HASOMED

RehaCom®

Cognitive therapy and brain performance training

Attention & concentration

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HASOMED®
Hard- und Software für die Medizin

RehaCom®

Cognitive therapy and brain performance training

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

In the procedure Attention & concentration a separately presented picture is compared to a matrix of pictures. The one picture resembling it in every detail is to be found. The pictures in the matrix - symbols, items, animals or abstract figures - are harder to differentiate the higher the level is. The abilities to differentiate and to concentrate are trained simultaneously.

The training screen is divided into two. One part represents the matrix which contains

- 3 pictures (1 by 3 matrix),
- 6 pictures (2 by 3 matrix) or
- 9 pictures (3 by 3 matrix)

according to the level of difficulty.

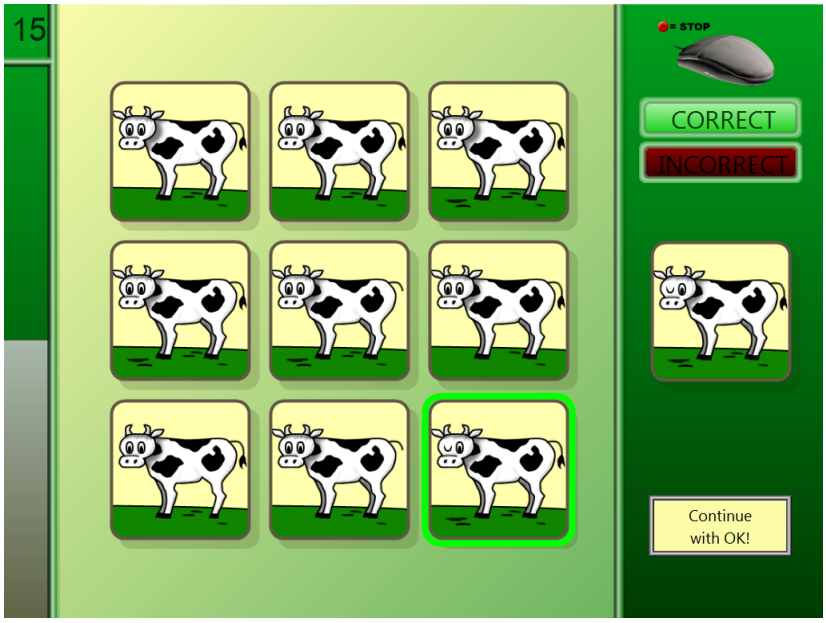

figure 1: screen with a 3 by 3 matrix in level 15. The selected picture is framed. The sign signals a correct choice.

The client has to ***recognize*** the picture shown separately and ***select*** it from the matrix.

The client selects the corresponding picture from the matrix by means of the big buttons on the patient panel, the mouse, a touchscreen or just the OK-Button on the patient panel (see also training parameters).

When using the big buttons of the panel, an yellow frame marks a picture in the matrix. By means of the buttons you move the frame to the picture you choose.

Once the picture you want is marked with the frame, press **OK**. This version is recommended for clients with disturbances of eye- hand- coordination, coarse tremor, disturbances of hand movement or manually unskilled people.
The big buttons can optionally be used by handicapped as pedals.

By using the numbers on older RehaCom-Pult 90 panels the pictures are numbered. Pressing a number-button selects the according picture. The yellow frame shows the selection. Pressing **OK** confirmes it.

When using a mouse, an arrow moves over the screen. If it touches a picture it is framed yellow. Again the selection is confirmed with the **OK** button on the panel, or the left mouse button. Additionally visuo-motor skills are trained.

Selecting via touchscreen is the easiest. Once a picture is touched the yellow frame will appear. Now the selected image can be zoomed using the yellow Plus button (+). By touching a selected picture a second time the selection will be confirmed and the framed picture will be evaluated. This alternative is especially recommended to children.

Another input option is the One Key Input: One picture will be selected automatically. It will be changed after a specific period of time, so the frame will move to the next picture. Using the **OK** button on the panel the picture selected in that moment will be confirmed and evaluated. This alternative is especially recommended to patients with motor problems.

After selecting a picture

- the procedure evaluates the choice and lights up a green sign "***CORRECT***" or a red sign "***INCORRECT***", and
- the performance bar (see figure 1. on the left) changes according to the reaction quality.

This performance bar grows or shrinks with every correct or incorrect choice. If it reaches its maximum or vanishes, the next higher or lower level starts. Before that switch a verbal evaluation is given stating the next level (see also feedback).

In the following, ***task*** means the presentation of the matrix, the selection of a picture and the final evaluation of the choice.

The procedure also works without a RehaCom panel.

1.2 Performance feedback

On a correct choice the green ***CORRECT***- sign appears and soon the next task is presented.
On an incorrect decision the correct picture is framed yellow and the wrongly

chosen one is marked red. Additionally a red ***INCORRECT***- sign flashes up. The client is then given time to compare the pictures and spot the differences. After an intervall, which can be adpted in the parameter menu, or pressing **OK**, the next task is given.

On top of the performance bar a number shows the current level of difficulty.

1.3 Levels of difficulty

The levels of difficutly are adapted automatically. Table 1 shows the structure of difficulty.

Table 1:
structure of difficulty.

level	difficulty (differentiablenes s of images)	number of images at matrix
1	1	3
2	1	6
3	1	9
4	2	3
5	2	6
6	2	9
7	3	3
8	3	6
9	3	9
10	4	3
11	4	6
12	4	9
13	5	3
14	5	6
15	5	9
16	6	3
17	6	6
18	6	9
19	7	3
20	7	6
21	7	9
22	8	3
23	8	6

24	8	9

The procedure contains 1232 pictures at the moment. There are 8 stages with several records of 16 pictures each, starting with low similarity of the objects (easy tasks) up to high resemblance (hard tasks). Each stage consists of 3 levels of difficulty with the matrix containing 3, 6 or 9 pictures. So alltogether there are 24 levels of difficulty.

By means of an interrater study the assignment of the picture sets to the levels of difficulty is guaranteed (77 sets of pictures were registered according to the average time necessary to solve the task and the average number of mistakes as objective criteria, and the estimation of difficulty as subjective criteria).

1.4 Training parameters

In the **Basic manual RehaCom** general hints are given about the training parameters and their effects. These hints shall be taken into consideration in the following.

figure 2: the parameter menu

Current level of difficulty:
The level of difficulty can be adapted between 1 and 24 by means of the therapist menu.

Length of session:
A training session is recommended to last 30 minutes.

Level up:
The next higher level of difficulty is reached as soon as the number of tasks given in ***Level up*** is solved correctly in succession. Wrong decisions lead to a dropping of the performance bar. They are compensated by the same number of correct choices. The next level begins when the performance bar reaches its maximum.

Level down:
The next lower level starts when the number of tasks generated in ***Level down*** has been solved incorrectly in succession, or if the performance bar reaches its bottom.

Input device:
The different input options were described in the training task.

One Key Interval:
Using One Key Interval the time until the next picture will be selected can be changed. This parameter is important when One Key is chosen as input device.

Side orientation:
In order to make allowances for lateralisations in the client, the training field can be exchanged left- right. This option may be of interest to clients with specific failures or who prefer a particular side of the screen, as e.g. in visual neglects or dicturbances of the visual field.

Graphic pool:
RehaCom uses a range of picture sets. The ***normal*** set was used for the validisation of the procedure. A second ***extended*** set may be used if a client has been working with the normal set for a longer time and wants variation. Sets particularly for children are in preparation. Sets generated by the user may also be used and can be integrated easily. Please contact the system service.

Limited solution time:
If this parameter is activated ([X]), the client`s time to solve a task is limited. The limitation depends on the level of difficulty: for the easiest task in the first level 1 minute is given. Each level the limitation expands for 5 seconds, so for the most difficult task it is 3 min 15 sec. With that, an additional time stressor can be set for strong clients. If the parameter is switched off, the time to solve a task is unlimited.

Stop on errors:
After choosing a picture, the computer gives a ***CORRECT*** or ***INCORRECT*** feedback. A ***CORRECT***- message stays on the screen for 3 seconds.
If the parameter ***Stop on errors*** is activated ([X]), the client can - in case of an incorrect choice - compare the pictures without time limitation and spot the differences. The correct picture is framed yellow. The next task only starts when the client presses **OK**.
If the parameter is inactive ([ ]), only 10 sec are given to compare the pictures. After that the next task starts. This option is recommended as additional stressor for strong clients.

Acoustic feedback
When activated ([X]), the acoustic feedback makes a sound in case of an incorrect solution. The acoustic feedback motivates most clients. However, if there are a number of clients working in one room, you are recommended to switch the acoustic feedback off or use headphones instead.

Allow zoom
This option is especially important for patients in an early rehabilitation phase and

for patients with visual field problems.
During the training there is the possibility to increase the size of the current picture to screen-size.
Pressing the ***Plus button*** the picture in the yellow frame will be zoomed together with the example picture for comparison.
Pressing the ***Plus button*** a second time or pressing any other button the zoom will disappear.

Neglect
This option is important for patients with critically developed neglects. The client's attention is drawn to the example picture for comparison by a red margin and a blinking arrow.

figure 3.: screen with a 3 by 3 matrix in level 15. The selected picture is framed. Red arrow and margin for patients with a neglect on the right side.

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

Current level of difficuly	1
Length of session	30 minutes
Input device	Big buttons
Level up	20
Level down	5
Side orientation	left
Graphic pool	extended
Limited solution time	off
Stop on errors	on
Acoustic feedback	on

Allow zoom	off
Neglect	off

1.5 Data analysis

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

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

Level	current level of difficulty
Effec. time	effective duration of the training
Breaks	number of breaks caused by the client
No. of trials	number of decisions in the selection
Diff. error	mistakes concerning differentiation (incorrect decisions)
Time error	decision came too late. Mistake in exceeding time limitation (only if the training parameter time limitation is acitivated).
Max. react. time	longest reaction time in milliseconds
Reaction time Quartile 3	3rd quartile reaction time
Median react. time	median of all reaction times in milliseconds
Reaction time Quartile 1	1st quartile reaction time
Min. react. time	shortest reaction time in milliseconds
Median left	median of all reaction times of left column
Median centre	median of all reaction times of centre column
Median right	median of all reaction times of right column

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

2 Theoretical concept

2.1 Foundations

The term ***attention*** sums up functions which put external and internal sequences of processes on an orderly basis regarding time and content. They enable the waking, oriented organism to form a picture of the current circumstances at any time through selecting and integrating relevant information from different modes of perception.

Broadbent (1958) based his "bottleneck- or filter theory" on the assumption of a *limited processing capacity* for incoming sensoric information meeting the organism, so that if reacting to *selected stimuli* other *stimuli simultaneously*

incoming are suppressed. From nowadays´ point of view there are a range of input channels for every mode of perception filtering incoming information. Sternberg (cf. also Keller & Grömminger, 1993) differentiates in his *action orientated modell of attention* between 4 phases:

1. perception,
2. identification of relevant stimuli,
3. choice of reaction and
4. starting a motor programm as reaction to the stimulus.

These processes partly happen automatically; if specific aspects of the situation are understood active analysis processes are started.
Automated processes run parallel with little capacity, whereas all others want a serial processing which needs more attention capacity and time.

The ability for *directed attention* is a basic precondition for a general capability regarding different cognitive demands.

Disturbances of attention and concentration can manifest themselfes in a reduced *perception and processing capacity*, reduced *information processing capacity*, rapid signs of *fatigue* especially when strained, but also higher *delicateness to distraction;* alltogether intellectual and practical actions may be impaired to a high degree.

On the basis of empirical studies one can assume that attention is no uniform construct. Rather one can differentiate between 4 independent aspects of attention (cf. Fimm, 1997; cf. Sturm, 1990; Sturm et al., 1994):

1. phasic activation, alertness
2. selective attention
3. divided attention
4. tonic activation, vigilance

Phasic activation is defined as the ability to increase the general activation niveau quickly (and thus making further reactions easier) on an alarming stimulus (alertness), whereas an activation niveau relatively stable over a longer period is called ***tonic activation***.
Tasks requiring ***divided attention*** consist of at least 2 sources of stimuli which have to be observed at once in order to react to relevant stimuli appearing simultaneously or sequentially.
Vigilance means attention over longer periods with low denseness of the stimuli; high denseness with relevant stimuli appearing often is called ***long- term attention***.
Selective attention, which is especially relevant in this RehaCom procedure, means focussing on certain aspects of a task and thus reacting to relevant stimuli quickly but ignoring irrelevant ones.

This skill to select and integrate defined stimuli or ideas is closely associated with the term *power of concentration*; the latter is defined as short time (lasting for some minutes), active turning and focussing of the attention with selective registration of relevant features of the situation (cf. Sturm, 1990).
For the visual area, Posner (1987; cf. also Fimm, 1997) differentiates between three *basic mechanisms* regarding selective attention, which can also be selectively impaired after certain brain lesions:

1. disengage attention
2. move attention
3. engage attention.

Disturbances of these basic functions can manifest in higher delicateness to distraction, tendency to perseveration or symptoms of neglect.

The selection of information depends on many inner conditions (physiological state, interests, emotions etc.) and external factors (intensity of stimulus, contrast, color, spatial relation, etc.). Especially intensive or new stimuli (with high information content) can focus the attention automatically, which means involuntarily, through an *orientation reaction*; cognitive processes modulate the current state of attention through thoughts, motivations and interests (Fröhlich, 1987). Especially the selectiveness of attention depends on *emotional* valuations and is maintained through *motivational processes*.

Empiric studies with laterally presented stimuli were carried out among healthy people and split-brain clients. They suggest special relevance of the right hemisphere regarding control and maintainance of elementary activation processes (Sturm et al., 1994). Nevertheless all neurological clients can possibly suffer from attention disturbances. Because many parts and structures of the brain are involved in attention processes, they are especially *vulnerable* to any cerebral insults and dysfunctions.

In psychological performance diagnosis, especially in clinical-neuropsychological diagnosis, *attention tests* are firmly established. The aspects of attention mentioned before can be distinguished diagnostically by assigning different tasks to each of them. Apart from paper- and- pencil tests, the *test battery for attention testing* according to Zimmermann & Finn (1989) gives a precise idea of disturbed functions.
Attention disorders in children are defined as developmentally inadaquate inattentiveness, impulsiveness and hyperactivity (Lauth & Schlottke, 1988) according to the diagnostic and statistic manual of psychological disorders (DSM III).

In the diagnostic practice, the estimation of attention is mostly done through "surface parameters" such as

- the time needed,

- the number and kind of mistakes made,
- the development of the mistakes made depending on time or
- the share of the jobs carried out in relation to all jobs given when coping with defined tasks.

With that, one easily gains readings which allow intra-individual (development of the illness, therapy evaluation) as well as inter-individual comparisions (orientating towards the measurements of a standard group).
In the last decade efforts increased to recover attention disorders, also in adult clients, by *cognitive training* (Säring, 1988). Mainly after cerebral damages the need for rehabilitation is enormous, because 80% of brain damage lead to attention and concentration disorders (Poeck, 1989, Van Zomeren & Brouwer, 1994).
Lauth (1988) suggests that, for the therapy of attention disorders, the procedures of cognitive behavioural modification represent important *ways of intervention.* Through that, skills in regulating and organizing deeds are imparted to the clients.

The parts training aim and target groups provide further information.

2.2 Training aim

The results of recent years´ research favour subtly differentiated training approaches. They want to treat specific attention disorders targettedly. Unspecific and unsound attention trainings are not successfull in all areas of attention (Gray & Robertson, 1989; Sohlberg & Mateer, 1987; Poser et al., 1992; Sturm et al., 1994; Sturm et al., 1997).
The RehaCom procedure **Attention & concentration** wants to train *selective attention deficits.* Further training effects in the sense of a general improvement of the reaction speed can be expected though. Most of all the ability to *focus* one´s attention and simultaneously *ignoring irrelevant information* is practiced. Choosing from different stimuli and reaction alternatives leads to a Covert Attention Shift . With growing complexity of the tasks one can expect that strategies to compare the visual stimuli are developed.
Furthermore the procedure can train long-term attention - by means of the parameter length of session - as it is required in all kinds of cognitive tasks.

Experience shows that computer-based training of one or more attention components is particularly successful if carried out in the post acute phase after the insult. Apart from the functional training, the computer gives a *systematic feedback* to the client which can improve his self-observation and thus teach him how to cope with his *attention ressources*. For the therapy it is important that the client is not only confronted with the deficits but also learns to develop strategies to cope with and compensate them; e.g. to avoid certain stress factors or use external help in specific situations of requirement. Relatives should be included in that.

Apart from practice through repitition, the RehaCom procedure **Attention & concentration** makes demands on the finding and development of solution strategies with growing level of difficulty.

The improvement of attention is a basic objective for the training of further cognitive functions. It is of elementary importance for the treatment of memory disturbances (taking in information as precondition for saving it).

On the basis of results of the receipt or process diagnosis, one should decide whether the procedure **Attention & concentration** is trained singly or in combination with further procedures (e.g. **Divided attention**, **Vigilance**).

2.3 Target groups

Attention disorders after functional or organic interference are the most frequent neuropsychological performance deficits after brain-damage (Van Zomeren & Brouwer, 1994). 80% of clients suffering from stroke, head trauma, diffuse brain-organic injury (e.g. alcohol abuse or intoxication) or other diseases of CNS are afflicted.

Conceptionally, one suggests different attention functions which can be disturbed selectively. Diffuse brain damages after traumatic or hypoxic etiology are often followed by *unspecific attention deficits* such as quick fatigue, a raised need of sleep and a general loss of initiative. Localised insults however, e.g. after vascular genesis, often lead to *specific attention deficits*. Fundamentally insults of any cortex area can cause attention disturbances. Especially after lesions of the brainstem in the region of the reticular formation or after lesions of the right parietal cortex, disturbances of the phasic or tonic alertness and of the vigilance have been reported. Certain aspects of attention selectivity are impaired in clients with left hemisphere cortical lesions, especially showing up in tasks requiring a choice between a range of stimuli and reaction alternatives (covert shift of attention) (cf. Sturm,1990)

In this context *emotional problems* such as particular stress in social situations as a consequence of serious attention disorders have to be taken into consideration as well.

From the assumption of *specific deficits* of different attention aspects their *specific capability of training* should be postulated as well.
The procedure on hand is especially suitable in disorders of the phasic activation and the selective attention.

On the assumption of maximum specifity and in order to achieve the optimum efficiency of the training,
a *subtly differentiated neuro-psychological diagnosis* should be prerequisite for the making of a therapy plan including computer-based procedures.

The procedure **attention & concentration** was evaluated in a range of studies, some of them evaluating other RehaCom procedures as well. Friedl-Francesconi (1995), Höschel et al. (1996), Liewald, (1996), Pfleger, (1996), Preetz et al. (1992), Puhr (1997), Regel & Fritsch (1997), Wenzelburger (1996) worked with different groups of clients (vascular cerebral injury, traumatic brain injury, dementia). Improvements of the cognitive performances were proved in tests (pre-post- comparisions) and partly in transfer effects to everyday situations. The procedure was tested with healthy children in the social-padiatric centre Sozialpädiatrisches Zentrum Magdeburg (Diebel et al.,1998)

The procedure supports the use in children from the age of 5 up to the age of 14 by using child-friendly instructions. We recommend a touchscreen as input device then.

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