HASOMED

RehaCom®

Cognitive therapy

Verbal 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).

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

The training uses a real-world scenario. The module asks the patient to imagine they are reading some articles from a newspaper. The patient is shown a news story and must remember facts from the story to answer the questions that follow.

Every piece of training consists of a number of tasks. In every task **one** story is memorized and then recalled. This consists of

- the acquisition phase and
- the recall phase.

In the acquisition phase, the story is shown on the screen (Fig. 1). The patient must memorize the contents of this story very well. The acquisition is ended automatically by pressing the button OK and/or after a <u>variable acquistion time</u>.

Millions of Hindus bathe in Ganges

Haridwar, the holy Indian city, on the banks of the Ganges River was a swirl of saffron, snake charmers and an estimated 10 million people Tuesday at the climax of the Kumbh Mela, the world's largest religious gathering. "I came to do some good and put 10 years of bad luck behind me," said Chapala Sadhu Khan, a 50-year old widow from Calcutta. She said she sneaked onto a train and traveled 14 hours to come to Haridwar. The

Guinness Book of World records calls the Kumbh Mela bathing ritual the earth's largest religious gathering. It happens every 12 years at Haridwar, a temple-filled town clinging to the foothills of the Himalayas 125 miles north from New Dehli. The four-month festival began Jan. 1 and ends April 30. Leeladhar Jagoori, a government official monitoring the festival, estimated that 10 million people had bathed in the river.
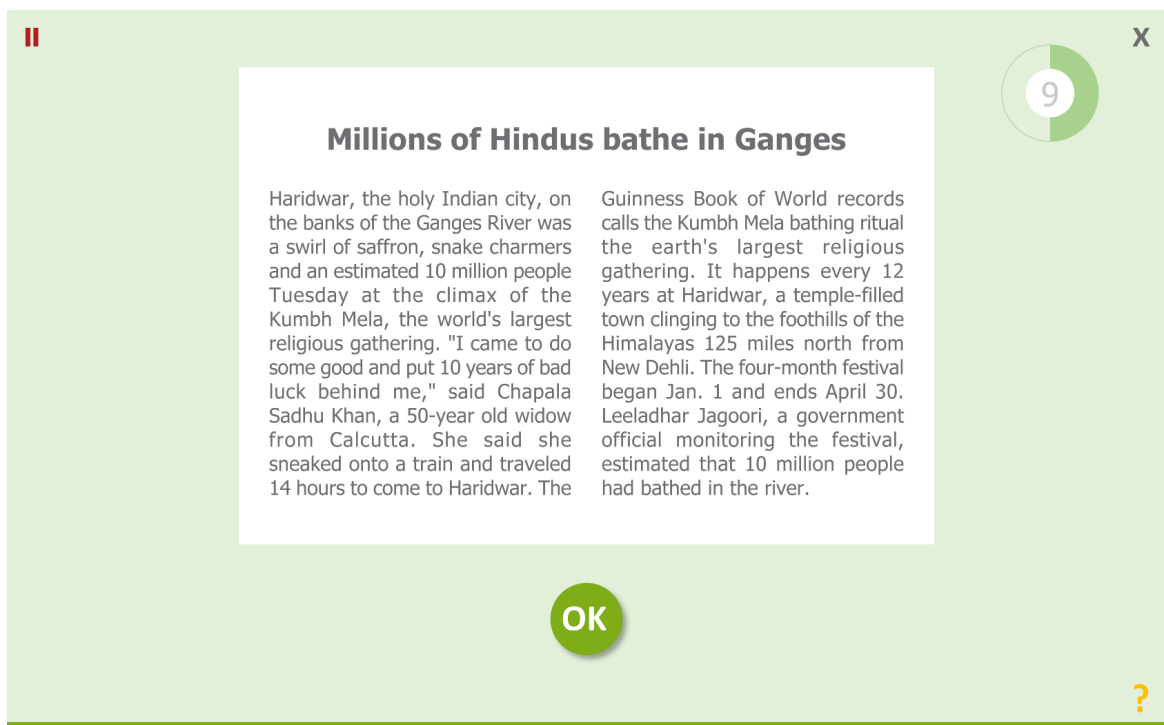
Figure 1: Acquisition phase of a story at the level of difficulty 9.

In the recall phase, the patient is asked questions that are either multiple choice or free recall.

For the questions that are multiple choice, the patient is shown four answers from which the correct answer is to be selected (see Fig. 2). The patient uses the RehaCom keyboard to select the answer. The selection is confirmed when the patient presses the OK button.

Alternatively, the mouse or a touch screen interface can be used. If the mouse is used, the mouse pointer can be shifted with one hand and the OK button can be activated with the other. More skillful patients can also use a mouse button for confirmation. The simplest form of use of the module is with a touch screen, where the patient simply touches the respective answer on the screen.
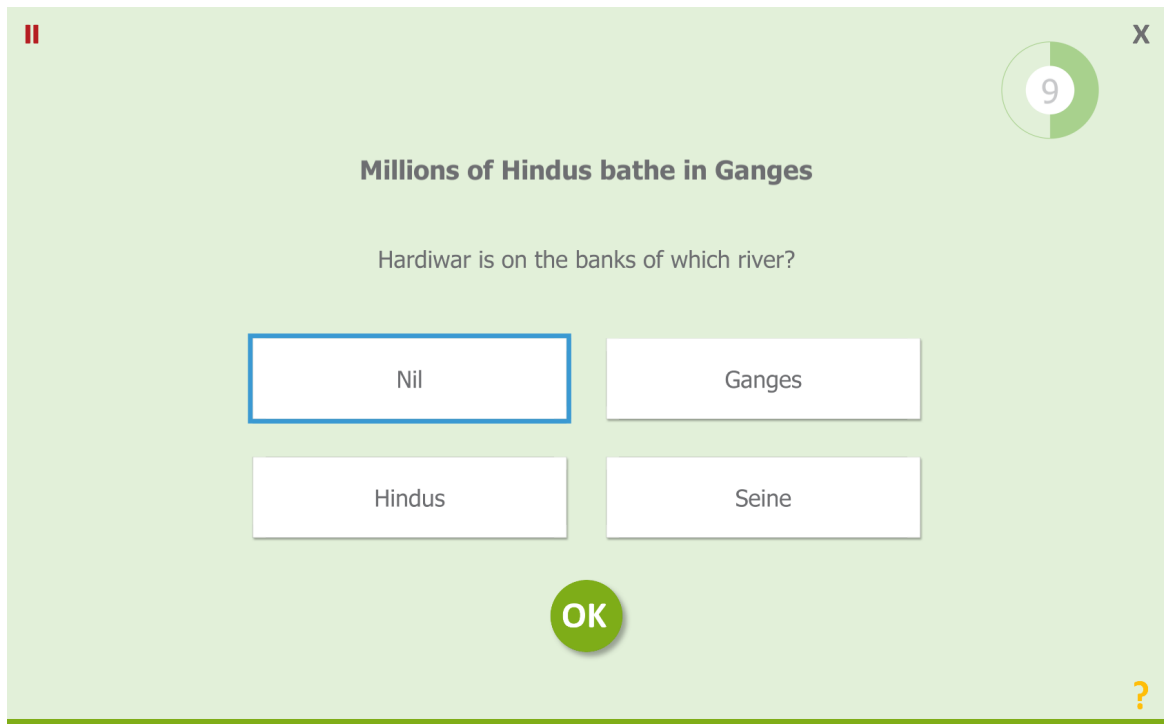

Figure 2: Reproduction phase with multiple choice with the use of the keyboard.

For questions that ask the patient to freely recall the answers, answers must be entered by using the PC keyboard (see Fig. 3). Answers for the free recall questions must be a single word or number. The space bar key is not permitted. The RehaCom program tolerates erroneous inputs (e.g., upper case/lower case, exchanged alphabetic characters) up to a certain extent (see Story Editor). Therefore, for independent training, the patient must be able to operate the PC keyboard. If necessary, the therapist can input the patient's free recall responses.

After all the questions for a story have been answered, the patient's performance is measured, and it is decided whether the patient should move to a higher level of difficulty.

For training long-term memory, questions from the previous session can be asked again without re-presenting the story. In the parameter menu, it is possible to determine how many questions (up to 10) should be asked for stories from the previous session. The quality of the answers is filed. At this stage there is no score available, regarding the content of the previous session, to reflect whether a change in the level of difficulty is necessary. Should a change in the level be required, the

therapist must carry out this variation.

The system can also be used without the RehaCom keyboard.

Figure 3: Reproduction phase with free reproduction in the moment of an correct decision.

1.2 Performance feedback

If the patient answers correctly, a the *green* frame will appear. After a short time (3 seconds), the next item will be presented
If the patient answers incorrectly, a visual feedback in the form of a red frame will appear and the correct answer will be marked *yellow*.
The patient is then given time to review the response. After an interval, which can be adapted in the parameter menu, or pressing **OK**, the next item will be presented.

In the upper right corner of the screen you can see the current level of difficulty and the level progress.

1.3 Levels of difficulty

The system works in an adaptive way. The 10 levels of difficulty are determined by the number of facts that have to be memorized (see Table 1). These facts are divided into three categories:
- numbers
- names

- events/objects

A training task is regarded as "correctly solved" if **all questions have been answered** ("number of facts" in table 1) and the **number of permissible mistakes** for the story (see table 1) have not been exceeded. Otherwise the story will be regarded as "incorrectly solved) and will be repeated several times, depending on the level (see column "Repetitions in the case of mistakes" in Table 1). If the patient cannot recall stories without errors, in spite of continuous repetition, the level of difficulty will be reduced.

Level	Number of facts	Number of permissible mistakes	Repetition in the case of mistakes
1	1	0	2
2	2	0	2
3	3	0	2
4	4	0	2
5	5	0	2
6	6	0	2
7	9	1	3
8	12	1	3
9	15	2	4
10	18	2	4

Table 1 Levels of difficulty

Using the [Story Editor](), it is possible to develop or change the story to suit the patient's needs.

1.4   Training parameters

Specific settings for the training module can be adjusted (see Fig. 4). This section describes each setting and explains how to adjust them.

Skip tutorial:
The integrated tutorial can be skipped by the therapist if necessary. Therefore, the lower corner button ⏭ or button 0 (zero) can be used.

Fig. 4: Parameter menu

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

Repetitions:
A change in level occurs if the number of tasks have been correctly and/or incorrectly solved (repetitions considered). In this way, the level of difficulty is only modified if an overall positive or negative performance occurred.

If the Repetitions parameter is set to 0, the level is only increased if every question in a task is answered correctly; otherwise, the level is reduced.

When the Repetitions parameter is set to some value other than 0, the patient is given the chance to re-read the story and answer the questions again.

Time limit acquisition:
A time stressor can be set if the value for Time limit acquisitionis changed. The acquisition time is calculated based on level by the following equation

("Time limit acquisition in seconds" * "Number of facts in Table 1") + 10s.

One should set a limited amount of time for acquisition only after a performance

consolidation (e.g., patient can confidently and correctly answer all questions at level 6). The Time limit acquisition setting can be changed to any number between 10 and 1000. The default setting is 99 seconds.

Reproduction:
The reproduction types and forms have already been described in the <u>Training task</u> section.

Memory mode:
By default, the module Verbal Memory is set to the *Short-term memory* mode. In this case, the recall questions always immediately follow the acquisition of the relevant story.

In the *Interference* mode, two stories are shown and both memorized before the recall phase for the first story is begun. Once the first task is concluded, the third story is shown for acquisition before the recall questions for the second story are presented, and so on. The acquisition of a new story comes before recall of an old story. Over the solution time of a task, the contents of the story to be solved and the next story must be memorized.

The *Select story* mode allows the individual training of memory strategies, under the observation of a therapist. One works with selected stories. When this mode is selected, training is not adaptive.

If a value other than 0 is entered for Long-term memory *Questions last sess.*, a selected number of questions from the last session are presented at the beginning of training.

If a training task has been solved correctly, a **reward image** will be shown after the feedback for a max of 20s.

Input mode:
The various ways for interacting with the program (i.e., mouse, touch screen, keyboard) have already been described in the <u>Training task</u> section.

Story complex:
The validation of the Verbal Memory module occurs with the stories in the file DEFAULT.STO, which is set as the default stories when training is set up with a new client. If the therapist wishes, a more difficult story can be selected from the story editor using the Select story option.

It is very easy to install patient's stories or clinically specific stories using the <u>Story Editor</u>.

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 session	30 Minutes
Repetitions	1

Time limit acquisition	99
Memory mode	Short-term memory
Reproduction	Multiple choice
Input mode	Keys
Story complexity	DEFAULT.STO
Reward image	On

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
Mistakes total	Total number of mistakes
Mistakes names	Number of mistakes in category Type
Mistakes numbers	Number of mistakes in category Number
Mistakes objects	Number of mistakes in category Object
Acquis. time	Duration of acquisition phase
Reprod. time	Duration of reproduction phase, solution time
Train. time task	Effective Training time in h:mm:ss
Breaks	Number of breaks by patient
Repetitions	Number of repetitions of the task

The number of mistakes is presented in an "a/b" format, where the first number is the actual number of mistakes and the second number is the total questions of a given type. In the picture, the percent part of the correct decisions in relation to the number of questions, is then shown.

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.

1.6 Story Editor

The stories used in the Verbal Memory module are stored in files with the file extension .STO (story). The therapist can modify the stories for a more individualistic type of training and/or to add new stories. The story editor helps with this function (see Fig. 5).

Because the stories used for the validation of the system cannot be changed in the default.STO file, the original file must first be saved under a different name (**File/ Save As**) before making changes. An empty story file can also be created from the menu (**File/New**).

In order to re-write stories or vary them, the therapist must know the internal structures of the module before rewriting or varying the stories. Each story is categorized into one of 10 levels of difficulty, depending on the number of facts that have to be memorized (see Tab. 1). The facts are assigned to one of three categories: numbers, names, or events/objects. If the stories are modified or rewritten, the facts should be organized in a manner so that they are evenly distributed among these three categories.

Fig. 5: Story editor

In order to modify stories and answers, only the changes must be registered. Retention occurs automatically with alternation of another question, another story or

when clicking on the **OK** button. The selection of stories and questions occurs via the steps

- *Selection of level of difficulty* (Click on the radio button next to the Level),
- *Selection of story* (Click on the arrow at the end of the Input field Header), and
- *Selection of questions* (Click on the arrow at the end of the Input field Multiple choice questions).

Time values have to be given in the 24 hour format "UTC(hh:mm).". During program runtime this time value will be displayed in a format suitable for the patient's location. I.e. a text containing "UTC(23:12)" will be displayed as "7:12 p.m. ET" in New York City.

By clicking on the New story button, a new story can be created. The therapist must now register **all** required information.

Writing new stories must be carried out in a very careful manner. Story and answers have to complement each other reasonably. For answers to free recall questions, a space can be used to separate several facts (see Fig. 5). RehaCom tests whether the information the patient inputs matches that of the facts. Errors in capitalization, missing alphabetic characters, or transposing alphabetic characters are tolerated to an extent.

The Delete story button deletes a story from the story files.

If required, your distributor or the RehaCom developers can offer advice and assistance.

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, 1990) 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, averages by 7±2 information units. The model of the working memory assumes several neural subsystems are involved, which store predominantly visual-spatial 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 and cannot be recalled or described verbally.(Hömberg, 1995)

Theories about the physiological and morphological correlations of memory processes have been postulated by, among others, Hebb (1949; to be compared with Kolb & Whishaw, 1985). Models on rules of coding, storing, and recalling of contents or their organizationare 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 more than a passive storage facility with processes for information acquisition, long-term storage, and recall. Rather, existing memory contents have an impact on future information processing and undergo a re-evaluation for practical behavior (Hoffmann, 1983). Therefore, they modulate a person's emotional experiences.

The diversity of the memory regions plays an important role in distinguishing memory functions. An evaluation of a person's cognitive abilities 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 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 disturbances are distinguished as follows (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 provide more information.

2.2   Training aim

The objective of training with the Verbal Memory modules is to improve memory for verbal material in relation to the retrieval of information through recognition or free recall.
In everyday life, information must be retrieved and/or is often encoded under

interference conditions. This module uses an interference technique to train the patient to acquire and recall information from several texts with different topics. Demands are also made on the patient's continuous attention.

The module **Verbal Memory** offers the therapist ways to help the patients develop effective memory strategies and practice them to overcome deficits in memory processes. .
When working on a text where the task is the extraction of information, the structural help of the Wh-questions is offered (Who? What? When? Where? How? Why?). Furthermore, one can resort to memory strategies of associative connection between the words in the story and visually imaginative pictures. Mnemonic devices can be created using the first alphabetic characters of the most important terms to form a new word.
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.

In order for the Verbal Memory module to be useful, the patient must be able to read, and have to a large extent, an undisturbed linguistic sense and have the attention to process such a task.

Other RehaCom modules for training memory include **Memory for Words** (WORT), F**igural Memory** (BILD), and **Topological Memory** (MEMO). The module **Attention & Concentration** (AUFM) can also be put to use. By using the **Physiognomic Memory** (GESI) module, particular memory functions are trained and the module **Shopping** (EINK), requires additional action planning skills.

2.3   Target groups

The training module was developed primarily for patients with disturbances to verbal memory (short-term & long-term memory, & recognition). Patients with brain injuries often have difficulty learning new information and storing or recalling information from long-term memory.

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 tumours 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.
During infarcts, the areas of the anterior cerebral artery and posterior cerebral artery as well as the polar thalamus artery are above all of great importance concerning memory disorders.

The memory for linguistic contents is often damaged after insults/strokes to the left hemisphere. The probability of problems occurring in visual memory is considerably greater after injuries to the right hemisphere.

The patients who suffer from a lesion to the left temporal lobe or temporal lobe epilepsy with left-sided focus show deficits and inefficiencies in verbal memory. They have difficulty with learning and storing verbal information. This applies whether the information is presented visually or aurally.

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.

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.

In everyday life, the short- and long-term retention of linguistic content is of special relevance, especially during conversations or while focusing on radio or TV.

Additional possible uses for the Verbal Memory module could be in the area of cognitive therapy or in the field of geriatrics.

This type of training can also be used to improve the performance of memory for verbal contents with eleven-year or older children. It is advisable that a therapist is available at all times. The module uses child-friendly instructions for patients up to the age of 14 and the instructions and words are on the vocabulary level of an average 10-year-old.

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

Regel and Fritsch (1997), Friedl-Francesconi (1995), and Polmin (1994) evaluated the RehaCom module Verbal Memory on different groups of patients who suffer from various insults to the brain or mental disorders (e.g., vascular brain damage, traumatic brain injury, dementia) and the result was improvements in cognitive performances (pre–post comparison) and in part improvements in the patient's everyday life.

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Index

- A -

- B -

- C -

- D -

- E -

- F -

- G -

- I -

- K -

- L -

- M -

- N -

- O -

- P -

- R -

- S -

- T -

- V -

- W -