HASOMED
RehaCom®

Cognitive therapy

Alertness Training

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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).

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 Alertness training module was developed for use with patients who have neurological or psychiatric disorders related to attention activation. The module focuses on improving the phasic and the tonic aspects of alertness.

In this training module, the patient is asked to press a button when a given stimulus appears. The program measures the responses of the patient and determines if he or she is able to work with other stimuli, scenarios, and/or interstimulus intervals.

Fig. 1: Training interface without cockpit

The module uses real images to train the patient's alertness functions. The patient is presented with a traffic situation. An object (e.g., an animal, vehicle, or person) suddenly pops up on the road (see Figs. 1 and 2). The patient has to press the OK button as soon as possible once the object appears.

There are 16 levels available for the training. Twenty objects are presented for each level. Depending on the number of correct reactions, the patient will either reach the next higher level (if there is a timely reaction to 90% of all presented objects), stay at the current level (if there is a timely reaction between 75 and 90% of all objects), or step down a level. These default settings can be changed at any time by the therapist (see Training parameters).

Fig. 2: Training interface with cockpit

Levels 1-6 are designed to improve phasic alertness. Before the stimulus appears, the patient is warned by a sound. The stimulus is presented on the screen in a stochastically calculated timeframe (1250–3750 ms; see Training parameters). The patient has up to 1250 milliseconds to react to each stimulus in the first level. The maximum reaction time decreases automatically as the level increases (see Levels of difficulty).
Starting with Level 7, the training tasks are designed to improve tonic alertness. At this level and higher, the patient does not hear a warning sound prior to the presentation of stimuli. For all levels, the interstimulus intervals vary by as much as 50% more or less than the set time between the objects (see Training parameters).

A total of 32 scenarios and 48 different objects are available for the training.

An optional setting includes choosing a cockpit view within the parameter menu (see Fig. 2).

1.2   Performance feedback

The patient receives feedback after the set number of stimuli were presented. The number of stimuli can be adjusted in the parameter menu. The feedback contains the number of times the patient was able to react in time during the task.
The patient is informed whenever the level will increase ("Training will continue with a more difficult task."), stay the same ("Training will continue with the same level of difficulty.") or decrease ("Training will continue with a less difficult task."). Upon reaching the highest level, the patient is told about his/her success ("You have

reached the highest level. Training will continue at this level to strengthen your abilities."). As long as the task is completed accurately (≥ 90% accuracy [see Training parameters]), the patient will continue to repeat the highest level until the consultation time expires.

No immediate feedback is given to the patient if objects are missed during the training.

After 60 seconds without pressing any button, a promt displays: "You did not react to the objects. Press the **OK** button as soon as an object appearson the screen! **Press OK to continue**!"

1.3   Levels of difficulty

Level	Background	Warning sound	Maximum reaction time for long reaction times [ms]	Maximum reaction time for short reaction times [ms]	Stimulus location	bw/color	**relevant** item	Hints and Signs
1	a) Country road b) Country road	yes	1200	700	central	bw	**6** -> a) 6 Vehicles **6** -> b) 6 Vehicles	no
2	a) Forest path b) Forest path	yes	1150	670	central	bw	**6** -> a) 6 Animals **6** -> b) 6 Animals	no
3	a) Village road b) Village road	yes	1100	640	central	color	**6** -> a) 6 Vehicles **6** -> b) 6 Vehicles	with traffic sign
4	a) Village road b) Village	yes	1060	610	right-left	color	**8** -> a) 8 Vehicles **8** -> b) 8 Vehicles	with traffic sign

	road							
5	a) Country road b) Country road	yes	1020	580	right -left	color	**8** -> a) 8 Vehicles **8** -> b) 8 Vehicles	with traffic sign
6	a) Village road b) Village road	yes	980	550	right -left	color	**8** -> a) 6 Vehicles, 1 Animal, 1 Person **8** -> b) 6 Vehicles, 1 Animal, 1 Person	with traffic sign
7	a) Country road b) Country road	no	940	520	right -left	color	**8** -> a) 8 Vehicles **8** -> b) 8 Vehicles	with traffic sign
8	a) Country road b) Country road	no	900	490	right -left	color	**8** -> a) 8 Vehicles **8** -> b) 7 Vehicles, 1 Person	with traffic sign
9	a) City road b) City road	no	870	470	vari ed	color	**8** -> a) 7 Vehicles, 1 Animal **8** -> b) 7 Vehicles, 1 Person	with traffic sign
10	a) Village road b) Village road	no	840	450	vari ed	color	**8** -> a) 3 Vehicles, 5 Animal **8** -> b) 3 Vehicles, 5 Animal	with traffic sign
11	a) Village road b) Village road	no	810	430	vari ed	color	**10** -> a) 6 Vehicles, 4 Persons **10** -> b) 6 Vehicles, 1 Animals, 3 Person	with traffic sign

12	a) City road b) City road	no	780	410	varied	color	**10** -> a) 6 Vehicles, 1 Animal, 3 Persons **10** -> b) 7 Vehicles, 3 Persons	with traffic sign
13	a) Forest path b) Forest path	no	750	390	varied	color	**10** -> a) 10 Animals **10** -> b) 10 Animals	with traffic sign
14	a) City road b) City road	no	720	370	varied	color	**10** -> a) 5 Vehicles, 1 Animal, 4 Persons **10** -> b) 3 Vehicles, 2 Animals, 5 Persons	with traffic sign
15	a) City road b) City road	no	700	350	varied	color	**12** -> a) 6 Vehicles, 1 Animal, 5 Persons **12** -> b) 6 Vehicles, 2 Animals, 4 Persons	with traffic sign + traffic lights
16	a) City road b) City road	no	680	330	varied	color	**14** -> a) 5 Vehicles, 3 Animals, 6 Persons **14** -> b) 5 Vehicles, 3 Animals, 6 Persons	with traffic sign + traffic lights

Tab 1.: Structure of difficulty

1.4   Training parameters

Specific settings for the training module can be adjusted (see Fig. 3). This section describes each setting and explains how to adjust them.

Fig. 3: Parameter settings

Level change

Duration of session:
In the parameter menu the session duration can be individually set for each patient. The duration should be chosen dependent on the resilience of the patient, and can be set between 5–60 inutes. The default time is 10 minutes.

Level up:
To go to the next level, the patient must react correctly to the given percentage of stimuli. The default value is 90%.

Level down:
The patient will go to an easier level if the number of reactions is less than or equal to the given percentage of stimuli. The default value is 75%.

If the percentage of correct reactions is between the Level up and Level down values, the current level will be repeated.

Number of items:
The number of stimuli per level can be adjust from 5–100. The default number of stimuli is 20.

Interstimulus intervals

The declared values are set as approximate values. The interstimulus intervals will vary by as much as ± 50% of the set value.

Before item:

Approximate time before the next warning sound or object is presented. The value can be changed to any number between 250 and 100,000 ms. The default value is set at 2500 ms.

From sound until item:
Approximate time between the warning sound and object appearing on the screen. The value can be changed to any number between 100 and 10,000 ms. The default value is set at 1500 ms.
This time interval is omitted if no warning sound is enabled.

After item:
Interval after the stimulus was hidden. The value can be changed to any number between 100 and 10,000 ms. The default value is set at 500 ms.

Automatic abort of module
Time before warning:
If there is no reaction within the given time, instructions will appear on the screen, requesting that the patient reacts.

Time after warning:
If there is no reaction after the warning for the given time, the training will be stopped.

Reaction times
Fixed response time:
When this option is chosen, the same maximum reaction time will be used for all levels.

The maximum reaction times defined in the Levels of difficulty will be ignored in that case.

Longer/Shorter response time:
Maximum reaction time for all levels will be used according the Levels of difficulty section.

Show cockpit:
When this option is chosen, the dashboard of an automobile will be displayed to simulate sitting in the driver's seat.

Warning sound
Depending on level:
The warning sound will be played as defined in the Levels of difficulty section. This means that only levels 1–6 will have warning sounds before the presentation of visual stimuli.

Sound off:

If this is selected, **no** warning sound will be played for any of the levels, independent of [Levels of difficulty](#).

Sound on:
If this is selected, a warning sound will be played for all levels, independent of [Levels of difficulty](#).

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

Current level of difficulty	1
Duration of Session	10 minutes
Level up	90%
Level down	75%
Number of items	20
Interstimulus intervals Before item	2500 milliseconds
Interstimulus intervals From sound until item	1500 milliseconds
Interstimulus intervals After item	500 milliseconds
Automatic abort of module Time before Warning	60 seconds
Automatic abort of module Time after Warning	60 seconds
Response time	Longer response time
Warning sound	Depending on level
Show cockpit	off

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 (see Fig. 4).

HASOMED **RehaCom** ® **Alertness Training**						3. Session Duration: 1 Minutes	
Task	**Level**	**Items**	**Correct**	**Correct [%]**	**Omissions**	**React. interstim.**	**Median react. time [ms]**
1	9	5	3	60	2	0	500
2	10	5	4	80	1	0	362
3	11	5	2	40	3	0	360
4	11	5	5	100	0	0	297
5	12	5	3	60	2	0	400

Trainings Settings:
Level up [%]: **60**; Level down [%]: **35**; Number of items: **5**; Warning sound activated: **Depending on level**;
Interval before activation [ms]: **250**; Interval between warning sound and item [ms]: **100**; Interval after item [ms]: **100**; Reaction times: **Longer response time**;
Show cockpit: **No**; Time until warning for aborting module [s]: **60**; Time from warning until aborting module [s]: **60**;

Number of correct reactions within reaction time max. [%]
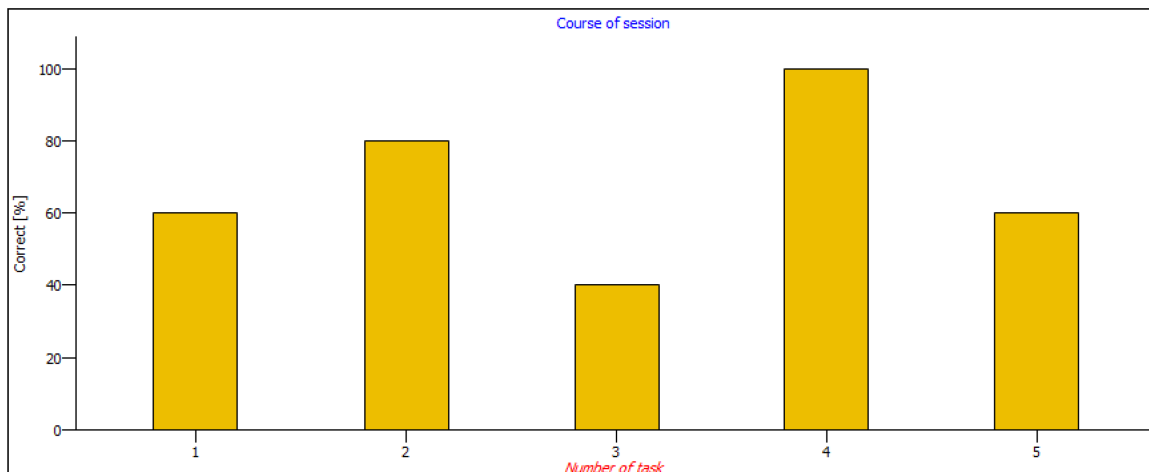
Median reaction time [ms]
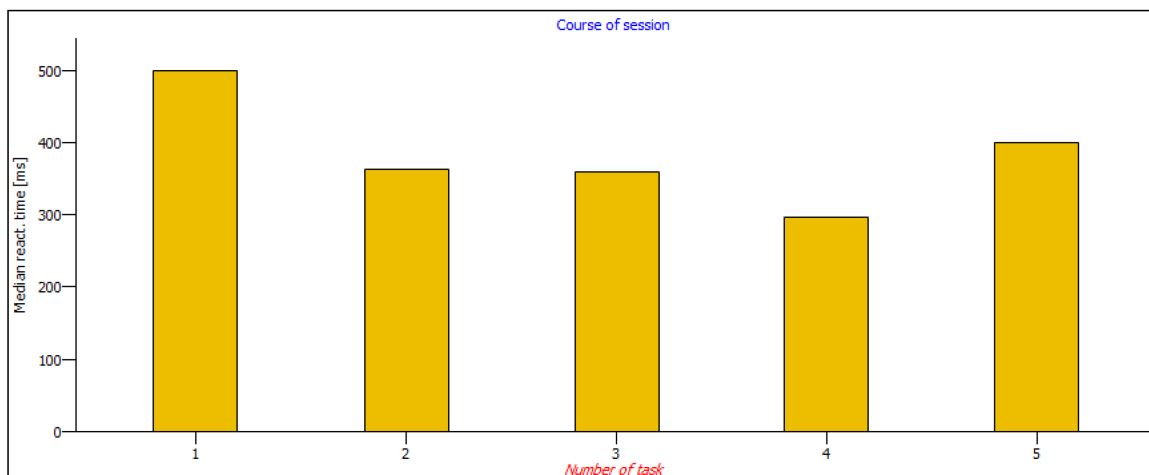
Fig. 4: Results of training

In the results table at the top of Fig. 4, the data for the training are displayed.

Explanation of columns in the results table

Items	Number of presented stimuli per task
Correct	Number of correct reactions within maximum reaction time (see Level of difficulty)
Correct [%]	Number of correct reactions within maximum reaction time out of all possible correct in percent (see Level of difficulty)
Omissions	Number of omitted stimuli (no reaction or out of max reaction time)
React. interstim.	Number of reactions during the interstimulus interval
Median react. time [ms]	Median reaction time per level

The parameter settings used during the training are displayed directly below the table. The graphical presentation of the results (percent correct per task, median reaction time per task) is also displayed on the Table and Chart tab.

2 Theoretical concept

2.1 Foundations

The Alertness therapy module presupposes complex psycho-physiological performance skills which allow individuals to react in a specific manner to particular external stimuli. Phasic attention parameters have a big role to play in this module.

Phasic activation is defined as the ability to increase the activation level for a subsequent reflex situation, rapidly reacting to a warning stimulus (alertness), while **tonic activation** is designated for a relatively long, stable attention level.

In relation to the above terms, the term **selective attention** refers to focusing on specific aspects of a task, reacting in a designated manner to a relevant stimulus and ignoring a irrelevant stimulus. (Sturm, Hartje, Orgaß, & Willmes, 1994).

The ability to focus one's attention is a fundamental prerequisite for a general capability with regard to different cognitive functions.

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 relationship).
Attention can be focused automatically (i.e., involuntarily) through especially intense or novel stimuli (with high information content) by an orientation reflex.

Sternberg (1969; as cited by Keller & Grömminger, 1993) distinguishes four stages in his **action oriented model of attention** :
1. Perception,
2. Identification of relevant stimuli,
3. Choice of reaction, and
4. Activity of a motor program in response to the stimuli.

These processes are partly automatic; and when specific aspects of situations are detected, active analysis processes are set in motion. Automatic processes operate in a smaller capacity in parallel, whilst all other processes require serial manipulation. This provides for a larger attention capacity and therefore can be dealt with more slowly.

In each reaction, there are several distinct phases:
- Increased attention level in expectation of a stimulus
- Presentation of stimulus
- Latency phase
- Decision time
- Motor action

Reaction time is the description for the length of time between the presentation of

the stimuli and the execution of a simple motor reflex. It consists of the **latency time** (duration of the excitement in the nervous system) and the **decision time** (duration of information processing) ([Fröhlich](#), 1987).

The reaction rate is seen in connection with the rate of information processing, whose most frequent operation represents the investigation of simple and complex stimulus reaction experiments ([Säring, 1988](#)).

[Münsterberg](#) (1924) makes a distinction between *simple- and multiple-choice reactions*.
- Simple-choice reactions refer to decisions where a reaction only to a relevant stimulus is expected even though several stimuli are presented.
- Multiple-choice reactions refer to decisions where one is expected to react differently to several relevant stimuli.

The reaction to relevant stimuli in a multiple-choice reaction is influenced by additional factors:
- Type of stimulus (acoustic, optical, thermal, etc.),
- The differentiation between type and degree of stimuli,
- Rate of appearance of relevant stimuli, and
- The possibility of associative coupling between stimulus and reaction.

Intellectual and practical activities are impeded by **attention and concentration problems,** which can be expressed in reduced photo and processing capacity, reduced information processing speed, rapid fatigue and above all an increase in distraction at a considerable measure.

[Disturbances to attention](#) include issues like *slowness of reaction* and an increased error count in different tasks. *Disturbances in Attention are caused most frequently by neurological performance deficiencies after brain damage to different areas or sources in the organic tissue of the brain* ([Van Zomeren & Brouwer](#), 1994). Disturbances to the [reaction capabilities](#) are found in approximately 70% of patients.

Above all, a slowing-down in reaction time and/or information processing speed is often observed ([Poeck & Hartje](#), 1989; [Sturm, Dahmen, Hartje, & Willmes](#), 1983; [Säring](#), 1988; [Benton](#), 1986). [Regel, Krause, and Krüger](#) (1981) consider the cognitive slow-down to be a main symptom of cerebral impairment.

In a psychological performance diagnostic, especially in clinical-neuropsychological assessment, tests have a firm place for the examination of attention and reaction capabilities ([Zimmermann & Fimm](#), 1989).

The attention fields mentioned at the beginning can be separated diagnostically by assigning different tasks to each of them.

Reaction behavior is often dealt with in connection with determination tasks. The following parameters should be considered:

- the required time,
- the number and kind of mistakes made,
- the development of mistakes over time or
- the processed amount of the submitted material in relation to overcoming defined tasks.

The advantages of such a diagnostic procedure lies in the extraction of measurable variables, both intra- (development of the illness, therapy evaluation) as well as interindividual comparisons (depending on the measurements of a normative group).

The sections Training aim and Target groups provide further information.

2.2   Training aim

The Alertness module's training aim is to improve the patient's **exactness and reaction speed** in relation to a set of given visual stimuli with and without a warning sound. By using simple reaction tasks, the patient's reactions to given stimuli—related to realistic traffic situations—is trained.

More recent research results recommends a differential approach to training, which deals with specifically targeted disturbances in attention, because less theoretically based or unspecific training tests have not been successful in all aspects of attention (Gray & Robertson, 1989; Sohlberg & Mateer, 1987; Poser, Kohler, & Sedlmeier, 1992; Sturm, Hartje, Orgaß, & Willmes, 1994; Sturm, Willmes, & Orgaß, 1997).

The module has also demands for visual performances. Furthermore, as with all cognitive tasks after a certain length of time, demands are also put on the patient's continuous attention capabilities.

Experience shows (Fernández et al., 2012) that computer-based training of one or more attention components is particularly successful if carried out in the post acute phase after the insult. In addition to the functional training, the computer gives *systematic feedback* to the patient which can improve his/her self-observation and thus teach him/her how to cope with his/her *attention resources*. The patient also has the chance to improve self-perception and thereby the optimal allocation of the program's attention resources are fully used. From a therapeutic point of view, it is important that, along with the confrontation of existing deficiencies, information transmission and individual coping and compensation strategies are developed (for example, the prevention of particular **stresses** or the use of external help by association with specific standard situations). Here, relatives could also assist in order to reduce stress levels.

On the basis of the first results and/or continuous diagnostic, it should be decided

whether to use the training module **Alertness training** (ALTA) alone, or in conjunction with other modules. (e.g., **Reaction behavior** [REVE], **Attention & Concentration** [AUFM], **Divided Attention** [GEAU], **Vigilance** [VIGI]).

2.3   Target groups

The use of this module is recommended for patients who suffer from diagnosed impairments to reaction speed/safety which have been caused by disturbances to memory or lesions to the brain.
Disturbances in reaction capabilities can occur after modal specific or unspecific neuropsychological illnesses. This is also true for disturbances in attention.

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

Assuming all the specific deficiencies of the different aspects of attention have been taken into consideration, then this training module could also be used.
This particular module is suitable for patients who suffer from disturbances that affect phasic activation and selective attention.

Patients who suffer from a type of motor sickness (e.g., partial paralysis) have the possibility to train their reaction speed with their dominant or healthier hand.

The demanding nature of the stimuli in this module on patients who suffer from a strong dysexecutive syndrome (which occurs after injuries to the frontal area of the brain) can have a positive effect on their reaction capabilities.

Under the premise of maximum specificity and to achieve the highest possible efficiency of training,
a differentiated neuropsychological diagnosis should be prerequisite for the creation of a therapy plan including computer-based procedures.

Excluded from the diagnostic are:
- serious visual deficits, and
- strong disturbances in attention.

2.4   Bibliography

Benton, A. (1986). Reaction time in brain disease; some reflections. *Cortex, 22*, 129–140.

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

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

Fernández, E., Bringas, M. L., Salazar, S., Rodríguez, D., García M. E., & Torres, M. (2012). Clinical impact of RehaCom software for cognitive rehabilitation of patients with acquired brain injury. MEDICC Review, 14(4), 32–35.

Fimm, B. (1997): Microanalyse von Aufmerksamkeitsprozessen. In S. Gauggel, & G. Kerkhoff, (Eds.), *Fallbuch der klinischen Neuropsychologie. Praxis der Neurorehabilitation* (pp. 25–38). Göttingen, Germany: Hogrefe.

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 S. Gauggel, & G. Kerkhoff, (Eds.), *Fallbuch der klinischen Neuropsychologie. Praxis der Neurorehabilitation* (pp. 39–47). Göttingen, Germany: Hogrefe.

Keller, I., & Grömminger, O. (1993). Aufmerksamkeit. In D. Y. von Cramon, N. Mai, & W. Ziegler, (Eds.), *Neuropsychologische Diagnostik*. Weinheim, Germany: VCH.

Münsterberg, H. (1924): Grundzüge der Psychologie. In T. Ziehen, (Ed.), *Allgemeine Psychologie*. Berlin, Germany: PAN-Verlag.

Niemann, T., & Gauggel, S. (1997). Computergestütztes Aufmerksamkeitstraining. In S. Gauggel, & G. Kerkhoff, (Eds.), *Fallbuch der klinischen Neuropsychologie. Praxis der Neurorehabilitation* (pp. 48–59). Göttingen, Germany: Hogrefe.

Poeck, K., & Hartje, W. (1989). *Klinische Neuropsychologie*. Stuttgart, Germany: Thieme.

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 M. Meier, A, Benton, & L. Diller (Eds.), *Neuropsychological rehabilitation*. Edinburgh, London: Churchill Livingstone.

Regel, H., & Fritsch, A. (1997). Evaluationsstudie zum computergestützten Training psychischer Basisfunktionen. Abschlußbericht zum geförderten Forschungsprojekt. Bonn, Germany: Kuratorium ZNS.

Regel, H., Krause, A., & Krüger, H. (1981). Konfigurationsfrequenzanalytische Einschätzung einiger psychometrischer Verfahren zur Hirnschadensdiagnostik. *Psychiatrie, Neurologie, medizinische Psychologie 33*, 347.

Säring, W. (1988). Aufmerksamkeit. In D. von Cramon, & J. Zihl (Eds.), *Neuropsychologische Rehabilation*. Berlin, Germany: Springerverlag.

Sohlberg, M. M., & Mateer, C. A. (1987). Effectiveness of an attention training program. *Journal of Clinical and Experimental Neuropsychology, 9*, 117–130.

Sternberg, S. (1969). Memory-scanning: Mental processes revealed by reaction-time experiments. American Scientist, 57, 421-457.

Sturm, W. (1990): Neuropsychologische Therapie von Hirnschädigungsbedingten Aufmerksamkeitsstörungen. *Zeitschrift für Neuropsychologie, 1*(1), 23–31.

Sturm, W., Dahmen, W., Hartje, W., & Willmes, K. (1983). Ergebnisse eines Trainingsprogramms zur Verbesserung der visuellen Auffassungsschnelligkeit und Konzentrationsfähigkeit bei Hirngeschädigten, *Archiv für Psychiatrie und Nervenkrankheiten, 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.

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

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