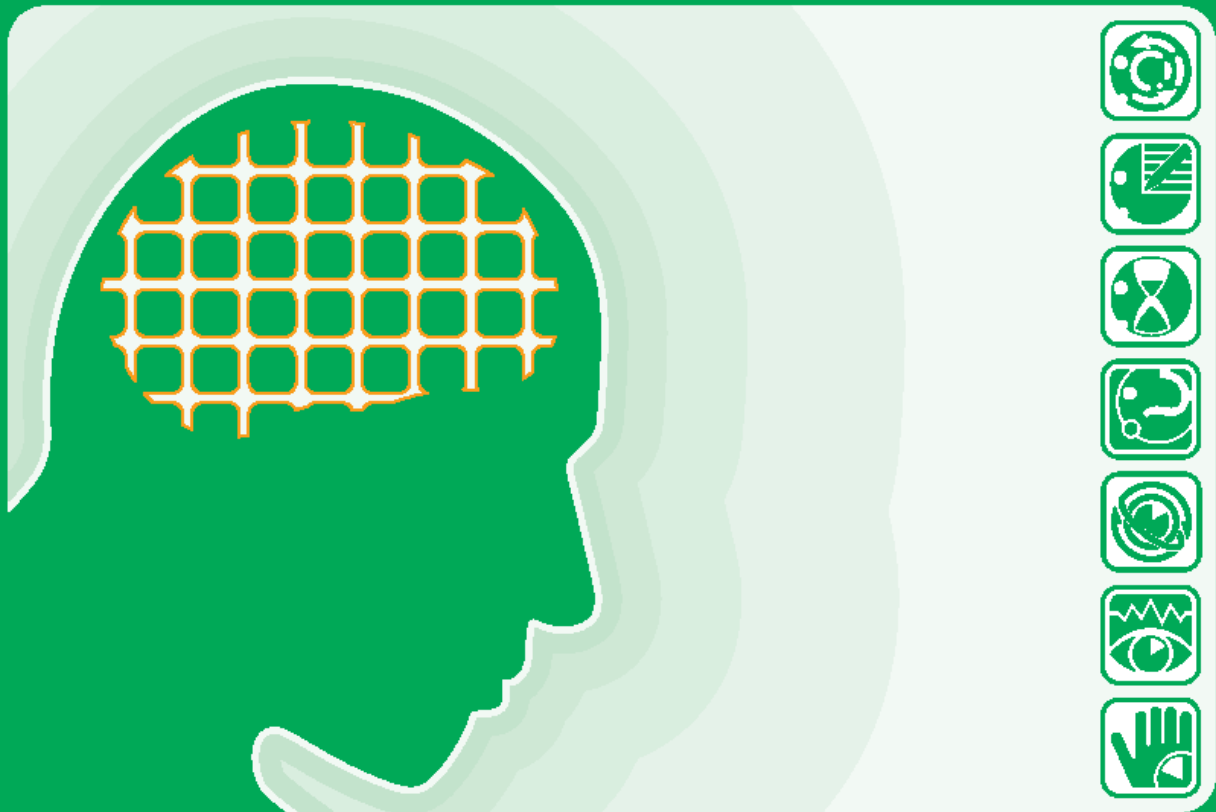


RehaCom

computer-assisted cognitive rehabilitation - brain performance training



Verbal memory

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

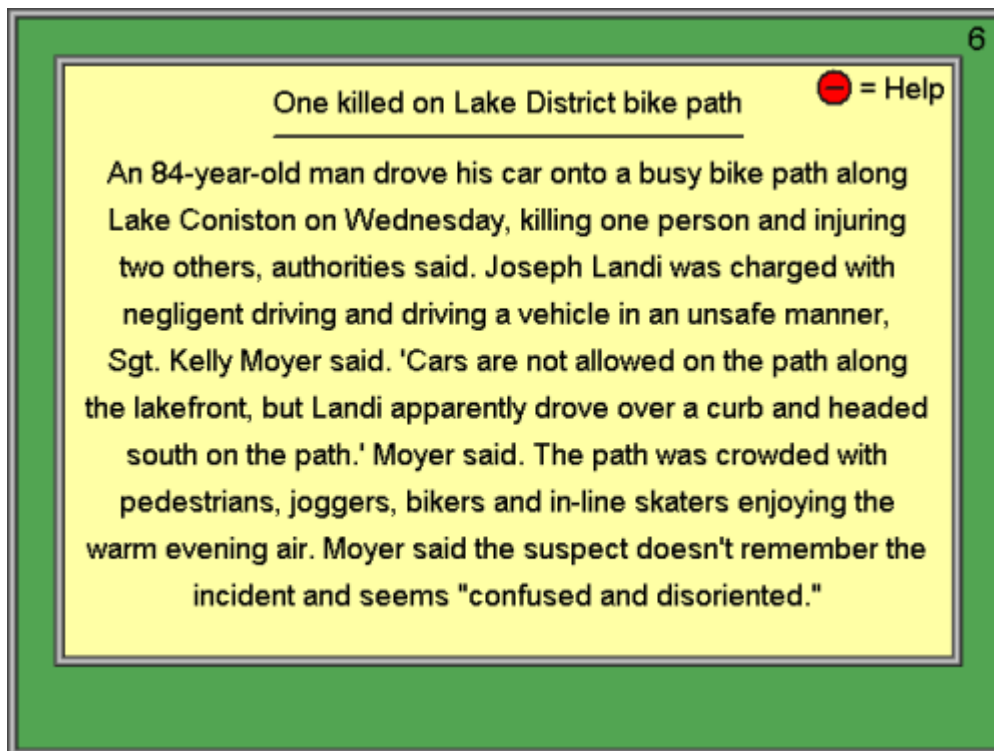
1.1 Training Task

Training occurs in a realistic sense. The patient is put into the situation where they have to read a newspaper. A text is shown to him on the screen in the form of a "short story". He must remember this story and subsequently reproduce it.

Every piece of training consists of a number of tasks. In every task **one** story is memorised and reproduced. This consists of

- . the acquisition- and
- . the reproduction phase.

In the acquisition stage, the story is shown on the screen (Picture 1). The patient must memorise the contents of this story very well. The acquisition is ended automatically by pressing the press button OK and/or after a [variable acquisition time](#).



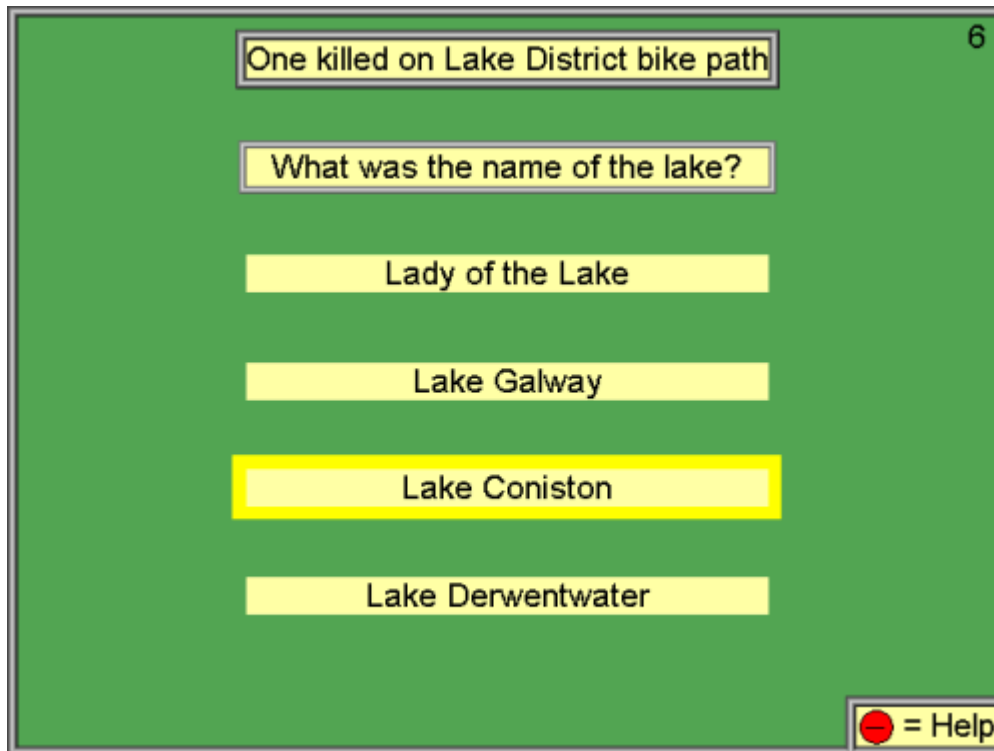
Picture 1. Acquisitions phase of a story at adifficulty level of 7.

In the reproduction phase, the patients are asked questions which are either of a "multiple choice" or "a open reproduction" nature.

In the "multiple choice" method patients are shown 4 answers from which the correct answer is to be selected for each question (Picture 2). In the input mode, the patient uses the RehaCom panel from which selection of the answer is made

by choosing between the keys. The selection is confirmed by pressing the OK button.

If the mouse is used, the mouse pointer can be shifted with one hand and the OK-Taste can be activated with the other. More adapt patients can also use a mouse button for confirmation. The simplest form of use of the procedure is with a Touch screen, where the respective answer is simply selected with the finger.



Picture 2. Reproductions phase with "multiple choice", where the mouse is being used.

In the "[open reproduction](#)" method questions are asked which must be answered with a single word or fact (Picture 3). This fact must be entered by using the PC keyboard.

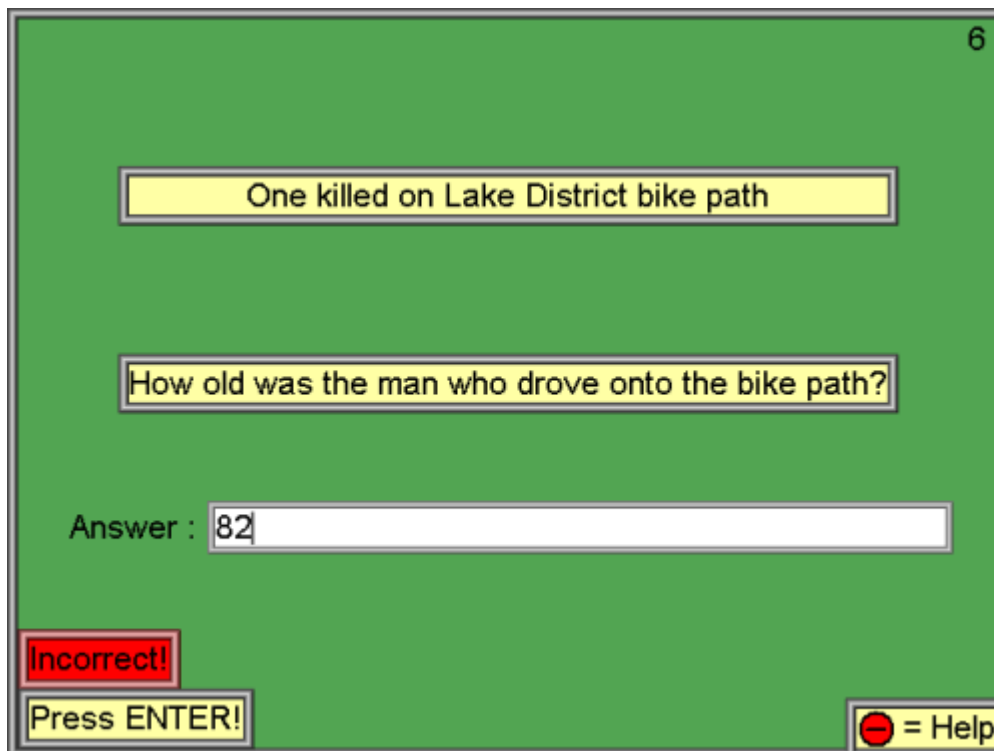
Bei "" wird die Frage so gestellt, daß sie immer mit einem einzigen Wort oder Fakt beantwortet werden kann (Abbildung 3). Dieser Fakt muß über die PC-Tastatur eingegeben werden. The space bar key is not permitted. RehaCom tolerates erroneous inputs (upper case/lower case, exchanged alphabetic characters) up to a certain extent (see [Story Editor](#)). Therefore, the patient must be able to operate the PC keyboard independently during training. Alternatively, the input can be achieved with the assistance of the therapist.

After all the questions 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 of the long-term memory, stories of the previous consultations can be reproduced. In the [parameter menu](#) it is possible to determine how many questions should be set for stories of the previous consultation. The quality of the answers is filed.

At this stage there is no score available to reflect that 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 panel.



Picture 3. Reproductions phase in open reproduction at the moment of an incorrect decision.

1.2 Performance feedback

During a wrong decision a visual reference "wrong" appears (See [Picture 3](#) -error field). Correct answers are not reported. After completion of a task, and with reference to the current errors, level of difficulty is recommended.

After further use, the patient learns how the system works (learning by doing).

The training screen shows the current difficulty in the upper right hand corner.

1.3 Levels of difficulty

The system works in an adaptive way. The 10 difficulty stages are determined by the number of the facts have to be determined (Table 1). These facts are divided into the categories

- . numbers,
- . names and
- . events/objects.

A training task is regarded as "correctly solved" if **all questions were answered correctly**. If mistakes were made, the story is repeated several times, depending on the level (see column in table 1 "repetitions in the case of mistakes"). If the story cannot be repeated or reproduced without errors, in spite of continuous repetition, then the task is declared as "incorrectly solved". The level of difficulty is then reduced.

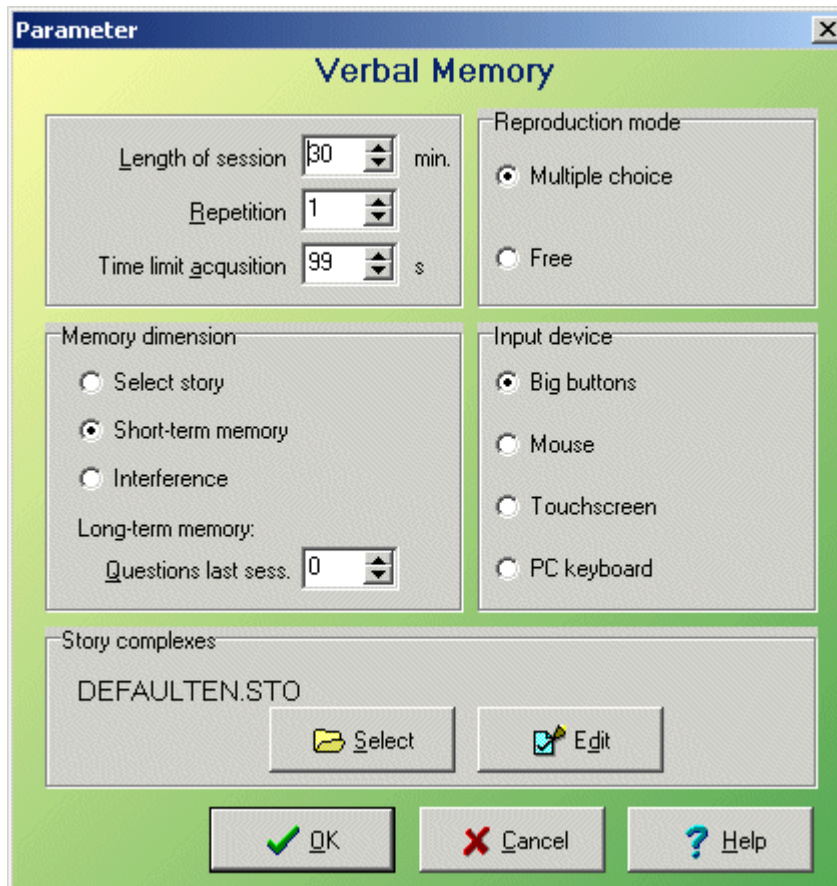
Table 1
Level of difficulty.

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

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

1.4 Training parameters

In the **RehaCom basic foundations**, general notes on training parameters and their effect are given. Furthermore, the following references should be considered.



Picture 4. Parameter-Menu.

Current Level of Difficulty:

The [level of difficulty](#) can be set up between 1 and 10 in the Thearpist menu.

Duration of training/Consulation. in mins:

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 a - positive or negative - performance consolidation occurred.

If the parameter is chosen with 0, the level is only increased according to every solved task and/or reduced again.

Similarly, with it the performance assessment set to "Repeat in the case of errors" a different consideration is achieved - see the description in the [training tasks](#).

Time limit acquisition:

For time available for acquisition, a 'time stressor' can be set. The acquisition

time is calculated - level dependant - by

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

One should adjust a limited acquisition time only after a performance consolidation (patient works safely in level 6). In basic setting, the acquisition time is limited with 99s i.e. practically no limit.

Memory mode:

By redefinition, **VERB** works in the memory mode **short-term memory**. In this case, **the reproduction of the same story** always follows the acquisition of a story.

In the **interference** mode 2 stories are (the 1st 2nd story) shown and memorised after another **and then the 1st story is reproduced**. If the 1st task was concluded, the 3rd story is shown for acquisition but the 2nd story is reproduced in format, and so forth in this way. The acquisition of a new story comes before reproduction of an old history. Over the solution time of a task, the contents of the story to be solved and the next story must be memorised.

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

For the **long-term memory**, the number of the questions, which are set up from the last consultation at the beginning of training, can be defined. In the description of the [training tasks](#), this has already been clarified.

Reproduction:

The reproduction types and forms have already been described in the [training tasks](#) section.

Input modus:

The variable possibilities for communication with the programme (mouse, touchscreen, keyboard), has also been described in the [training tasks](#) section.

Story complexity:

The validation of the system VERB occurs with the stories in the file DEFAULT.STO which, in the case of redefinition of training are automatically standardised. If the therapist wishes a more difficult story can be selected from the story editor using the - **choose** story button.

Using the [Story Editor](#) it is very easy to install patient's stories or clinically specific stories.

By re-definition of a training the following default values are automatically set up:

Current level of difficulty	1
Duration of training/cons.	30 Minutes
Repetitions	1
Time limit Acquisition	99s (an so practically inactive)
Memory mode	Short term memory
Reproduction	multiple choice
Input mode	Control panel
Story complexity	DEFAULT.STO

1.5 Data analysis

The diverse possibilities of the data analysis for the determination of the further training strategy are described in the **RehaCom basic foundations**.

In the pictures as well as the tables, alongside the setting for the [trainings parameter](#) the following information is available:

Level	Current level of difficulty
Training time (effective)	Effective Training time
Pauses	Number of breaks by patient
Acquisition.-duration	Duration of the Acquisition phase
Repro-duration	Duration of the Reproduction phase, Solution time
Error type Name	Number of errors in the catogery Type
Error Number	Number of errors in the catogery Number
Error Object	Number of errors in the catogery Object

The information "number of the mistakes" occurs in kind "a / b" format, where the number of actual mistakes in "b" signals possible mistakes. In the picture, the percent part of the correct decisions in relation to the number of questions, is then shown.

In this way, it becomes possible to refer the patient to specific weaknesses.

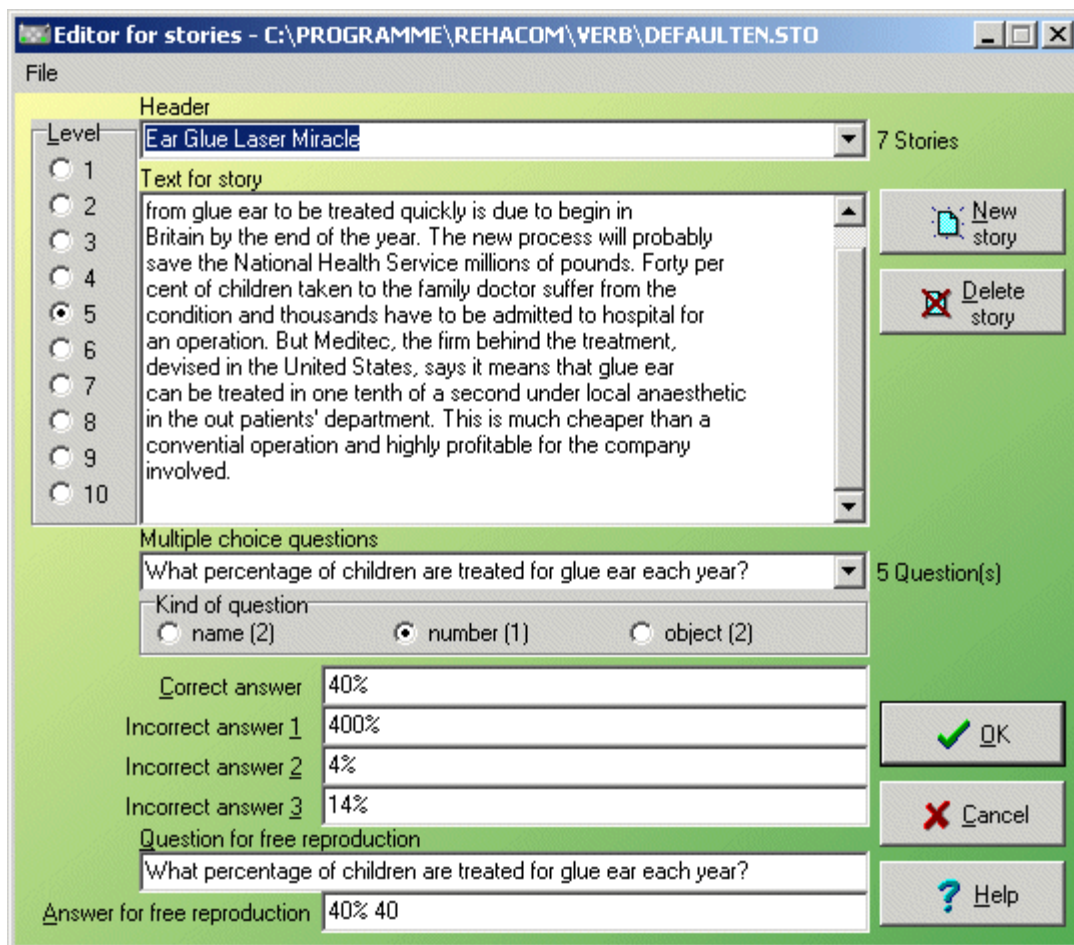
Specific information in relation to all aspects of training can be printed.

1.6 Story Editor

The stories employed by the system/programme **VERB** are filed in particular files with the filename extension .STO (story). The therapist has the possibility to modify the stories for a more individualistic type of training and/ to or to add new stories. The story editor helps with this function (Picture 5).

As the stories used for the validation of the system may not, and can not be changed in this file default.STO; one first has to save this file under a different name ([file/save under](#)) in order to make changes. From the menu ([file/new](#)) an empty story file can be created.

In order to re-write stories or vary them, the therapist must know the internal structures. Depending on the number of facts ([Table 1](#)) which have to be memorised the stories are put into 10 levels of difficulty. The facts are in turn assigned to 3 categories numbers, names and event/objects. If the stories are modified or written again, the facts should be re-written in a manner so that they are evenly distributed among these categories.



Picture 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 through operation of the **OK** window/switch. The selection of stories and questions occurs via the steps

- . **Selection of level of difficulty** (Group **Level** with the 10 radio buttons),
- . **Selection of story** (Click on the arrow at the end of the Input field '**Overwrite**') and
- . **Selection of questions** (Click on the arrow at the end of the Input field '**Question multiple choice**').

Using the **new story** switch, a new story in accordance with the adjusted level of difficulty can be predefined. The therapist must now register **all** required information.

The writing stories must be carried out in a very careful manner. Story and answers have to complement each other reasonably. In the case of the answers which are expected after open re-production, several facts which are separated by a blank can be defaulted (see Picture 5 below). RehaCom tests whether the information the patient inputs matches that of the facts. In this case of mistakes such as, upper and lower case errors, missing alphabetic characters or the interchanging of alphabetic characters; these are tolerated up to a "specific measure".

The switch **delete story** 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, which ends in an relatively stable variation of behaviour. ([Kolb & Wishaw](#), 1985)

Impairments in memory performance with patients who suffer from injuries to the brain have in many cases very different origins. This can lead to vast hindrances in both professional and private life. The clinical appearances of such dysfunctions are inconsistent and can affect specific areas of memory, particularly in reference to duration and specific characteristics of the learning. When we talk about memory dysfunction we have to differentiate **retrograde Amnesia** from the **anterograde Amnesia**: the first defines the incapacity to remember a specific time frame before the illness; the latter defines the inability (after a brain lesion) to hold or describe new information.

The first endeavours to understand and examine the complex function system of memory had already started at the beginning of the nineteenth century. In the

foundational research and in the clinical everyday life the **short-term memory** and the **long-term memory** ([Atkinson & Shiffrin](#) 1968, [Warrington](#) 1982); the procedural and the declarative ([Cohen & Squire](#) 1980), the semantic and the episodic ([Tulving](#), 1972), the verbal, the non-verbal or the figurative memory, and the explicit and the implicit ([Graf & Schacter](#), 1985) memory functions had been contrasted.

One of the classification systems of memory, with reference to recording and *storing of information*, follows from the results of the interdisciplinary foundational research:

- . Sensory Memory (less than 100 ms)
- . Short-term Memory ([Broadbent](#), 1958; [Wickelgreen](#), 1970) and Working Memory (cp. [Baddeley](#) 1990) with one second to one minute disposability of information.
- . Long-term Memory with a retention time from minutes, to hours, weeks or years.

The capacity of the **short-term memory**, the memory span, averages by 7+-2 information units. The model of the **working memory** assumes that it works from various parties of neurological subsystems, which record predominantly visual-spatial and also to a large extent acoustic-linguistic information ([Hömborg](#), 1995). In addition to the short-term "retention" of the information, the parallel processing of the contents is taken for granted. Indications of a functioning working memory are for example repeating and counting backwards or reproducing in reverse a previous visual memory span.

For a description of the **long-term memory** functions multiple differences must be dealt with in:

- . the **explicit memory**, the knowledge data bank (semantic knowledge) and biographical data (episodic knowledge) where information is stored, which can be directly accessed and labeled, and
- . the **implicit (procedural) memory** in which learned co-ordination and rules are stored, which cannot immediately be recalled or described verbally. ([Hömborg](#), 1995),

Theories for *physiological* as well as *morphological* correlations of memory processes like long-term potentiality have been postulated by, amongst others, [Hebb](#) (1949; to be compared with [Kolb & Wishaw](#)). Model conceptions of the standard encoding, storage and accessing of the contents, resp. the organisation of which, is still very controversial.

An important result of research into memory is the current treatment of the memory as an integrative element of cognitive abilities. Memory functions are in this sense not just the process of **recorded information**, the long-term **storage** and procedures of **re-call** (in a sense a passive storage facility); but rather the means by which the content of memory has an effect on the future recording of information and the experience needed for the practical treatment of **side affects** ([Hoffmann](#), 1983). And consequently modulate the emotional experiences of the individual.

The multi-variousness of the memory area plays an important roll in the gathering of information for the memory function. The evaluation of the status of the cognitive abilities, is only possible after an extensive **analysis**, which includes the modularly-specific phase of memory, the short or long-term retention, as well as the re-call of new and old contents of memory (with or without help, and to recognise). Possible inferences could impair the storage and access of information, which should be taken into account in patients with unusual disturbances. The **Rivermead Behavioral Memory Test** (RBMT, [Wilson](#) 1992 is an example of a strong behaviour-orientations test, which test different areas of memory. Furthermore, the WMS-R (**Wechsler Memory Scale**) is a sophisticated diagnostic instrument in the cognitive realm.

Four ground breaking methods of rehabilitation of disturbances to memory distinguished as follows (cf. [von Cramon](#), 1988):

- . Repeated performance of learning material,
- . Learning memory strategies,
- . Use of external aids and
- . Teaching of particular knowledge via the memory and possible disturbances ([Glisky & Schacter](#), 1989).

During a visual perception performance a restitution seems possible by direct stimulation of the faulty functional area, it has now been discovered that in the case of memory processes, that a restitution is hardly possible in the case of a damaged function ([Sturm](#) 1989).

That means that a neuropsychological training of memory functions should concentrate on *substitution* and *compensation* strategies.

The section [Aim of training](#) as well as [Target groups](#) provides more Information.

2.2 Training aim

The aim of the training is an **improvement in memory** for *verbal material* in relation to the *retrieval of information* through *recognition* or *open/ free reproduction*.

In everyday life, information must be retrieved and/or is often encoded under interference conditions. There exists in the case of this practice procedure the possibility, to acquire and reproduce, in a chronological order, information from several texts for with different topics. In addition to that, demands are made on continuous attention.

By means of defaulted texts, the possibility exists, with the patient, to elaborate different **memory strategies** and to consolidate them by practice.

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? and Why?).

Furthermore, one can resort to memory strategies of associative connection between read words and visually imaginative pictures. In the case of the first letter-priming, the first alphabetic characters of the most important terms are memorised: in the form of a new word or in their order.

By using this method a "deep" or elaborate process, the retention of material is supported. Spontaneous individual strategies inserted by the patients should be adapted. At this point it should be considered that processing activities, which in healthy people functions in part automatically, is a conscious effort with amnesia patients may require and therefore represent, an additional burden.

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

Further RehaCom procedures and the training of the **word memory** (WORD), of the **figurative memory** (PICTURE) or of the **topological memory** (MEMO) and/or of the **attention & concentration** (AUFM) can also be put into use. By using the **facial memory** (GESI) particular memory functions are trained; and with the programme **purchase** (EINK) more complex sets of tasks are trained.

2.3 Target groups

The training procedure was developed primarily for patients with **disturbances to the verbal memory** (short-term & long term memory, & recognition). Such [disturbances of memory](#) can appear after numerous different types of injuries to the brain (primary- and secondary-degenerative illness of the brain, Hypoxie, infections and so forth) as well as in the case of vascular cerebral injuries (infarcts, hemorrhages), skull-traumas and tumours with subsequent lesions

which occur unilateral or on both sides of the brain. Also following a neurosurgical intervention, for example in the case of epilepsy, there are often disturbances to memory. Medial temporal or thalamic areas, mamillary body or basal front brain structures, Gyrus parahippocampal or hippocampus are structures which, almost always result in disturbances to memory, after incurring damaged. 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, when we talk of disturbances to memory.

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

From all the patients, the ones who suffer from a *lesion to the left temporal lobe* or temporal lobe epilepsy with left-sided focus; these patients show deficits and inefficiencies of the *verbal memory*. They have difficulties with learning and storing verbal material. This applies to presentation of visual and auditory material.

Disturbances in memory are more often accompanied by different disorders in brain performance, like attention and linguistic problems, which through the blending effect complicate neuropsychological diagnostics and greatly effect memory performance in everyday life (Coding, re-call).

Also problems in the patient's ability to *plan actions* , and *problem solving skills* or a *lack of insight into the illness* can complicate therapeutic measures because an independent use of strategies often occurs at inadequate measure.

Patients who suffer from a form of brain damage often find it difficult to learn new information and they have problems storing or re-calling this information from the [long-term memory](#).

In combination with an increased level of distraction and other *attention troubles*, it is difficult for these patients to remember a summary of the information when confronted with by larger amounts of information. They also have difficulties coding information in order to support a more durable type of retention.

Inefficiencies in the [working memory](#) and disturbances in attention prevent a transfer of the information content into a longer-term form of retention.

In everyday life the short or it is long-term retention of linguistic content is of special relevance: during conversations; or whilst focusing ones attention on radio or TV.

Additional possible uses for the programme VERB could be in the area of cognitive therapy or in the field of geriatrics.

This type of training can be also be used to assist in the improvement in the performance of memory for verbal contents with children from approx. 11 years. It is advisable that a therapist is available at all times. The procedure can be used for child patients younger than or just 14 years of age for when instructions and words are used from the linguistic range of a 10 year old.

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 procedure **attention & concentration**).

[Regel & Fritsch](#) (1997), [Friedl-Francesconi](#) (1995) und [Polmin](#) (1994) evaluated VERB (in its basic form) on different groups of patients (Vascular brain damage, skull-trauma, dementia) and the result was improvements in cognitive performances in the raised tests (Prae-post comparison) and in part improvements in the patient's everyday life.

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