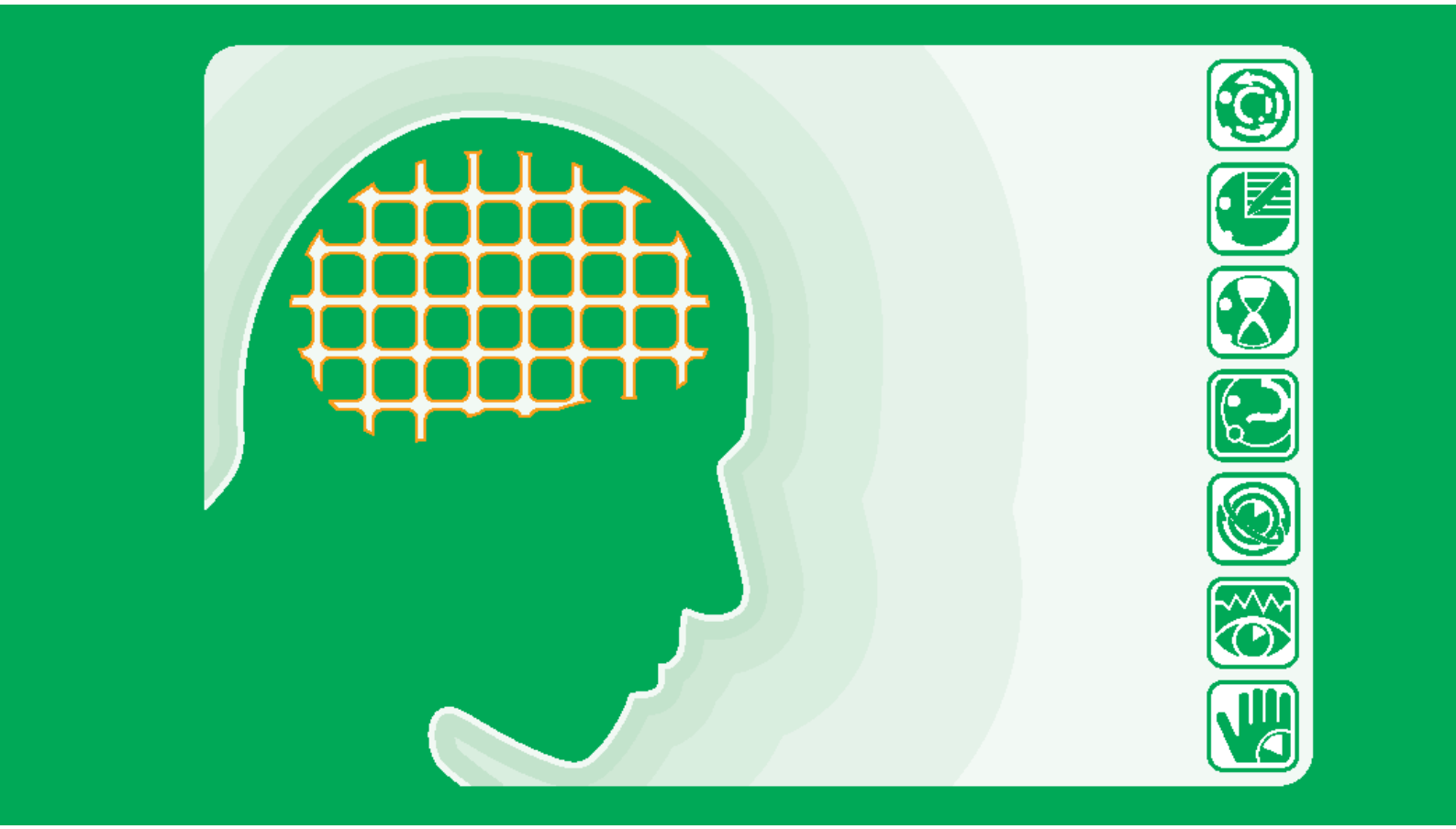
RehaCom

computer-assisted cognitive rehabilitation - brain performance training



Figural memory

www.rehacom.com

HASOMED®

Hard- und Software für die Medizin

RehaCom®

computer-assisted cognitive rehabilitation

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.

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1 Training description

1.1 Training task

The procedure **Figural memory** combines visual-figural taking in with verbal reproduction: ***not the objects themselves have to be reproduced but their names.***

from version 5.00:
From RehaCom Ver. 5.00 there are 3 different trainingmodes:

1) Pictures are acquired -> Pictures are reproduced
2) Pictures are acquired -> Words are reproduced
3) Words are acquired -> Pictures are reproduced

You can setup the trainings-mode of the client at the parameter-menue.

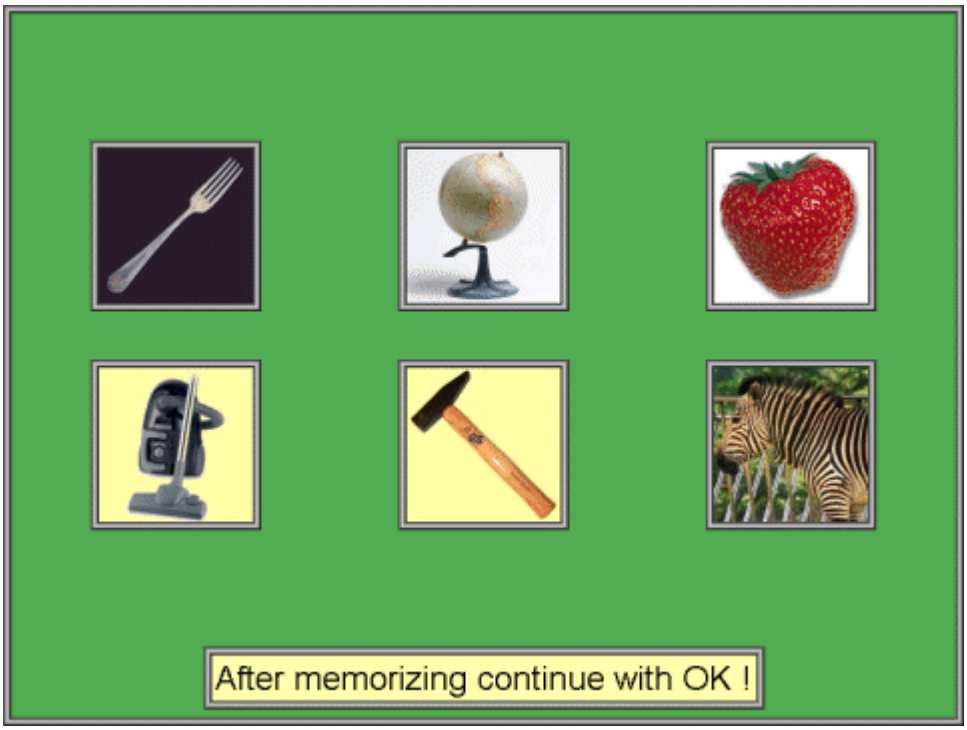

Figure 1. phase of acquisition in level 6. 6 objects have to be memorized.

During a session several tasks have to be carried out. Each task consists of an ***acquisition*** and a ***reproduction phase***.

In the ***acquisition phase*** (Figure 1) pictures/words of concrete objects are presented. The number of pictures/words depends on the level of difficulty. The length of the acquisition phase is determined by the client. He can close this

phase by pressing **OK**.

In the ***reproduction phase*** (Figure 2) the client has to recognize the names/pictures of the concrete objects. The designation has to be picked out from a number of nouns/pictures moving over the screen from right to left. By pressing **OK** the client selects a relevant word/picture. However the **OK** button has to be pressed while the word/picture is inside the area marked by three arrows. The reproduction phase closes when all words/pictures of a task have been presented. The performance of the client is rated then: he receives information about the quality of his responses and whether the level will change.

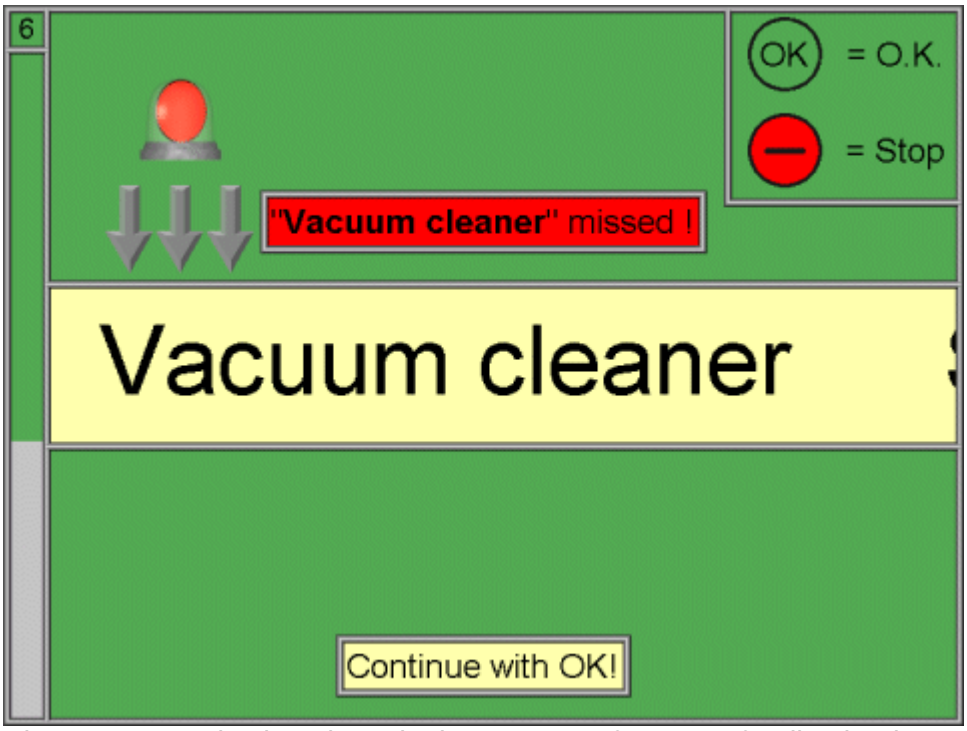

Figure 2. Reproduction phase in the moment of an error feedback. The text feedback is activated.

The procedure works also without a RehaCom panel.

1.2 Performance feedback

A range of feedback modalities can be set by the therapist in the parameter menu (see training parameters):

- Acoustic feedback,
- Visual feedback and
- Text / autostop.

The pictures and their designations were selected in a way that a clear matching is guaranteed. Nevertheless a client possibly associates a picture with a name different from the name saved, and therefore makes mistakes (see here for further information).

In activated ***visual*** and/or ***acoustic feedback,*** every response of the client is evaluated.
The ***visual*** feedback signals a correct decision with a green lamp, an incorrect one with a red lamp. For children, a little cartoon man evaluates correct decisions with a nod of the head, incorrect ones by shaking his head.
The ***acoustic*** feedback evaluates correct decisions with a pleasant sound, incorrect decisions with another typical sound.

If the feedback ***Text*** is activated ([X]), the client receives the matching word if he ***missed a word*** (see figure 2.). So he can correct his associations. The training *stops* and is continued only after pressing **OK**. If the client selects an ***incorrect word***, he only receives the message "incorrect". Correct decisions are not evaluated.

On the left side on the screen, you see a performance bar showing the state of the performance in the current task (see figure 2.) The bar grows with every correct response and shrinks with every incorrect one. If the bar reaches its top in the course of a task, the task is evaluated as ***solved correctly***.

1.3 Levels of difficulty

The training uses a pool of more than 120 concrete pictures (register cash, tree, horse, etc.). Each picture is matched with a term (name) which is presented in the reproduction phase.

Inspite of a careful selection it may happen that **particular words** are not used in some areas (dialects etc.) In that case the therapist can **change** them. For that he needs an editor (e.g.notepad in windows) which generates no additional control characters. Once you have changed a word list, remember to save your changes. If you plan to have your procedures updated, your individual word lists will be overwritten if you have not saved them. The file BILDER.TXT produces the matching between picture and name. Changes in it MUST NOT effect the order of the words.
The file IRREL.TXT contains irrelevant words. if changing that file make sure that you do not insert a word contained already in the file BILDER.TXT !!

The program works adaptively. The level of difficulty can be set between 1 and 9. The levels are determined by the number of pictures to memorize.

Table 1
Structure of difficulty.

level	no. of images	max. errors
1	1	0
2	2	0
3	3	0
4	4	0
5	5	0
6	6	0
7	7	0
8	8	1
9	9	1

A task solved is rated as ***correct*** if the number of errors is smaller than the error limit. This error limit is defined in table 1. Up to level 7 no error is allowed. From level 8 onward it is possible to make one error and still receive a correct rating. After a task has been solved correctly, the next task is generated with new, coincidently selected pictures. Pictures the client had to memorize in the current training are excluded.

After ***two consecutive tasks*** have been solved ***correctly*** the program switches to the ***next higher level*** of difficulty.

If a tasks has been solved ***incorrectly***, the same pictures are presented for up to ***5 times***. The client has repeatedly the chance to memorize the same pictures. The sequence of the pictures in the acquisition phase and of the words in the reproduction phase is varied, though. ***After 5 incorrect reproductions*** the program switches to the ***previous level of difficulty***.

The maximum number of 9 pictures to memorize has been set according to clinical studies. With the structure of difficulty, tasks ranging from very easy up to very hard are possible.

It is the therapist´s turn to provide the client with strategies about how to improve the memory capacity. The procedure helps to apply and train these strategies.

1.4 Training parameters

General notes on training parameters and their effects are described in the **Basic manual RehaCom**. These notes should be taken into consideration for the points described below.

Figure 3 shows the parameter menu.

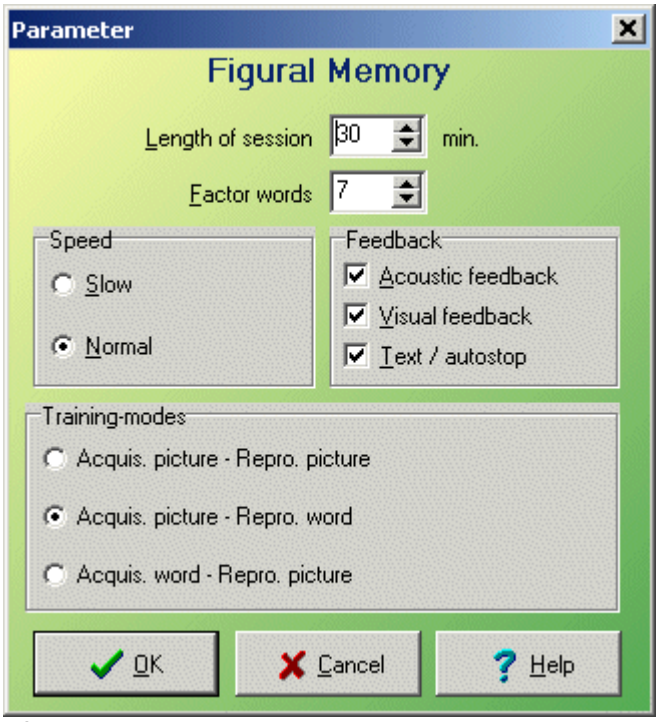

Figure 3. Parameter menu.

Current level of difficulty:
The current level of difficulty can be set in the therapist´s menu between 1 - 12.

Length of training session (in min.):
We recommend a length of 25 - 30 minutes.

Factor words:
The number of words in the reproduction has to be set. It results from the number of pictures to memorize multiplied by the ***factor words***. At least ten words will be shown however. The factor ranges from 5 to 10. If a low factor is chosen the time for reproduction will be shorter. If a high factor is chosen the ***long time attention*** is trained additionally in the higher levels of difficulty.

Speed:
The speed of the words moving across the screen has to be set. There are two different speeds available: normal and slow. Generally "***normal***" should be set for the training. Clients with a low achievement rate or who are generally slow should work with the "slow" setting to avoid frustration.

Acoustic feedback:
This feedback should generally be activated ([X]). An inactive state can raise the

difficulty for clients with high performance as additional stressor. In that case however, all the other feedback modes should be inactivated. If there are several clients training in one room, the acoustic feedback may lead to interference, so better inactivate it then.

Visual feedback:
We recommend this feedback especially for children.

Feedback text/ autostop:
Generally this option should be activated. For clients with high performance the difficulty is increased if the option is inactivated.

from version 5.00:
Training-modes:
Here you can adjust the mode you work. Both, words and pictures can be acquired and reproduced.
The mode acquiring words -> reproducing words isn't provided, please take advantage of the procedure **word memory** for this training.

When newly defining a training, the system automatically uses the following default values:

Current level of difficulty	1
Length of training session	30 minutes
factor words	7
Speed	normal
Acoustic feedback	on [X]
Visual feedback	on [X]
Feedback text	on [X]
Training-modes	Acquis. picture -> Repro. word

1.5 Data analysis

The various possibilities of analysing the data in order to find strategies how to continue the training are described in the **Basic manual RehaCom**.

In the graph as well as in the tables you find - beside the setting of the training parameters - the following information:

Level	current level of difficulty
Effec. time	effective duration of the training
Breaks	number of breaks caused by the client
No. of words	number of the words to memorize

Acquisition time	length of acquisition time
solution time	time taken to solve the task
Incorrect items	number of mistakes "selected an incorrect word/picture"
Missed items	number of mistakes "missed a relevant word/picture"

Through that you can point particular deficits out to the client.

Specific information about the current session or also about alle sessions can be printed out.

2 Theoretical concept

2.1 Foundations

Memory is understood as a process leading to a relatively stable change of the behaviour. (Kolb & Wishaw, 1985).

Impairments of the memory capacities are often found in clients with damages of the brain of different origin, they may lead to serious handicaps in their professional and private life. The clinical image of such a disturbance is non-uniform and can selectively afflict particular memory areas concerning duration and character of the learning material. In memory disturbances one differentiates ***retrograde*** from ***anterograde amnesia***. The first means the inability to remember a particular period before the disease, whereas the latter means 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* where carried out at the beginning of the 19th century.
In the basic research and clinical reality one sets the ***short-term memory*** against the l***ong-time memory*** (Atkinson & Shiffrin 1968, Warrington 1982); the ***procedural*** against the ***declarative*** (Cohen & Squire, 1980), the ***semantic*** against the ***episodic*** (Tulving, 1972), the ***verbal*** against the ***non-verbal*** or ***figural*** memory, ***explicit*** against ***implicit*** (Graf & Schacter, 1985) capacities.

The structure of the memory according to the *duration of the information saving* results from the outcome of interdisciplinary basic research:

- ***sensoric memory*** (retention time of a few 100 milliseconds),
- ***short-term memory*** (Broadbent, 1958; Wickelgreen, 1970) and ***working***

memory (cf. Baddeley, 1990) with an availability of information of a few seconds up to one minute,

. ***long-time memory*** with a retention time of minutes, hours, weeks or years; carries general knowledge about the world.

The *capacity* of the ***short-term memory***, the *memory span*, is in healthy people 7ñ2 information units. The model of the *working memory* assumes that several neural subsystems are involved which on the one hand store predominantly *visuo-spatial* information, on the other hand mainly *phonological* information (Hömberg, 1995). In addition to short-time retention of information, a parallel processing of the contents is assumed. Indicators for the functioning of the working memory are for example the backwards repeating of numbers, or the backwards reproduced visual memory span.

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

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

Theories about the *physiological* and the *morphological correlation* of memory processes, as e.g. the long-term increase, were postulated, among others, by Hebb (1949, cf. Kolb & Wishaw). Models on rules of *coding, storing and recalling* of contents or their organisation are discussed controversially.

An important outcome of the memory research is the current view at the memory as *integrative part of cognitive activity, as an active process.*
In this sense, memory functions are not only processes of ***information acquisition***, longer-term ***storing*** and processes of ***recalling*** (in the sense of a passive store). Rather, existing memory contents have an impact on the future information processing and undergo a ***re-evaluation*** for practical behavior (Hoffmann, 1983). In that way they also modulate a person´s emotional experiences.

The variousness of the memory regions plays an important role in the assignment of memory functions. An evaluation of the state of cognitive skills is possible only after a subtly differentiated diagnosis. It should modality specifically register the phase of acquisition, the short- or longer-time storing and the recalling of new and old memory contents (with or without external help, recognition).
Possible interference effects may impair the storing or recalling of information which has to be considered in clients with attention disturbances.
The **Rivermead Behavioral Memory Test** (RBMT; Wilson et al., 1992) is an

example for a strongly behaviourally oriented test examining various regions of the memory. The WMS-R (**Wechsler Memory Scale**) is a differentiated diagnostic equipment in the cognitive area.

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

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

In visual perception capacities it seems possible to restitute the disturbed functional areas through direct stimulation. In contrast, a *restitution* of impaired memory functions is acknowledged to be hardly possible (Sturm, 1989). That means neuro-psychological training of memory capacities should concentrate on *substitution and compensation strategies*.

The chapters training aim and target groups will provide further information.

2.2 Training aim

The objective of this procedure is to ***improve the memory for visual material*** under the *condition of recognition*. Furthermore long-term attention is trained.
The procedure **Figural memory** is based on the committing of visually presented pictures to memory and recognizing them as words which move - embedded in irrelevant words - across the screen in a line.
This way of acquisition and reproduction makes it possible to find various ***memory strategies*** - together with the client - and consolidate them through practice.
A range of memory strategies can be used: e.g. the *associative connecting* of the pictures (and their names) *with existing memories*, the forming *categories* of the words (semantically or phonologically), or *initial letters- priming* (the initial letters of several words to remember are stored as new word or in their sequence).
Furthermore a *connection regarding the content* can be found, e.g. through using the words in a sentence, making up a story or a sequence of actions. By means of these methods a "deep" or elaborate processing and thus the storing of the material is supported.

Spontaneous *individual strategies* found by the client should be taken up. One should take into consideration that processes running automatically in healthy people need particular effort in clients suffering from amnesty, and mean an

additional load for them.

The basic procedure **Figural memory** can be supplemented with the training of different memory functions by means of the RehaCom procedures **Memory for words** (WORT), **Topological memory** (MEMO) and **Verbal memory** (VERB). A more specific training is presented in the procedure **Physiognomic memory** (GESI); **Shopping** (EINK) requires additionally action planning skills.

2.3 Target groups

People with brain damages often have *difficulties to take in new information* and to *store it in the* long-term memory *and/or recall it*. In combination with a higher delicateness to distraction and further *attention deficits*, the clients often have problems to keep track of things if confronted with a lot of information. They find it hard to put the information in an order, thus make a basis for encoding it, and to support a lasting storing. *Deficits of the* working memory and attention disturbances prevent a transition of the data to longer-term storage.

Such memory disturbances occur after a range of *diffuse damages of the brain* (primary and secondary degenerative diseases of the brain, hypoxia, infections etc.) and in *vascular cerebral damages* (infarction, bleedings), *traumatic brain injuries* and *tumors* with lesions on one side or on both sides following. *Neuro-surgical operations* e.g. in epilepsia frequently lead to memory disorders. Medial temporal or thalamic regions, mamillary bodies or frontal cerebral structures, Gyrus parahippocampalis or hippocampus are structures which after damage often lead to memory disorders.

Mediale temporale oder thalamische Regionen, Mamillarkörper oder basale Vorderhirnstrukturen, Gyrus parahippocampalis oder Hippocampus sind Strukturen, welche nach Schädigung fast immer Gedächtnisstörungen zur Folge haben.

In infarctions most of all the the supply regions of the arteria cerebri anterior and posterior and also the polar thalamus arteria are of importance concerning memory disorders.
Often the *memory for visual contents* is impaired after *insults of the right hemisphere*, whereas *damages of the left hemisphere* impact the *verbal memory*.

Memory disturbances are often accompanied by further brain capacitiy disorders as e.g. *attention and speech deficit*s which have a strong impact on memory capacities in everyday reality. Intermixing effects resulting from that make *neuro-psychological diagnostics* hard.

Therapeutical measures can also be affected by *disturbances of the action planning, of problem-solving thinking* or a *lack of disease understanding*. An independent use of strategies often happens insufficiently then.

The training procedure was developed most of all for clients with ***impairments of the visual short-time and working memory***. Furthermore it is suitable for clients with ***impairments of the visual span and a reduced recognition capacity***. The training can also be used in clients with aphasic disturbances. Diagnostically excluded should be serious attention deficits (possibly clients can train with the RehaCom procedure **Attention & concentration** first) and serious deficits of the visual perception functions. The procedure can also be used for cognitive therapy in the scholastic and geriatric area, in children (from the age of 11 on) a therapist should be available any time though. The procedure uses child-friendly instructions for clients up to the age of 14, the instructions and words are on the vocabulary level of a 10-years old child.

Polmin et al. (1994) tested the RehaCom procedure **Figural memory** in 30 clients with impairments of the memory after stroke. In the control group receiving no training only 22% showed a short-time and 17% a longer-time improvement. In contrast, in the training group 60% showed a short-time and 70% a longer-time cognitive improvement.

Friedl-Francesconi (1995) tested several of the RehaCom procedures in clients suffering from dementia. They achieved improvements in memory and attention functions. Höschel (1996) tested the effectivity of a range of RehaCom procedures in delayed rehabilitation of clients who had a traumatic brain injury and suffered from attention and memory disturbances.The pre-post-comparision showed improvements for a range of functions, too.

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