HASOMED

RehaCom®

Cognitive therapy

Vigilance

www.rehacom.com

HASOMED

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).

Germany / Europe / Worldwide:
HASOMED GmbH
Paul-Ecke-Str. 1
D-39114 Magdeburg

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

USA:
Pearson Clinical Assessment
19500 Bulverde Road, Suite 201
San Antonio, TX 78259-3701

Phone: 1-888-783-6363
www.pearsonclinical.com/RehaCom
rehacominfo@pearson.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.

Table of contents

© 2019 HASOMED GmbH

1 Training description

1.1 Training task

The training module Vigilance has the patient work as a high-quality controller at the end of a manufacturing line in a factory (drink and/or canned food production, furniture industry, electronics manufacturing or production of budget subjects) to achieve high ecological validity.

The patient's task is to test objects which glide by as if on an assembly line (bottles, piece of furniture, electronics item and so forth) and to remove from the assembly line the objects which do not match the constantly visible high-quality standard.

Fig. 1 is an example of a training level. The assembly line appears in the horizontal area in the middle of the screen. Here, the objects glide continuously and in a smooth fashion from left to right.

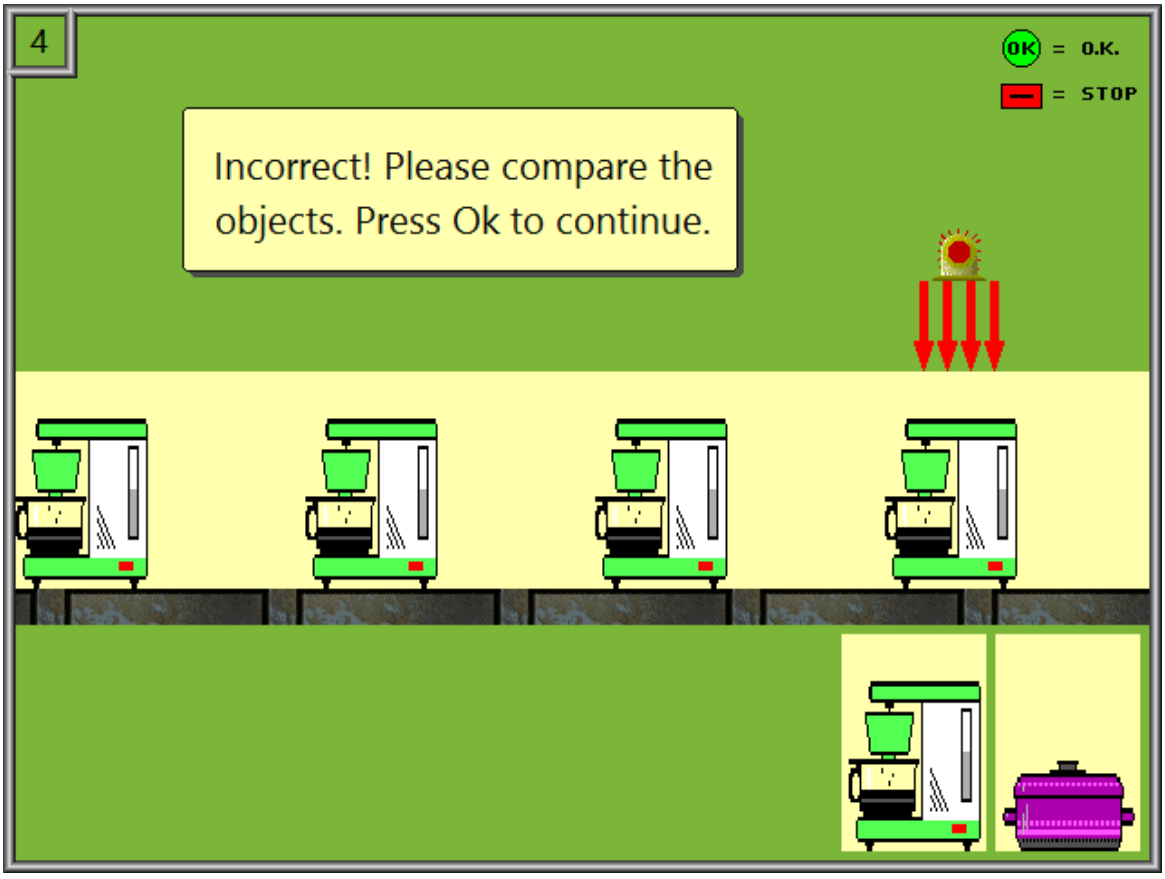

Fig. 1: An example of the training at a difficulty level of 4 at the moment of a notification of error. The patient pressed the OK key when a correct object was under the arrows.

Each task has 2 phases:

- the preparation phase, and

© 2019 HASOMED GmbH

- the working phase.

During the preparation phase, the patient is shown the quality standard. The patient is advised to remember all the aspects of the object or objects. The patient can end the preparatory phase by pressing the **OK** key.

The working phase then follows. At the end of the assembly line, on the right-hand side, there are 4 arrows which mark the area where a defective object can be removed by pressing onto the **OK** key. The patient must spot that there is something wrong with the object and then press **OK** when the defective object is under the arrows. The object then disappears from the assembly line.

The objects, which symbolize the high-quality standard, are constantly visible under the assembly line. Any objects that differ from the standard object should be removed.

Above the arrows of the area where incorrect objects have to be removed, there is a light which provides a type of visual feedback: it lights up green during a correct decision and red when an incorrect decision is made.

Only particular keys should be used for the Vigilance training module. The **OK** key should be used for selecting defective objects, and the red "-" key can be used by the patient to interrupt training and review the instructions. No other keys should be used.

In the top left corner of the screen is a number displaying the current level of difficulty.

The patient's decisions are evaluated and any incorrect decisions are distinguished as one of the following types of errors:

- a defective object was overlooked (omissions), or
- a correct object was incorrectly selected by pressing the **OK** key (mistakes).

The number and the types of error are registered and form the basis for an adaptive training therapy using the **Vigilance** module**.**

1.2 Performance feedback

A visual and/or an acoustic feedback are available during the training. The visual feedback (green or red light) is described in training task. If acoustic feedback is enabled, different sounds occur during correct and incorrect reactions.

The text / autostop feedback is recommended especially for weaker patients. If an error is made, the assembly line stops to give the patient time to compare the object

© 2019 HASOMED GmbH

on the assembly line to the quality standard. The assembly line is turned on again when the patient presses the **OK** key.

1.3 Levels of difficulty

The module works in an adaptive way. It uses 5 graphic pools of solid objects (furniture, bottles, glasses, small and big household objects) and 3 pools with abstract objects (symbols, geometric figures). Each object has 3 variations (easy, medium, difficult), which are used to specify the differences in the defective objects from the original objects.

The difficulty of tasks increases in two ways: the number of the objects (number of the high-quality standards) to be matched increases and the differences from the standard object become smaller and less obvious.

In determining the level of difficulty, one must distinguish between the processing of abstract objects and concrete subjects. For both classes, there are 15 difficulties (see Tab. 1):

level of difficulty	image difficulty	no. of standard objects
1	low	1
2	medium	1
3	high	1
4	low	2
5	medium	2
6	high	2
7	low	3
8	medium	3
9	high	3
10	low	4
11	medium	4
12	high	4
13	low	5
14	medium	5
15	high	5

Tab. 1: Structure of the levels of difficulty.

After the completion of a task (processing a determined number of objects), the module computes the number of correct decisions in relation to the number of total objects as a percentage. If this percentage exceeds the threshold defined as **"continue to the next level"**, the patient then trains the next level of difficulty. If the percentage falls below the value defined as **"repeat the previous level"**, then the patient must repeat the previous level to the one he was working on. If the percentage falls between **"continue to the next level"** and **"repeat the previous**

© 2019 HASOMED GmbH

level" then the patient repeats a level with the same difficulty as the one which he was working on.

In addition, it is important to refer to the differences of training with concrete subjects and abstract objects. Training with abstract objects is in general simpler compared to work with concrete objects. Weather the training used concrete and abstract objects should be considered when interpreting the training results.

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.

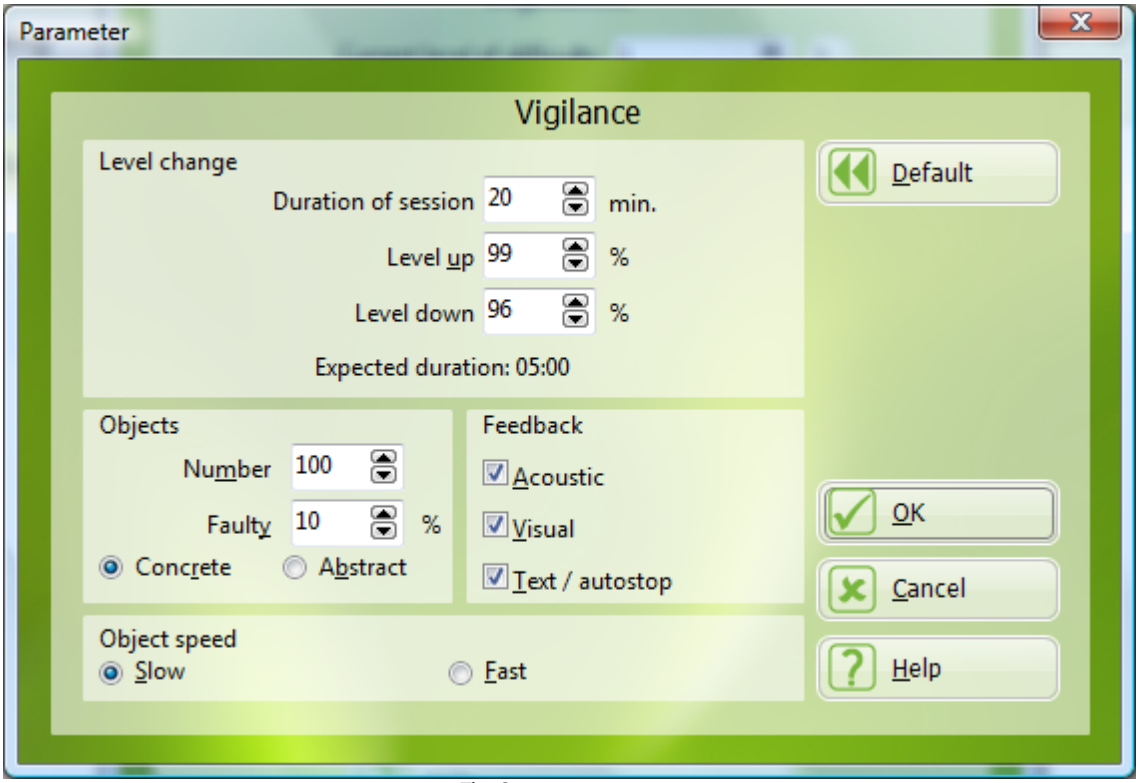

Fig. 2: parameter menu

Duration of session:
A training duration of 20–30 minutes is recommended.

Level up:
The number of correct decisions in reference to the total number of objects shown is calculated as a percentage. The level of difficulty increases when the percent correct exceeds the rate in the *Level up* parameter.

Level down:

© 2019 HASOMED GmbH

The number of correct decisions in reference to the total number of objects shown is calculated as a percentage. The level of difficulty decreases when the percent correct falls below the rate in the *Level down* parameter.

Number of objects:
The total number of objects which appear during a task on the assembly line is clearly defined. The choice of the number of objects depends on the status of the patient. For weaker patients, it is recommended to set the number of objects to 50 at the beginning. Once the patient's performance shows improvement in the vigilance task, it is recommended that default value of 100 objects should be set up once again. For high performance patients, an increase of the number of objects of up to 250 is recommended, and the rate of the assembly line should also be set to "fast".

Ratio of incorrect objects (Faulty):
The percent ratio of the incorrect / defective objects in relation to the total number of objects can be set between 5 and 50%.
When the percent ratio of incorrect objects is decreased, the type of training concentrated on here is vigilance, whereas an increase in the number of incorrect objects is more specific to continuous concentration. In this way, the therapist has the possibility to train both categories. If continuous concentration is to be trained, it is recommended that the ratio of wrong objects should be set at 50%.

Type of objects:
Whether the objects on the assembly line are concrete objects or abstract objects can be selected from this parameter setting (see the structure of the level of difficulty). In general, it is recommended that the training should be used with the concrete objects. This allows the module to more closely reflect reality, thereby increasing the motivation levels. Patients who have previously worked with "boring" procedures have seen great improvements here. For weaker patients who have had a problem with differentiation, the abstract objects should be used at the beginning of training. However, when improvements in performance can be seen, the training should switch to concrete objects.

Object speed:
The speed of the objects on the assembly line can be varied. A slower assembly line focuses on the vigilance task. A faster assembly line increases the level of difficulty and focuses on the continuous concentration task.

Acoustic feedback:
When enabled, a sound follows every reaction of the patient. The sound is one of two audio files that signal either a correct or incorrect reaction was made. In general, this option should be enabled. However, this may cause interference for high performing patient and, therefore, should be disabled. Similarly it is recommended that the acoustic feedback should be disabled if there are a lot of patients working in one room.

© 2019 HASOMED GmbH

Visual feedback:
In general the visual feedback should also be enabled. A red or green lamp signals the quality of the decision.

Feedback text / autostop:
When Text / autostop is enabled, the patient is given a chance to analyze their errors to see why the reaction was incorrect. The patient can continue the training by pressing the **OK** key. The autostop feature supports this type of training, especially at the beginning of the training. The particular differences between the standard objects and the defective objects is clearer for the patients at this stage. If this option is disabled, the training session is complicated and is better suited to high performance patients.

Particularly high demands are made on high performance patients when all of the feedback facilities are disabled. The patient is informed about correct and incorrect decisions. This option can cause additional stress in many patients. The module Vigilance would be rather monotonous, if there were no interruptions or feedback during the training.

When setting up the module Vigilance, the computer determines the time which an object requires by means of the available technology (e.g., processor service, graphic card) to move across the screen. This time is stored and the average duration of a task computed from this. This average is increased if the patient makes a mistake or inserts a break.

When setting up training for the first time with a new patient, the following default values are automatically set up:

Duration of Session	20 min
Level up	99 %
Level down	96 %
Number of objects	100
Faulty objects	10 % (Training of Vigilance)
Type of objects	Concrete
Object speed	Slow
Acoustic Feedback	Enabled
Visual Feedback	Enabled
Automatic stop	Enabled

Tab. 2: Default parameters

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.

© 2019 HASOMED GmbH

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

Level	Current level of difficulty
Mistakes	Number of mistakes
Omissions	Number of omissions
React. between objects	Reaction time between objects
Acquisition time	Time from the beginning of the task until the pressing of the OK button in seconds
Assembly line running time	Assembly line running time in mm:ss
Train. time task	Effective Training time in h:mm:ss
Breaks	Number of breaks caused by the patient

Tab. 3: Results

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

© 2019 HASOMED GmbH

2 Theoretical concept

2.1 Foundations

The term *attention* comprises functions which guarantee properly arranged external and internal sequences of objects in terms of contents and time. This enables conscious, orientated organisms to create a rational picture of life. This is achieved by a selection and integration of relevant information from different modes of perception.

Broadbent (1958) based his "bottleneck or filter theory" on the assumption of a limited processing capacity for incoming sensory information for an organism. That is, if stimuli are presented simultaneously, then a person can respond to selected stimuli and suppress the other stimuli. There are a range of input channels for every mode of perception, where information is filtered. Sternberg (1969; as cited by Keller & Grömminger, 1993) distinguishes in his *action orientated model of attention* between 4 phases:

1. Perception,
2. Identification of relevant stimuli,
3. Choice of the reaction, and
4. Activity of a motor program in reaction to the stimuli.

These processes are partially automatic; with the registration of specific aspects of situations, active analysis processes are set in operation. Automatic processes operate in a smaller capacity in parallel. All other processes, however, take more time because they require a serial manipulation, which requires larger attention capacities.

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

Intellectual and practical activities are impaired by attention and concentration problems which can be expressed in reduced retention and processing capacity, reduced information processing speed, rapid fatigue, and above all an increase in distractibility.

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):

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

© 2019 HASOMED GmbH

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. This aims to encourage the patient to respond both to relevant simultaneous stimuli and to relevant sequential stimuli. One example of divided attention is a situation where the driver of a car has to drive on an overcrowded street during rush-hour while talking to his/her passenger. When there are many stimuli presented at the same time, they interfere with each other. Thus, mistakes are likely to be made, and performance decreases. This function is the subject of the present training program.

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.

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 attention status through thoughts, motivations, and interest. In particular, the selectivity of attention is maintained (or not maintained) in a controlled manner constantly by emotional evaluations and through motivation processes.

Empirical studies with laterally presented stimuli that were carried out among healthy people and split-brain patients suggest the right hemisphere of the brain has special relevance regarding control and maintenance of elementary activation processes (Sturm et al., 1994). This concerns all patients with attention deficits, regardless of individually varying kinds and degrees of those deficits. After cerebral strokes leading to dysfunctions, the attention system is highly *vulnerable*, since it is closely linked to brain fields and brain structures.

In the psychological performance diagnostic, in particular in clinical-neuropsychological diagnostic, tests for the examination of attention capabilities are essential (Zimmermann & Fimm, 1989).. The aspects of attention mentioned before can be distinguished diagnostically by assigning different tasks to each of them. According to the Diagnostic and Statistical Manual of Mental Disorders (5th ed.; *DSM–5*), attention disorders in children are defined as a persistent pattern of

© 2019 HASOMED GmbH

inattention, impulsiveness and hyperactivity that interferes with functioning or development (American Psychiatric Association, 2013).

In diagnostic practice, the evaluation of attention mostly occurs through "surface parameters" such as

- the required time,
- the number and kind of the mistakes,
- the development of mistakes over time, or
- the processed amount of the submitted material when fulfilling specific tasks.

The advantages of such a diagnostic procedure lie in the extraction of measurable variables, both intra-individual (course of disease, therapy evaluation) and inter-individual (based on the measurements of a standard group).

Efforts to improve adult patients' attention skills by doing cognitive brain performance training have increased (Säring, 1988). In cases where the cerebral area is damaged, the demand for rehabilitation is particularly high because 80 percent of all brain injuries results in attention and concentration problems (Poeck, 1989; Van Zomeren & Brouwer, 1994).

The sections Training aim and Target groups provide further information.
.

2.2 Training aim

More recent research results recommend 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, & Strätz, 1992; Sturm et al., 1994; Sturm, Willmes, & Orgaß, 1997).

A specific aim of the Vigilance module is to improve the patient's performance in the area of tonic activation, with specific attention focused on maintaining visual vigilance in difficult observation situations (e.g., the continuous observation of a radar screen as an air traffic controller or the check of an industrial plant).

In the current training program, the patient's reaction skills are put under pressure because irrelevant stimuli are also used.

The training module aims to stabilize a patient’s vigilance and improve the patient's attention skills (duration of attention). In the training task, a monotonous series of similar visual stimuli are presented. The frequency of different objects can vary in order to test vigilance (few different objects) or continuous concentration (more frequent different objects). Demands are made at the same time on the extent of the

© 2019 HASOMED GmbH

objects (increasing number of elements to be considered) and the flexibility of the focus of attention (alternation of the tasks). In this case, it is especially problematic to maintain the motivation of the patient during training.

The memory requirements are minimized because the objects that have to be matched are constantly visible during the task. The patient's motivation to work with the module is increased the more the program reflects reality.

Experience shows (e.g. Fernández et al., 2012) that performance improvements with computer supported training or more attention components are expected, in particular, in the post-acute phase after a stroke.

In addition to the functional training, the computer gives systematic feedback to the patient which can improve the patient's self-observation and thus teach him or her how to cope with his or her attention resources. The patient also has the chance to improve self-perception and thereby the optimal allocation of the program's attention resources is fully used.

From a therapist's point of view, it is important that the patient is not only confronted with the deficits but also learns to develop strategies to cope with and compensate for them (e.g. to avoid certain stress factors or use external help in specific situations of requirement). Relatives could also be included in order to reduce stress levels.

The improvement of attention is a basic objective for the training of further cognitive functions. It is of fundamental importance for the treatment of memory disturbances (information recording as precondition for storage).

On the basis of results of diagnosis, it should be decided if the Vigilance module is used alone for therapy or in combination with additional modules, such as Attention & Concentration (AUFM) or Divided Attention (GEAU).

2.3 Target groups

Attention disorders after functional or organic interference are the most frequent neuropsychological performance deficits after brain damage (Van Zomeren & Brouwer, 1994). 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.

Conceptually, 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. Especially after lesions of the brainstem in the region of the reticular formation or after lesions of the right parietal

© 2019 HASOMED GmbH

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 are especially noticeable in tasks requiring a choice between a range of stimuli and reaction alternatives (covert shift of attention) (Sturm, 1990).

One should also consider the possibility to train for these particular deficits in the different aspects of attention.
This module is particularly suitable for patients who suffer from disturbances affecting tonic activation: vigilance and continuous attention.

Using the premise of maximum specificity and to achieve the highest possible efficiency in the training, one should start with a differentiated singular *neuropsychological* diagnostic before preparing the therapy plan that includes computer-assisted procedures.

The module uses child-friendly instructions for patients up to the age of 15. The touch screen is the recommended form of use for the module in the case of children.

Vigilance was evaluated on patients with vascular brain injuries, traumatic brain injuries, and dementia by Friedl-Francesconi (1995), Höschel et al. (1996), Liewald (1996), Preetz et al. (1992), and Regel & Fritsch (1997). Improvements in cognitive services in the raised tests (Pre-post comparison) and in part improvements in everyday life activities have been recorded.

2.4 Bibliography

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.

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

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.

Broadbent, D. (1958): Perception and communication. London: Pergamon Press.

Cramon, D.Y. v. (1988): Lern-und Gedächtnisstörungen bei umschriebenen zerebralen Gewebsläsionen. In: Schönpflug, W. (Hrsg.). Bericht über den 36. Kongreß der Deutschen Gesellschaft für Psychologie. Berlin.

Cramon, D.Y. v.; Mai, N. & Ziegler, W. (Hrsg.) (1993): Neuropsychologische Diagnostik. Weinheim: VCH Verlagsgesellschaft mbH.

© 2019 HASOMED GmbH

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 International Neurological Restoration Center (CIREN 2012), Havana, Cuba in MEDICC Review, Vol 14, No 4.

Fimm, B. (1997): Microanalyse von Aufmerksamkeitsprozessen. In: Gauggel, S. & Kerkhoff, G. (Hrsg.): Fallbuch der Klinischen Neuropsychologie. Praxis der Neurorehabilitation. Göttingen: Hogrefe. S. 25-38.

Friedl-Francesconi, H. (1995): "Leistungsinseln" bei Demenzpatienten. Diagnostische und therapeutische Möglichkeiten der Neuropsychologie. In: Hinterhuber, H. (Hrsg.): Dementielle Syndrome. Innsbruck: Integrative Psychiatrie VIP, S. 86-91.

Gray, J. & Robertson, I.H. (1989): Remediation of attentional difficulties following brain injury: three experimental single case studies. Brain Injury, 3, S. 163-170.

Höschel,K. (1996): Effektivität eines ambulanten neuropsychologischen Aufmerksamkeits- und Gedächtnistrainings in der Spätphase nach Schädel-Hirn-Trauma. Zeitschrift für Neuropsychologie, 7 (2), S. 69-82.

Keller, I. (1997): Aufmerksamkeitsstörungen. In: Gauggel, S. & Kerkhoff, G. (Hrsg.): Fallbuch der Klinischen Neuropsychologie. Praxis der Neurorehabilitation. Göttingen: Hogrefe. S. 39-47.

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

Liewald, A. (1996): Computerunterstütztes kognitives Training mit Alkoholabhängigen in der Entgiftungsphase. Dissertation an der medizinischen Fakultät der Eberhard-Karls-Universität Tübingen.

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.

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.

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.

© 2019 HASOMED GmbH

Preetz, N. (1992): Untersuchung zur Validierung eines computergestützten neuropsychologischen Gedächtnis- und Konzentrations-Trainingsprogrammes für zerebralgeschädigte Patienten an einer Klinik für neurologische und orthopädische Rehabilitation. Dissertation an der Medizinischen Akademie Magdeburg.

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

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

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

Sohlberg, M.M. & Mateer, C.A. 81987): Effectiveness of an Attention Training Program. Journal of Clinical and Experimental Neuropsychology, 9, S. 117-130.

Sturm, W. (1990): Neuropsychologische Therapie von hirnschädigungsbedingten Aufmerksamkeitsstörungen. Zeitschrift für Neuropsychologie, 1 (1), S. 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, S. 9-22.

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

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

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

Zimmermann, P. & Fimm, B. (1993): Neuropsychologische Testbatterie zur Erfassung von Aufmerksamkeitsdefiziten. Freiburg: Psychologisches Institut der Universität.

© 2019 HASOMED GmbH

Index

© 2019 HASOMED GmbH

- N -

- O -

- P -

- Q -

- R -

- S -

- T -

- V -

- W -