

Development of a computer controlled cognitive diagnostics and rehabilitation method

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Abstract. In this paper we introduce a computer controlled method (HELp Neuropsychology = HELEN) which enables - as a difference to methods used internationally - not only the establishment of the diagnosis, but permits measurement of the effectiveness of the therapy. It allows

- To produce a database of the patients that contains not only their personal data but also the results of the tests, their drawings and audio recordings.
- It is an intensive therapeutic test, which contains tutorial programs too.

1. Introductions: Cognitive computer aided therapy

It is a computer controlled flexible procedure that enables clinical neuropsychological tests and therapeutic systems. The single tasks contain decision-making situations, for these the system provides material of assistance. The methods, how the patient solves the problems shows how he or she thinks about the question, in case of failure the system provides the possibility of a new trial. For these we had to elaborate such interactive procedures, which enable the solution along different concepts. This should not influence the test results, expressed in points, but should influence the way of rehabilitation. By this we enable the patients to control their own manifestations, and the way they deal with the problems. Thus this enables the use of the problem solutions encountered during the diagnostic phase and makes their transfer to the rehabilitation possible; it uses them in selecting the best strategy. The method uses syndrome-analysis, thus it is not only a mere collection of computerised tests, but has been built in such a form that it uses the solutions provided by the patient to choose the next task. At the same time it shows the efficiency numerically. By this it enables to develop diagnostic and therapeutic programs according to the individual needs and at the same time it supplies exact results and comparative data. This means that we investigate the cognitive and behaviour deficits in such a form that we activate the intact functions. The system contains tasks that relate to the perception, memory, attention, writing, reading, counting, etc. By this technique the patient controls the course by its own procedures, he or she is rehabilitated along his or her own activity, i.e. gets involved in the process and thus one can hope that the speed of the rehabilitation will increase. New aspect is that by using modern technical support, within the described system

one can change the difficulty of the task by using colouring, changing the local or global intensity, adding noise [1,2,3].

The main menu of the HELEN program is constructed in such a way that the sequence and selection of the tasks that was given in the beginning of the therapy can be changed any time depending on the patient's performance.

2. The specification of the logical structure of the HELEN software

The following data are stored in the database of the software

Personal data:

- Name (maiden name as well)
- Name of mother
- Date of birth
- TAJ number (Hungarian social security number)
- Address
- Telephone number
- Name of next of kin
- Accessibility (Tel., e-mail)
- Left or right handed (this has to be known for the best strategy of some tasks)

Data obtained from tests:

- Results of the tests
- Strategy of solution
- Drawings prepared by the patient
- Audio recordings.
- Remarks of the neuropsychologist

The HELEN interactive therapeutic test and teaching software contains the following tasks:

- Memory game
- Puzzle game
- Where
- How many cubes do you see?
- How many pictures do you see?
- How many black and white checked drawings do you see?
- Concealed pictures
- Stories similar to the Binet pictures
- Amendment of half pictures
- Picture with noisy background
- Identify!
- Ordering according to form and colour
- Ordering of pictures
- Ordering of sentences
- Logical cards
- Clock
- Situation practice
- Recognition of faces
- Recognition of emotions

- Blind map
- Story
- Labyrinth

3. Some tasks in detail:

3.1. *Memory game*

This game is similar to the traditional memory game, but the pictures are chosen thematically. Pictures from different topics are included in each game: fruits, plants, vehicles, clothes, etc. Maximum 4*5 sized memory game can be played. The patient can get verbal help after time limit or after several unsuccessful attempts. The program saves the steps of the solution [4].

3.2. *Puzzle game*

At the beginning we can see the pieces of a picture dispersed and rotated at the border of the screen. On the border of the picture to be assembled we can see the outlines of the piece to be inserted. The picture is fit into a frame. The program saves:

- The order of the chosen pieces (It's important to know whether the patient is left or right handed, because he or she starts elsewhere)
- If the patient tries to put a piece to a wrong place
- If he or she gives up inserting the chosen piece and chooses a new one
- the given helps

3.3. *Where*

The patient sees 4-5 3D objects and 4-5 horizontal plans. The task is to put the objects to the right plans. The program gives help only after several unsuccessful attempts, maybe it rotates the object, the patient can take a look at the bottom of the object, so it can be compared with the horizontal plans. The program saves the attempts and the given helps.

3.4. *How many cubes do you see?*

On the screen a 3D object can be seen, which is built of congruent cubes. The task is to tell the number of the cubes. If the patient doesn't know the answer, we can give a base plan where the patient can write in the number of the cubes in a given place. If he still doesn't know he can rotate the object. The program saves the attempts and the given helps.

3.5. *How many pictures do you see?*

On the screen 2D figures can be seen drawn onto each other. The task is to tell the number of the figures. The program can help with coloring the figures, or it chooses one and shades it. The program saves the attempts and the given helps.

3.6. *Identify*

Only one half of a number of 2D images of everyday objects can be seen, the task is to recognize the objects. The program can help with showing a similar object rotated. If the patient still doesn't know the answer, the program shows the original object rotated and in a

different size. We save the number of the recognized objects. It's important to let the patient control which help he uses.

3.7. *Ordering of pictures*

We can see stories in 4, 6 or 8 pictures according to the difficulty level. The task is to put the pictures in an order. If the patient is ready with the ordering, he or she tells the story. If during the story telling the patient recognizes that the order is wrong, he can put the pictures in another order. If he can't do it, the program gives sentences to the pictures. The program saves the attempts and the story telling.

3.8. *Clock*

The program tells the patient to draw on a circle the time he heard. The program can help with drawing the main lines of the watch. The program saves the attempts.

3.9. *Story*

We adapt known tales (only in foreign languages). On the screen we can turn over the pages just like in a book. The patient has to look at the tale, and has to tell the time he needs to tell the story. The program saves his story telling.

3.10. *Labyrinth*

The labyrinth program can be played with words or with numbers. This is asked at the beginning and then the size is asked (min 5*5, max 20*20). After that the labyrinth is drawn. The letters of a word or of a number from a mathematical expression are hidden as treasures. These treasures have to be brought out of the labyrinth in the shortest time. If all are brought out the program tells the time elapsed. Then we have to complete the word or the mathematical expression. The program saves the time needed to solve the program [5].

4. Steps of the solutions of the applied research

The group of interactive computer controlled rehabilitation programs makes it possible that we reveal the individual changes of the mental capacity of the patient, and by doing this get new information on the cognitive functioning of the patient or group of patients. The information in the database reveals further data on the individual path followed by the patient, thus can provide information on the typical behaviour, how he or she recognises something, and gives us further insight in the sequencing of perceptions [6], [7].

5. Summary

We have designed such an interactive multimedia software that helps the testing and rehabilitation of brain vain patients. We will show some examples of the software in the oral presentation.

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