HASOMED

RehaCom®

Cognitive therapy

Spatial Operations 2

HASOMED
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).

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

With the therapy module **Spatial Operations 2** basic functions of <u>visual-spatial tasks</u> can be trained in the following categories:

- position estimation,
- angle estimation,
- fill level estimation,
- size estimation one-dimensional,
- parallelism estimation,
- length estimation,
- dividing lines,
- size estimation two-dimensional
- speed/distance estimation.

The training works adaptively, while for each category a separate <u>Level Sequence</u> from 1 to 11 is defined. In the levels of difficulty 7 to 9 the *visual short time memory* for spatial formations is trained additionally in the categories position estimation, angle estimation and size estimation. The tasks of each category will be explained to the patient in a tutorial, in case the task will be started with the option *Instruction*. At the end of the tutorial an easy task needs to be solved in order to start the actual training.
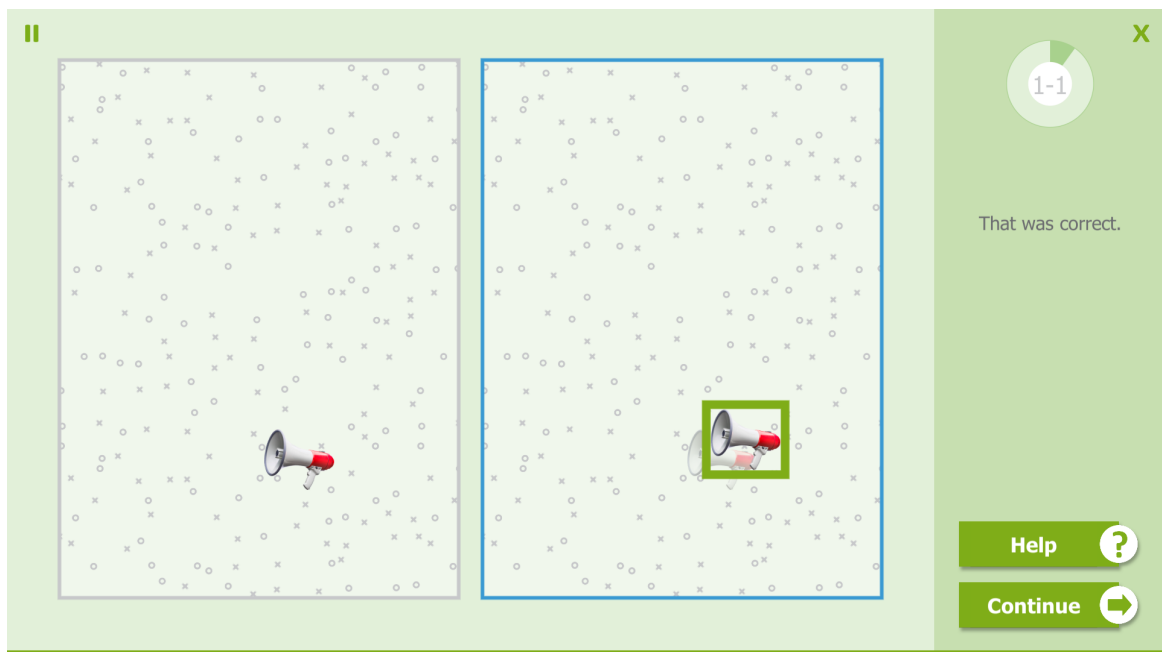

Figure 1: Position estimation first level of difficulty

Fig. 1 shows the task type ***Position Estimation***. In this task, two big fields appear

on the screen. One field shows an object or an animal at a fixed position. In the second field there is the same motive at a different position. It can be moved with the cursor keys, with the mouse or with the touch input (via drag & drop or by clicking/ tapping on the desired position). The task is to move the object within its field to the position of the fixed object. To confirm, press the "OK" button or click/tap onto the "Finish" button. Help marks or irritating lines (distractors) act as modifiers of the difficulty.

Around the moved object a green or red frame will appear as performance feedback, which shows whether or not the object is located within defined deviation tolerance.
A transparent object shows the ideal target position. When the deviation with the red frame is too big, a yellow frame additionally marks the target position.

In the preset for the training the *single* tolerance range is 5%. The Level Structure provides the information that a task has to be executed with a big tolerance area (*double* tolerance is defined with 2 x 5%=10%) at first, before the training continues with a smaller tolerance range (single tolerance – 5%) later on. The tolerance area can be increased for patients with severe impairments. After the performance has been strengthened, it should be decreased back to 5% again.
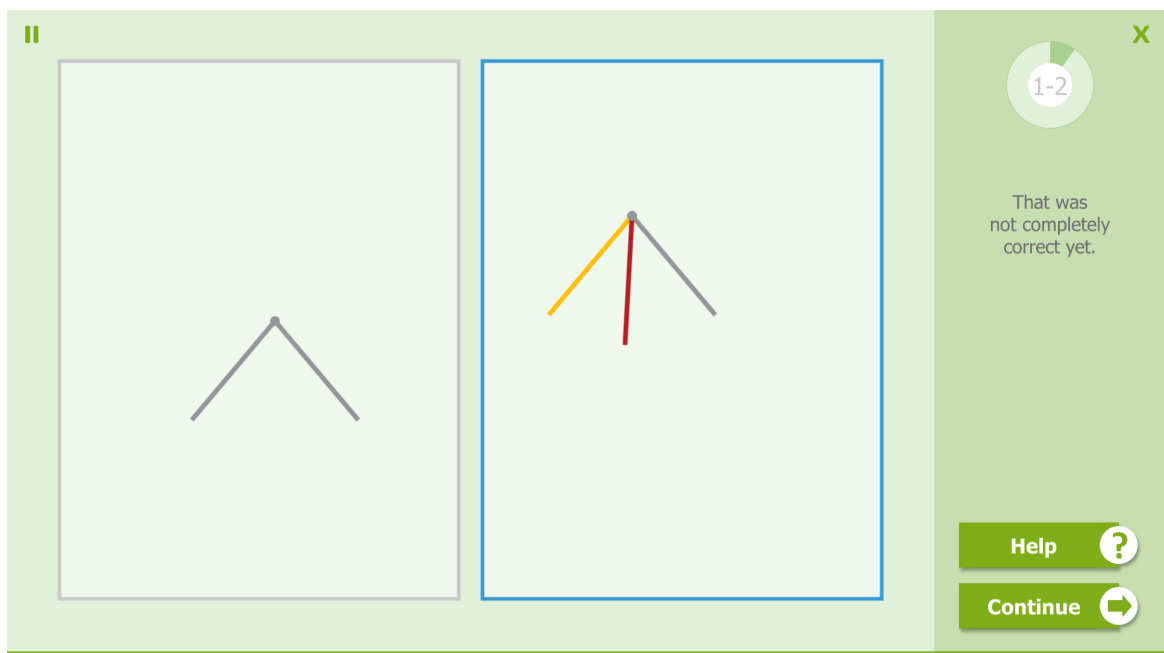
Figure 2: Angle estimation first level of difficulty

When doing the ***Angle Estimation*** line pairs will be shown in both fields, which are arranged to each other in a specific angle (see Fig. 2). The angle on the right side has to be adjusted to the left angle by using the cursor keys "arrow left" or "arrow right", the drag & drop or by clicking/tapping in the desired direction. After adjusting and confirming the angle, a feedback concerning the setting rating will be given in form of a color: If the line turns green, it means that the angle was within the

tolerance, otherwise it turns red. In this case, the target position will be displayed in yellow (see Fig.2), otherwise in grey.

Figure 3: Relation estimation first level of difficulty

The *Fill Level Estimation* is carried out by the filling of vessels with a given amount of fluid (1/2 full, 1/3 full etc.) (see Fig. 3). The fluid has to be filled in (the level of fluid increases in height) by using the arrow key "arrow up". With the "arrow down" key fluid can be removed from the vessel. The level of fluid can also be adjusted by using the Drag & Drop as well as by clicking/tapping onto the vessel. In order to confirm, one has to press the "OK" button or click/tap onto the "Finish" button. A green line marks the current level within the tolerance, and a red line marks the current level outside of the tolerance area (insufficient performance). Additionally, in case of a correct solution, a reward object will be displayed and in case of an incorrect solution, the target level will be displayed with a yellow line. **The volume** of the filled in amount will be used to evaluate the solution quality, assuming a round cross section horizontally. The form of the vessel functions as a modifier of the difficulty. In the beginning vessels with vertical walls will be used, for which the fill height is proportional to the filled in amount of fluid, respectively to the volume. For higher levels of difficulty the walls of the vessels are formed randomly (e.g. a conical champagne glass). Then, the height is not proportional to the filled in amount of fluid anymore. For the example in Fig.3 the vessel had to be emptied to the half. The green line marks the target level.
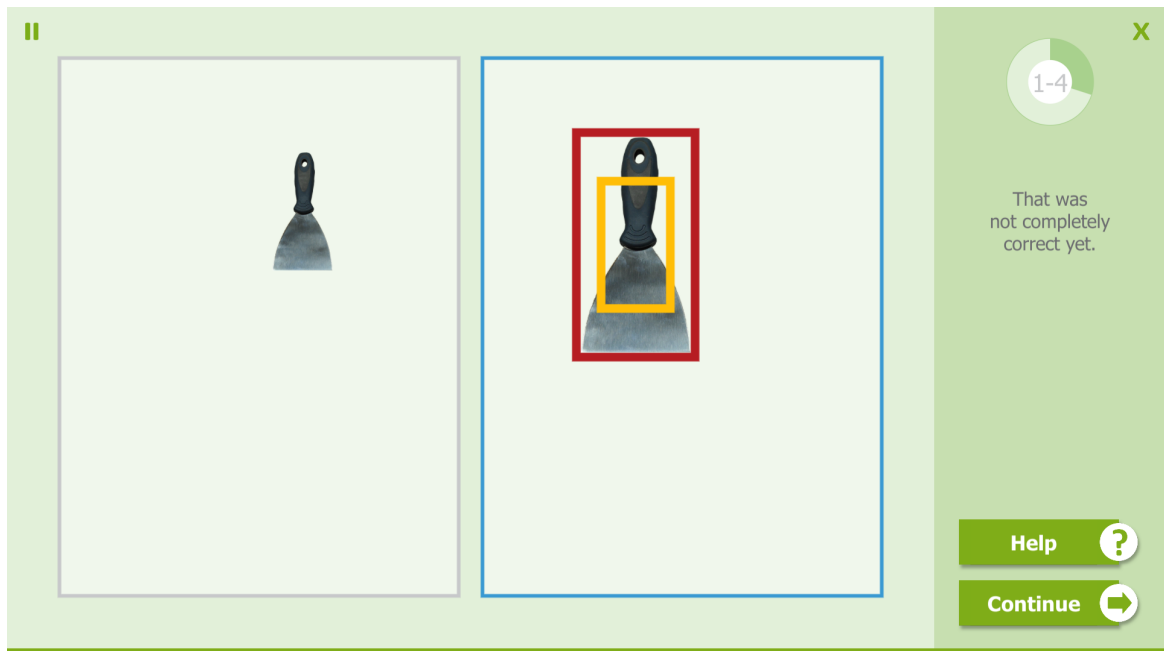
Figure 4: Size estimation first level of difficulty. The result (red) and target (yellow) size are marked by the coloured frames.

When doing the *size estimation*, objects of different sizes are displayed in the fields, which have to be adjusted to the same size by using the cursor keys (see Fig. 4). In the version *one-dimensional,* the size of an object increases and decreases proportionally in x and y direction. In the version *two-dimensional,* the x-coordinate can be changed with the arrow keys "arrow left" and "arrow right" and the y-coordinate can be changed with "arrow up" or "arrow down". Besides, one can also adjust the size by clicking and pulling with the mouse or sliding with the finger to the right/left or up/down. The object is being compressed or elongated. A task has been solved correctly, when both coordinates are within the tolerance (a green frame will appear). Symmetrical and asymmetrical objects as well as the rotation by 90°, 180° or 270° act as modifiers of the difficulty.
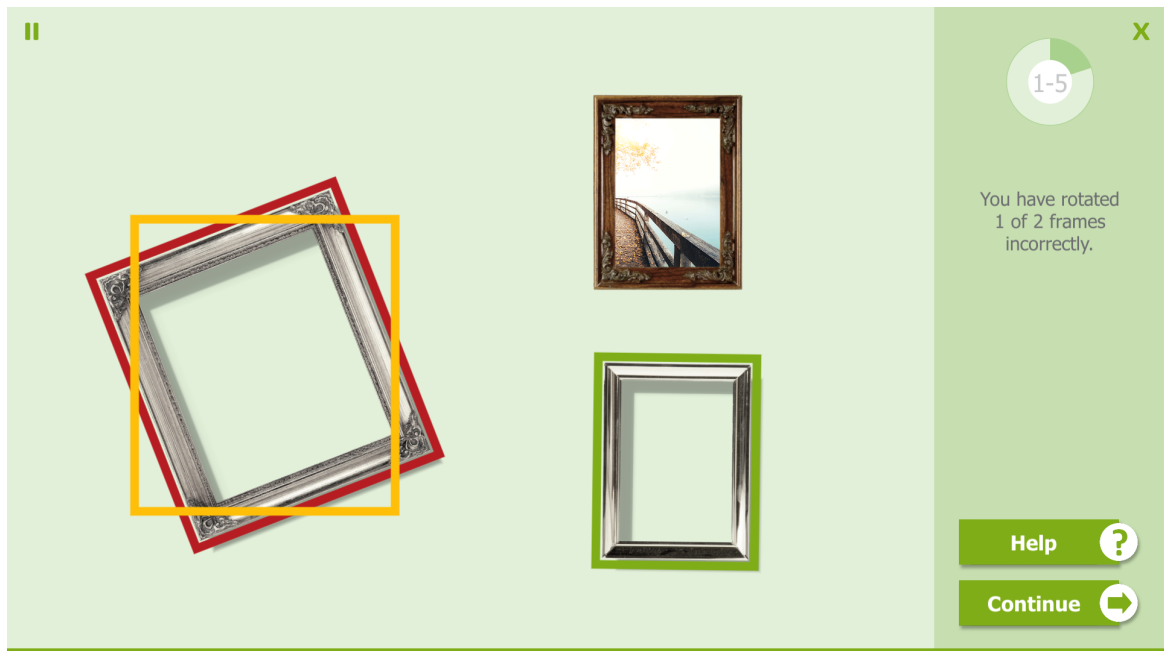
Figure 5: Parallelism estimation first level of difficulty. The result (red) and target (yellow) size are marked by coloured frames and the correct alignment by a green frame.

For the *Parallelism Estimation*, objects have to be adjusted to the same alignment as the reference object. The objects can be rotated by using the left/right arrow key or by clicking/tapping and pulling with the mouse/finger. In case of an installed keyboard/panel control, for every object a numeric key will be displayed when there are multiple objects that have to be rotated, which can be used for the selection. Otherwise, the objects can be selected by clicking/tapping on them.

The modifiers of the difficulty for this task are the types of objects and their respective alignments. Therefore, simple picture frames have to be straightened in the beginning, while in higher levels, lines and later on concrete objects have to be put in the correct alignment. Besides, the number of the objects in the respective object categories will be increased step by step, while already one object outside of the tolerance range will be regarded as a mistake.
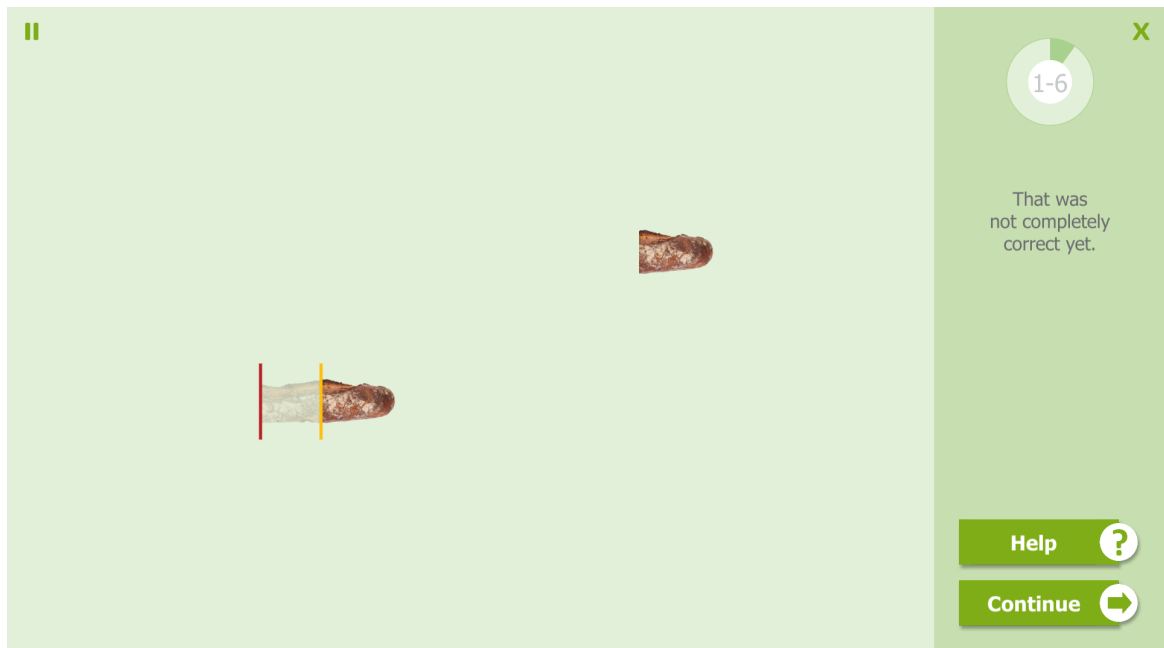
Figure 6: Length estimation first level of difficulty. The lines tag the result length (red) and the target length (yellow), the transparent area shows the difference between the lengths.

For the **Length Estimation**, an object has to be adjusted to the same length as the reference object. The length can be adjusted with the left/right arrow key as well as by clicking/tapping and pulling with the mouse/finger.

The difficulty will increase due to the transition of equal pictures to simple lines (orientation points disappear), and due to the position of the two objects to each other, which changes from horizontal over parallel to random.
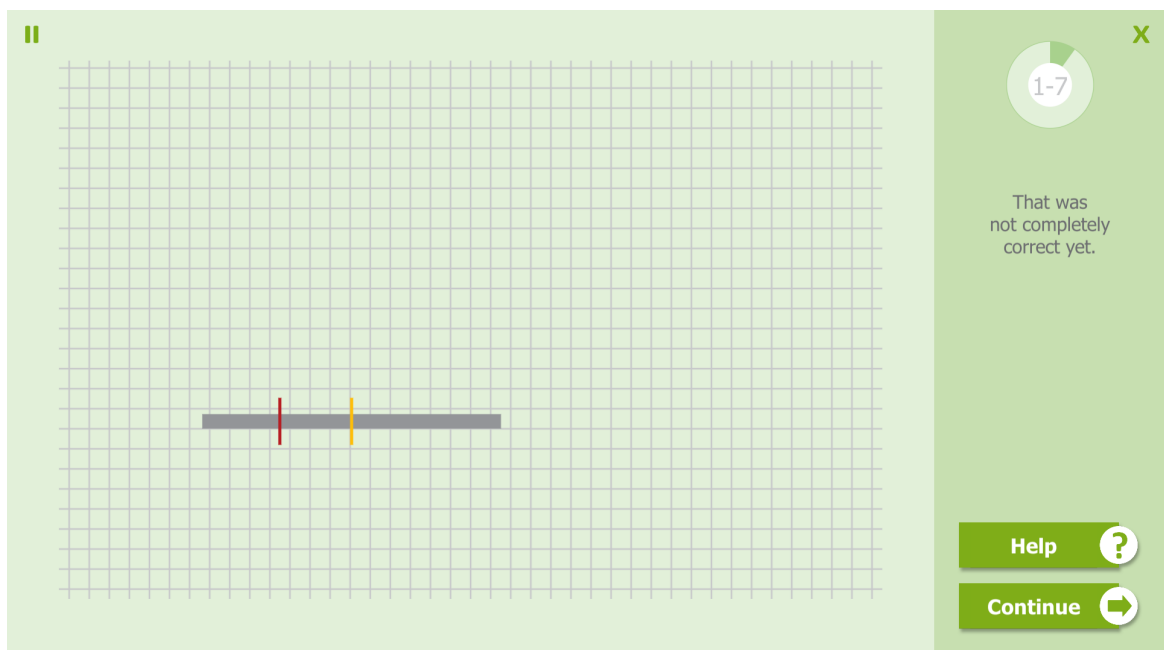

Figure 7: Dividing lines first level of difficulty. The short lines mark the result (red) and the actual middle (yellow).

In the task **Dividing Lines**, a line needs to be divided in the middle by another line as exact as possible. This line can be moved to the desired position by using the left/right arrow key as well as by clicking/tapping and pulling. If the deviation of the line position from the actual middle is within the tolerance range (in relation to the total length of the object), the task will be regarded as correctly solved and the placed line will turn green. If the deviation is in fact too large, the line will turn red and an additional yellow line will mark the correct position.

For variation of the difficulty in this task, the length of the lines will be increased and the help raster, which will be shown in the beginning, will disappear step by step. Additionally, the complexity of the objects increases due to the transition from simple lines to concrete daily objects. The object position changes as well from relatively centric to random positions. In the highest levels, the objects will be rotated additionally.
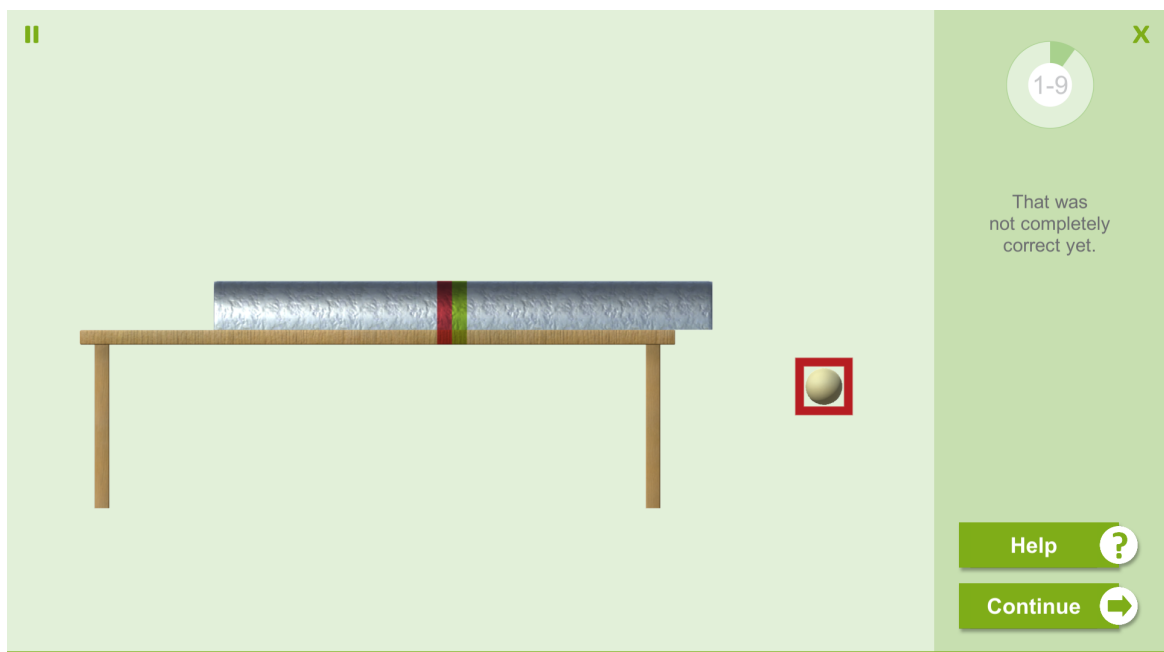
Figure 8: Speed/Distance estimation first level of difficulty. The red frame shows a too early or too late reaction.

The **Speed/Distance Estimation** proceeds in two steps. First, one starts the steady rolling movement of a ball on a table by pressing the OK button or the Start button. After some time, the ball is not visible anymore, since it rolls under "cover". The task is to stop the ball as close to the edge of the table as possible by pressing the Ok button or the Stop button, avoiding that the ball rolls past this point and falls off the table.

Additional demands to the spatial short term memory

In the task types *Position Estimation*, *Angle Estimation* and *Size Estimation* in the levels 7 to 9, the spatial short term memory will be trained additionally. Therefore, the reference object on the left disappears and the setting of position, angle and size

has to be made from memory, after the memorizing phase has been finished by pressing the OK button or Continue button. When pressing the OK button or the Finish button, both objects will appear again to enable the patient to evaluate his/her solution.

1.2 Performance feedback

The feedback of the solution quality will be given by colored frames or lines. If the positioning happens within the Tolerance Range (sufficient estimation), the current position will appear in *green*. If the positioning is too imprecise (outside of the tolerance range), the current position will appear in *red* as well as a *yellow* mark that shows the target position.

In the upper right of the screen there is a *progress circle*, whose fill level indicates how many tasks the patient has completed while progressing to the next evaluation step, respectively, how many have to be completed still. Once the circle is filled completely, the level evaluation appears. The patient either progresses to the next higher level, stays in the same level or gets downgraded to the next lower level. However, this will only be visible the next time the patient works with this task type. The patient always moves to the next chosen task type and continues the training with these tasks.
Within the circle one can see the current level as well as the current active task type.

If the acoustic feedback is on, an error signal can be heard when making a wrong decision. To avoid distractions, the acoustic feedback should be turned off when there are more than one persons in the room.

1.3 Levels of difficulty

This module provides the adaptive setting of the difficulty.
Since different task categories are being trained in the module **Spatial Operations 2**, (which are described in the section Training tasks), and due to the fact that the task categories are based on different cognitive-spatial tasks, the level of difficulty will be set specifically for every task type. This way a user might have progressed to level 7 in the *size estimation*, while having difficulties when doing the *length estimation* and therefore working in level 3.
Tables 1 to 9 show the structure of the levels of difficulty for the categories. In the therapist menu the level of the last trained category is displayed. If one value gets changed here, the level will be set to this value for all task categories.

Level	Tolerance	Memo	Specifics
1	double	no	Help marks provided
2	single	no	Help marks provided
3	double	no	Without help marks

4	single	no	Without help marks
5	double	no	Irritating lines
6	single	no	Irritating lines
7	double	yes	Help marks provided
8	single	yes	Help marks provided
9	single	yes	Without help marks
10	double	no	Background pictures
11	single	no	Background pictures

Tab. 1: Difficulty structure for the category position estimation

Level	Tolerance	Memo	Angle range	Opening Direction	Objects
1	double	no	15° - 90°	identical	Simple lines
2	single	no	15° - 90°	identical	watches
3	double	no	15° - 90°	different	Simple lines
4	single	no	15° - 90°	different	Simple lines
5	double	no	60° - 165°	different	Simple lines
6	single	no	60° - 165°	different	Simple lines
7	double	yes	15° - 90°	identical	watches
8	double	yes	15° - 90°	different	Simple lines
9	single	yes	15° - 90°	different	Simple lines
10	double	no	60° - 165°	different	Pizza, cake etc.
11	single	no	60° - 165°	different	Pizza, cake etc.

Tab. 2: Difficulty structure for the category angle estimation.

Level	Tolerance	Vessel walls	Filling
1	double	vertical	1/2
2	single	vertical	1/2
3	double	vertical	x/3, x/4, x/5
4	single	vertical	x/3, x/4, x/5
5	double	aslope	1/2
6	single	aslope	1/2
7	single	aslope	x/3, x/4, x/5
8	double	complex	1/2
9	single	complex	1/2
10	double	complex	x/3, x/4, x/5
11	single	complex	x/3, x/4, x/5

Tab. 3: Difficulty structure for the category fill level estimation

Level	Tolerance	Memo	Symmetry	Rotation	Background picture
1	double	no	yes	no	no
2	single	no	yes	no	no
3	double	no	no	no	no
4	single	no	no	no	no
5	double	no	no	yes	no
6	single	no	no	yes	no
7	double	yes	yes	no	no
8	single	yes	yes	no	no
9	single	yes	no	yes	no
10	double	no	no	no	yes
11	single	no	no	no	yes

Tab. 4: Difficulty structure for the category size estimation (one degree of freedom)

Level	Tolerance	Object form	Number of Objects	Alignment
1	double	Picture frame	1 to 2	horizontal/ vertical
2	single	Picture frame	2 to 5	horizontal/ vertical
3	single	Picture frame	5 to 8	horizontal/ vertical
4	double	Simple lines	1 to 2	random (with auxiliary lines)
5	single	Simple lines	1 to 2	random (with auxiliary lines)
6	double	Simple lines	2 to 5	random
7	single	Simple lines	5 to 8	random
8	double	real	1 to 2	random
9	double	real	2 to 5	random
10	single	real	5 to 8	random
11	single	real	5 to 8	random

Tab. 5: Difficulty structure for the category parallelism estimation

Level	Tolerance	Object form	Parallelism

1	double	pictures	horizontal
2	single	pictures	horizontal
3	double	pictures	yes
4	single	pictures	yes
5	double	pictures	no
6	single	pictures	no
7	double	Lines	horizontal
8	double	Lines	yes
9	single	Lines	yes
10	double	Lines	no
11	single	Lines	no

Tab. 6: Difficulty structure for the category length estimation.

Level	Tolerance	Length	Position	Alignment	Object form	Background
1	double	half	centred below	horizontal	Line	Line raster
2	single	half	centred below	horizontal	Line	Line raster
3	double	normal	centred below	horizontal	Line	Dot raster
4	single	normal	centred below	horizontal	Line	Dot raster
5	double	normal	random	horizontal	Line	nothing
6	single	normal	random	horizontal	Line	nothing
7	double	half	centred below	horizontal	picture	nothing
8	single	normal	centred below	horizontal	picture	nothing
9	double	normal	random	horizontal	picture	nothing
10	single	normal	random	random	picture	nothing
11	single	normal	random	random	picture	nothing

Tab. 7: Difficulty structure for the category dividing lines.

Level	Tolerance	Memo	Symmetry	Rotation	Background picture
1	double	no	yes	no	no

2	single	no	yes	no	no
3	double	No	no	no	no
4	single	no	no	no	no
5	double	no	no	yes	no
6	single	no	no	yes	no
7	double	yes	yes	no	no
8	single	yes	yes	no	no
9	single	yes	no	yes	no
10	double	no	no	no	yes
11	single	no	no	no	yes

Tab. 8: Difficulty structure for the category size estimation (two degrees of freedom)

Level	Tolerance	Projection	speed	covering
1	double	orthographic	fast	short
2	single	orthographic	fast	short
3	double	orthographic	fast	long
4	single	orthographic	fast	long
5	double	orthographic	fast	short
6	single	orthographic	slow	short
7	double	perspective	fast	short
8	single	perspective	fast	short
9	single	perspective	fast	long
10	single	perspective	slow	short
11	single	perspective	slow	long

Tab. 9: Difficulty structure for the category speed/distance estimation

1.4 Training parameters

General information concerning the training parameters and their effects can be viewed in the RehaCom Foundations. These information should be taken into account in the following.

Skip tutorial:
The integrated tutorial can be skipped by the therapist if necessary. Therefore, the lower corner button or button 0 (zero) can be used.

Figure 9: Parameter menu

Duration of session in min:
The duration of session defines the length of the planned training session. A duration of session of 25-30 minutes is recommended.

Level up:
For every task category an upgrade to the next level happens when, according to the set number of tasks per level, the percentage of correctly solved tasks at least equals this set percentage.

Level down:
If the set percentage of correctly solved tasks has not been reached, the patient will be downgraded to the next easier task for the respective task category.

Tolerance range:
The tolerance defines a range around the target position in which a positioning will be regarded as correct. By decreasing the range of tolerance, the task will become more difficult. For patients with severe impairments of the spatial perception ability the tolerance should be increased to ensure training success in the beginning.
The 100% value of the tolerance is defined differently for every category. For the position estimation the width of the field is 100%. For the angle estimation an angle of 120° is defined as 100%, for the parallelism estimation it is an angle of 90°. For

the size estimation the size of the target object is defined as 100%. For the fill level estimation a full container is defined as 100%. For the length estimation 100% is the initial length of the object that has to be adjusted, respectively, half the height of the screen. At the same time, in the task Dividing Lines 100% is the half of the maximum length of the line that has to be divided and therefore, half the height of the screen as well. For the speed/distance estimation 60 lengths of the ball from the edge of the table are defined as 100%.

Training categories:
Here the task types to be trained (see Training Task) can be activated or deactivated. Deactivated categories will be skipped during the sequence of tasks.

Acoustic Feedback: see Performance Feedback.

Memory:
In the levels of difficulty 7 to 9 in the position estimation, the angle and size estimation, the spatial short term memory is trained additionally. For patients, for who a training of the short term memory is not indicated, the option should be turned off. For these levels of difficulties the respective categories will be skipped.

When redefining a patient, the system automatically sets the following default values:

Duration of session	30 Minutes
Level of difficulty	1
Training category	All
Level up	90 %
Level down	70 %
Tolerance range	5 %
Acoustic Feedback	on
Memory	on
Tasks per level	10

Tab. 6: Standard Parameter

Input mode:
Defines the input mode for which the help and instruction texts will be displayed. Further, the display of specific help symbols will be defined here as well. For example, only when keyboard control is activated in the parallelism estimation, numeric symbols for the selection of object that has to be rotated with the numeric keys will be displayed. The other input modes can be used as well independent from the set mode, and the mouse cursor can be turned on/off when needed.

The ***orientation*** (right-left alignment) can be selected in the menu
Clients→Edit→Index: File→Option field: Impairment of visual field

1.5   Data analysis

The different possibilities of data analysis for the determination of the training strategy can be viewed in the RehaCom Foundations.

In the graphic as well as the tables, beside the settings of the Trainings parameters, the following information are displayed:

Level	Current level of difficulty
Category	Category (position, angle, size1, size2, filling, parallelism, length, dividing lines, speed)
Level category	Level of difficulty within the category (1-11)
tries	Number of solved tasks until level change
Mistakes	Number of mistakes
1st quartile tolerance x	Accuracy of the positioning 1st quartile (x-coordinate) [%]
1st quartile tolerance y	Accuracy of the positioning 1st quartile (y-coordinate) [%]
Median tolerance x	Median of the deviation of the current position and target (x-coordinate) [%]
Median tolerance y	Median of the deviation of the current position and target (y-coordinate) [%]
3rd quartile tolerance x	Accuracy of the positioning 3rd quartile (x-coordinate) [%]
3rd quartile tolerance y	Accuracy of the positioning 3rd quartile (y-coordinate) [%]
Training time / task	Effective time of training [h:mm:ss]
Breaks	Number of breaks made by the patient

Tab. 7: Results

Because of this information it is possible to discuss the course of the training with the patient and to point out specific deficits.

2 Theoretical concept

2.1 Foundations

Visual spatial performance is defined as perception abilities which require a visual comparison of spatial stimulus without manual effort from the patient. In contrast to this, spatial-constructive performance demands the exact manual-constructive component to be under visual control (Kerkhoff, Münßinger & Marquardt, 1993). The precondition for visual-constructive performance is an intact spatial-operation perception.

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

Visual spatial perceptive performance
- Estimation of the subjective visual vertical line or subjective visual horizontal line
- Estimation of length
- Estimation of distances
- Halving of lines
- Estimation of angles
- Estimation of positions
- Estimation of shapes

Visual spatial operation
- Mental rotation
- Transformation performance (measure, angle, size transformations, tasks with varied spatial systems)

In contrast to the visual spatial perceptive performance, visual spatial operations require cognitive services in the form of an intermediate step separate from the stimulus material.

Basic functions of the visual spatial perception, such as estimating lengths, distances, size, and position of objects, estimating angles, and recognizing main spatial directions are of great relevance in everyday life, particularly in traffic. From following a straight line 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. Patients with technical professions who suffer from these deficits will often lose their positions and therefore are clearly more affected than others.
Several studies (von Cramon & Zihl, 1988; Kerkhoff & Marquardt, 1995) showed a statistical connection between visual-constructive and visual-spatial problems and impaired activities of daily living (ADL) where a causal relationship was discussed. This is not surprising when where there is dependency on an intact visual-spatial

perception and/or spatial-constructive subsets of the system and numerous activities of daily life:

- Dressing
- Folding laundry
- Estimating and separating amounts
- Decorating a table
- Tidying
- Grabbing objects
- Estimating the depth of steps/stairs
- Reading plans or sketches
- Filling in forms and documents
- Maintaining lines and columns while drawing
- Finding one's way
- Navigating a wheel chair

More complex disturbances to perception are often a result of disturbances to elementary visual tasks, such as depth perception. Loss of depth of vision means that everything appears to be flat (e.g., dice appear to be six cornered objects). 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 amblyopia, problems with shape and color perception which occurs in most cases after post-chiasmatic injuries.

Impaired visual localization of stimulus affects the appraisal of distances. The patient then overestimates or underestimates distances.

Impairments of the appraisal of the main visual spatial directions leads, in most cases, to a shift of the subjective vertical, horizontal, and straight directions. In the case of unilateral lesions, vertical and straight line direction perception is normally shifted to the side opposite the area of brain damage, the horizontal perception is mostly displaced equally to the vertical axis (von Cramon, 1988).

Visual spatial orientation problems express themselves in the loss of the spatial organization of a pattern of stimuli. This loss is often coupled with difficulties in measuring through impairments in the recognition or localization of spatial positions and regions as well as the ability for spatial imagination.

Visual spatial perception deficits are often correlated with visual-constructive impairments in a cause-effect relationship (von Cramon, 1988).

Spatial-constructive problems, or constructive apraxia, refer to the inability or decreased ability in patients with a brain injury to draw two-dimensional or three-dimensional shapes and figures correctly and/or to join elements of a figure together

to form a total figure.

While processing such tasks, length and angular distortions, changes in size or the erroneous ordering of individual elements of a total figure can occur, which are also sometimes reconstructed in a completely fragmented manner.

Also independent constructive performances like the drawing of a spatial series, for example a room is no longer possible with the above described/defined deficits.

A personal medical history of complaints is only useful for patients without visual neglect, anosognosia, or anosodiaphoria. For the patient group with reduced insight, Kerkhoff & Blaut (1992, Kerkhoff, et al., 1993) have developed an external clinical history form. To diagnose performance in visual-spatial perception, the following tests, such as line orientation, line halving, spatial sub tests in intelligence tests or the computer-assisted procedure, are suitable (Kerkhoff, et al., 1993). The latter registers elementary performances of the visual spatial perception in contrast to all other procedures. The tests for visual object and spatial perceptions (VOSP; Warrington & James, 1992) also tests for problems with basic visual functions which often occur together with constructive apraxia and are possibly the cause.

To diagnose spatial-constructive problems, the free copying of geometric or other patterns, the copying of perspective drawings, or the drawing test according to Grossmann (1988) are suitable. The Block Design or Picture Completion subtests from the Wechsler Adult Intelligence Scales–Revised (WAIS–IV; Wechsler, 2008), the Benton Test (Benton, 1981) or the Rey-Osterrieth-Figure (Osterrieth, 1944) are also suitable as diagnostic instruments.

2.2   Training aim

The aim of the training module **Spatial Operations** is the specific training of two dimensional visual spatial basic functions like the estimation of angles, the position of objects as well as the estimation of sizes and surfaces. The tasks for this module take into account the importance of the relevance to everyday life, like the filling of vessels of different forms. In addition, a therapeutic benefit in relation to more complex problems is expected when visual-spatial basic functions are improved. Each single module concentrates on a component visual-spatial basic functions while the involvement of other intellectual abilities is greatly reduced.

It is to be expected, that the improvement in the visual spatial basic performance has a favourable effect in the ADL area (Activities of Daily Living), because problems with spatial perception and spatial operations hinder numerous practical activities, in particular, if these activities depend on a precise visual-motor co-ordination.

Under the premise of maximum specificity of therapy, one should always precede with a differentiated problem specific neuro psychological diagnostic (for specific tests see basic functions).

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 above-mentioned basic functions as well as a continuous control/observation.

In addition, the training tasks beginning at level 7 train visual memory (except in the category of estimation of relations).

For additional training, the RehaCom module **Two-Dimensional Operations** (VRO1) can be used.

2.3 Target groups

The **Spatial Operations** training module is recommended for patients who suffer from impairments to their visual spatial perception and their spatial construction ability. Patients who are mostly affected are those whose brain has been damaged after posterior and/or parieto-occipital uni- and bilateral lesions or injuries to the visual system. In particular, visual-spatial problems often occur after right side parietal lesions.

The visual-spatial functions can be affected by various types of injuries to the brain (e.g., insult, hypoxia, TBI, tumors). Other patients who will also benefit from this training are patients with visuo-constructive problems, visual neglect, field of vision problems and patients with impairments to their objective perception due to deficits in their elementary visual capabilities.

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

In addition to hemiplegia, visual-construction and visual-spatial problems are the most important predictor for the rehabilitation process in patients with injuries to the right hemisphere of the brain (see Foundations).

It was repeatedly found that, for patients with left hemispheric hemiplegia, the rehabilitation process is unfavorable for deficits of visual perception (Kerkhoff, 1988).

The module can be used with children ages 8 years and older. When using this module as a part of therapy for a child, appropriate language suitable to the linguistic range of the average 8-year-old is used. A therapist must also be present at all times.

2.4 Bibliography

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