figure 4.0 The screen of Articulator for Windows

Simple to use and cost effective - Articulator is designed to be user friendly. The various cues required can be selected simply by clicking the mouse on the appropriate icon (Figure 4.0). Little training is needed to operate the program, and carers can be easily taught to assist those unable to operate Articulator independently. On top of this, having been developed locally, it is cost effective.

CHARACTERISTICS OF ARTICULATOR FOR WINDOWS

High-Quality Voice Output

Most of the computerised voice output systems for speech disorder rehabilitation use synthesized speech. However, many people hearing phoneme-based synthetic speech for the first time are surprised by its poor quality, and usually find it very hard to understand, which may be especially so for those with speech disorders. What they need is a precise sounding voice for replication. In fact, the Institution of Electrical and Electronics Engineers (IEEE) published a recommended practice for speech quality measurements in 1969 (IEEE 1969), but this has never been widely adopted as the basis of standardized testing (Edwards 1991). Edwards (1991) also showed that no existing rule-based synthesizer would come close to passing the test of being indistinguishable from natural speech. Therefore, using recorded speech is preferred.

There are about 300 sound recordings used with Articulator and all were digitized on an IBM compatible computer with a SoundBlaster Card. Microsoft Windows Sound Recorder version 3.1, which is a software program for recording sound was used. A condenser microphone, with a hooded cover was used to prevent sound distortions from air bursts. Natural voice was digitized at 11KHz and a 8 bits digitized voice channel (DAC) was used. Sound output is run through two speakers

connected to the SoundBlaster card. Since SoundBlaster card has a built-in amplifier (4W per channel), the playback achieved is of a very high quality.

Articulator's Graphical Interface

An interactive screen is one which is not only dynamically responsive to the particular needs of its user, but is also capable of capturing the user's attention. An effective interface screen design plays a significant part in achieving these goals. For example, since each button has a sound attached to it, it should generate greater client motivation and interest (Thimbleby 1990, Cox and Walker 1990).

The Microsoft Windows graphics environment enables better quality of screen graphics to be presented. All graphics within Articulator consist of 256 colours and a 640x480 resolution. Due to the hardware independence of MS Windows, different resolutions and colours can also be achieved according to the setup for Windows. However, the VGA (Video Graphic Adaptor) mode is recommended.

MS Windows provides the standard Graphics User interface (GUI). By making use of buttons and pointing control devices, the interface becomes more user friendly. The design of the interface should also take into account the special needs for those with motor speech disorders, such as extra-large buttons and icons, as shown in Figure 4.0.

Device Independent Inputs

By using MS Windows, input devices are not restricted to only the mouse and the keyboard, however, the program can also be controlled by use of a single tap switch, joysticks, head pointers, lightbeam pointers, touch screens, or any other type of control device, as long as these devices have Windows' drivers. This makes the program more versatile as it can be adjusted to suit the needs of the individual client with different physical disabilities (Reichle *et al.* 1991, Vanderheiden and Lloyd 1986).

Full Range of Applicable Services

Articulator can also be used for child education, articulation therapy, ESL (English Second Language) learners, or it may accompany therapy for speech disorders of a different nature.

CONCLUSIONS

Articulator is a computer based therapeutic tool for use by those with motor speech disorders. As well as being interesting and visually stimulating to the patient, time is saved and the patient can progress at their own pace. The different levels of cues available the patients provides a hierarchy of levels to match abilities.

Since Articulator is designed on a personal computer Microsoft Windows platform, by using state of art computer technology, features of this therapeutic tool are its user friendly, high quality graphical interface with animation and natural sound characteristics.

Initial trials on a small group of patients for 9 months at Royal Perth (Rehabilitation) Hospital, have been promising and further developments and trials are currently being done.

Speech pathologists, traditionally attempt to accomplish this arduous task armed with little more than a handful of photocopied pictures of mouth positions and gallons of patience. Most commonly the patient is unable to practise the skills he/she has learnt out side of the clinic session or must rely upon a caregiver learning to act as a therapist to support his/her attempts at home. Thus therapy can be slow, methodical and monotonous. Further clinical continuity is often interrupted by patient or therapist vacation periods, holidays, illness or institution schedules.

Given the above difficulties then, the development of a computer program to enhance therapy with this population or enable a patient to practise alone can only be heralded as a major breakthrough for the general clinician.

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