HASOMED

RehaCom®

Cognitive therapy

Vigilance 2

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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 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 Everything at a glance

- Designed for patients/clients with declining concentration and high levels of distractibility during tasks with increasing monotonous requirements.
- The level of fatigue should not exceed the value 5 on the "subjective burden scale" (0-10) during training (>= 10 minutes). If the training leads to an excessive demand on the patient's mental capacity or even to an abortion of the training during the first 5 minutes, the indication should be reconsidered.
- Attention: The task requires lots of focused horizontal eye movements and could in some cases lead to signs of excessive demand (for example, if the patient is still suffering from a whiplash).
- Conveyor line scenario with 9 levels of difficulty (see table) with concrete and abstract objects.
- Discovery task: Sorting out faulty objects.
- Start training with concrete daily life objects, then change to abstract objects.
- The advancement criterion is "level %" and it can be seen in the evaluation table of the respective training session.
- The faulty objects will differ from the reference object in that the faulty objects have different shapes, colors and details.
- Discuss the faulty objects and the requirements for the exploration task with the patients/clients in order to direct their focus of attention towards it.
- Faulty objects are easier to distinguish from the reference object in the first 4 levels and more difficult to distinguish from the original object in the levels 5-9. The speed of the conveyor line increases and the error density decreases with higher levels of difficulty and there will be times of "idle" on the screen.

1.2 Training task

Vigilance as a Form of Sustained Attention

Vigilance (lat. *vigilantia* "alertness", "care") or alertness describes states of permanent attention focusing in case of a rare stimuli frequency and stimuli that are rather difficult to discriminate. Vigilance is a special form of sustained attention and is, along other tasks of sustained attention and alertness, part of the attention intensity.

Task settings for the training of vigilance extend to a longer period of time and follow the scenario of "observation tasks" in everyday life, e.g. night-time observation of the

air space on a radar, observation of control lights in a power station or control tasks on a conveyor. They are different from other sustained attention tasks due to the low frequency of "critical/relevant" events and the long time periods that do not show any changes, which require any form of action.
The attention requirements of vigilance tasks are the retention of the attention focus (observation signals) and the attention level (intensity of attention or degree of alertness) as well as to avoid distraction due to mental digression or external events that may occur in the environment.
Therefore, they require the regulation of the instrinsic *attention focus* (see Sturm, 2005) over a longer period of time: - internal focus on observing while avoiding *internal and external distraction*, *orientation reaction* when a relevant/critical object appears and the activation of *alertness*, *selective attention* in case an object differs from the original one as well as the timing of the selection reaction in the selection frame. Under the condition of monotonicity, an increasing duration results in a higher difficulty to maintain an alert state of concentration with quick reactions and accuracy ("vigilance decrement", see Mackworth, 1948).

Description of the Modules Vigilance and Sustained Attention

In reality, vigilance needs to be maintained for many hours, e.g. during a night shift in a factory or while driving down a highway for a couple of hours during night. These long periods cannot be depicted one-to-one within a computer-based training. Therefore the RehaCom modules "Vigilance 2" and "Sustained Attention" have been designed as related tasks (conveyor) that focus on the mental effort of sustained attention performances in a more compressed way, with the difference of an opposite direction of the task requirements.

In the Vigilance module, the difficulty of discriminating objects as well as the time between objects increases from level to level, while the frequency of relevant/critical objects decreases, up until monotonicity has been reached in the highest levels. The sequence of relevant and non-relevant objects as well as the time between the objects are completely random and do not allow automated expectation. The speed of the conveyor will be increased from level to level. This way the focus of attention is frequently required for a short time and the objects will quickly move across the monitor after an empty screen.

In the Sustained Attention module, the difficulty of discriminating objects (objects on the conveyor) decreases in the higher levels, because the speed of the conveyor increases simultaneously and would otherwise force the client to make faster reactions, which leaves not enough time for a visual information search. With increasing levels, the frequency of the relevant/critical objects, and consequently the frequency of required decisions, increase proportionally.
This results in increased requirements for mental efforts and concentration. In the module Sustained Attention the sequence of relevant and non-relevant objects as well as the time between the objects are completely random and do not allow automated expectation.

Indication

The training Sustained Attention/Vigilance is designed for patients/clients that complain about a decline in concentration or exhaustion with an increased error rate or experienced excessive demands when exposed to intensive mental stress over a longer period of time. Before the training begins, the content and the aim of this scenario should be discussed with the client . The training time should be adjusted to the performance limit of the patient and should not reach into the "red area" of overstress/exhaustion. By default, a level is defined for 10 min with a consultation time of 20 minutes. In special cases, the training can be increased up to a consultation time of 15-20 minutes with an interval of 5 minutes starting from a level time of 5 minutes.

Scenario and Description of the Task

In the RehaCom module **Viligance 2**, the client works as an administrator at the end of a conveyor in a factory (e.g. production of beverages or cans, furniture factory, production of home appliances or electronic devices) to ensure ecological validity. The clients task is to check objects (bottles, furniture, electronic devices, etc..) or their packaging, which are passing by in large intervals, and to sort out those objects that do not correspond with the permanent visible reference object.
In the lower levels, the speed of the conveyor is slow and the sequence of objects is higher, so that the client can get used to the conveyor scenario. While progressing through the levels, the initial sustained attention (higher frequency of stimuli and reactions) becomes vigilance with a lower frequency of stimuli (objects) and long breaks that are susceptible to digressions.

Figure 1 shows the user interface. On the horizontal conveyor, objects continuously move from the left side to the right.

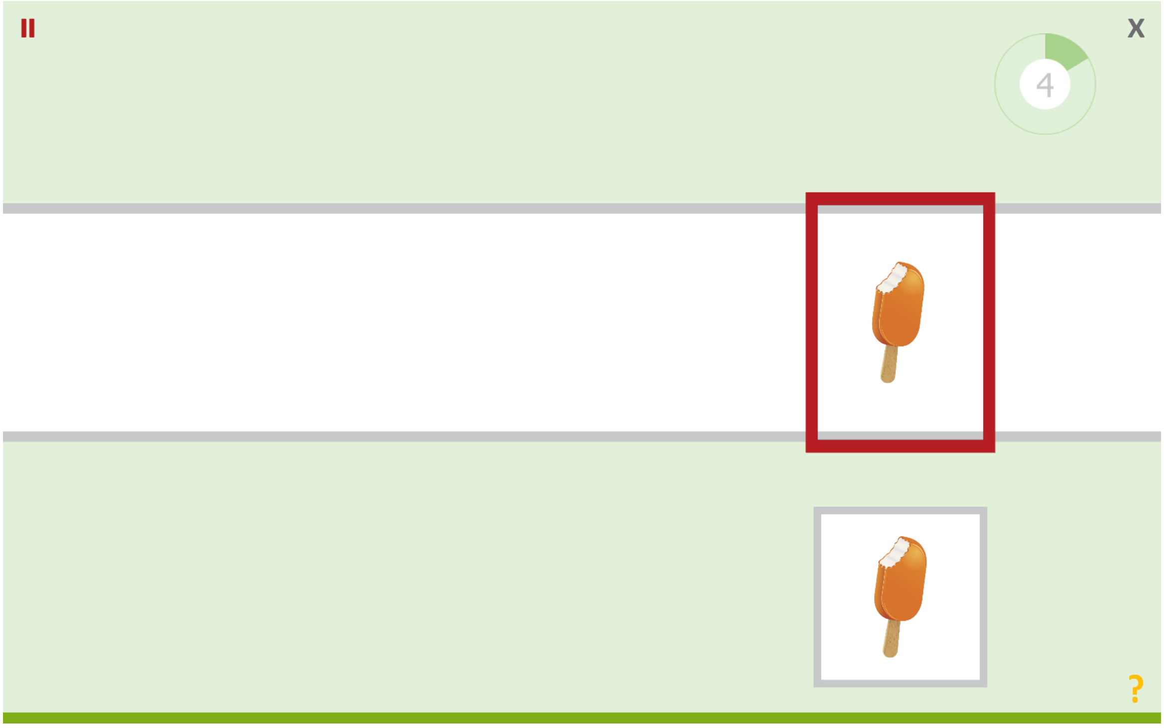


Fig. 1: Training interface in case of a mistake.
The client reacted, although there was no difference to the original image.

For patients with an impairment of the right visual field, the conveyor will move from the right side to the left. Simultaneously, the reference image, the selection frame and the progress will be displayed on the left (fig. 2). You can select "impairment of visual field right" in "client data"-->"file"-->"hemianopia" in the master program of RehaCom. Analog for impairment of visual field on the left.

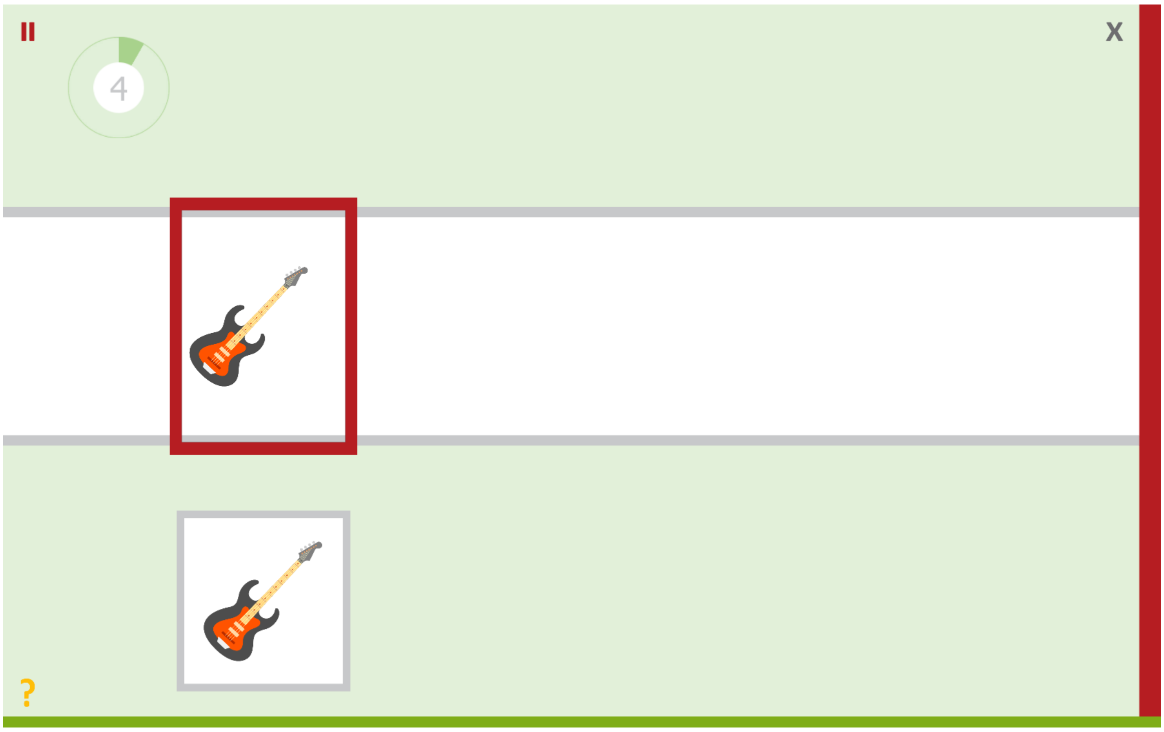


Fig. 2: Training interface in case of a mistake.
A correct guitar has been evaluated wrongly. You can see a red frame.
The reference image and selection frame are on the left.

Each consultation consists of one or more task runs, depending on the level and duration of the session. Each run (e.g. 10 or 15 minutes) is divided into two phases:

- the **acquisition phase** and
- the **working phase**.

During the acquisition phase the original objects, meaning the required quality standard, will be presented to the client (reference objects in a gray frame in the lower right or left corner). The client has to memorize the reference objects and their details. After that, he/she can finish the acquisition phase by pressing the OK button. Next, the client enters the **working phase**.

There is a selection frame at the right (or left) end of the conveyor, which marks the area in which a faulty object has to be removed by pressing the OK button. The OK button has to be pressed exactly when the faulty object is inside the frame. Afterwards, the object disappears from the conveyor. When missing an object or wrongly marking a correct object, a yellow or red coloring will provide visual feedback to the client.

The reference objects, which symbolize the quality standard, will be displayed below the conveyor at all times. If the objects on the conveyor differ from the reference object, they need to be removed. The faulty objects are the "critical/ relevant" events.

In the upper right or left of the screen a number indicates the current level . The outer frame will be filled when increasing the level duration.

The choices made by the client will be evaluated by the module, while a distinction between the following types of mistakes is made:

correct:	a faulty object has been recognized and removed correctly
missed:	a faulty object has been missed
mistake:	a correct object has been wrongly selected by pressing the OK button.

The correct ones, the missed ones and the mistakes are the basis for level ups or downs (see evaluation).

Reactions in the inter stimuli interval will be registered as well and displayed in the evaluation, but they will not have an effect on level ups and downs.
Frequent inter stimuli reactions should be supervised to detect their cause, which could be neuromuscular problems when trying to press a key in time or problems of the visual estimation of the distance between the moving objects and the selection frame.

1.3 Performance feedback

When working at the conveyor, a visual and/or an acoustic feedback will be provided. The visual feedback has already been described. When the acoustic feedback is activated (adjustment in the parameter menu) several different sounds can be heard for correct and incorrect reactions.

1.4 Levels of difficulty

This module works adaptively. It uses a certain number of real objects (e.g. cake, torch, tools,...) and abstract objects. "Images" can be selected as abstract objects in the parameter menu.

The differences between the faulty objects and the reference object are defined by three features, which are divided into multiple levels of difficulty respectively:

- The **color** may change.
- They can differ in the appearing form (**outline**)
- They may be different in **detail** and texture.

Only one feature will differ from the original.

The images have been correlated with the levels in ascending difficulty by the critical error features (defined in the table with an x), by the difficulty in recognizing them (discriminability) and by the visual complexity of the reference object.

The complexity of the recognition task continuously increases because of the increase of the number of objects that have to be compared (number of reference objects) and the number of error features. Consequently, the number of selections (number of reference objects x number of error features) increases as well, which constrains the client to constantly keep an eye on the screen.
The requirements on the regulation of the attention in the observation task increases due to the increase of the distances between the objects. It may take several seconds until a new objects appears on the conveyor. The possible distances between two objects on the conveyor are defined in the table. Distance "1" means that an objects succeeds another object by the width of the selection frame.
The time span of the "permissible" inattentiveness decreases, since the presentation time decreases due to the increasing speed of the conveyor.

Level	number of reference objects	differentiation type object			difficulty		error objects	presentation time	distance objects	
		color	outline	detail	discriminability	visual complexity			from - to	fixed
1	1	x	x		easy	simple	33%	8 s	1 - 3	1.5
2	1	x	x	x	easy	medium	30%	8 s	1 - 3	1.5
3	2	x	x		easy	complex	28%	7 s	1.5 - 4	2
4	2	x	x	x	medium	simple	26%	7 s	1.5 - 4	2
5	2	x	x		medium	medium	24%	7 s	2 - 5	3
6	2	x	x	x	medium	complex	22%	7 s	2 - 6	3
7	3	x	x		hard	simple	20%	6 s	2 - 8	3.5
8	3	x	x	x	hard	medium	15%	6 s	2 - 9	4
9	3	x	x	x	hard	complex	10%	6 s	2 - 10	4

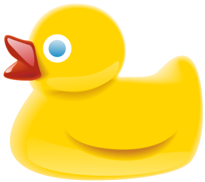
Tab. 1: level of difficulty structure.

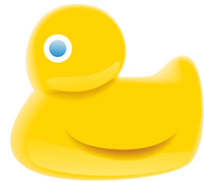
After finishing a run (time adjustable in the Parameters in the section "level duration") the module calculates a percentage for the level up/down. The number of "correct decisions" in comparison to the number of total possible decisions is the determining factor for the observation task and the performances. This value is depicted as "level %". It can be calculated with the total number of critical/relevant objects minus the error objects (omissions) that have been missed. The result is the number of correct selections (correct). On the other hand, the wrong selection of correct reference objects (mistake) has to be considered as well. These mistakes are included in the calculation (with 1/3), since in reality these mistakes do not affect as much as omissions (the client will have disadvantages, if he/she receives faulty goods). For this reason a third of the mistakes is subtracted from the number of correct ones. The calculated value (number of critical/relevant objects minus 1/3 of mistakes = correct ones) is put in relation to total number of relevant objects that have been presented. If this percentage succeeds the defined value for **level up** (default: 85%), the client will progress to the next level of difficulty. If it is lower than the value for **level down** (70 %)**,** the level of difficulty will be reduced. If the value is between **level up** and **level down**, the client will stay at the same level of difficulty.

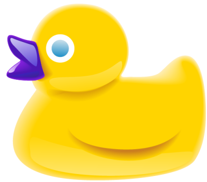
The same definitions of the levels apply to the training with abstract objects.

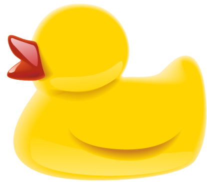
Examples

Real object with easy discrimination of error features and low visual complexity:


reference

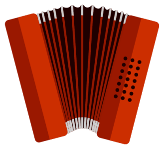

error outline

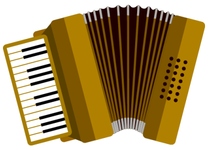

error color

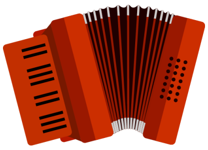

error detail

Real object with easy discrimination of error features and high visual complexity:


reference


error outline


error color


error detail

Real object with with hard discrimination of error features and low visual complexity:


reference


error outline


error color


error detail

Real object with hard discrimination of error features and high visual complexity:

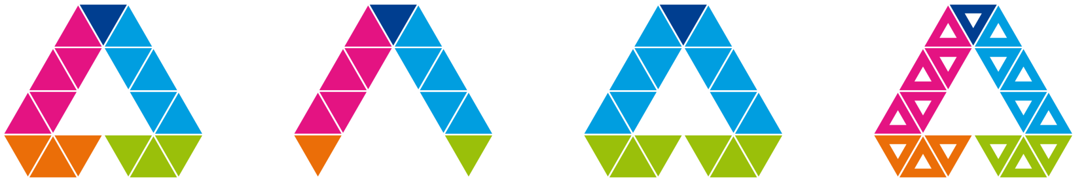

reference


error outline


error color


error detail

Abstract object with easy discrimination of error features and low visual complexity:



reference | error outline | error color | error detail

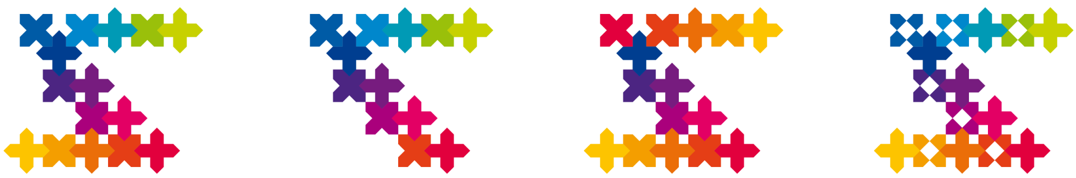
Abstract object with easy discrimination of error features and high visual complexity:

reference | error outline | error color | error detail

Abstract object with hard discrimination of error features and low visual complexity:

reference | error outline | error color | error detail

Abstract object with hard discrimination of error features and high visual complexity:



reference | error outline | error color | error detail

1.5 Training parameters

In the Foundations RehaCom, general information concerning the parameters and their effects can be viewed.
These information should be considered as follows.

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.

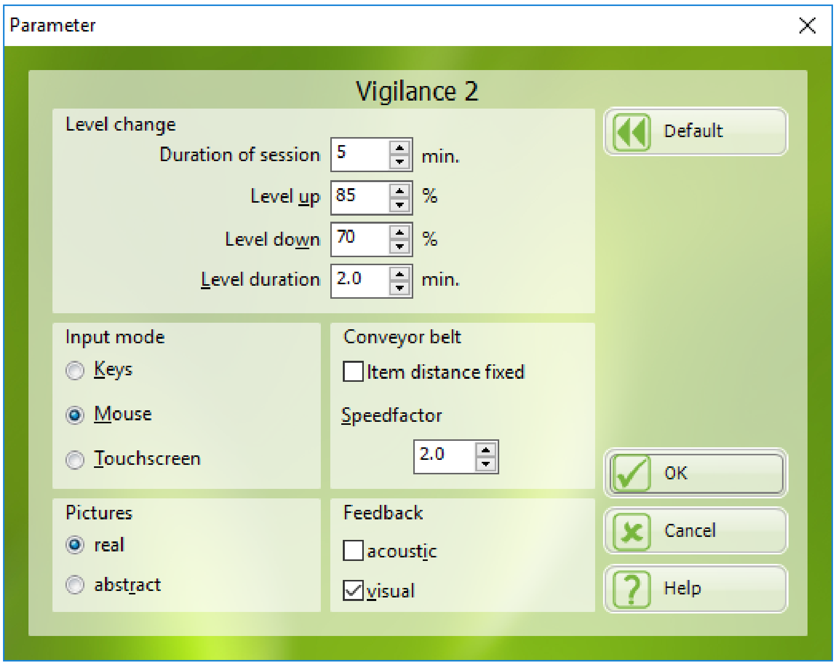


Fig. 2: Parameter menu

Current level of difficulty:
The level of difficulty can be adjusted between 1 and 9 in the parameter menu.

Duration of session in min:
A training time of 20-30 minutes, with a standard value of 20 minutes, which can be increased in the course of the treatment, is recommended.

Level up (%):
The level will be increased if the value of the number of correct decision (number of critical/relevant objects minus omissions minus 1/3 mistakes) in relation to the total number of presented relevant objects succeeds the value for "level up".

Level down (%):
The level will be reduced if the value of the number of correct decision (number of critical/relevant objects minus omissions minus 1/3 mistakes) in relation to the total

number of presented relevant objects is below the value for "level down".

Level duration:
The duration of a single task is defined. The choice of the level duration depends on the clients status. For clients with an even weaker performance, this value can be set to 5 minutes at the beginning. After the performance has been strengthened, this default value can be set to 10 minutes again. For patients with a strong performance an increase of the duration is recommended.

Input mode:
This training can be controlled with the (panel) keys as well as with the mouse or touchscreen. By default, the control with the panel keys is recommended. When changing to the mouse it is important to know that a simple click with the left mouse button will be evaluated the same as pressing the OK button.

Item distance fixed:
To avoid that the client adjusts to a rhythm, the items will run over the conveyor in changing intervals. When selecting the option "item distance fixed" the objects will run over the conveyor in fixed intervals (length of the intervals: see table 1 in the chapter level of difficulty structure).

Speed factor:
The speed of the objects on the conveyor can be adjusted to take the individual needs of the clients into account. The preset is "1", an increase of the number means an increase of the speed of the conveyor. The efficiency of the computer and the graphic board limits the speed.

Images:
You can choose between real images and abstract objects.

Acoustic feedback:
Depending on the answer (wrong or correct decision) the reaction of the client will be evaluated with a specific tone sequence of RehaCom. This can be deactivated.

Visual feedback:
The selection frame changes its color depending on the quality of the decision (red = wrong positive reaction / yellow = omission).

The defaults (standard values) are:

duration of session	20 min
level up	85 %
level down	70 %
level time	10 minutes
input mode	panel
item distance fixed	of ([ ])
speed factor	1,0
images	real
acoustic feedback	on ([X])
visual feedback	on ([X])

Tab. 2: Standard parameters

1.6 Data analysis

Besides the settings of the training parameters, the following information are available in the graphics and tables:

Level	Current level of difficulty
Objects total	Number of total relevant and non-relevant objects
Number of relevant objects	Number of faulty objects that have to be sorted out by the patient
Correct	Number of correctly selected relevant (faulty) objects
Omissions	Number of relevant (faulty) objects that have not been sorted out
Mistakes	Number of wrongly selected correct objects (wrong positive)
Level [%]	Percentage of correct decisions according to calculation: (number of critical/relevant objects minus omissions minus 1/3 mistakes) in relation to the total number of presented relevant objects This is the criteria for level up/down.
Inter stimuli reactions	Number of reactions between two objects
Correct [%]	Percentage of correctly selected relevant objects
learning time [s]	Time span from the start of a task, including the instruction, until pressing the OK button for the first time to start the working phase in seconds
Train. time task	Training time of the respective task [h:mm:ss]
Breaks	Number of breaks by the patient

Tab. 3: Results

The depiction of the most important values in a table in the evaluation area (see main window: Results) enables the therapist to discuss the performance with the client and to adjust further training sessions.

All information regarding the current, respectively all consultations, can be printed by using the Print button.

2 Theoretical concept

2.1 Foundations

Vigilance (lat. vigilantia "alertness", "care") or alertness describes states of permanent attention focusing in case of a rare stimuli frequency and stimuli that are rather difficult *to discriminate.* Vigilance is a special form of sustained attention and is, along other tasks of sustained attention and alertness, part of the attention intensity.

Task settings for the training of vigilance extend to a longer period of time and follow the scenario of "observation tasks" in everyday life, e.g. night-time observation of the air space on a radar, observation of control lights in a power station or control tasks on a conveyor. They are different from other sustained attention tasks due to the low frequency of the "critical/relevant" events and the long time periods that do not show any changes, which require any form of action.
The attention requirements of vigilance tasks are the retention of the attention focus (observation signals) and the attention level (intensity of attention or degree of alertness) as well as to avoid distraction due to mental digression or external events that may occur in the environment.
Therefore they require the regulation of the intrinsic alertness (see Sturm, 2005) over a longer period of time: - internal focus on observing while avoiding internal and external distraction, orientation reaction when a relevant/critical objects appears and the activation of alertness, selective attention in case an objects differs from the original object as well as the timing of the selection reaction in the selection frame.
Under the condition of monotonicity, an increasing duration results in a higher difficulty to maintain an alert concentration with quick reactions and accuracy ("vigilance decrement", see Mackworth, 1948).

Due to empirical research it is assumed that ***attention*** is not a consistent/ homogeneous construct. According to the attention taxonomy postulated by Sturm (1996 and 2015), which is an extension of the model by Van Zomeren and Brouwer (1994), the following areas are related to the dimensions of intensity and selectivity:

- attention activation
- sustained attention
- vigilance
- as well as
    - o selective or focused attention
    - o visual - spatial attention with alternating attention focus
    - o divided attention

and connected to task paradigms.

Impairments of sustained attention/vigilance with symptoms of fatigue/exhaustion belong to the most common attention disorders. As aspects of attention intensity,

alertness and sustained attention are being processed in overlapping neural networks primarily in the right hemisphere, while selective attention is processed primarily in the left hemisphere (for a more detailed explanation see Sturm (2005) and Fimm (2012)).
With the help of the task settings of the module Vigilance and Sustained Attention intrinsic and extrinsic processes of the attention intensity as well as the selective attention are being activated.
The loss of attention focus (hormic selectivity) due to the focus of intrinsic and extrinsic stimuli, images or thoughts (= distractibility) is particularly critical in the module Vigilance because of monotonicity. Amnesic requirements are minimized by the fact that the reference objects that have to be compared, are visible at all times during the task. The patient is motivated to work with this module by being presented to a realistic scenario.

The sections Training aim and Target groups provide further information.

2.1.1 Training aim

Recent research supports differential training approaches, which target ***specific attention disorders,*** because unspecific and non-theoretical attention trainings are not successful in all areas of attention (Gray & Robertson, 1989; Sohlberg & Mateer, 1987; Poser et al., 1992; Sturm et al., 1994; Sturm et al., 1997).

Trainings of vigilance particularly target deficits in the regulation of the *attention intensity*, and in the special case of visual vigilance the *retention of alertness*, in *low stimuli observation situations* (e.g. constant observation of a radar by a air traffic controller or the observation of an industrial plant).

This task also practices the suppression of reactions when non-relevant information are presented.

This module aims to *stabilize vigilance and sustained attention*. In the task, homogeneous optical signals will be presented in monotonic intervals.
In this stimuli continuum, depending on the parameter settings, different individual objects will be embedded in a, for vigilance relatively rare, and, for sustained attention more frequent manner. Simultaneously, there are requirements on the amount of the stimuli material (increasing number of elements) and the flexibility of the attention focus (changing tasks). In this process it is particularly difficult to *maintain the motivation* of the patient over the whole duration of the training.

Amnesic requirement are minimized by the fact that the reference objects that have to be compared, are visible at all times during the task. The patient is motivated to work with this module by being presented to a realistic scenario.

Experience has shown that an improvement of the performance with the help of computer based trainings of one or multiple components of attention can be expected, especially in the *post-acute-phase* of an insult. Besides the functional training, working with a computer provides a *systematic performance feedback* that enables the patient to improve self-awareness and helps to distribute the ***attention resources*** in a sufficient way. In a therapeutic sense it is favorable to provide information and to develop individual *coping and compensation strategies* in addition to the confrontation of the existing deficits; e.g. avoiding stress factors or using external help when dealing with specific situation. The relatives should be involved in this process as well.

The improvement of attention is the basis for further training aims in regard to different *cognitive functions* and is of particular importance for the treatment of *memory disorders* (information reception as the basis for storage).

On the basis of the results of the initial and development diagnostics it is to decide whether the module ***Vigilance 2*** (VIG2) will be applied alone or in combination with other modules (***Attention and Concentration (***AUFM), ***Divided Attention*** (GEAU), etc.).

2.2 Target groups

Attention disorders are the most common neuropsychological efficiency deficits after brain damage of different localization and convalescence (Van Zomeren & Brouwer, 1994). They occur in 80% of the patients that had a seizure, traumatic brain injury, diffuse impairments of the brain (e.g. as a result of chronic abuse or intoxication.) as well as other diseases of the central nervous system.

Conceptually, different attention functions are assumed that can be impaired selectively. Diffuse brain damage after traumatic or hypoxic etiologies usually come with other *unspecific attention deficits* such as quick exhaustion, increased need to sleep and a general loss of initiative, while localized insults, e.g. vascular convalescence, often result in *specific attention deficits*. Generally, insults of every cortex area can lead to impairments of attention. Especially after lesions of the brain stem in the area of the formatio reticularis and parietal lesions of the right hemisphere, disorders of the *phasic or tonic alertness* as well as *vigilance* can be observed, while parietal insults in the left hemisphere rather impair *selective attention performances*; particularly for tasks in which decisions between multiple stimuli or reaction alternatives have to be made (Covert Shift of Attention) (see Sturm, 1990).

Based on the assumption that there are *specific deficits* of different aspects of attention, the *specific trainability* of these functions should be postulated as well.

This module is specifically suitable for patients with *disorders of the tonic attention areas* vigilance and sustained attention.

Based on the assumption of maximum specificity and to reach a high training efficiency, a *differentiated neuropsychological diagnostics* should be performed before creating a computer-based therapy plan.

Numerous results for the evaluation of RehaCom are available, of which several use multiple modules simultaneously.
Vigilance has been evaluated in many studies of patients with vascular brain damage, traumatic brain injury and dementia: Friedl-Francesconi (1995), Höschel et al. (1996), Liewald, (1996), Preetz et al. (1992), Regel & Fritsch (1997). Improvements of cognitive functions in the performed test (pre-post-comparisons) and partially transfer effects in everyday life have been observed.

This module supports the implementation for children, since children from one to 14 years are instructed in a child-oriented manner. In this case, a touchscreen is recommended for the control of the module.

2.3 Bibliography

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.

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

Fimm, B. & Zimmermann, P. (2012). TAP Manual zur Testbatterie von Aufmerksamkeitsstörungen Version 2.2

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.

Mackworth, N.H. (1948). The breakdown of vigilance during prolonged visual search. Quarterly Journal of Experimental Psychology, 1, 6-21.

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.

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.

Saring, 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 Trainings 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.

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