HASOMED

RehaCom®

Cognitive therapy

Visuo-Constructional Ability

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RehaCom®

Cognitive therapy

by Hasomed GmbH

This manual contains information about using the RehaCom therapy system.

Our therapy system RehaCom delivers tested methodologies and procedures to train brain performance.
RehaCom helps patients after stroke or brain trauma with the improvement on such important abilities like memory, attention, concentration, planning, etc.

Since 1986 we develop the therapy system progressive. It is our aim to give you a tool which supports your work by technical competence and simple handling, to support you at clinic and practice.

User assistance information:

Please find help on RehaCom website of your country. In case of any questions contact us via e-mail or phone (see contact information below).

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Dear user,
please read the entire instruction manual before trying to operate RehaCom.
It's unsafe to start using RehaCom without reading this manual.
This manual includes lots of advice, supporting information and hints in order to reach the best therapy results for the patients.

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1 Training description

1.1 Training task

The module **Visuo-constructive abilities** trains the visual reconstruction of pictures of three dimensional concrete objects. Puzzles (jigsaws) are used. Each training task consists of an acquisition phase and a reproduction phase.

In the **acquisition phase** a picture can be seen on the monitor (Fig. 1) in which the contents have to be memorized. When the client presses the OK-button the acquisition time ends.

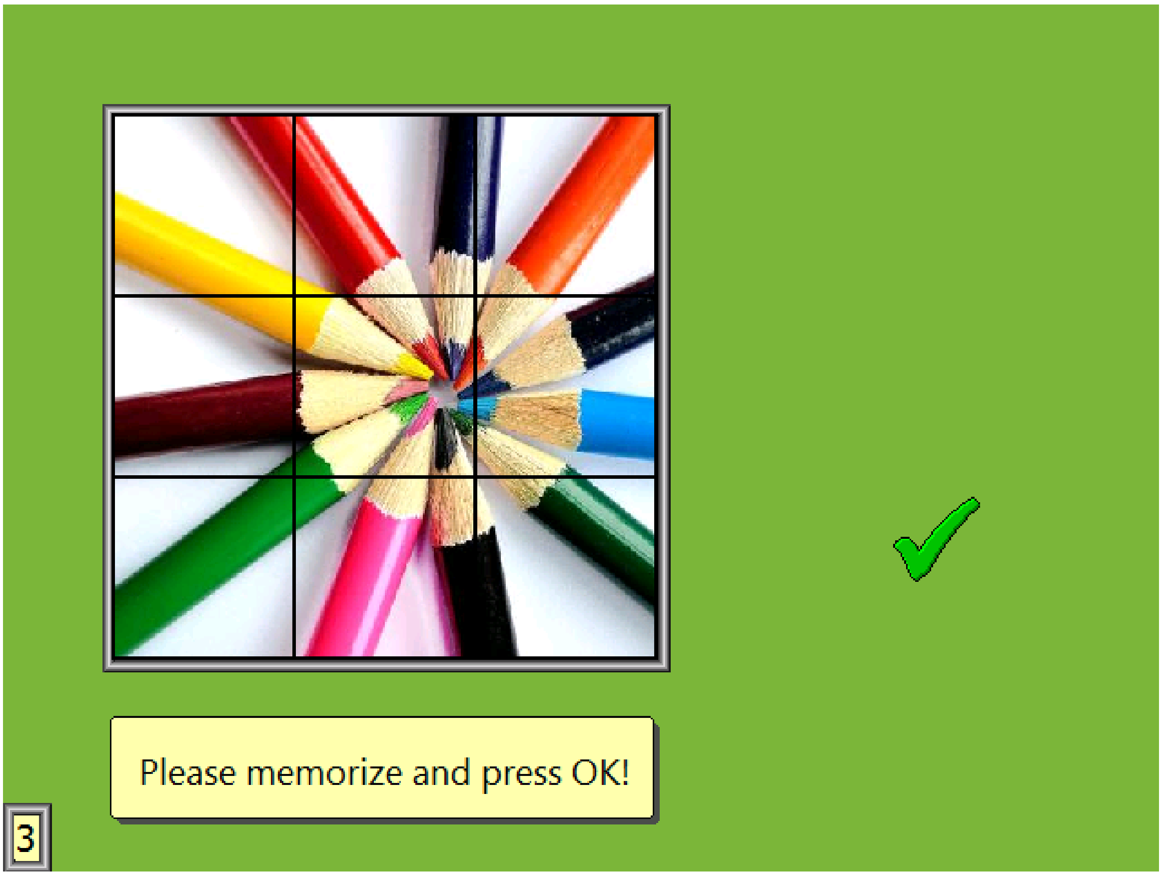


Fig. 1: Acquisition phase at level 3; operation w ith the mouse

The reproduction phase begins (Fig. 2). The picture is fragmented into parts (jigsaw) and then set in a 'film' on the right hand side. A grid into which the fragments have to be placed, is on the left hand side of the page. The fragments have to be selected from the 'film' on the right and then placed correctly into the **grid** on the left.

The module can be operated with the RehaCom Keyboard, a joystick, the mouse, or the touch screen.

A green frame is moved by using the cursor keys on the RehaCom Keyboard. When moving a part of the puzzle from the film frame to the grid, a green frame in the grid must appear before the client can press the OK-button to confirm. In this way each part of the puzzle is moved over piece by piece. If a green picture frame is moved from the left over to the right it jumps from the grid over to the film frame. A picture can now be selected from the film frame by using the keys 'arrow up' and 'arrow down'. A picture can then be selected from the film frame and after this the task is to find the right place for it in the grid on the left.

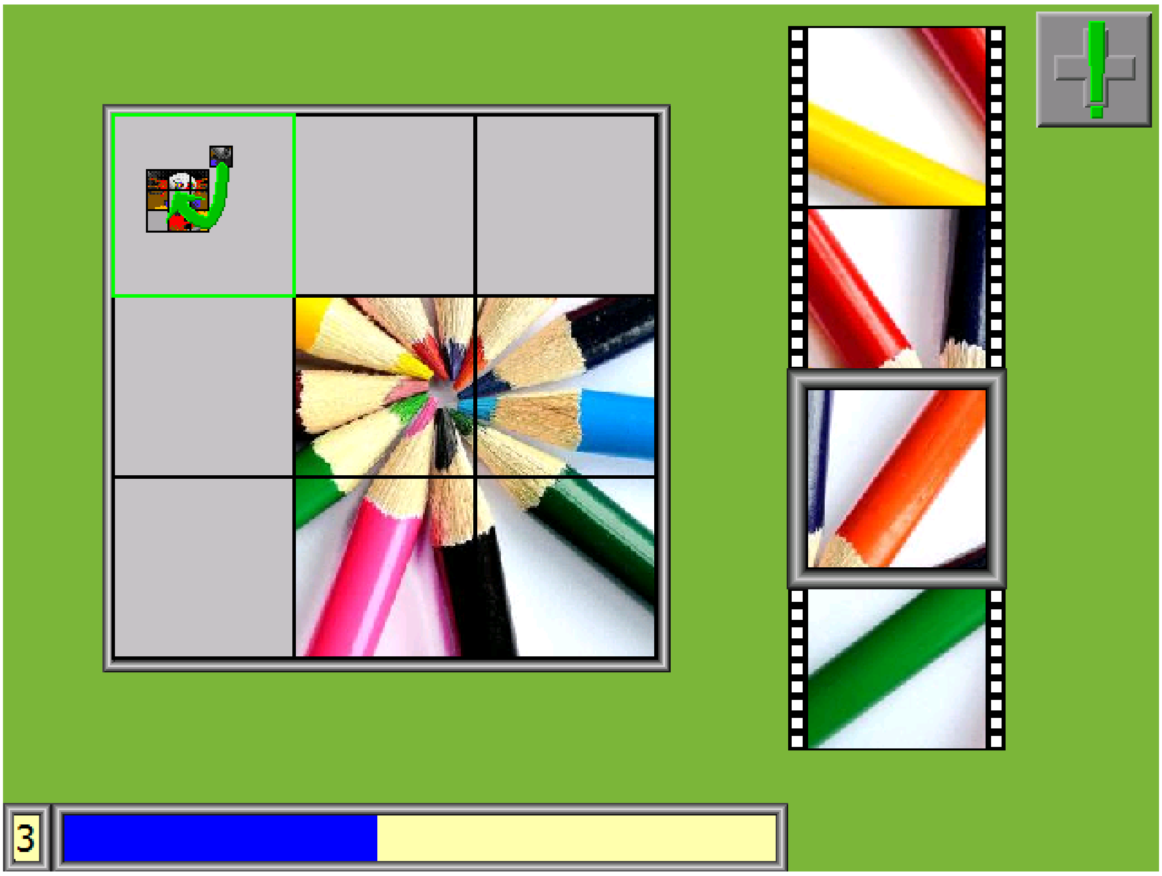


Fig. 2: Reproduction phase at level 3; operation w ith the mouse

The training is a lot easier with the mouse. A cursor in the form of a green arrow is used to select the correct position in the grid. By pressing the mouse button or the OK-button a picture is moved from the film frame to the selected grid position (one hand can operate the mouse; the other can press the OK-key on the RehaCom Keyboard). If the client wants to move the pictures in the film frame he simple moves the cursor to the top of the film frame or the bottom of the film frame. The mouse cursor appears as a green arrow. He then presses the OK-button or the mouse button to move the pictures in the required direction. The **joystick** can be used in the same way.

Operation with the **touch screen** is easier again if there is one available. To place a picture in the grid the client must first select the desired position in the grid and then drag the picture from the film frame on the right to the grid on the left. The pictures in the film frame can be moved when the patient touches the top or the bottom of the film frame. Alternatively, on the screen the switch with the arrows symbols can be pressed.

At higher levels of difficulty the pictures in the film frame are turned to 90°, 180° or 270° before one has to order them to the correct position in the grid (mental rotation). A picture can only be turned when it is in the film frame. The picture can be turned with the **cursor keys** - when the picture is surrounded with a green frame it can be turned and the client selects the correct angle by pressing the OK-button. With the **mouse** the patient simply clicks on the required picture (thee cursor then changes to a rotation arrow). With the **touch screen** the picture can be rotated in the film frame or the client can use the rotation symbols to the right of the film.

This description sounds rather complicated, but the clients learn how to operate the module quite quickly. At first the mouse or the touch screen method is recommended. In the instruction phase the client has the opportunity to 'learn by doing'.

When all the pictures have been correctly sorted the client can marvel at his/her work -the grid disappears. The training can be continued by pressing the OK-button. At completion of the puzzle the task is evaluated and the client is advise as to whether a change of level should take place. The criteria for a change of level is calculated by observing the number of correct decisions in relation to the number of attempts made. A percentage is then calculated and compared to the set values for 'continue to the next level' or 'repeat the previous level' (see Training parameters).

1.2 Performance feedback

Below the screen, a blue bar can be found (see Fig. 2). With every correct decision, the bar grows from left to right. The bar can be disabled in the parameter menu. On the left end of the bar, the level of difficulty is displayed.

If the acoustic feedback is enabled, an error signal is heard with each incorrect choice. If there is more than one patient in the room, the acoustic feedback should be disabled or headphones used.

1.3 Level of difficulty

In order to have a very diversified training there are more than 100 pictures and photographs available. Child-friendly pictures can be used as well. The diverse surfaces support the motivation of the patient.

The module works adaptively. In default setting training, the number of the puzzle parts into which the initial image is placed as well as the already mentioned rotation of the parts affects the modification of difficulty.

Further possibilities to match the module to the patient's performance are described in the Training parameters.

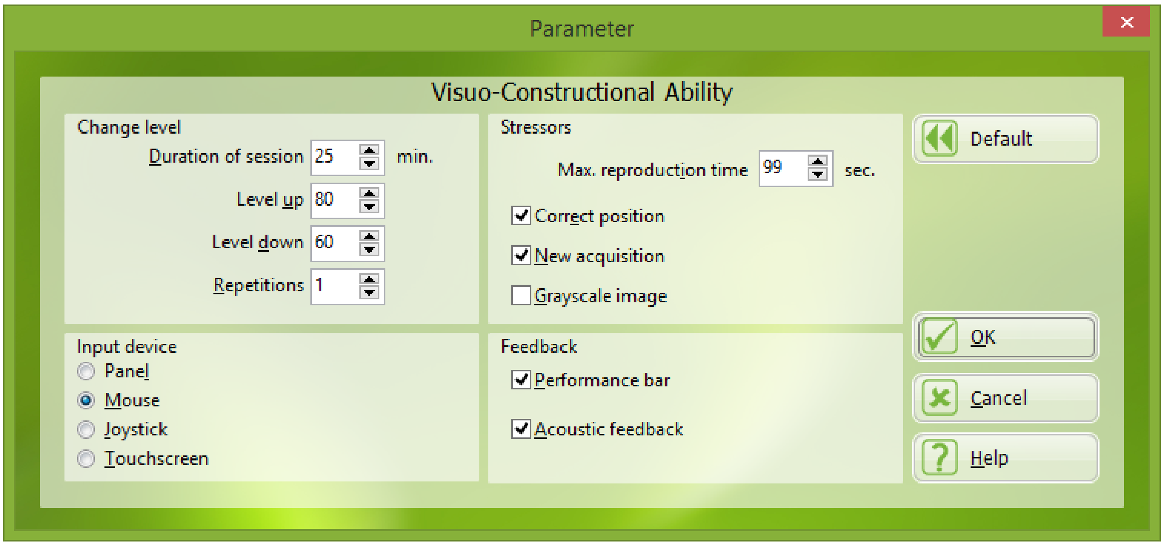
Level	Number of parts	Rotation
1	4	no
2	6	no
3	9	no
4	12	no
5	16	no
6	20	no
7	25	no
8	30	no
9	36	no
10	4	yes
11	6	yes
12	9	yes
13	12	yes
14	16	yes
15	20	yes
16	25	yes
17	30	yes
18	36	yes

Table 1 Structure of the level of difficulty

When the client changes from level 9 to 10 he gets additional tasks. The parts of the picture are turned and have to be corrected. For most of the clients, the jump from 36 to 4 puzzle parts is regarded as an easier task.
This is intention of the module developers. It should be certain that the client only learns the extended operation - rotation of the parts. With increasing number of the puzzle parts in the following tasks, the difficulty once again increases in a very fast way. One also no longer switches automatically back to level 9 if a patient reached level 10 with an inadequate performance.

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.



parameter menu

Duration of session in min:
A training period of 25-30 Minutes is recommended.

Level up / Level down:
See Training tasks.

Repetitions:
The level changes if the number of established tasks with "repetitions" is successfully solved and vice versa. The level is only changed if a consolidation of performance - positive or negative - occurs. If the parameter is set to 0 the after each task is solved - the level then increases and vice versa. If a puzzle is solved without any errors, the next level is set up - there is no repetition. This acts as an additional aspect of performance assessment.

Maximum reproduction time:
If the value is for the "maximum reproduction time" is not equal to 99, an additional time stress factor is set. A clock appears which displays the remaining time. The maximum reproduction time is calculated from the max. time multiplied by the number of pictures. If a client does not solve a task within the maximum time, then the training is broken off and the clients performance up to this point is analysed in order to give a result and an easier task is then set up.

Correct position:
If this parameter is activated, it is then no longer possible to put a part of the puzzle in an incorrect position. After notification of error the incorrectly placed picture wanders back over to the film frame. The training becomes more difficult when this parameter is deactivated. Pictures can then be placed in the wrong position. They then have to be removed from the grid and placed back into the film frame again. In addition, the green frame can be placed in the wrong position in the grid using the cursor keys and then the OK-button pressed. However, with the mouse one clicks on

the picture and when the picture is placed in the grid in the wrong position the green arrow changes to a red one pointing out of the grid. With the touch screen the puzzle can be ordered by using your finger.

New acquisition:
The training becomes easier when the patient operates the module with the renewed acquisition option. The memory aspect of the training is then lost. By pressing the "+" key on the RehaCom Keyboard the original picture appears. When using the mouse or the touch screen there is a switch on the screen whereby this option can be used (see Picture 2). After the client has memorized the picture again, the training can be continued by pressing the "+" button or the OK-button.

Grayscale image:
An additional component of memory can be controlled by using the so-called "Gray-picture". If this option is activated, the original picture is continuously shown as a gray-picture in the grid. The training then becomes considerably easier and becomes more dependent on comparison between the pictures in the film frame and the grid.

Input mode:
See Level of difficulty.

Performance Bar:
See Feedback.

Acoustic Feedback:
See Feedback.

With each new set up of the training the following defaults are automatically installed (middle standard level):

level of difficulty	1
duration of training/Consultation	25 Minutes
continue to the next level	80 %
repeat the previous level	60 %
input device	Mouse
performance bar	on
acoustic feedback	on
grayscale image	off
new acquisition	on
correct position	on
max. reproduction time	99 s (no clock appears)
repetitions	1

1.5 Data analysis

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

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
Picture parts	Number of picture parts
Correct picture parts	Number of correct picture parts (after aborting with max. reproduction time)
Trials	Number of selections
Correct trials	Number of correct selections
Correct trials %	Number of correct selections in %
Position errors	Number of position errors
Rotation errors	Number of rotation errors
No. new acquis.	Number of renewed acquisitions
Acquis. time	Acquisition time in s (incl. renewed acquisitions)
Reprod. time	Reproduction time in s
Train. time task	Effective Training time in h:mm:ss
Breaks	Number of pause by the patient

In this way it is possible to give the patient advise on their short-comings.

2 Theoretical concept

2.1 Foundations

One defines **visual spatial performance** as perception abilities which require a visual comparison of spatial stimulus without manual effort from the client. In contrast to this, **spatial-constructive performance** demands this exact manual-constructive component to be under visual control (cf.Kerkhoff, Münßinger & Marquardt, 1993).

According to Kolb & Whishaw deficits in the latter field for the group **visuo motor problems** those also may also include disturbances to the visual scanning and graphomotoric disturbances.
The abilities which one recognizes as being part of ***visuo constructive performance*** are, for example, the putting together of elements (Dice, puzzles) or the drawing of two dimensional or three dimensional figures or the spontaneous drawing of a single figure. **Spatial-constructive problems** or **constructive apraxia** refer to the decreased ability or inability in patients, with brain damaged, to draw such shapes and figures correctly and/or to join elements of a figure together to form a total figure.

According to Goldenberg (1993), in contrast to the Apraxia, this is a partial symptom of a more general impairment of spatial perception or it can also be seen as an impairment to problem solving.

The Apraxia, which according to Liepmann (1905, 1908; cf.Goldenberg, 1993) can be distinguished as follows: ideomotoric (incorrect imitation of gestures) and ideatoric (incorrect results to actions and loss of knowledge about the correct use of objects). Liepmann goes on to say that these types of apraxia are related to the planning or carrying out motor actions and that in the case of unilateral lesions always also affect, in relation to the lesion, the opposite side of the body. As the medical literature is full of many different variations in the definition of apractic disturbances and that these are often seen in conjunction with other neuropsychological deficits; it may be helpful here to give an exact classification of apraxia, with the aid of clinical differentiation:

- in relation to the affected part of the body,
- the particular disturbance in movement
- the error

Errors, which clients make who suffer from brain damage while copying geometrical figures, often exist in omissions or errors in positioning of individual components as well as the distorted fabrication of the presentation. In the Mosaic Test (see below) inversion or incorrect rotation often occurs. In serious cases, the basic quadratic form can completely disappear. There is a similar reaction in 3 dimensional pictures (incorrect spatial rotation). The folding or cutting out of figures from paper is complicated or impossible. Length and angular distortions may also occur, size modifications or an erroneous order of individual elements of the total figure which is sometimes also reconstructed in a completely fragmented manner. In addition independent constructive abilities like the drawing of spatial orders of a room for example, with above mentioned deficits is just not possible.

Apractic problems are possibly the result of visual-spatial impairments because the precondition for **visuo constructive performance** is an intact visual-spatial perception, which helps us to deal with the world around us.

The visual-spatial perception is a component of elementary visual efficiency and consists of the following basic functions (Kerkhoff, 1988):

Visual spatial perceptive performance

- Distance estimation (horizontal / vertical),
- Estimation of distances,
- Estimation of relative positions,
- Estimation of angles,
- Main visual spatial (subjective perpendicular / horizontal),
- Subjective straight ahead direction / subjective middle.

Visual spatial operation

- mental rotation,
- Transformation performance (measure, angle, size transformations, tasks with varied spatial systems).

In contrast to the visual spatial perception, with visual room operations it is a question of cognitive services which require a intermediate step separated by the stimulus material.

Basic functions of the visual spatial perception are in everyday life, in particular in traffic, of great relevance. From the straight line directing while walking to fine motor adjustment while reading, (which are dependent on the elementary aspect of visual performance), spatial disturbances can affect all practical everyday activities which require a visual spatial operation or a partial spatial-constructive performance. Clients with technical professions who suffer from these deficits will often loose their positions and therefore are clearly more affected than others.

Several investigations into the predicators of the rehabilitation (v. Cramon & Zihl, 1988; Kerkhoff & Marquardt, 1995) showed a statistical connection between visual-constructive and visual-spatial problems and impaired ADL-activities (activities of daily living); where a causal relationship was discussed. This is not surprising when one only considers some examples from everyday life, where there is dependency on an intact visual-spatial perception and/or spatial-constructive subsets of the system:

- Dressing

- Folding of washing
- Estimating and separating amounts
- Decorating a table
- Tidying
- Grabbing objects
- Estimating the depth of steps/stairs
- Reading of plans or sketches
- The filling in of forms and documents
- Maintain lines and columns while drawing
- Finding the way
- Wheel chair navigation

More complex disturbances to perception are often a result of disturbances to the elementary visual efficiency, like the *depth perception*. Loss of depth of vision means that everything appears to be flat (e.g. a dye appears to be a six cornered object). The trouble with disturbances to depth of vision is that it is sometimes combined with changes in the perception of the sizes of objects (Micropsia and Macropsia), however, it can also affect the appearance of objects and faces. The latter is also to be seen in the case of cerebral of amblyopia, problems with the shaping and colour perception which occurs in most cases after post-chiasmatic injuries.

A damaged visual localization of stimulus affects the appraisal of distances. The client then over- or under-estimates distances.

Visual-spatial orientation problems express themselves in the loss of the spatial organization of a pattern of stimuli, which is often coupled with "difficulties in measuring" through impairments in the recognition or localizing of spatial positions and regions as well as the *ability for spatial imagination.* Therefore, finding a way is also complicated in the case of the labyrinth tasks.

An innate medical history of the complaints is reasonable only with patients without visual neglect, anosognosia or anosodiaphoria. For the client group with reduced insight Kerkhoff & Blaut have developed (1992, cf.Kerkhoff, Münßinger & Marquardt, 1993) a clinical hetero-medical history curve. For the diagnosis of performance in visual-spatial perception, the following tests are suitable, for example line orientation, line halving, spatial sub tests in intelligence tests or the computer-assisted module is also suitable(cf.Kerkhoff, Münßinger & Marquardt, 1993). The latter registers elementary performances of the visual spatial perception in contrast to all other modules. The tests for visual object and spatial perceptions (VOSP,Warrington & James, 1992) also tests the visual basic functions problems which often occur together with constructive apraxia and are possibly its cause. For the diagnosis of the spatial-constructive troubles - the free copying of geometric or other patterns, the copying of perspective drawings or the drawing test according to Grossmann (1988) are suitable. The mosaic test or the sub test 'figure placing' from the Hamburg change/switching intelligence test (HAWIE-R, Tewes 1991), the

Benton-Test (Benton, 1981) or the Rey-Osterrieth-Figur (Osterrieth, 1944) are also suitable as diagnostic instruments. However there are in part particular aspects; partial combination of many aspects of more complex functions registered. i.e. several spatial basic functions are tested simultaneously.

2.2 Training aim

The aim of the training is to improve the client's visuo constructive performance. This computer training helps to improve functions and abilities required in everyday life; as it is highly probable that visuo-constructive impairments occur as a result of deficits to the basic performance of perception.

In training puzzles are used which must be memorized and reconstructed. In this way, the visual memory is supported in addition to training visuo-constructive abilities. If required, less emphasis can be placed on the aspect of memory in that the client can constantly refer to the gray picture or there is also the possibility to refer back to the original picture and to match this with his current version of the puzzle.

The segmentation of the matrix is simultaneously a starting point for the procurement of strategy - the division of more complex drafts into components is useful as in the case of copying or re-creating.

It is to be expected that the improvement of visual-spatial basic functions may have a positive affect on that ADL- field (Activities of Daily Living).

Impairments of spatial perception and spatial operations hinder numerous practical activities (eating, dressing, body-care, writing, drawing, car driving), in particular if it depends on a precise type of visuo-motor coordination.
Furthermore, there are significant statistical connections between mosaic test and figure batching (HAWIE) and the ADL measures (cf.Kerkhoff, 1988), so that may first be employed as predicators for independence in everyday life. On the basis of the maximum specification of therapy, one should always precede with a differentiated problem specific neuropsychological diagnostic.

A good preparation for training with the module **Visuo-construction** is to practice with the module RAUM. The aim of the latter module is the specific training of basic visual-spatial single performances and the estimating of angles, the positioning of subjects as well as the appraisal of sizes and faces. In this case, emphasis was placed on the closeness to reality of the tasks as in, for example, the filling of vessels of different forms. Each single module concentrates itself on a component of visual-spatial basic functions while the demand on other intellectual abilities was kept to a minimum.

In consideration of the lack of methods to diagnose and handle visual spatial perceptions and the disturbances to spatial operations, the module also offers the possibility of a more differentiated recording of the underlying problems.

For additional training, the RehaCom-modules **Spatial Operation** (RAUM), **Visuo-Motor Coordination** (WISO) and **Two dimensional Operationen** (VOR1) can be used.
Due to the complexity of the module it may also be used in the areas of **Attention** and **figurative memory** in connection with the RehaCom-Training modules (AUFM, GEAU).

2.3 Target groups

It is recommended that the module is used to train the visuo-constructive abilities for clients with diagnosed impairments to the performance visual spatial perception and disturbances to their spatial-constructive abilities.

It is mainly clients whose brain has been damaged after posterior and/or parieto-occipital uni- and bilateral lesions or injuries to the visual system, who are affected. In particular visual-spatial problems often occur after right-hand parietal lesions.

Visual-spatial functions can be affected by different types of brain damage of different genesis (insult, hypoxia, SHT, tumours).

The clients who will also benefit from a training of spatial functions are certainly those with visual neglect, impairments to field of vision and those with impairments to their object perception caused by deficits in elementary visual performance. The latter is also the case, when we refer to cerebral amblyopia (difficulties with shape and colour perception) which mostly occurs after postchiasmatic injuries.
Furthermore, the module can be employed as a type of problem solving training.

For clients with to the right hemispheric injuries to the brain there is a clear indication of a covariance between impairments to the visual spatial perception and visual constructive problems (cf.Kerkhoff, 1988). Also a decreased ability for mental rotation, which is observed after right- and left hemispheric posterior lesions, impairs the visual constructive performance.

In addition to a half-side paralysis, visual-constructive and visual-spatial problems is the most important predictor for the rehabilitation process in clients with injuries the right hemisphere of the brain.

It was repeatedly found, that in particular patient groups with deficits to visual perception a less favourable rehabilitation process was observed in the left hemispheric hemiplegia (cf.Kerkhoff, 1988).

Client's who suffer from hemiplegia often experience motor problems in their dominant hand. The Module KONS can help to improve the dexterity of the other hand.

As per the standard parameters, the training requires the visual memory to store the picture presented in the acquisition stage in memory for so long until it has to be

reconstructed. Therefore, the module can be used for clients with problematic visual memory performance which occurs in clients with brain damages of different localization and genesis - but predominantly in clients with right hemispheric insults, tumours and traumas.
For clients with weak memory performance, a permanent a gray image of the target image can be used or depending on set up in the training parameter the initial image may also be used.

It is possible to put the module to use with children of 8 years and older. It is then recommended that relevant pictures and instructions be used for the children and that, at least the first training session should be gone through with the support of a therapist.

From a diagnostic point of view it is recommended to exclude those clients with serious deficits in intelligence.

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