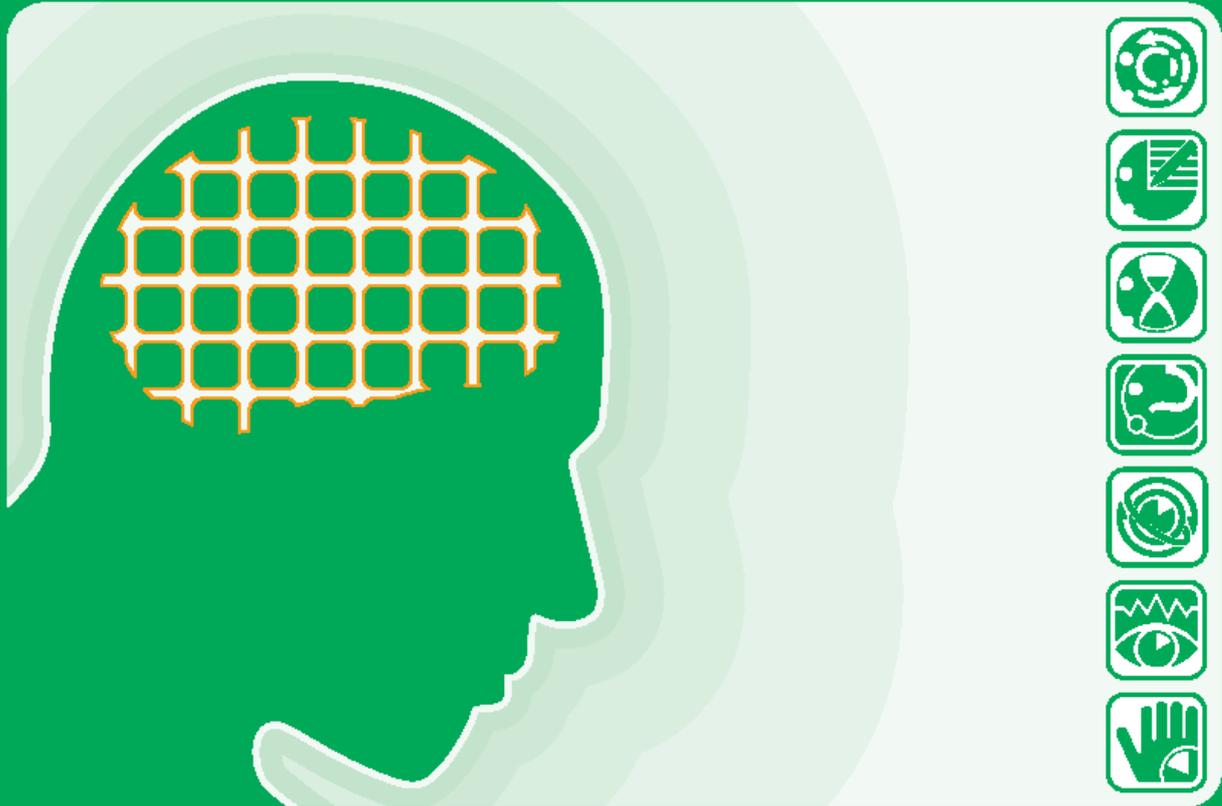


RehaCom

computer-assisted cognitive rehabilitation - brain performance training



Memory for words

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.

HASOMED GmbH
Paul-Ecke-Str. 1
D-39114 Magdeburg
Germany

Tel. +49-391-6230112

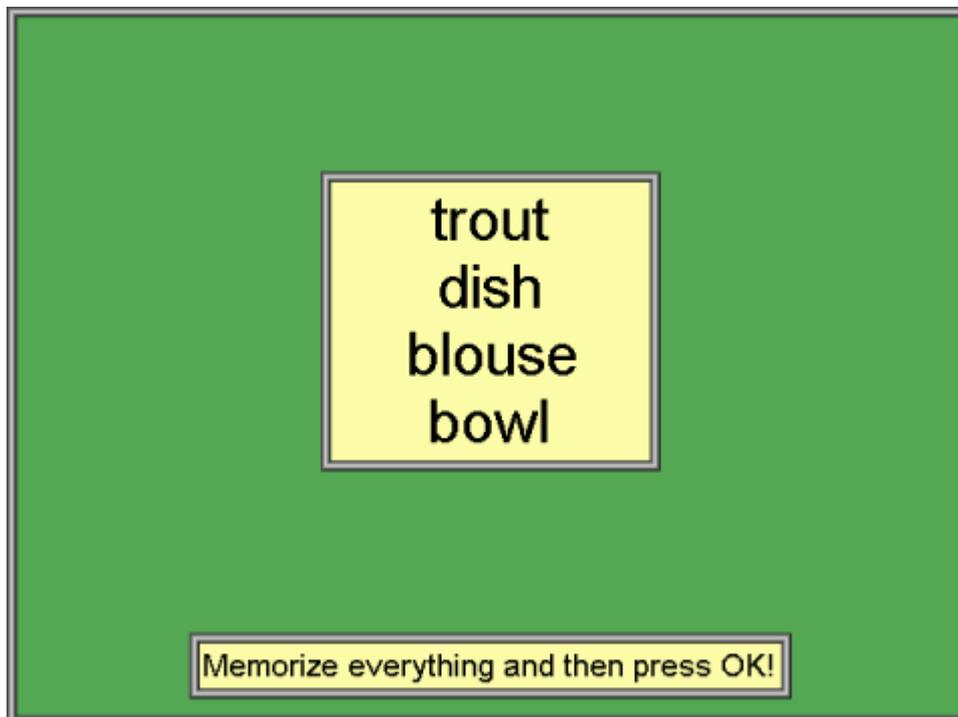
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1 Training description

1.1 Training task

In the training procedure '[Memory for words](#)' the patient has to memorise a group of words. In every consultation, several tasks have to be dealt with. Every task consists of an **acquisition** - and a **reproduction phase**.

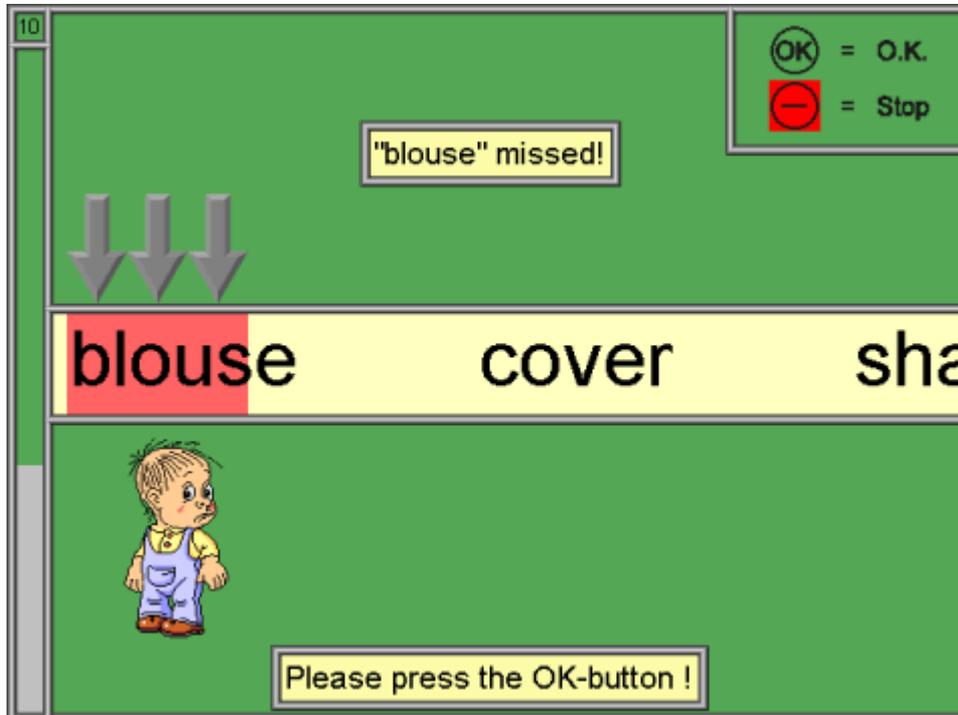


Picture 1. Acquisition phase at a difficulty level of 10. There are four very easy words to remember.

In the **acquisition** phase (Picture 1), a list of nouns in accordance with the current level of difficulty is shown to the patient. The patient must then memorise these nouns. The period for memorising is determined by the patient himself. He ends the acquisition by pressing that OK-key.

The **reproduction phase** (illustration 2) in which the memorised words have to be recognized/ or recalled from an series of nouns follows the acquisition phase. The nouns appear as "scrolling text" which moves continuously and freely over the screen from the right to the left. Using the OK-key on the patient panel, the patient can select the correct words from the series. However, the OK-key must be pressed in moment when the word is under the three big arrows. Assessment of the words (i.e. pressing the OK-key) can be made from the time when the first letter of the word enters the red area on the conveyor belt, until the last letter leaves the red area. If the OK-key has been pressed correctly the scrolling text pauses for a moment signaling the correct choice. In addition, further modes of

feedback (see [performance feedback](#)) are available. The reproduction phase is ended when all words in a task have been shown. After this the performance is then evaluated by RehaCom . The patient is informed as to which and how many mistakes were made and whether the patient should continue to the next level of or return to a previous one.



Picture 2. Reproduction phase at difficulty level 10 at the moment of an error notification - textual feedback. This error display is taken from the children version.

The procedure can also be used without the RehaCom panel.

1.2 Performance feedback

The following modes of feedback can be selected from the parameter menu by the therapist (see [Training parameters](#)).

- . help text,
- . acoustic and
- . visual feedback.

If the **"text"** feedback is activated, then the patient receives advice as to which words he has overlooked (through the "word overlooked" text), see [Picture 2](#)). The training then stops and to continue the patient just has to press the OK-key. when the error text displays "incorrect" then the patient has selected incorrect word from the series. (i.e. one which should not have been memorised). There

are no comments for correct selections.

When the visual or acoustic feedback is activated, there is a reaction to each action the patient makes.

When using the visual feedback a green light appears to indicate a correct choice - during a wrong decision, a red light is shown. With children, a small man nods his head to correct decisions and shakes his head to incorrect ones.

In the case of the acoustic feedback, applause is heard when a correct decision is made and during a wrong decision a different noise is made.

In addition a performance column is to be found on the left hand-side, which shows the performance level during a task [Picture 2](#). When the column reaches the upper edge of the screen in the process of the training, then the current task is evaluated as "[solved](#)". The column measures the quality of the patients reactions. Incorrect decisions reduce the level and correct one increase it.

1.3 Levels of difficulty

The training procedure uses a pool of over 600 words 3 different [levels of difficulty](#):

- A) **simple words**: approx. 200 simple one syllabic or two syllabic words (milk, sugar etc.),
- B) **medium type Words**: approx. 200 from words which are formed from two nouns (handbag, doorknob etc.) and
- C) **difficult Words**: approx. 200 difficult combinations of words (feedback, earthenware, earthquake), which are not used that often in everyday language.

When using the training procedure for children up to the age of 14, one can use a pool of approx. 600 words which can be found in the word range of an average 10 year old.

Despite careful selection it is probable that some words may not be relevant to the English speaking world. For this reason there is a facility whereby the therapist can replace the respective word. Here, the therapist will require an editor which will not generate additional control characters (e.g. note pad.exe in windows). However, these changes must be stored or secured before an update of the procedure takes place. Otherwise, they are retyped. If required the therapist can generate his own word lists.

The words are in the files WOS1en.TXT - WOS3en.TXT and/or KINDWOS1en.TXT - KINDWOS3en.TXT.

The levels of difficulty of the procedure are adaptive. There are 30 stages of difficulty which are determined by the number and the kind of the words to be memorised. Table 1 describes structure of the levels of difficulty.

A task is evaluated as "solved" if the error count is below a defaulted margin of error. The margins of error are defined in table 1. No error is permitted when the task consists of only 4 words. At a level of 5 words, the task is still evaluated as "solved" if there is only one mistake and at a level of 9 words two mistakes are permitted. After receiving an evaluation of "solved" the patient then **proceeds to the next level** where a new selection of random words have to be memorised. The words which were used in the current task do not appear in the following task.

The level of difficulty is increased when the patient solves two tasks one after the other.

If the **margin of error** is exceeded during the solution of the task, the identical words are trained up to times. The patient has the occasion to memorise the identical words repeatedly. The order of the words in the acquisition- and in the reproduction phase are variable. If after the 5th repetition of the reproduction phase, the patient is still not able to solve the task, then the patient must **repeat the previous level**.

The maximum of '10 words to memorise' was determined after clinical preliminary investigations. In choosing a level of difficulty, a spectrum of very easy to difficult training tasks is then possible.

Table 1
Structure of the level of difficulty

Difficulty level	number of words	type of words	error margin
1	1	A	0
2	1	B	0
3	1	C	0
4	2	A	0
5	2	B	0
6	2	C	0
7	3	A	0
8	3	B	0
9	3	C	0
10	4	A	0

11	4	B	0
12	4	C	0
13	5	A	1
14	5	B	1
15	5	C	1
16	6	A	1
17	6	B	1
18	6	C	1
19	7	A	1
20	7	B	1
21	7	C	1
22	8	A	1
23	8	B	1
24	8	C	1
25	9	A	2
26	9	B	2
27	9	C	2
28	10	A	2
29	10	B	2
30	10	C	2

The therapist should help the patient to develop strategies for memorising and improve performance of memory. The procedure helps to develop and train these capabilities.

1.4 Training parameters

In the **RehaCom basic foundations** there is general advice given on the training parameters and the impact on the procedure. This advice should be taken into consideration when using the procedure. Picture 3 shows an example of the parameter menu.

Current level of difficulty

The level of difficulty can be set at levels from 1 to 30 at therapists menu.

Duration of training/Cons. in min:

A training duration of 25-30 minutes is recommended.

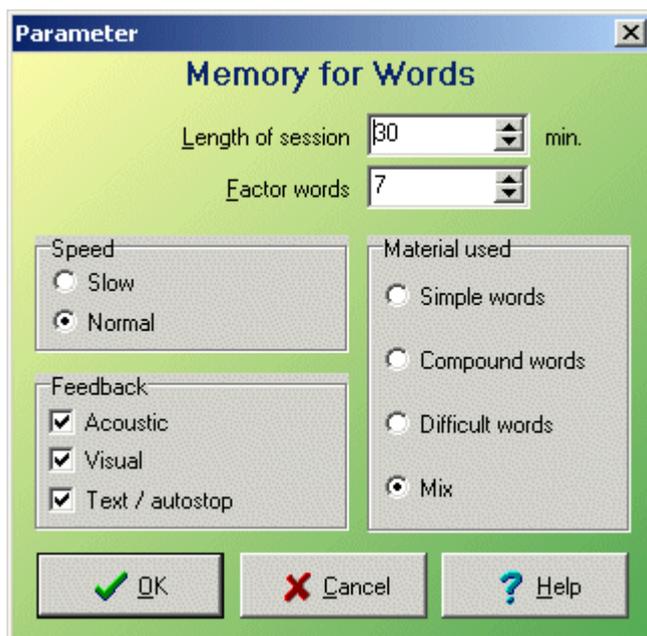
Factor words

The number of the words which appear in the reproduction phase is clearly established. It is calculated as the number of words which have to be

memorised, times, the factor words. However, a minimum of 10 words are shown. If the factor is reduced (e.g. 4), the reproduction phase is shortened. At a factor of 10 in the higher levels of difficulty the continuous attention is also trained.

Speed:

The rate at which the words move across the screen can be modified. In general one should work with the rate "**normal**". Changing to the slower speed is recommended for patients with a weaker performance level. However, one should return to the 'normal' level after an improvement in performance.



Picture 3. Parameter-Menu.

Training mode (Material used):

In practice, it turned out that a series of patients did not achieve a higher level of difficulty when the [type of words](#) were changed (e.g. from single words to word combinations, even with the same number of words). In such cases, influences on performance should be taken into consideration which effect the mnestic functions, e.g., restrictions of literacy, phasic influences. For these patients the procedure offers the possibilities to modify only the number of the words to be memorised and not the kind of material. Training is only carried out with the determined type of words (see table 1). In choosing the simple words level for example, this then means that one works with these types of words at the levels of difficulty - 1,4,7,10 and so forth to 28.

Textual feedback:

In general this option should always be activated ([X]). It can however be

deactivated for patients with a very high performance level. The training is then more difficult.

Acoustic feedback:

If there is more than one patient working in the room then the acoustic feedback should be deactivated or head phones may be used.

Visual feedback:

The visual feedback is highly recommended with children.

When establishing the procedure to suit a patient the following defaults are automatically set up:

Current level of difficulty	1
Duration of training/Cons	30 Minutes
Factor Words	7
Speed	normal
Type of words	mixed words
Textual feedback	on [X]
acoustic feedback	on [X]
visual feedback	on [X]

1.5 Data analysis

The diverse possibilities of 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 the patient
Number of Words	Number of words which have to be memorised
Acquisition.-time	Acquisition time
Solution time	Solution time
Word overlooked	Number of errors "word overlooked"
incorrect word	Number of errors "incorrect word"

It is then possible to inform the patient about particular short-comings.

Any specific or even all of the information can be printed.

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 effect specific areas of memory, particularly in reference to duration and specific characteristics of the learning. When we talk about memory dysfunction we have to differ **retrograde Amnesia** from the **anterograde Amnesia**: the first defines the incapacity to remember a specific time frame before the illness; hilt the latter defines the inability (after a brain lesion) to hold or describe new information.

The first endeavours to understand and examine to complex function system of memory had already started at the beginning of the nineteen hundreds. 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 ([Hömberg](#),

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. ([Hömberg](#), 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-variance 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 of training is to **improve memory for verbal material** by means of exercising recognition capabilities. In addition demands on the patient's continuous attention are also made.

This procedure for the training of [verbal memory](#) is based on the memorising nouns which are simultaneously presented on the screen. These words must then be recognised from a list of irrelevant terms which appear - in a line across the screen. In using this form of acquisition and reproduction, it is possible to elaborate on different types of **memory strategies** with the patient and to consolidate them with practice.

For example, in building strategies for memory, associative connections can be made between the read words and a visual picture - categories can be formed (semantic or phonological). The meaning of the words can also be incorporated into a story or a set of tasks in order to develop memory. An additional re-call method is the so called 'first letter priming' (all first letters of the words to be memorised are stored in their order of appearance or as a new word). Several words could also be sorted into semantic categories/general terms. Through this method of "deep" or elaborate processing the storing and memorising of the material is improved and developed.

Individual spontaneous strategies developed by the patient should be dealt with; patients are not encouraged to develop their own strategies. At this point one

should be considered that this processing capability, which operates in part automatically in healthy individuals, will require a conscious effort with patients who suffer from amnesia and therefore represents an additional load or stress factor.

Complementary training procedures to the **Memory for words** procedure are **Figural memory** (BILD), **Topological memory** (MEMO) and **Verbal memory** (VERB). Specific training is also offered by the procedures **Physiognomic memory** (GESI); **Shopping** (EINK) - all develop skills related to planning of actions.

2.3 Target groups

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.

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. After incurring damage the 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. 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 visual contents is often damaged after insults/strokes to the right hemisphere. The probability of problems occurring in linguistic memory is considerably greater after injuries to the left hemisphere and thereafter affected by aphasia.

Disturbances in memory are more often accompanied by different disorders in

brain performance, like attention and linguistic problems, which through the 'blending effect' complicate the [neuropsychological diagnostic](#) and have a negative effect on memory performance in everyday life (Coding, re-call). Also problems in the patient's ability to *plan actions*, and their *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.

The training procedure was primarily developed for patients with **disturbances to their verbal short- and long-term memory**. In addition this training can be used with patients who suffer from disturbances to their range of words or patients who have problems with recognition. It can also be used with patients who have **aphasic problems**.

From a diagnostic point of view, one should exclude patients who suffer from strong **attention problems** (perhaps previous training of these deficits with the RehaCom procedure attention & concentration) and difficult deficits of visual perception functions.

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 from approx. 11 years. With children, it is advisable that a therapist is available at all times. The procedure can be used with children up to the age of 14 - at this age the appropriate word age of the average 0 year old is available.

[Höschel](#) (1996), [Puhr](#) (1997) as well as [Regel & Fritsch](#) (1997) have evaluated the effectiveness of the procedure WORT on various patient groups - which resulted in improvements in their cognitive performance (as related by the higher Pre-Post tests) and in part improvements in everyday life was also noticed (transfer effect).

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