HASOMED

RehaCom®

Cognitive therapy

Topological Memory

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Cognitive therapy

by Hasomed GmbH

This manual contains information about using the RehaCom therapy system.

Our therapy system RehaCom delivers tested methodologies and procedures to train brain performance.
RehaCom helps patients after stroke or brain trauma with the improvement on such important abilities like memory, attention, concentration, planning, etc.

Since 1986 we develop the therapy system progressive. It is our aim to give you a tool which supports your work by technical competence and simple handling, to support you at clinic and practice.

User assistance information:

Please find help on RehaCom website of your country. In case of any questions contact us via e-mail or phone (see contact information below).

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Dear user,
please read the entire instruction manual before trying to operate RehaCom.
It's unsafe to start using RehaCom without reading this manual.
This manual includes lots of advice, supporting information and hints in order to reach the best therapy results for the patients.

Table of contents

1 Training description

1.1 Training task

Every training task in the Topological Memory module is divided into two phases:

- the **acquisition** phase and
- the **recall** phase.

In the ***acquisition phase*** (see Fig. 1), pictures (subjects, figures, symbols) appear on the monitor in a matrix with 3, 4, 5, 6, 7, 8, 9, 10, 12, 14 or 16 objects (see Levels of difficulty). The length of the acquisition phase is determined by the patient. Once the patient has memorized the location of all the images, he or she can continue to the next phase by pressing **OK**.

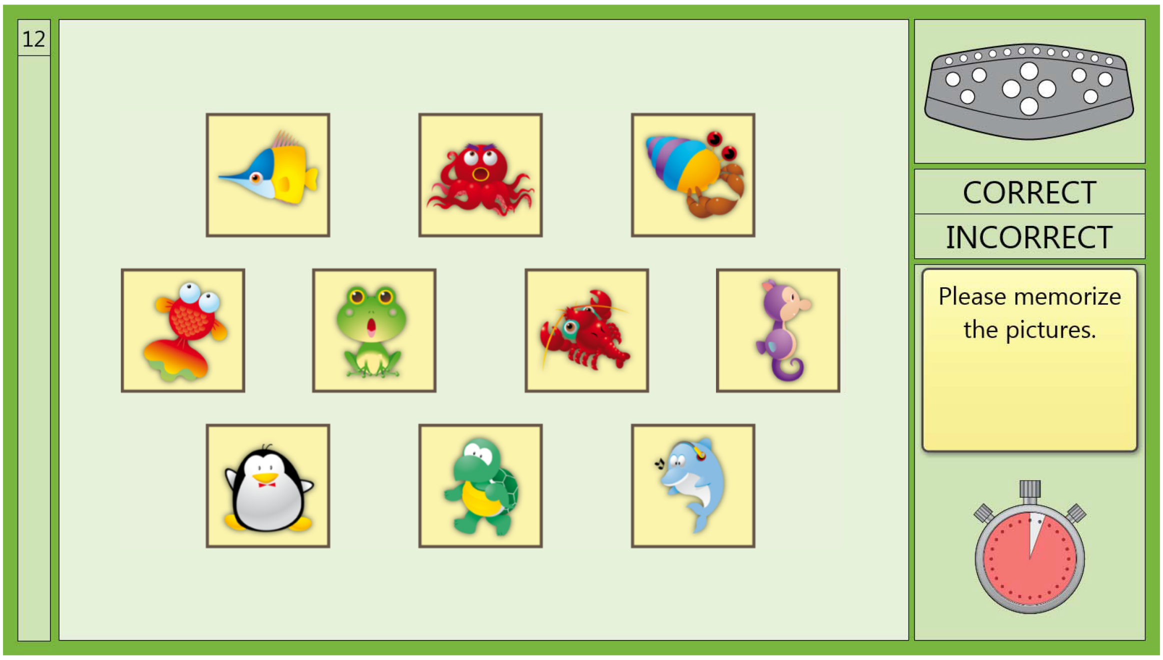

Fig. 1: Acquisition phase at level 12

In the ***recall phase*** (see Fig. 2), the pictures are turned over to hide the image. A picture that matches one of the hidden pictures is then presented separately. The patient must find the picture's pair from the matrix of hidden pictures.

Different input modes can be used for the selection of the missing pair:

- the RehaCom keyboard,
- the mouse, or
- a touch screen

(see Training parameters).

Using the arrows keys on the keyboard, the patient can move the selection frame to one of the hidden pictures and select it by pressing the OK button.

When using a mouse, the patient moves an arrow over the screen to one of the hidden pictures. A selection frame appears around a picture when the arrow moves over it. The patient can then confirm the selection by either pressing the OK button or pressing the mouse button, depending on the patient's capability.

The simplest form of use of the module is with a touch screen, where the patient simply touches the respective answer on the screen.

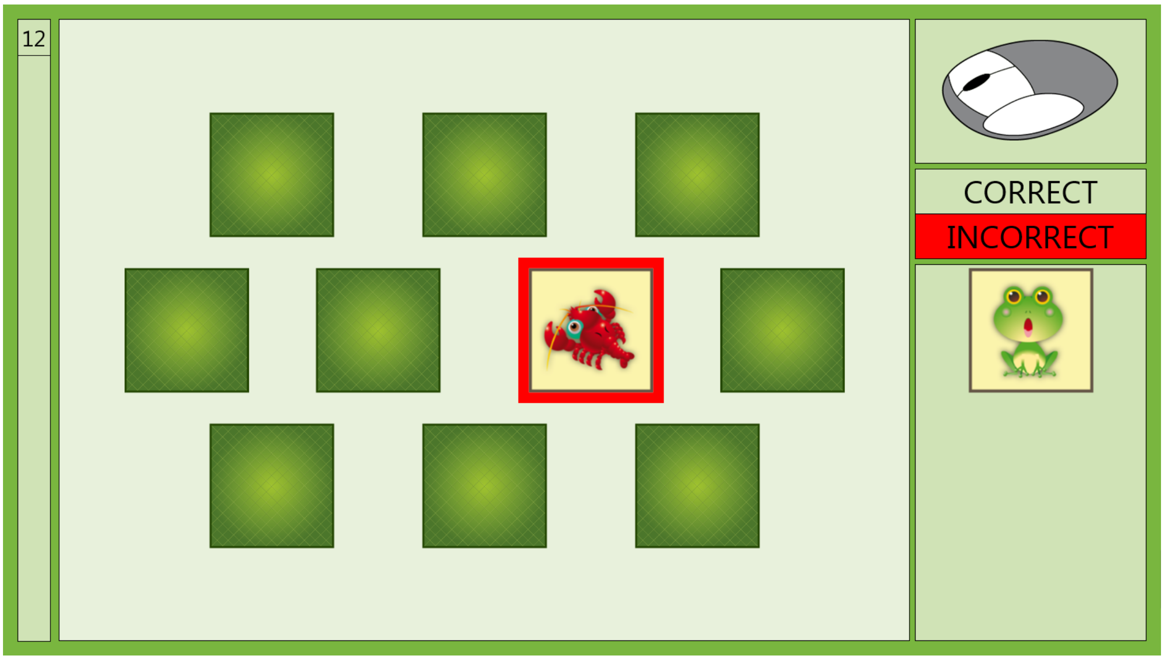

Fig. 2: Recall phase at level 12 showing incorrect answer selected

After selecting a picture the module evaluates the choice and either the green ***CORRECT*** sign or the red ***INCORRECT*** sign lights up.
If the choice was correct, then the picture is removed from the matrix. Incorrectly selected pictures are shown for 5 seconds and then hidden again. Pressing the OK button or the mouse button shortens this time.

The recall phase ends when all of the hidden pictures in the matrix have been paired. There then follows a performance feedback followed by the next task.

1.2 Performance feedback

One type of feedback appears in the form of a **stopwatch** (see Fig. 1) that shows the remaining time during the acquisition phase (see Training parameters). When this clock is visible, the patient can prepare themselves for the available acquisition time and where necessary, make better use of the provided time. On the other hand, this representation of the time remaining may have a negative stressful effect on some patients. For this reason, both the patient's personality and aspects of the mode of difficulty of the task should be taken into account when considering this option.

In the **recall phase**, when the patient chooses the correct picture, the patient's choice is framed in green, and the green ***CORRECT*** sign lights up. When the patient chooses an incorrect picture, the patient's choice is framed in red and the red ***INCORRECT*** sign lights up. After a short time (3 seconds after correct answers and 5 seconds after incorrect answers), the next picture is presented. A correctly selected picture disappears from the picture matrix before the presentation of the next picture.

A performance bar displays on the left side on the screen, showing the state of the performance in the current task (see Fig. 2). The bar grows with every correct response. Once all the pictures are paired, the bar reaches the top and specific number of errors is presented.

1.3 Levels of difficulty

The variation in the units of information per level is set up to ensure an adaptive level of difficulty.

The difficulty is determined by the number and the rate of variation of the pictures which have to be memorized. Tab. 1 shows difficulty structure of each level.

An interrater study was conducted. Using the feedback from this study, the pictures were assessed with regard to their rate of variation and a method for establishing the difficulty was determined. Only a few people manage to correctly complete the highest levels of difficulty. In general, a patient's performance plateau is usually reached earlier in the module.

The variation rates are divided into four categories: in category 1, pictures have concrete contents and heavily contrasted colors. In category 2, the pictures become more abstract; however, the heavily contrasted colors remain. In category 3, colored geometric representations are used. In category 4, the color information is greatly reduced and only monochromatic geometric figures are employed.

Level	Matrix	Variation rate	Max number of errors	Max acquisition time
1	3	1	-	60s
2	4	1	2	60s
3	5	1	2	60s
4	6	1	3	60s
5	7	2	3	60s
6	8	2	4	75s

7	8	3	4	75s
8	9	2	4	75s
9	9	3	4	75s
10	10	2	4	75s
11	10	3	4	75s
12	12	2	5	90s
13	12	3	5	90s
14	12	4	5	90s
15	14	2	6	105s
16	14	3	6	105s
17	14	4	6	105s
18	16	2	6	120s
19	16	3	6	120s
20	16	4	6	120s

Tab. 1: Levels of difficulty

Changing to a higher level occurs when the number of tasks solved without errors exceeds the number specified in the parameter setting for repetitions. Changing to a lower level of difficulty occurs when the patient exceeds the max number of permitted errors (see Tab. 1) for the number of times (based on repetition parameter) for the current level.

1.4 Training parameters

Specific settings for the training module can be adjusted (see Fig. 3). This section describes each setting and explains how to adjust them.

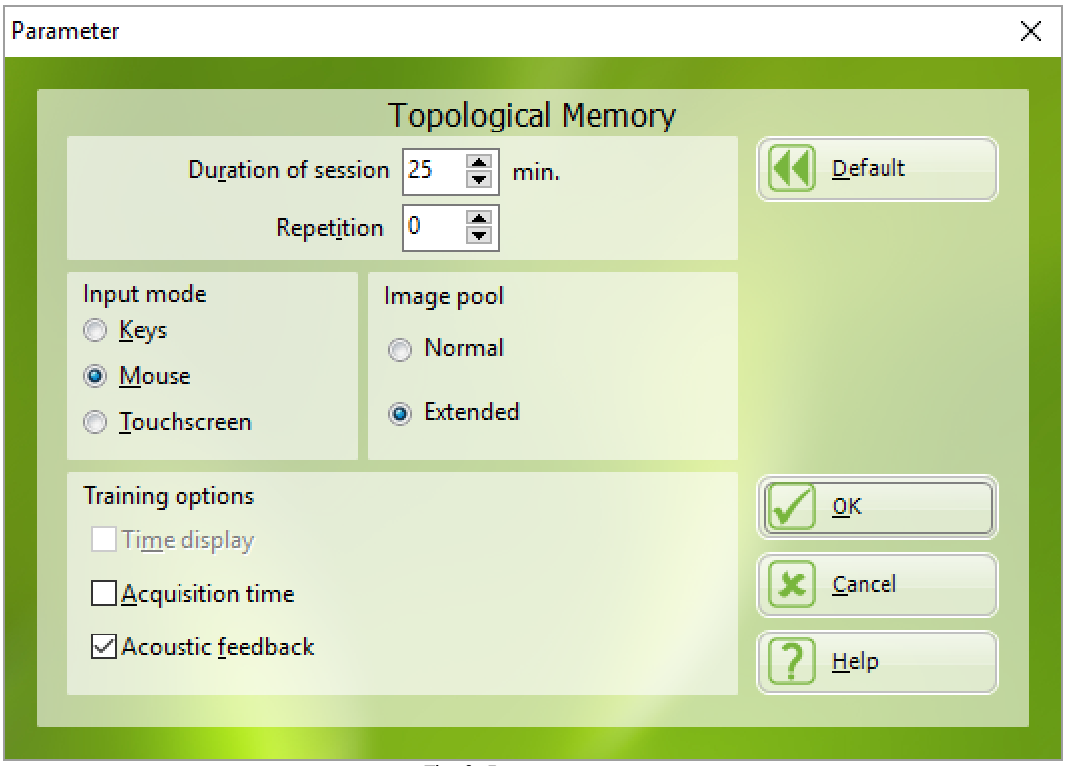

Fig. 3: Parameter menu

Duration of session in min:
A training time of 25–30 minutes is recommended.

Repetition:
A change in level occurs only if the number of tasks specified by the repetition parameter have been correctly or incorrectly solved. In this way, the level of difficulty is only modified if a positive or negative performance consistently occurs. While it is more difficult to reach the next level, intermittent performance problems do not directly cause the patient to fall to a lower level. The patient's motivation to train is then positively influenced. In general, it is recommended only to increase the level if a task is repeatedly solved correctly.

Input mode:
The various ways for interacting with the program (i.e., mouse, touch screen, keyboard) have already been described in the Training task section. The use of the large keys on the RehaCom keyboard is recommended for patients with coarse stroke-tremor syndrome and for patients with other hand movement problems or simply inexperienced patients.
For patients without motor problems, the mouse simplifies the handling of the program.
The simplest type of operation is to use a touch screen.

Image pool:
RehaCom supports the use of an additional set of pictures. The normal setting is

automatically set up in the program. An additional set of pictures is available with the Extended setting. The extended series of pictures should be used after the patient has had a lot of experience with the normal set of pictures. This helps to maintain motivation. The user may also generate their own set of pictures. Integrating these new pictures into the program is quite simple. Please choose the system service option.

Time display:
If Time display is enabled, a stopwatch shows the time available during the acquisition phase. The visible clock is used to improve the patient's performance and should not be used with patients whose performance is considered weak (see Performance feedback).

Acquisition time:
If Acquisition time is enabled, the patient's time to memorize the pictures will be limited (see Tab. 1). In general, this option should always be used. However, to reduce the stress level for patients with a weak performance level, this option can be disabled. Once the patient shows improvement in performance, the limited time period should be activated again. The patient can end the acquisition phase at any time by pressing the OK button.

Acoustic Feedback
When acoustic feedback is enabled, a bell type noise is rung after each correct decision. When an incorrect decision is made a different type of bell tone is sounded. Many patients find the acoustic feedback to be very motivating. If a lot of people are working in the same room, the acoustic feedback should be disabled or head phones should be used.

Orientation:
The training field is defaulted to the left side of the screen. For patients with particular lateral visual problems, the training field can be switched to the right side. This option is of interest for patients who have specific disturbances or who may favor a specific side of the screen (e.g., neglect).
You are able to change the ***Side Orientation*** in the menu: Clients -> Edit -> Tab: File -> Options field: Hemianopsia

When setting up training for the first time with a new client, the following default values are automatically set up:

Current level of difficulty	1
Duration of training/cons. in min	25
Repetition	1
Input mode	Keys
Orientation	left
Image pool	normal
Time display	off

Acquisition time	on
Acoustic Feedback	on
Picture material	normal

Tab. 2: Default parameters

1.5 Data analysis

All training sessions are placed in a chart within the Results tab. A training session is selected by double clicking on the bar in the chart. Once selected, the results of the session are presented in the Table and Chart tab.

Explanation of columns in the results table or under More Details on the results page

Level	Current level of difficulty
No. pictures	Number of pictures in matrix
Trials	Number of trials
Errors	Number of errors
Acquis. time used	Required acquisition time in s
Max. acquis. time	Max. acquisition time in s
Solution time	Required reproduction time in s
Train. time task	Effective training time h:mm:ss
Breaks	Number of interruptions by the client

Tab. 3: Results

The parameter settings used during the training are displayed directly below the table. The graphical presentation of the results (e.g., percent total mistakes, acquisition time per task) is also displayed on the Table and Chart tab.

2 Theoretical concept

2.1 Foundations

Memory is understood to be a process leading to a relatively stable change of the behavior (Kolb & Whishaw, 1985).

Impairments in memory capacities are often found in patients with brain insults of various origins, which may lead to serious handicaps in their professional and private life. The clinical image of such a disturbance is inconsistent and can selectively afflict particular memory areas concerning duration and character of the learning material. In memory disturbances, a distinction is made between ***retrograde*** and ***anterograde amnesia***. The first refers to the inability to remember a particular period before the disease, whereas the latter refers to the inability to memorize new things (after the lesion of the brain).

The first attempts to study and understand the complex functional system of our memory were carried out at the beginning of the 19th century.
In the basic research and clinical reality, a distinction is made between the ***short-term memory*** and the ***long-time memory*** (Atkinson & Shiffrin 1968, Warrington 1982), the procedural and the declarative (Cohen & Squire, 1980), the semantic and the episodic (Tulving, 1972), the verbal and the non-verbal or figural memory, explicit and implicit (Graf & Schacter, 1985) capacities.

The description of the structure of memory, based on the duration of information storage, results from the outcome of interdisciplinary research:

- sensory memory (retention time of a few hundred milliseconds),
- short-term memory (Broadbent, 1958; Wickelgreen, 1970) and working memory (cf. Baddeley, 1997) with an availability of information for a few seconds up to one minute, and
- long-term memory with a retention time from minutes to hours, weeks, or years.

The capacity of short-term memory, the memory span, is in healthy people 7± 2 information units. The model of the working memory assumes that several neural subsystems are involved which store predominantly visual-spatial information and phonological information (Hömberg, 1995). In addition to short-term retention of information, working memory also processes content in parallel. Some indicators for evaluating the functioning of working memory are the recall of numbers backwards, or the recall of visual memory span backwards.

The functions described as long-term memory are often divided into:

- explicit memory; which stores semantic knowledge and biographic data (episodic knowledge) and can be recalled and named directly, and
- implicit (procedural) memory; which stores memories about motor sequences or rules which cannot be described directly (Hömberg, 1995).

Theories about the physiological and morphological correlation of memory processes have been postulated by, among others, Hebb (1949; cf. Kolb & Whishaw, 1985). Models on rules of coding, storing, and recalling of contents or their organization is still very controversial.

An important result of memory research is the current treatment of memory as an integral part of cognitive activity, and as an active process.
In this sense, memory functions are not only processes of information acquisition, long-term storage, and recall (in the sense of a passive store). Rather, existing memory contents have an impact on future information processing and undergo a ***re-evaluation*** for practical behavior (Hoffmann, 1983). Therefore, they also modulate a person's emotional experiences.

The diversity of the memory regions plays an important role in distinguishing memory functions. An evaluation of a patient's cognitive skills is possible only after extensive analysis, which includes the phase of acquisition, short- or long-term retention, and recall or recognition of new and old memory contents (with or without external help). Possible interference effects may impair the storage or recall of information, which should be taken into account in patients with attention disturbances.

Four methods in the rehabilitation of memory disorders are distinguished (von Cramon, 1988):

- repeated presentation of learning material,
- learning memory strategies,
- using external aids, and
- teaching specific knowledge about memory and possible disturbances (Glisky & Schacter, 1989).

When a patient's visual perception capacities are disturbed, restoring those capacities seems possible through direct stimulation. In contrast, restoring impaired memory functions is acknowledged to be hardly possible (Sturm, 1989). That means neuropsychological training of memory capacities should concentrate on substitution and compensation strategies.

The sections Training aim and Target groups provides further information.

2.2 Training aim

The objective of training with this module is to improve memory for visual-spatial information**.**
The Topological Memory module is based on memorizing the spatial order of several figures in the acquisition phase and their assignment to the pool of concealed information in the recall phase.

It is possible for therapist and patient to work together to develop effective memory strategies for ordering the set of pictures in a topological way and practice them to overcome deficits in memory processes.
A range of memory strategies can be used: associating the pictures (and their names) with existing memories, forming categories of the images (semantically or phonologically), or forming a new word with the first letters of the names of the images. Furthermore, a connection regarding the content can be found through using the names of images in a sentence or making up a story or a sequence of actions. By using these methods, the information can be stored more easily.

Also, the *Loci method* can be helpful during this type of training (a known system or series is subdivided into particular stations or places and these are then associated with certain objects/terms).

Spontaneous individual strategies found by the patient should be discussed and developed into effective strategies. Please note that processes that function automatically in healthy people will require a conscious effort for patients who suffer from amnesia. These additional strategies may then represent additional demands on the patients.

Complementary training modules to the module Topological Memory (MEMO) are: **Word Memory** (WORD), **Figural Memory** (BILD) and **Verbal Memory** (VERB). By using the **Physiognomic Memory** (GESI) module, particular memory functions are trained; and with the **Shopping** (EINK) module, more complex sets of tasks are trained, such as memory and action planning.

Topological aspects of visual information have a close connection to the 'cluster ability' of visual-spatial perception.

Problems in the visual-spatial perception and/or visual spatial operations are designated as neuropsychological symptoms, in which the two- or three-dimensional spatial relationships between different objects or parts of an object cannot be registered.

For training of visual-spatial perception in combination with spatial operation the following RehaCom-modules are available **Two Dimensional Operations** (VRO1) as well as **Spatial Operations** (RAUM) and can be supplemented by the program **Visual-construction abilities** (KONS).

Patients who suffer from strong attention problems should first train with the RehaCom module Attention & Concentration.

2.3 Target groups

Patients with brain injuries often have difficulty learning new information and storing or recalling information from long-term memory.

In addition to being prone to distraction and attention deficits, the patients who have a brain injury often have problems keeping track of things if confronted with a lot of information. They have difficulty ordering information and encoding it for long-term storage. Deficits in working memory and attention disturbances prevent the information from transferring to long-term storage.

Such memory disturbances can occur after numerous different types of injuries to the brain (e.g., primary and secondary degenerative diseases of the brain, hypoxia, infections) in vascular cerebral injuries (e.g., infarcts, hemorrhages), skull-traumas and tumors with lesions on one or both sides. Neurosurgical operations also can often lead to memory disorders. Damage to the medial temporal or thalamic regions, mammillary bodies, frontal cerebral structures, parahippocampal gyrus, or hippocampus often lead to memory disturbances.

Disturbances to the visual-spatial memory, which often occur after posterior strokes to the right hemisphere, are often blended with deficits in visual memory.

Memory disturbances are often accompanied by different disorders in brain performance, such as attention and linguistic problems, which have a strong impact on memory performance. Also problems in the patient's ability to plan actions, skills in problem solving, or lack of understanding about the illness can reduce the effectiveness of therapeutic memory strategies because the use of therapeutic strategies outside the clinical setting is often inconsistent.

The training module was specifically developed for patients with disturbances to visual memory, where problems occur in ordering visual stimuli. Furthermore, the training is suitable for patients with disturbances to their visual range and for patients who suffer from weaknesses with recognition. This training can also be used with patients who suffer from aphasia.

The diagnostic of serious attention problems and considerable deficiencies in the visual perception functions should be excluded (perhaps previous training of these deficiencies should be carried out with the RehaCom module **attention & concentration**).

This type of training can be also be used to assist in the improvement in the performance of memory in the field of geriatrics and also with children 11 years and older. It is advisable that a therapist be available at all times. The module uses child-friendly instructions for patients up to the age of 15 and the instructions and words are on the vocabulary level of an average 10-year-old. For younger patients, it is recommended that the touch screen or the mouse should be used.

Numerous effectiveness studies are currently available for different random samples of patients using the RehaCom module Topological Memory: Friedl-Francesconi (1995; 1996) tested several RehaCom modules on patients with dementia or traumatic brain injury and achieved group improvements in memory and attention functions; with the latter excluding the visual short-term memory. In a study by Höschel (1996), the effectiveness of different RehaCom modules was tested in later rehabilitation of trauma patients who had disturbances in memory and attention: improvements in individual functions were also shown here, in the pre post comparison test. Preetz (1992), Puhr (1997)and also Regel & Fritsch (1997) evaluated the Topological Memory module on different patient groups and found, among other things, improvements in cognitive services in the pre-post comparison) and partial relevant transfer effects in everyday life. A controlled effectiveness study on 3 experimental groups of alcoholics is available from Günthner (1992), who concluded that the "RehaCom group" had the highest improvements in non-verbal memory performances (Benton-Test). Günthner (1994) was able to prove similar improvements with schizophrenic patients, with a single 2 x 2 experimental setup (and also with the Benton-Test). Liewald (1996) and Wenzelburger (1996) were able to show improvements in performance of visual memory of alcoholics using this module. The first study was highly dependent on the "age" and the "seriousness" of the alcoholic problem. Pfleger (1996) found non-specific effects with regard to the illness process of chronic schizophrenics.

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Index

- A -

- B -

- C -

- D -

- E -

- F -

- G -

- I -

- L -

- M -

- N -

- O -

- P -

- R -

- S -

- T -

- V -

- W -