# RehaCom

computer-assisted cognitive rehabilitation - brain performance training

## Shopping

HASOMED ®

Hard- und Software für die Medizin
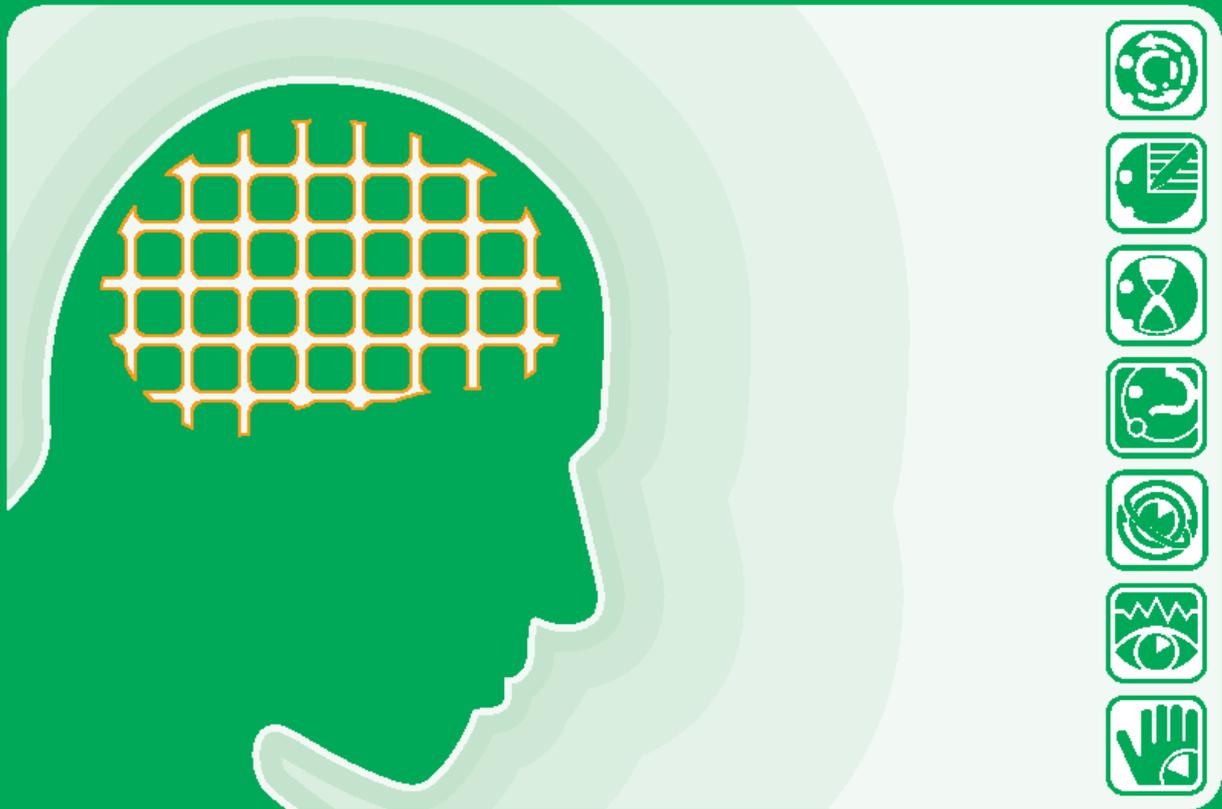
# RehaCom®

## 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 RehaCom procedure **Shopping** is a highly realistic training. The client solves the same tasks on the computer that he would have to do when going shopping in a supermarket. A shopping list contains all items that have to be bought. The client has to find these items and put them in a trolley. When all items are collected the client leaves the supermarket passing the cash register.

The procedure is operated through big symbol buttons located at the bottom of the screen (Figure 1).

- Button **Shopping   list**,
- Button **Trolley**,
- Button **Supermarket** (shelves),
- Button **Money**,
- Button **Cash   register.**



*Figure 1*. Function buttons.

To operate the buttons, move the mouse - symbolized by a big arrow - to the appropriate one, then press the **OK** button on the RehaCom panel. Manually dexterous clients click at it using the mouse button. Alternatively, the joystick of the RehaCom panel can be used. The easiest way is the use of a touchscreen - the button has just to be touched with a finger.

The further description assumes the use of a mouse.

In each session several tasks have to be solved. Each task consists of two phases:

- the **acquisition   phase**, and
- the **shopping   phase.**

In the acquisition phase the client receives the shopping list (Figure 2) containing the names of the items to be bought. After memorizing them the client presses the button **supermarket**.

Then the shopping phase starts, the supermarket appears (Figure 3). The view

from above shows "shelves". Each shelf contains a group of goods. After clicking at the shelf that - in the client's opinion - contains the desired item, the contents of the shelf is displayed (Figure 4).



*Figure 2*. Shopping list in level 14. From level 11 onward, an amount of money the client has at his/her disposal is displayed in the upper left of the screen.
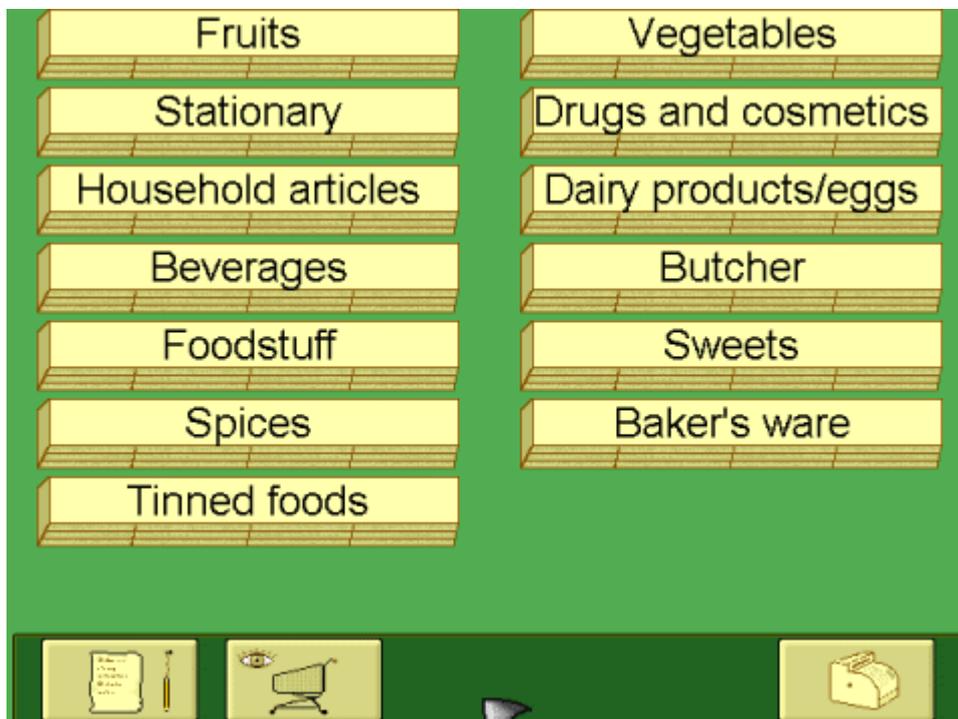
*Figure 3*. View from above on the supermarket with the shelves representing different groups of goods, level 1 (the button "money" is missing).

Each shelve is made up of one or several parts, each containing 4 items. To collect an item, the client simply clicks at it. To confirm that the item "falls" into the trolley, the cursor cross shortly changes to a trolley symbol and a typical sound (something falls into a trolley) is heard.
The client gets to the next items in the shelf by clicking the **arrow** button. By clicking at the upper left button **supermarket** (shelves) the client gets back to the supermarket. In this way the client moves through the rows of shelves and collects items.



*Figure 4.* . Looking at a shelf. Very realistically, scanned photos of supermarket items are displayed. From level 11 on, the price of each item is additionally displayed.

To have a look at the shopping list (figure 2) the client has to press the button **shopping   list**.
After inactivated new acquisition this button is not available!

After pressing the button **trolley** its content is displayed (Figure 5). An item is removed from the trolley by clicking at it. Pressing the button **supermarket,** one gets back to the supermarket. The shopping ends after the button **cash   register** has been pressed.

From level 11 on the procedure extends through elements tranining the handling of money (arithmetical thinking). The shopping list then shows an amount of money that is in the client's "wallet". Additionally to the selection of items the client has to decide if the money in the "wallet" is sufficient. Therefore the price of each item is displayed next to it in the shelf and in the trolley. It's up to the therapist to decide how the client should calculate the total of the item prices (adding up on a sheet of paper, with a calculator, or "in his/her head"). The therapist should impart appropriate strategies. When the client has collected all items and calculated the total, the total sum and the "money in the wallet" have to be compared. If there is enough money "in the wallet", leave the supermarket as usual via the button **cash register**. If there is not enough money "in the wallet", the button **money**, visible from level 11 on, must be pressed.

The procedure works also without a RehaCom panel.



*Figure 5*. A look in the trolley. From level 11 on the price for each item is displayed next to it.

## 1.2    Performance feedback

The RehaCom procedure  **Shopping** gives a feedback on the performance only after exiting the supermarket by pressing either **cash register** or **money.** This method corresponds to the real-life situation. Only when the client comes home, the client's wife or husband notices if an item is missing or if too much items have been bought. Only at the cash register the client will see if the money in the wallet

is sufficient for paying all items.

The performance of the client is commented and a note regarding the difficulty of the following task is given. Errors are notified.

## 1.3 Levels of difficulty

The adjustment in the levels of difficulty is carried out adaptively (Table 1). There are two modes, differing in the use of money. Within these modes the difficulty varies with the number of items that have to be bought.

Table 1. *Structure of difficulty.*

| level | no. items | price |
|-------|-----------|-------|
| 1 | 1 | no |
| 2 | 2 | no |
| 3 | 3 | no |
| 4 | 4 | no |
| 5 | 5 | no |
| 6 | 6 | no |
| 7 | 7 | no |
| 8 | 8 | no |
| 9 | 9 | no |
| 10 | 10 | no |
| 11 | 3 | yes |
| 12 | 4 | yes |
| 13 | 5 | yes |
| 14 | 6 | yes |
| 15 | 7 | yes |
| 16 | 8 | yes |
| 17 | 9 | yes |
| 18 | 10 | yes |

## 1.4 Training parameters

In the **Basic manual RehaCom** you find general comments on training parameters and their effects. Of course they hold true for this procedure as well. Figure 6 shows the parameter menu.

*Current level of difficulty:*

The <u>level of difficulty</u> can be adjusted between 1 and 18 in the therapist menu.

***Change level***
***Length of session (min.):***
You are recommended to set the duration of the training to 30 minutes.

***Level up:***
As criterion for the change of level a percentage value, based on the number of correct decisions in relation to the number of items that should be bought, is calculated. If this percentage value is higher than the one set for ***level up,*** the program switches to the next higher level. For the default value 90% it means, that only in level 10, where 10 items have to be bought, ***one*** incorrect decision is allowed in order to reach the next level. Otherwise no errors are allowed. From level 11 on, the difficulty will only increase if the correct decision regarding the sufficiency of money is chosen as well. Moreover, the change to the next level is only done if a certain number shoppings, set under ***repetitions,*** has been performed correctly ***subsequently***.

***Level down:***
If the percentage value is lower than the threshold set for ***level down,*** the program switches to the previous level. A default value of 80% means that the program switches to the lower level, if for 5-8 items 2 errors and for more than 8 items 3 errors are made. Moreover, the change to the next level is only done if a certain number of ***subsequently*** incorrectly performed shoppings, set under ***repetitions,*** has been carried out.

***Repetition:***
Before the program switches to the next level, a good performance has to be achieved several times. The same holds true for switching to a previous leve. In this way the change in the level of difficulty is done only after a performance consolidation. If the value 0 is chosen for this parameter, no repetitions are necessary for a level change.

*Figure 6.* Parameter menu.

### Timelimit
### Maximum acquisition time:
A time limit for the acquisition can be set as an additional stressor for highly performing clients. The time limit depends on the number of items to be bought and is calculated as this number multiplied by the ***maximum acquisition time***. In the default setup the limit, set at 90 seconds per item, is practically inactive.

### Maximum time for shopping:
For highly performing clients once more the shopping time can be limited as stressor. Again, the total time at the clients disposal is made up of the value ***max. time for shopping*** multiplied by the number of items to be bought.

### New acquisition:
If repeated acquisition is allowed, the client can have a look at the shopping list at any time by pressing the button **shopping   list**. Generally, a short-time memory task is demanded because at least for the time between switching from the

shopping list to the trolley the items have to be remembered. Adding to the difficulty is the fact that the items in the trolley appear in the order in which they were bought. Thus, the arrangement of the two lists are perhaps not identical! If repeated acquisition is not allowed, the medium-term memory is trained. A maximum of 10 items and the amount of money at one's disposal have to be memorized. After a consolidation in the client's performance this option should be chosen.

### Name of item:

In order to find the items from the shopping list easier in the shelves, the name of each item can be displayed in the shelves. If the client knows the assignments, the option should be switched off again. The associating skills are trained then.

### Speak items:

To make the recognition of shelves and items more easy to the client, the name of the shelve/item on first choose is spoken (use of soundcard).
At second choose of shelve/item the desicion is made.
If more than one client works at one room, this option should be deactivated.

### Price factor:

From level 11 on all items are priced. These prices should correspond to the real prices in a supermarket. They can be found in the file WTB.DAT which can be changed by the user if needed. The prices in the file WTB.DAT are multiplied by the price factor. The price factor is set at 1.0 for Germany. For other countries the factor should be set to about the value of the German Mark in that country's currency.

### Input device:

The training can be conducted using the mouse, the joystick or the touchscreen. The use of these input devices has been described before.

The following default values are automatically set for a new training:

| | |
|---|---|
| Current level of difficulty | 1 |
| Length of session | 30 minutes |
| Level up (%) | 90 |
| Level down (%) | 80 |
| Repetition | 1 |
| Max. acquisition time | 90s/item (practically turned off) |
| Max time for shopping | 900s/item (practically turned off) |
| New acquisition | on |
| Name of item | off |
| Price factor | 1.0 for Germany |

Input device                       Mouse

## 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 training time |
| Breaks | number of breaks by the client |
| No. of items | number of items on the shopping list |
| No. of missing items | number of items that were forgotten |
| No. of incorrect items | number of items bought additionally |
| No. of acquisition | number of the views at the shopping list |
| Acquisition time | duration of acquisition |
| Reproduction time | duration of the shopping |
| Cancelled by time limit | note if the shopping or the acquisition was finished by time limit |
| Decisions conc. money | evaluation of the arithmetical thinking:<br>"without" up to level 10<br>"OK" correct decision<br>"Too much" or "too few": miscalculation, incorrect decision: the client believed to have enough money but had not (too few), or believed to need more money (pressed the **wallet**) but had enough |

In this way it is possible to point certain deficits out to the client and find further strategies for the training.

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

# 2　Theoretical concept

## 2.1　Foundations

Everyday actions mostly require a range of motor and cognitive capacities consisting of several interdependent skills.
The basic skill to design plans and realize them through suitable actions belongs

to the most complex cognitive skill of human beings.

Reasonable and independent actions are only possible if behaviour can be planned and organized, and in case of competition priorities can be found. It requires the skill to initiate actions, control them, reflect upon them and possibly adapt flexibly (Alderman & Ward, 1991; Burgess & Alderman, 1990; cf. Wilson et al., 1998). The term *planning* means - as a kind of test action in the mind - to explore and co-ordinate all variables affecting the objective. Simultaneously mental planning sequences are action drafts with flexible and reversible components. The single actions are studied regarding their consequences and put together as action chains which once more are tested for possible consequences (Dörner, 1990; cf. von Cramon & von Cramon, 1993). Extensive problem analyses require the generating of hypotheses and the recalling of a range of heuristics: a wealth of information has to be kept in mind (memory) and processed simultaneously.

The skill to plan and act belongs to the **executive    functions**. Lezak (1983; cf. von Cramon & von Cramon, 1993) understands it as the skill enabling a person to care for him/herself sufficiently, go to work and take part in social life. For that it is necessary:

   . to formulate one´s very own objectives,
   . realize plans in the direction of the objective, and
   . control these actions in away that they lead to the objective.

Stuss & Benson (1984) distinguish the executive functions from basal cognitive systems as attention, visuo-spatial capacities, memory, speech, motion and others, and differentiate them into the components *anticipation*, *choice of objective*, *planning* and *control*. In their hierarchically organized feedback-feedforward- model (Stuss, 1992) of brain functions there are three functional levels:

   **1.** sensoric -perceptual level (perception, automated programs),
   **2.** level of the frontally controlled executive control,
   **3.** level of self-reflexion, relation between self and environment.

The *central executive*, as postulated in the model on the **working    memory** by Baddeley & Hitch (1974), and the *supervisory system* according to Shallice (1982; cf. Shallice & Burgess,1991) can be understood analogue to the functions of the executive control according to Stuss.

Karnath (1992) summed up facts different theories about the involvement of frontal structures in mental planning processes (Pribram, 1987; Berstein 1975;

Shallice,1988 and Luria 1966; cf. Karnath, 1992) have in common, as follows:

1. situation analysis, exploration
2. planning process
   a) designing action models / a structure of action sequences
   b) anticipation (if there is no idea how to solve the problem after the situation analysis)
3. automatic recalling of available plans for routine situations
4. carrying out actions
5. control of the actions through feedback process, cf.action plan

A conclusive theoretical model about the morphological basis and the functioning of frontal neural nets has not been found yet. According to clinical experience, however, it can be assumed that the human frontal brain is involved in mental processes generating the skills mentioned (cf. Stuss & Benson, 1984).

Considering the relevance of these skills for the independence in everyday life, clients with disturbances of the executive functions often suffer from serious handicaps in their professional and private life. The clinical picture of the disturbance is non-uniform and can selectively affect certain *cognitive, emotional* and *behavioural regions*. Particularly a complex of symptoms consisting of disturbances of the action planning, of the memory, of the problem- solving thinking and a lack of disease understanding can make therapeutical measures hard because strategies often are not inependently and sufficiently.

Clients with disturbances of the executive functions can achieve unobtrusive results in standard diagnosis procedures, but have problems in everyday reality. Lately more and more procedures were developed orientating by planning situations close to reality, and therefore claiming a higher ecological validity. The *Behavioural Assessment of the Dysexecutive Syndrome* (BADS - Wilson et al., 1998) contains tasks which can - in combination with an observation of the behaviour during the test - very distinctively register the symptoms mentioned above.

Therapeutical approaches for the treatment of executive disturbances should take into consideration a  number of aspects:

- renewed establishing of lost functions
- learning internal strategies (e.g. self- instruction)
- establishing external help (e.g. notes, quix, Psyx)
- control of the behaviour through the environment (e.g.behavioural therapeutical approaches)

In a therapy programm developed by <u>von Cramon & von Cramon</u> (1992), cognitive as well as behavioural aspects of this complex of disturbances are considered.

The chapters <u>training aim</u> and <u>target groups</u> will provide further information.

## 2.2    Training aim

The procedure aims at an ***improvement of the executive functions***, particularly of the <u>planning and acting competence</u> in realistic situations. Carrying out the training requires the keeping to certain sequences and a continous control of the steps.

The procedure enables the therapist to find interactively, in co-operation with the client, strategies for an *improvement of the cognitive functions* and of *the self-control*. In disturbances of the *control and self-regulation of one´s own actions* (monitoring), the procedure helps to to establish and practise *behavioural therapeutical techniques* (e.g. self-verbalising). Based on that, more complex planning processes - as e.g. very unstructured realistic situations - can be tackled with the aim to find different available components and choose the right or most efficient one.

When memorizing the items on the shopping list, memory strategies should be used: organizing the items through *forming categories* (semantically or phonologically), *associative connecting of words* and *visual ideas*, *connections regarding the content* through embedding the items in a made-up story or a sequence of actions. Also, the initial letters of the words to remember can be stored in their succession or as new word (*initial-letter priming)*; or the items can be *associated with familiar things* (imaginary walk through a supermarket familiar to the client). Through these methods a "deep" or elaborate processing and thus 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.

**Shopping** is a highly realistic training procedure requiring *basal* as well as *more complex cognitive skills.* It can be used memory intensively as well as memory relieving: the client may or may not have the possibility to have further looks at the shopping list. Still, the information units "item bought" or "item still to buy" have to be kept in the short-time memory. Verbally presented items (shopping list) have to be found - like in everyday life - visually. In higher levels of difficulty

the prices of all items have to be added up. The sum is compared to the amount of money "at the client´s disposal". Clients with primary and secondary acalculias need support at that point (pocket calculator).

One of the main advantages is that single actions and sequences of actions are comprehensible, so the overall process can be controlled by the client at any time.

Before the training, basal skills can be trained with further RehaCom procedures such as **Verbal memory** (VERB), **Memory for words** (WORT), **Figural memory** (BILD), **Topological memory** (MEMO) or **Attention & concentration** (AUFM). Alltogether, a subtly differentiated neuro-psychological diagnosis should be prerequisite for the making of a therapy plan containing computer-aided cognitive rehabilitation.

## 2.3 Target groups

The application of the procedure **Shopping** is recommended for clients with *impairments of the executive functions*, particularly of the *action planning*, of *problem-solving thinking* and of the *short-time or working memory* (see also basics).

Particularly uni- or bilateral damages of the frontal brain regions frequently lead to a conglomeration of *cognititve, emotional and behavioural disturbances*, summed up in the following under functional aspects with the term *dysexecutive sndrom* (Baddeley & Wilson, 1988; (Stuss & Benson, 1984; Duncan, 1986; Baddeley & Wilson, 1988; Shallice & Burgess, 1991; von Cramon & von Cramon, 1992; Stuss, 1992).
These may include:

- disturbances of the attention control (selection, focussing),
- vigilance disorders,
- higher delicateness to distraction/ interference,
- memory disturbances,
- reduced learning capacity,
- disturbances of the skill to act purposively,
- disturbances of the logical problem-orientated thinking,
- reduced ability to abstract,
- inability to differentiate between important and unimportant things (information selection),
- reduced ability to initiate actions and organize them in sequences,
- tendency to perseveration, rigidity,
- disturbed feeling for timewise successions,

- impulsiveness or loss of initiative,
- difficulties to understand and use feedback,
- lack of the ability to find and correct mistakes,
- dissociation of knowledge and action,
- disturbed anticipation of sequences of actions (thinking with regards to the future),
- disturbed self-regulation and self- perception,
- inadequate social behaviour,
- lack of disease understanding, anosognosia.

Luria (1966, cf. von Cramon & von Cramon, 1993) describes this kind of disturbances of thinking and action as a kind of *disconnection syndrom*: ".. The patients have difficulties to analyse the preconditions of a problem and recognize important connections and relations. The sequence of purposive operations seems to be fragmented and unsystematic; they skip the phase of preparative studying of preconditions and limitations of a problem and substitue purely intellectual operations by unrelated, impulsive actions..."

Apart from *damages of the frontal brain regions* of different genesis (vascular cerebral damages as infarctations and bleedings, traumatic brain injury, brain tumors), the disturbances mentioned above can be observed after numerous *diffuse damages of the brain* (primary and secondary degenerative brain diseases, hypoxia, infections etc.)

Clients with brain damages often have difficulties to organize their everyday life because of deficits in partial capacities or the dysexecutive syndrom. The syndrom, based on interrelations of d*isturbances of the attention, the memory, the action planning and the behaviour*, means a particular challenge to therapists in the neuro-psychological sector. What makes it even more difficult is that people with damages of the brain often - more or less - suffer from impairments of basal capacities (attention, visuo-spatial performances, memory, speech, motoricity); these deficits afflict more complex functions or represent a disease immanent part of complex disturbances.

The procedure can also be applied to memory clients -especially in impairments of the short-time and working memory - under the precondition of an undisturbed capacity to plan actions.
The training of relevant components can be reasonable in case special skills are no longer or only partially available (memory, forming catageories, counting).
Apart from neuro-psychological rehabilitation, the procedure can also be used  for the therapy in the scholastic as well as in the geriatric area.

In order to use the procedure sensibly, the client needs a largely undisturbed

understanding of the written language and have the attention capacity to fullfill the tasks. Seriously amnestic clients with massive deficits of the short-time and working memory need particular therapeutical support, or should use less complex procedures.

The procedure supports the application to children from the age of 11 on. Up to the age of 14 child-friendly instruction texts are used. As input device for them a touchscreen is recommended.

Controlled evaluating studies of this procedure are not yet available. A new RehaCom procedure for action planning is in progress.

## 2.4    Bibliography

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