

HASOMED RehaCom[®]

Cognitive therapy



Spatial Operations 3D



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).

Germany / Europe / Worldwide:
HASOMED Hard- und Software für Medizin Gesellschaft mbH
Paul-Ecke-Str. 1
D-39114 Magdeburg

Tel: +49 (391) 610 7645
www.rehacom.com
info@rehacom.com

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

In the upper half of the screen, a three-dimensional object is shown. The patient can view it from all sides. In the bottom half of the screen are 3, 4, 5, or 6 objects which are similar to each other, but only one object matches the object at the top exactly. The objects on the bottom half can be viewed from all sides as well. The patient's task is to find the object which looks exactly like the object above. Overall, 432 three dimensional objects in 67 groups are available as training material.

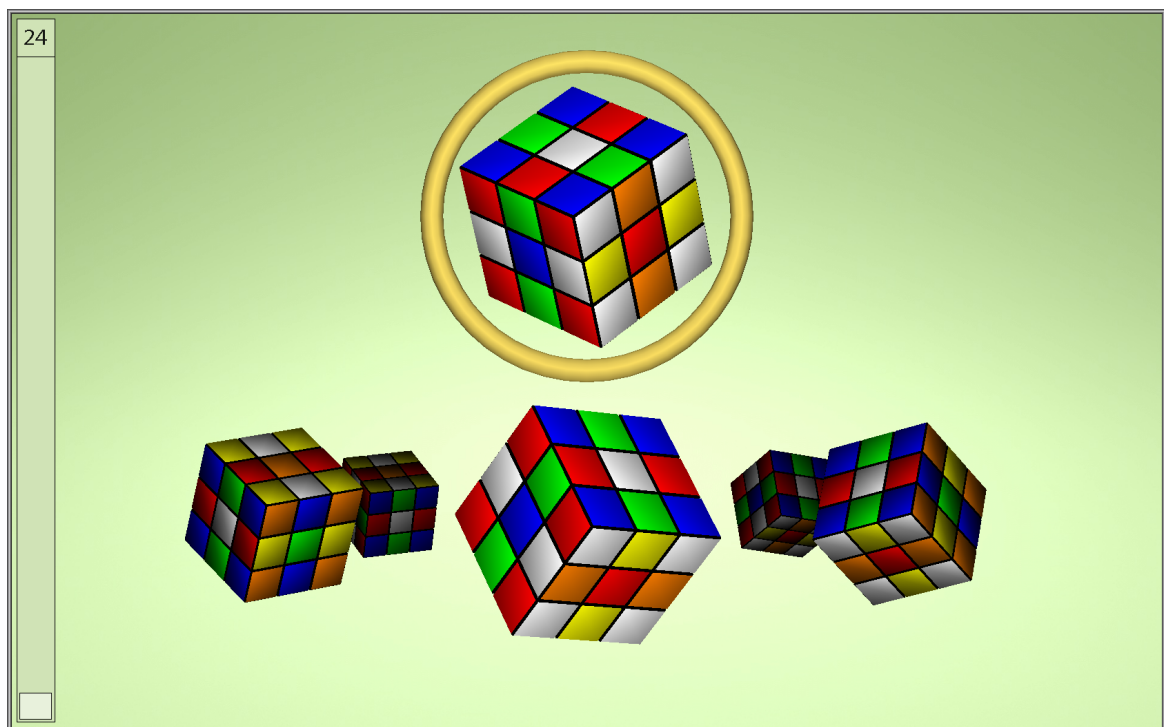


Fig. 1: Training screen

The selected object is always surrounded by a ring. That object can be turned in all directions with the movement of the mouse. The selection ring can be moved between the upper and lower screen half by using the **Up** and **Down** arrow keys. While the selection ring is in the bottom half of the screen, another object can be chosen for visual comparison with the cursor keys **Left** and **Right** arrow keys.

The selected object can be enlarged and rotated with the **plus “+”** button. By pressing the **plus “+”** button again, the enlarge object will reduce in size (switched back to the default trainings mode).

After the selection of an object by the patient

- the system evaluates the decision and the green field "CORRECT" or the red field "INCORRECT" lights up and

- a performance bar (see Fig. 1) changes according to the quality of the reaction.

When the performance bar reaches its maximum or disappears during the course of the training, the system switches to either the next or the previous level of difficulty. A verbal performance evaluation is provided that indicates whether the difficulty increases or decreases (see [Performance feedback](#)).

Furthermore, the task is the presentation of the object, the selection of an object by the patient, and the subsequent evaluation of the decision. The module can also be used without the RehaCom keyboard.

1.2 Performance feedback

When the patient chooses the correct object, the field "Correct" lights up in green and the selection ring turns green. Shortly after, the next task is presented. If the reaction was incorrect, the field "Incorrect" lights up in red and the selection ring turns red. After an incorrect reaction, the patient can check its choice by continuing to rotate all objects. The selection ring stays red until the patient has selected the correct object. After pressing the **OK** button, the next task is shown.

The function of the [Performance bar](#) was already mentioned. At the top of the performance bar is a number, which indicates the current level of difficulty.

1.3 Levels of difficulty

There are a total of 24 levels (see Tab. 1). Within the training, the degree of difficulty varies by using 3, 4, 5 or 6 comparable fields. Another modification of difficulty is achieved by starting the training with easy range of difficulty, which includes objects with the same area. Later, composed objects are used, which can be used with and without a direction note. A direction note can be a certain color or a striking point on an object, which is equal to all comparable fields. In the highest levels of difficulty, the complexity of the fields increases rapidly. The 6 ranges of difficulty are differentiated according to Tab. 2.

Level of difficulty	Number of the comparable fields	Range of difficulty
1	3	1
2	4	1
3	5	1
4	6	1
5	3	2
6	4	2
7	5	2

8	6	2
9	3	3
10	4	3
11	5	3
12	6	3
13	3	4
14	4	4
15	5	4
16	6	4
17	3	5
18	4	5
19	5	5
20	6	5
21	3	6
22	4	6
23	5	6
24	6	6

Tab. 1: Levels of difficulty

Range of difficulty	Level of difficulty	Description of range
1	1 - 4	Easy objects with the same area
2	5 - 8	Easy composed objects
3	9 - 12	Composed objects with a direction note
4	13 - 16	Composed objects without a direction note
5	17 - 20	Complex composed objects with a direction note
6	21 - 24	Complex composed objects without a direction note

Tab. 2: Range of difficulty

1.4 Training parameters

Specific settings for the training module can be adjusted (see Fig. 2). This section describes each setting and explains how to adjust them.

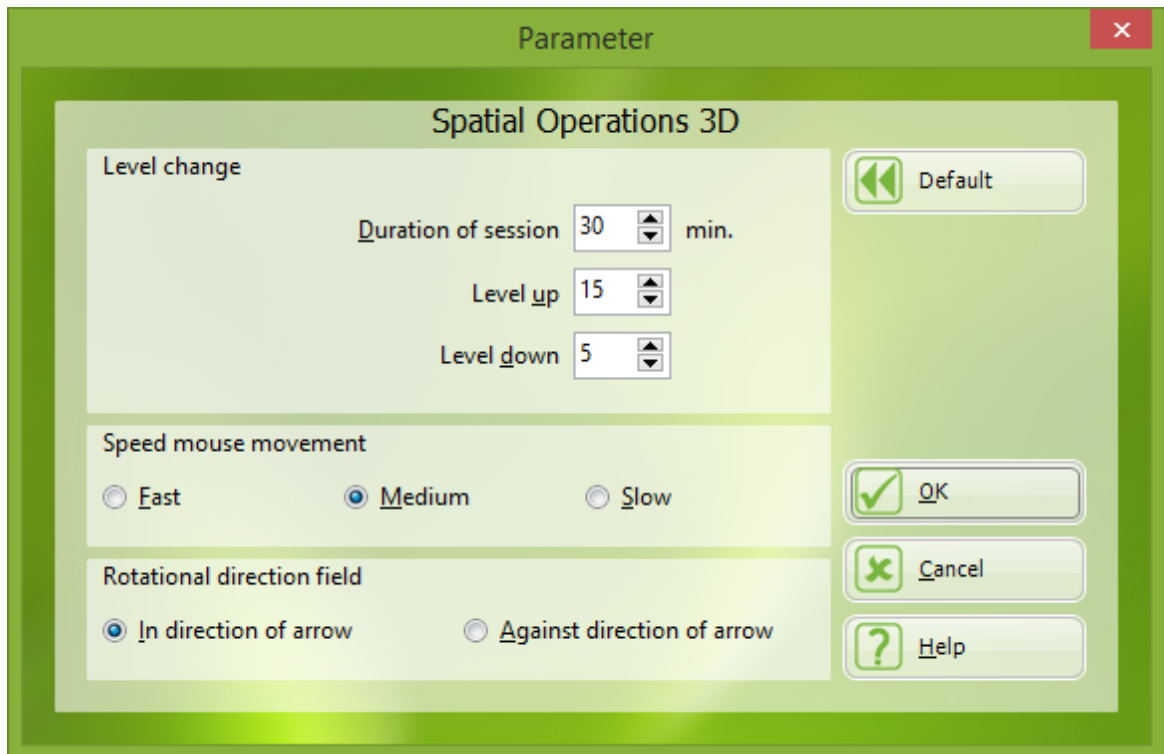


Fig. 2: Parameter menu

Duration of session in min:

A training time of 25 - 30 minutes is recommended.

Level up:

To reach the next higher level, the number of correct answers must exceed the number of incorrect answers by the number in the **Level up** setting. Incorrect decisions will reduce the performance bar on the left side of the screen while correct answers increase it. The next level begins when the performance bar reaches its maximum.

Level down:

The next lower level starts when the number of items solved incorrectly in succession is equal to the number in **Level down**, or if the performance bar reaches its bottom.

Speed mouse movement:

When selected, each 3D object is turned on its own axis by moving the mouse. The sensitivity of the mouse can be set to fast, medium, or slow. When the parameter is set to fast, the movement of the mouse causes a higher rotation of the object than the same movement of the mouse would do when the parameter is set to slow.

Rotational direction field:

During training, the comparison objects are arranged in a circle in three dimensional space. The selection of a new comparison object takes place with the **Left** and **Right** arrow keys. Depending on the setting, the **Left** arrow key will rotate the circle

of objects either to the left (setting "in direction of arrow") or to the right (setting "against direction of arrow").

When starting this training for a patient for the first time, the system automatically uses the following default values:

Current level of difficulty	1
Duration of session	30 min
Level up	15
Level down	2
Speed mouse movement	Medium
Rotational direction field	In direction of arrow

1.5 Data analysis

All training sessions are placed in a chart within the Results tab. A training session is selected by double clicking on the bar in the chart. Once selected, the results of the session are presented in the Table and Chart tab.

Explanation of columns in the results table or under More Details on the results page

Level	Current level of difficulty
Correct	Number of correct solutions in the level
Mistakes	Number of incorrect solutions in the level
Items in level	Number of comparable items in the level (3,4,5 or 6)
Items checked	Number of comparable items, which were checked
Items checked %	Checked items in the level in %
Quartil 1 reaction time	Reaction time quartile 1 in s
Median reaction time	Median of all reaction times in s
Quartil 3 reaction time	Reaction time quartile 3 in s
Train. time task	Effective consultation time in [h:mm:ss]
Breaks	Number of breaks caused by the patient

The values quartil 1 reaction time, median reaction time, and quartil 3 reaction time follow as quartile 1 and 3 as well as median of the reaction time in seconds. The reaction time describes the duration from the start of a task to the selection of an object by the patient. Reaction times are only recorded in these statistics if the answers were correct.

The parameter settings used during the training are displayed directly below the table. The graphical presentation of the results (e.g., percent correct, omissions) is

also displayed on the Table and Chart tab.

Because of this detailed analysis of the training, it is possible to indicate deficits to the patient and to draw conclusions for further training.

1.6 System requirements/Troubleshooting

System requirements:

To properly run the module **Spatial Operations 3D**, the following system specifications are required.

- Pentium I5 dual core processor
- 2GB RAM
- Direct3D graphics card with 32-bit color depth
- Graphics card with 256MB internal memory

Notes on how to use the DirectX diagnostic program "DXDiag"

Please first ensure that at least the DirectX version 9c is installed on your PC. For this purpose open the file DXDiag.exe. To find it insert "dxdiag" (without quotation marks) into the field "Run..." of the Start menu and then to click on OK.

The DirectX version can be read from the System tab of the DirectX diagnostic program. If a version is displayed, which is lower than version 9c, the current version of DirectX can be installed from the RehaCom-CD.

Change to the Display tab. You can find the device properties of your graphics card in the Device field. In the DirectX Functions section, DirectDraw Acceleration and Direct3D Acceleration must be enabled. If the DirectX functions are disabled, you have to download and install a new graphics card driver from the Internet. If you have the latest driver for your graphics card or this function cannot otherwise be enabled, a new graphics card has to be installed in the computer.

The module Spatial Operations 3D does not run without these DirectX functions enabled. If you have to install a new graphics card, we recommend graphic cards with a nVidia chipset.

If the module **Spatial Operations 3D** does not start, a window opens where different error messages are displayed indicating why the training could not be activated.

The following messages may appear:

Error message

Error not enough system memory

Troubleshooting

The internal memory is not large enough. The module Spatial Operations 3D only runs with an internal

	memory of at least 64 MB RAM. The internal memory has to be increased.
Direct3DCreate9 failed! Please install DirectX 9c or higher!	An outdated DirectX version is installed on the computer. Please install the DirectX version available from the RehaCom CD.
Your graphic adapter does not support 3D mode!	The 3D mode is not supported by your graphics card. Try to download a new graphics card driver from the Internet or install a new graphics card. Please also refer to the point "Notes on the DirectX diagnostic program DXDiag".
Direct3D9.CreateDevice failed!	Please install a new graphics card driver.
Device not supports enough Texturewidth/ Textureheight	Your graphics card can't display textures at a sufficient height and width. Please install a new graphics card.

2 Theoretical concept

2.1 Foundations

The patient's abilities in visual thinking and attention are trained. This is done by showing several three-dimensional objects on the screen which have to be compared with a reference object. All objects on the screen can be rotated freely so that a three-dimensional viewing is possible.

Visual thinking

In many places, spatial performances are still insufficiently examined and treated. It has been proven in several studies that the degree of independence in practical things is heavily dependent on the improvement of impaired spatial performances. The following spatial disorders are distinguished:

- disorders of visual spatial operations
- disorders of constructive performances
- disorders of visual spatial perception
- disorders of the perception of the own body axis

Disorders of visual spatial operations

The visual spatial operations include the mental rotation and transformation achievements. Mental rotation is the ability to rotate an angle of 45 degrees by, for example, 90 degrees. In contrast, the transformation achievement is the ability to estimate the scale ratio between different lines and angles.

Disorders of constructive performances

A disorder of spatial-constructive performances is characterized by, for example, existing difficulties in self-help performances like dressing or the faulty assembling of an entire figure from individual parts.

Disorders of visual-spatial perception

Disorders of visual-spatial perception affect the following basic functions:

- 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

Attention

The ability to focus one's attention is an important skill for coping with everyday demands. Only those things to which attention is focused can be recalled later.

Generally, *attention* is used to refer to selective attention, which is the selective and focused consideration of relevant stimuli while simultaneously suppressing irrelevant stimuli. This means selecting specific information in pursuit of a task, focusing mental effort on an objective, and ignoring unrelated facts. (-> [werner stangl's worksheets](#))

Empirical studies have shown that attention is not a uniform construct. In fact, the four attention aspects are to a large extent independent from each other and can be distinguished as follows ([Fimm](#), 1997; [Sturm](#), 1990; [Sturm, Hartje, Orgaß & Willmes](#), 1994):

- phasic activation, alertness
- selective attention
- divided attention
- tonic activation, vigilance

Phasic activation is defined as the ability to rapidly increase the activation level for a subsequent reflex situation, rapidly reaction to a warning stimulus (alertness). *Tonic activation*, however, is an attention level which stays stable for a longer period of time.

Selective attention is considered the action of focussing on specific aspects of one task while ignoring irrelevant stimuli. This ability to select and integrate defined stimuli/objects is closely linked to the term *power of concentration*, which is defined as a short-term attention span (lasting for several minutes) that allows for recognition of relevant stimuli ([Sturm](#), 1990).

Tasks requiring **divided attention** abilities have to include at least two stimuli to look for simultaneously.

Vigilance refers to attention abilities with small stimulus density over long periods of time. Attention abilities where situations present a high temporal density of relevant stimuli are referred to as continuous attention.

For the visual area, [Posner](#) and Rafal (1987) and also [Fimm](#) (1997) differentiate 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 increased distractibility, tendency to perseverate, or symptoms of neglect.

The ability to focus attention on relevant stimuli is dependent on internal variables (e.g., physiological state, cognitive processes, emotions) and external factors (e.g., stimulus intensity, contrast, color, shape, spatial relation). Attention can be focused automatically (i.e., involuntarily) through especially intense or novel stimuli (with high information content) by an orientation reflex. 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.

2.2 Training aim

The module is recommended for the therapy of cognitive disorders, in particular the treatment of functions of the spatial perception. The module can additionally be used to continue attention training on a high level.

Due to the usage of nonverbal material, also patients with limitation in speech and word comprehension can work with the module.

The aim of the module **Spatial Operations 3D** is the improvement of attention and concentration by training basic visual-spatial functions like the sense of direction, the sense of shape, the estimation of length and angle, as well as the ability to imagine structures in different planes and to keep those in mind.

Furthermore, a therapeutic benefit concerning disorders of visuo-motor coordination is expected with an improvement of deficits of selective attention performances and the basic visual-spatial functions. The improvement of attention offers a basis for training aims regarding further cognitive functions. It is of elementary importance for the treatment of memory disorders (taking in information as precondition for saving it).

It is to be expected that the improvement of basic visual-spatial functions has a favorable effect on the Activities of Daily Living (ADL), because problems with spatial perception and spatial operations hinder numerous practical activities.

This module can help with a differentiated detection of the underlying disorder of visual spatial perception or spatial operations in addition to being a tool for training the basic visual spatial functions as a follow-up.

For additional training, the RehaCom modules **Spatial Operations** (RAUM) and **Attention and Concentration** (AUFM) can be used.

2.3 Target groups

Visual thinking is connected to complex cognitive performances. On the one hand, it requires basal attention performances; on the other hand, considerable correlations with the ability of abstract reasoning were found in many studies. For patients with

severe intellectual impairment or with distinct attention disorders, the training is less suitable. Especially in higher levels of difficulty where small details have to be recognized, unimpaired vision is required.

The module is recommended for patients who suffer from attention disorders or have been diagnosed with visual-spatial perceptive or spatial-constructive disorders. The visual-spatial functions can be affected by various injuries to the brain (insult, hypoxia, TBI, tumors). Attention disorders after functional or organic interference are the most frequent neuropsychological performance deficits after brain damage ([Van Zomeren & Brouwer, 1994](#)). Attention deficits affect 80% of patients after stroke, traumatic brain injury, diffuse organic brain injury (e.g., alcohol abuse or intoxication) or other diseases of CNS. The present module is especially suitable for disorders of the selective attention.

Conceptual, one suggests different attention functions which can be disturbed selectively. Diffuse brain injuries after traumatic or hypoxic etiology are often followed by unspecific attention deficits such as rapid fatigue, an increased need for sleep, and a general loss of motivation. Localized insults, however (e.g., after vascular genesis), often lead to specific attention deficits. Fundamentally, insults of any cortex area can cause attention disturbances. Disturbances in phasic or tonic alertness and in vigilance have been reported after lesions of the brainstem in the region of the reticular formation or after lesions of the right parietal cortex. Left-sided cortical lesions, on the other hand, damage aspects of attention selectivity, and are especially noticeable in tasks requiring a choice between a range of stimuli and reaction alternatives (covert shift of attention) ([Sturm, 1990](#)).

Patients with [visuo-constructive disorders](#), visual neglect, visual field disorders, and impairments of objective perception due to deficits in their [elementary visual capabilities](#) will also benefit from a training of attention and spatial functions. Furthermore, this training task challenges the visual memory.

The module can be used with children age 8 years and older. The module uses child-friendly instructions for patients age 14 years or younger. A therapist should also be present.

2.4 Bibliography

Werner Stangl's worksheets (<http://arbeitsblaetter.stangl-taller.at>)

Ben-Yishay, Y., Piassetzky, E. & Rattock, J. (1987). A systematic method for ameliorating disorders in basic attention. In Meier, M., Benton, A. & Diller, L. (Ed.). Neuropsychological rehabilitation. Livingstone, Edinburgh: Churchill.

Brickenkamp, R. & Karl R. (1986). Geräte zur Messung von Aufmerksamkeit, Konzentration und Vigilanz. In Brickenkamp, R. (Hrsg.). Handbuch apparativer Verfahren in der Psychologie. Göttingen: Hogrefe.

- Cramon, D. v. (1988). Lern-und Gedächtnisstörungen bei umschriebenen zerebralen Gewebsläsionen. In Schönpflug, W. (Hrsg.). Bericht über den 36. Kongress der Deutschen Gesellschaft für Psychologie. Berlin.
- Fimm, B. (1997): Microanalyse von Aufmerksamkeitsprozessen. In: Gauggel, S. & Kerkhoff, G. (Hrsg.): Fallbuch der Klinischen Neuropsychologie. Praxis der Neurorehabilitation. Göttingen: Hogrefe. S. 25-38.
- Fröhlich, W. D. (1987). *Wörterbuch zur Psychologie*. München, Germany: DTV.
- Gray, J. & Robertson, I.H. (1989). Remediation of attentional difficulties following brain injury: three experimental single case studies. *Brain Injury*, 3, 163-170.
- Keller, I. (1997): Aufmerksamkeitsstörungen. In: Gauggel, S. & Kerkhoff, G. (Hrsg.): Fallbuch der Klinischen Neuropsychologie. Praxis der Neurorehabilitation. Göttingen: Hogrefe. S. 39-47.
- Lauth, G. W. (1988). Die Vermittlung handlungsorganisierender und handlungsregulierender Komponenten in der Therapie von Aufmerksamkeitsstörungen. In Schönpflug, W. (Hrsg.). Bericht über den 36. Kongress der Deutschen Gesellschaft für Psychologie. Berlin.
- Lauth, G. W. & Schlottke, P.F. (1988). Aufmerksamkeitsstörungen. In Schönpflug, W. (Hrsg.). Bericht über den 36. Kongress der Deutschen Gesellschaft für Psychologie. Berlin.
- Niemann, T. & Gauggel, S. (1997): Computergestütztes Aufmerksamkeitstraining. In: Gauggel, S. & Kerkhoff, G. (Hrsg.): Fallbuch der Klinischen Neuropsychologie. Praxis der Neurorehabilitation. Göttingen: Hogrefe. S. 48-59.
- Poser, U.; Kohler, J.; Sedlmeier, P. & Strätz, A. (1992): Evaluierung eines neuropsychologischen Funktionstrainings bei Patienten mit kognitiver Verlangsamung nach Schädelhirntrauma. *Zeitschrift für Neuropsychologie*, 1, 3-24.
- Posner, M. & Rafal, R. (1987). Cognitive theories of attention and the rehabilitation of attentional deficits. In: Meier, M., Benton, A. & Diller, L. (Ed.). *Neuropsychological rehabilitation*. Edinburgh, London: Churchill Livingstone.
- Poeck, K. (1989). (Hrsg.). *Klinische Neuropsychologie*. Stuttgart, New York: Thieme-Verlag.
- Polmin, K.; Schmidt, R.; Irmeler, A. & Koch, M. (1994): Effektivität eines ambulanten neuropsychologischen Aufmerksamkeits- und Gedächtnistrainings in der Spätphase nach Schädel-Hirn-Trauma. Referat der Jahrestagung der Österreichischen Gesellschaft für Neurorehabilitation.

Saring, W. (1988). Aufmerksamkeit. In Cramon, D. v. & Zihl, J. (Hrsg.). Neuropsychologische Rehabilitation. Berlin, Heidelberg, New York: Springer-Verlag.

Sohlberg, M.M. & Mateer, C.A. (1987): Effectiveness of an Attention Training Program. Journal of Clinical and Experimental Neuropsychology, 9, 117-130.

Sturm, W. (1990): Neuropsychologische Therapie von hirnschädigungsbedingten Aufmerksamkeitsstörungen. Zeitschrift für Neuropsychologie, 1 (1), 23-31.

Sturm, W., Dahmen, W., Hartje, W. & Wilmes, K. (1983). Ergebnisse eines Trainingsprogramms zur Verbesserung der visuellen Auffassungsschnelligkeit und Konzentrationsfähigkeit bei Hirngeschädigten, Arch. Psychiatr. Nervenkr. 233, 9-22.

Sturm, W.; Hartje, W.; Orgaß, B. & Willmes, K. (1994): Effektivität eines computergestützten Trainings von vier Aufmerksamkeitsfunktionen. Zeitschrift für Neuropsychologie, 1, 15-28.

Sturm, W.; Willmes, K. & Orgaß, B. (1997): Do Specific Attention Deficits Need Specific Training? Neuropsychological Rehabilitation, 7 (2), 81-103.

Van Zomeren, A.H. & Brouwer, W.H. (1994): Clinical Neuropsychology of Attention. Oxford: Oxford University Press.

Wenzelburger, K.T. (1996): Veränderung und Trainierbarkeit kognitiver Funktionen bei alkoholabhängigen Patienten im Entzug - eine kontrollierte Verlaufsstudie. Dissertation an der medizinischen Fakultät der Eberhard-Karls-Universität Tübingen.

Zimmermann, P. & Fimm, B. (1989): Neuropsychologische Testbatterie zur Erfassung von Aufmerksamkeitsdefiziten. Freiburg: Psychologisches Institut der Universität.

Krämer, S.; Walter K.-D. (1996): Konzentration und Gedächtnis;

Prosiegel, M.; (1998) Neuropsychologische Störungen;

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