

Interactive rehabilitation software for treating patients with aphasia

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ABSTRACT

Aphasia is an impairment of language, affecting the production or comprehension of speech and the ability to read or write. Most common cause of aphasia is – about 23–40 % of stroke survivors - acquired aphasia. The rehabilitation of aphasia is a medical, special treatment (speech therapy), which is the task of a psychologist. It needs long and intensive therapy. More detailed information about therapy can be found in (Engl at al, 1990, Subosits, 1986). In this paper we present our implementation or realization of interactive multimedia educational software to develop readiness of speech for helping the therapy. The software were developed within the frame of youth scientific and MSc thesis works. The first program was developed in Flash, the second in Macromedia Director. The goal of our software is to teach the most important everyday words. The software will be a useful device in the education of children with heavy mental deficiencies. Reading the program you can learn how it works and what current results we have achieved.

1. WHAT IS APHASIA?

Aphasia is an impairment of language, an acquired communication disorder that impairs a person's ability to process language, but does not affect intelligence. It also impairs ability to speak and understand others and most people with aphasia experience difficulty in reading and writing. While aphasia is most common among older people, it can occur in people of all ages, races, nationalities and gender. Further information about Aphasia can be found in (Leel and Ósi, 1988).

1.1 Types of Aphasia

Global Aphasia is the most severe form. Patients with this type of aphasia produce only few recognizable words, can understand little or no spoken speech at all and they can neither read nor write. These symptoms can usually be seen after a patient has suffered a stroke and they may rapidly improve if the damage has not been too extensive and there has not been greater brain damage or more severe and lasting disability.

Broca's Aphasia means that speech output is severely reduced, limited mainly to short utterances of less than four words. As a result vocabulary access is limited, the formation of the sounds is often laborious and clumsy. Patients with Broca's aphasia may understand speech and be able to read but the quality of speech is halting and effortful. Furthermore, they are very limited in writing.

Mixed non fluent aphasia means sparse and effortful speech resembling Broca's aphasia. Patients of this illness are limited in comprehension of speech and they do not read or write beyond elementary level.

In case of Anomic Aphasia persons are left with a persistent inability to supply words for the things that they want to talk about. Mainly they have problems with nouns and verbs. However they can understand speech well and in most cases they can read adequately. Unfortunately they have poor writing ability.

1.2 *What causes Aphasia?*

Most common cause of aphasia – about 23 – 40 % of stroke survivors acquire aphasia. It can also result from head injury, brain tumour or other neurological causes. It is estimated that about one million people in the United States have acquired aphasia, or 1 in every 250 people.

More common than Parkinson's Disease, cerebral palsy or muscular dystrophy. About 1/3rd of severely head-injured persons have aphasia. However, most people have never heard of it.

1.3 *Recovery from Aphasia*

After stroke – if symptoms last longer than two or three months, complete recovery is unlikely. However, it is important to note that some people continue to improve over a period of years and even decades. Improvement is a slow process that usually involves both helping the individual and the family understand the nature of aphasia and learning compensatory strategies for communicating.

How do you communicate with a person with aphasia? Communication Do's and Don'ts.

First and foremost, a person with aphasia has to be considered as a normal human being, so talk to them as an adult not as to a child. Minimizing or eliminating background noises helps a lot in understanding. Before starting communication make sure you have the person's attention. To make them feel confident encourage them all the time. Use all modes of communication: speech, writing, drawing and yes-or-no responses to avoid being boring during studying. Give them enough time to talk and permit a reasonable amount of time to respond as well. It is essential that you should accept all communication attempts. Keep your own communication simple but adult-like. It is better to use simplified sentence structures and keep in mind to reduce your rate of speech. Keep your voice at a normal level and do emphasize key words. If it is possible, use a lot of gestures and aids during communication. Do not hesitate to repeat any statement when it is necessary but never ever attempt to finish the patients' statements for them.

2. SOFTWARE DEVELOPMENT

2.1 *Developing environment*

The first program was developed in Flash MX, the second in Macromedia Director.

The Flash MX has more useful tools, which helped programming the subtasks. The Flash MX is suitable to develop interactive multimedia programs, too, in contrast with other programming languages. As a matter of fact, the Flash MX is an animated software which supports the vector graphical and "raster" based pictures. This is a development environment constructing interactive programs by means of its ability to be programmed. With the help of the animated software called Flash MX interactive programs including extremely fast and spectacular multimedia elements can be created. Further information about Macromedia Flash MX can be found in (Macromedia website).

Macromedia Director is a widely used multimedia developing environment, which combines the effectiveness of high level programming languages with the show of animation studios. The developing of interactive multimedia programs is complicated and takes a lot of time with conventional programming languages, such as Pascal or C++, but with the help of Director these applications can be written more easily and quickly. Further information about Macromedia Director can be found in (Macromedia website).

We will make a comparison between of the two software so that the users can decide which one has more advantages for them and is worth further development in an other article. The comparison and analysis of developing environments is not the theme of this article. The major characteristic feature of the program developed in Flash MX is its extraordinary speed that can be achieved with not using much memory. Due to the low number of Kbytes used, it can be used through the Internet very easily. What helps the Aphasic patients the most is that they do not need to study in rehabilitation centres but owing to the flexibility of the program they can also practise in their homes. Though they need the guidance of a teacher in every case. The program developed in Director is used only at home or in the rehabilitation centre. It is not downloaded from the Internet.

2.1 *Progress of development*

First of all, we got acquainted with the topic through several books special teachers consultants offered us. Naturally, after immersing in studying the disease itself we consulted with the therapists in the school a couple of times. Their confirmations meant an essential step during the process of developing of the program

since from their feedback we knew that the main idea of the program functioned smoothly, it just needed some polishing at certain parts. The basis of the multimedia software are the books "Everyday tasks" by Jacqueline Stark and "Speak without fear" by Takácsné Csór Marianna. The second book has more exercises becoming more and more difficult through the whole book. After collecting the tasks into several groups we designed the main menu. We took the following items into account: simplicity, easy to survey, easy to use, do not distract the attention.

The programming was started after the searching for simple figures and illustrations easy to survey. At the beginning we had to consider that there were a lot of similar exercises. The program had to be terminable. The number of the visible pictures on the screen is not the same in every task therefore we had to watch out for their sizes. The order of the cast members on the stage was also important. The pictures are randomly arranged in every skill level of the program. In this way protection against monotony is assured. By using the interactivity of our software the computer informs the user about the right or wrong solution. Both cases are marked with adequate figure and sound.

3. THE INTRODUCTION OF THE SOFTWARE

The application of an educational software can have difficulties in Hungarian schools and rehabilitation institutes because of the low number and quality of the computers. Unfortunately the situation is the same with the equipment of the psychologist and special teachers who take care of the aphasia patients. It was an important point of view that the programs should also run easily on an average computer to avoid any difficulties. Considering these factors we have chosen programming on HTML basis because of its being modular and having a small size. The Microsoft Windows operating system is generally installed on school computers. The objects and their interactivities were made with Flash MX, which does not need a compiler and the building of large executable files, only the downloading of the Flash Player 6.

We can direct the interactive objects of the film in the Director, as a fictive director. The action is taking place on the stage and it is visible for the user. The cast members are pictures, video clips, music and all of the buttons and tools. Events can be added to the objects and with them we can handle the information received by the computer.

The program starts in both cases with choosing one of the tasks. The user may not be able to use the software alone in this phase of the rehabilitation, so a teacher or a therapist's guidance is inevitable. Answering the questions does not happen in a fixed order, so it is possible to begin the practice from his (or her) own skill level.

We take care of the interactive participation using the possibilities of the manipulation technique in every task. The number of the right answers isn't displayed with points but only with illustrating animations. The programs are user friendly, they do not require special knowledge and everybody is able to acquire how to use them in a few seconds.

Requirements: Pentium class or equivalent CPU, SVGA display with 800*600 resolution, Windows operating system with included Internet Explorer WEB browser, Mouse, Sound card, Macromedia Flash Player 6.

3.1 The structure of the menus

There are three pictures in the main menu of the first program (Figure 1). Here the patient or the teacher can choose from the language with a mouse click. The next step after choosing the language is giving the user's first and family name. User's name is required for the further developing of the records.

You can get into the next level only if you fill in the field of the User's name. Then you can choose from the given rooms. (Figure 3) The second program shows only the objects of the house. The main menu of the second program starts with a user's guide. (Figure 4)

4. THE TASKS

The main task of both pieces of software is to teach the everyday words of the house or of the environment near the house. (Figure 5) In every submenu there are 4 skill levels.

The first level makes the user acquainted with the objects of the room. (Figures 6 and 7) If the user points with the mouse to an object, the name of the object appears on the screen and it can be read. This first skill level trains the user's memory power.

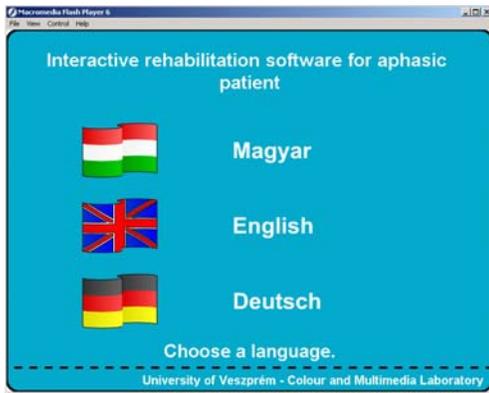


Figure 1. Main menu (Flash version).

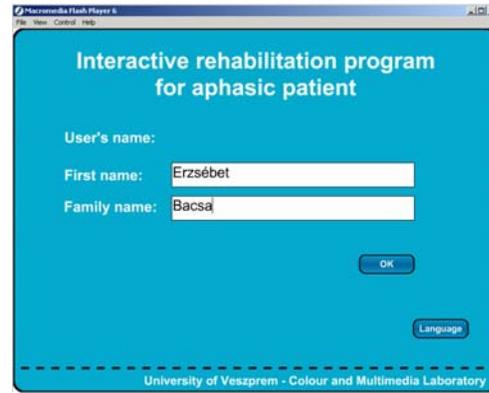


Figure 2. Submenu - User's name



Figure 3. Submenu – rooms (Flash version).

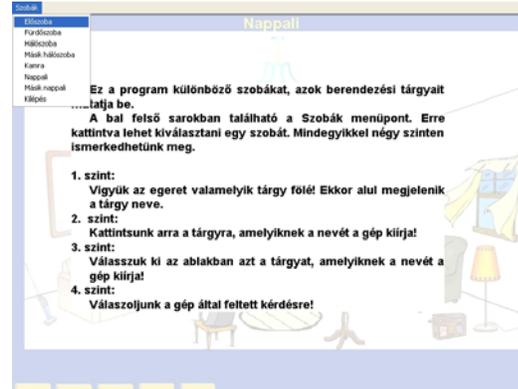


Figure 4. Main menu (Director version)



Figure 5. Menu of room (Flash version)

The second level shows an uncoloured picture. The program asks the user to show the named objects. (Figures 8 and 9) If the user manages to find the asked object, the object turns into a coloured one. In this way the user can make the whole picture colourful. If the user is unsuccessful, the program sends an error message and the user can continue.

The user's ability is also controlled on the third level. The earlier learned room is in the background, but it is pale. (Figures 10 and 11) The program shows three figures randomly and the user has to choose one with answering a question. This is essential because the user cannot recall its name but only its place properly. The real knowledge is examined at this level.

If the user could not answer, the program sends an error picture. This third level asks questions as long as the user or the teacher does not choose another skill level. The fourth level asks more difficult questions than the third level. The questions deal with the handling of the objects. (Figures 12 and 13)



Figure 6. 1st skill level (Flash).



Figure 7. 1st skill level (Director)



Figure 8. 2nd skill level (Flash).



Figure 9. 2nd skill level (Director)

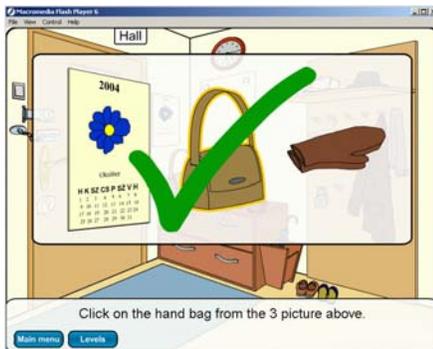


Figure 10. 3rd skill level (Flash).



Figure 11. 3rd skill level (Director)

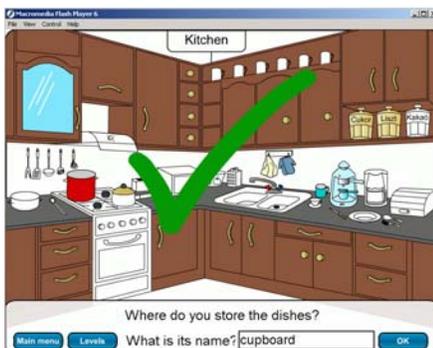


Figure 12. 4th skill level (Flash).



Figure 13. 4th skill level (Director)

If the user can find the object, the program asks its name and the user has to write it into an input row on the screen. After the right answer the program asks a new question. The therapist chooses the starting level and the tasks. It can be used with the therapist's assistance.

5. SUMMARY

Within the frame of youth scientific and MSc thesis works we have prepared interactive multimedia educational pieces of software to develop the readiness of speech for helping the therapies. The software package contains two programs. The first program was developed in Flash, the second in Macromedia Director. The goal of our software is to teach the most important everyday words. We made the first tests in the Kozmutza Flora Special Primary School and Talent Developing / Training Collage. We have tested only the user interface design so far. In the second step during second term in the 2003/2004 academic year we are going to make the efficiency examination not only in this school but in the National Centre of Brain Vein Diseases too.

People with difficulties in naming objects have been tested up to now. They managed to get through levels 1-3 easily. At the 4th level naming of the objects, especially in case of long words, required more time than at the previous ones. The aim of testing is to be able to use the learned material in real life. One result of the first test is that the software is a useful device not only in the education of aphasic but heavy mental deficient children too. Moreover, both the children and the teachers can use it easily. Considering the advice of the teachers helping us during the program development, the children need some motivating animation reassuring the right answer and increasing their interest for the oncoming items. On the contrary, adults do not require such motivating exercises or tasks. The English and German versions and the audio confirmation of the words are being developed at present.

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