HASOMED

RehaCom®

Cognitive therapy

Screening: Alertness

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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).

⚠ CAUTION	Risk of misdiagnosis. Screening for use of RehaCom only. Use standardized tests for diagnostic.

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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

1 Applications

Basic information on the screening modules is available in the RehaCom manual, Chapter "Use of RehaCom screening modules".

Alertness describes the general alertness, which makes it possible to react quickly and appropriately to a specific task. Alertness is the basis for any attention performance and therefore the precondition for adequate action.

A distinction is made between the "tonic arousal," the general state of being awake, and the "phasic arousal," which describes the increased responsiveness in anticipation of an expected event.

The following, very different processes are summarized in the term "Alertness":

- general alertness ("tonic arousal")
- maintenance of responsiveness over a longer period of time ("intrinsic alertness")
- short- term focusing of attention on an expected event ("phasic arousal").

It is checked by means of a simple visual reaction task (without intrinsic control of the activation level, tonic course of the activation level) or with a warning stimulus (phasic activation).

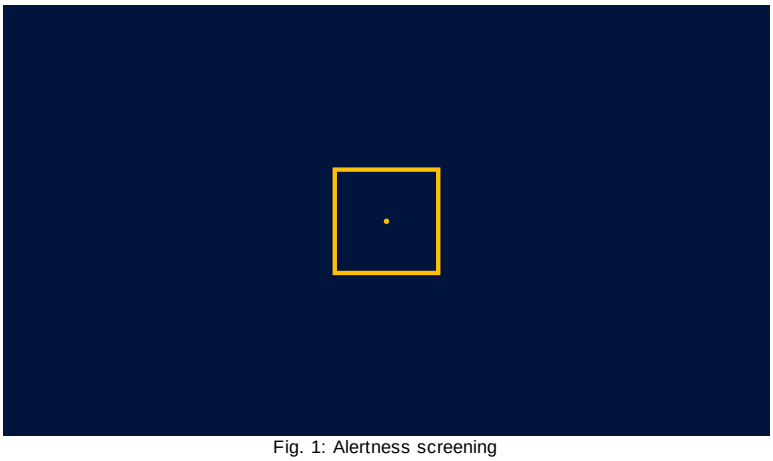


Fig. 1: Alertness screening

2 Target group

Attention disorders may occur in almost all neurological diseases, which affect the central nervous system. Depending on whether these diseases lead to rather circumscribed and localized brain damages (such as a stroke) or to rather diffused impairments (such as traumatic brain injury or degenerative diseases), the malfunction in the attention area can be rather specific or global.

Cerebrovascular Diseases

After lesions in the brain stem portion of the formatio reticularis (Mesulam, 1985) and after strokes, especially in the area of the median brain artery (A. cerebri media) of the right brain hemisphere, disorders of attention activation as well as of vigilance and the long-term maintenance of attention can occur (Posner, Inhoff, Friedrich, & Cohen, 1987).

While the reticular system of the brain stem portion is the "noradrenergic source" of attention activation (Stuss & Benson, 1984), the frontothalamic gating system controls the selective and directed allocation of this attention activation. Lesions of this system lead to a limited selectivity for external stimuli and to increased distractibility (i.e., to attention disorders).

Lesions especially of frontal parts of the left hemisphere, also cause impairments of attention selectivity, especially in situations in which decisions between relevant and irrelevant aspects of a task have to be made quickly (Dee & van Allen, 1973; Sturm & Büssing, 1986).

Disorders of spatial attention can be selectively affected by localized brain damages. Damages of the posterior parietal lobe seem to lead especially to disorders of disengaging attention from a stimulus, when the attention must be moved towards a target stimulus in the room on the opposite side of the lesion (Posner, Walker, Friedrich, & Rafel, 1984). Here, a cause for a unilateral neglect after a parietal lesion is seen (see the guideline "Rehabilitation of disorders of spatial cognition").

Disorders of divided attention seem to occur particularly often after bilateral frontal vascular injury (Rousseaux et al., 1996).

Traumatic Brain Injury (TBI)

Along with memory disorders, attention impairments are the most common neuropsychological deficits after a TBI. The most consistent result after TBI is a general, non-specific slowdown of the information processing. The cause of this slowdown after TBI remains largely unclear. As a pathological correlate of the damage due mainly to the rotational acceleration of the brain, diffuse axonal injuries are discussed or a hypometabolism in prefrontal and cingulate brain areas (Fontaine et al., 1999).

Multiple Sclerosis

Cognitive slowing and increased variability with an often preserved performance quality at the beginning of the disease are common symptoms in patients with multiple sclerosis (MS), so tests that measure reaction time are of special significance in diagnosing this disease. It is obvious that the deficit in reaction time is relatively independent of the individual sub-functions of attention performance. Because MS is neuronal based, a diffusely localized axonal injury and demyelination is assumed, and a generally increased degree of brain atrophy could be proved (Lazeron et al., 2006).

Neurodegenerative Diseases

Attention deficits are often seen during the early stage of Alzheimer's disease (AD). They often seem to occur after memory disorders, but before impairments of language and spatial performances (Perry, Watson, & Hodges, 2000). Other results indicate a relative maintenance of the cognitive control of attention activation and visuo-spatial attention, but also early disorders of selective attention. In the course of the disease, disorders of inhibitory control also increase.

In Lewy body dementia (LBD), fluctuating attention performances and deficits in the visuo-spatial attention are a central diagnostic criterion. Some studies (Calderon et al., 2001) have reported that patients with LBD showed significantly worse results in almost all attention functions (sustained attention, selective attention, divided attention) compared to AD-patients.

Patients with Parkinson's disease or Huntington's disease generally show no deficits in phasic alertness and vigilance tasks, whereas patients with progressive supranuclear palsy (Steele-Richardson-Olszewski-Syndrome) suffer from such deficits. Deficits in divided attention seem to be a general problem in later stages of the diseases.

Depression and Attention Disorders

Even in the case of depression, memory and attention disorders are to the fore of the cognitive functional impairments. Primarily, conscious cognitive controlled functions are affected. Especially the performance during tasks for the attention distribution has been identified as a prognostic parameter (Majer et al., 2004). Disorders of automatic processing can be presented only in cases of very severe depression (Hartlage, Alloy, Vásquez, & Dykman, 1993). In comparison to patients after traumatic brain injury (TBI), depressed patients often estimate their performances worse than they actually are in the psychometric examination. Farrin et al. (2003) could show that this negative self-assessment (e.g during task for sustained attention) can lead to "disaster reactions" after mistakes with increased reaction times immediately afterwards. TBI -patients did not show such reactions.

Source: Diener, H.-C., Putzki, N., Berlit, P., Deuschl, G., Elger, C., Gold, R., ... Weller, M. (2008). *Leitlinien für Diagnostik und Therapie in der Neurologie* [Guidelines for diagnosis and therapy in neurology] (4th rev. ed.). Stuttgart, Germany: Georg Thieme Verlag.

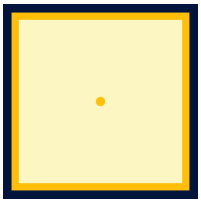
3 Structure

The reaction time is checked under two conditions.

1.Condition

An object appears on the screen in a fixed location.

In randomized intervals, the object changes.



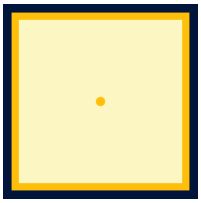
The task is to react as quickly as possible to the changed object by pressing a button.

Intrinsic alertness, or the ability to maintain responsiveness over a longer period of time, is measured here.

2. Condition

An object appears on the screen in a fixed location.

Before the object changes in randomized intervals, an acoustic cue stimulus (warning sound) is played.



Phasic arousal, or the temporal alignment of the attention focus is measured here.

4 Implementation and Duration

Implementation

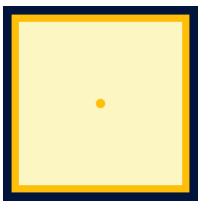
The test starts with an exercise in which a message appears if the patient reacts too early (i.e., before the stimulus changes). The exercise is not completed until 2 consecutively correct reactions were made in each run.

Following the exercise, the test is also performed in two parts, in a simple ABBA-pattern:

1. Run without warning sound (A).
2. Run with warning sound (B).
3. Run with warning sound (B).
4. Run without warning sound (A).

Every run starts out with the following empty square being displayed:

As soon as the area in the square is filled with a brighter color,



press the Ok-button as fast as possible.

Directly after the Ok-button was pressed the rectangle will return to its unfilled appearance until the next stimulus is presented.

In runs 2 and 3 an acoustic cue stimulus (warning sound) is played shortly before the filled square appears. This is done in order to measure phasic arousal.

In each run the first two stimuli are sample stimuli which are excluded from analysis. Starting from the third stimulus, the reaction times of the patient are measured. Upon

incorrect reactions, additional stimuli will appear until 10 correct reactions are recorded. So at the end each run will consist of at least 2+10=12 stimuli, plus a number of additional stimuli equivalent to the number of incorrect reactions.

Duration

about 6 min (without exercise)

5 Data analysis

Basic information on the data analysis of screening results are available in the RehaCom manual, chapter "Screening results".

For the *Alertness* screening module, two Z-values are calculated.

Z-value 1: Alertness without warning sound (tonic alertness)

Median of all reactions without warning sound

Z-value 2: Alertness with warning sound (phasic alertness)

Median of all reactions with warning sound

Details

Detailed information on the results of the screening can be displayed via the "Details" button. On the right side of the Details display, all conducted screenings for Alertness are listed by date. Results marked with an asterisk (*) indicate that the particular screening was canceled. In this case, the evaluation is incomplete (i.e. no Z-values are displayed).

When you click on a screening session in the list, the display in the diagrams change accordingly.

The following data are available for evaluation:

- The median reaction time measures the general processing speed and thus provides indications on the slowing down caused by the brain damage.
- The variability of the reaction time is a measure of the stability of the performance level. Higher standard deviations indicate low stability.
- A trend in the response times in the direction of longer times indicates a (fast) fatigue and thus the decrease of tonic arousal.

Marc Testpatient B-Day.: 01/01/2000 Date: 09/02/2016

HASOMED RehaCom Alertness

Condition	Correct	Omissions	Outliers	Anticipations	Avg. Reac. Time [ms]	Median Reac. Time [ms]	SD Reac. Time [ms]	Z Value
without warning sound	20 (100%)	0 (0%)	1	3	506	298	436	0.02 (50.8%)
with warning sound	20 (100%)	0 (0%)	1	8	628	364	615	-1.04 (15.0%)

Norm Alertness without warning sound (Average value: 299 ms; Standard deviation: 74 ms) - Median reaction time
Norm Alertness with warning sound (Average value: 292 ms; Standard deviation: 70 ms) - Median reaction time

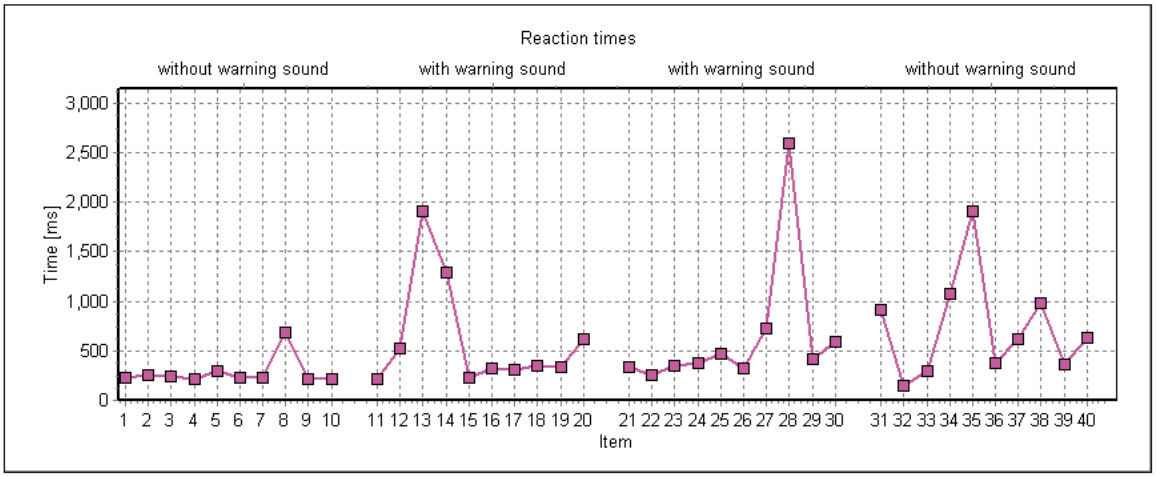


Fig. 2: Detailed results of alertness screening

In the upper table (summary), rows for each condition (without warning sound, with warning sound) show the number of correct and omitted reactions, reaction time values (mean, median, standard deviation) and the calculated Z values. Percentile rank is presented after the Z-value in parentheses. The given value is an approximation based on the Gaussian normal distribution.

Omissions: An increased number of omissions may be an indication for increased reaction latency and should be related to the results of the Go/ Nogo Screenings.

Anticipation: If the patient pressed the button before the stimulus is presented or if the reaction time is less than 100 milliseconds.

Outlier: Each reaction time, which lies over the mean reaction time plus the 2.35-times standard deviation.

The diagram "Reaction times" (lower part of Fig. 2) shows all single reaction times. If the patient didn't react to a stimulus or reacted before the stimulus presentation, no marker is drawn. More than 10 stimuli are only drawn if the patient reacted incorrectly during the regular stimuli (1-10).

The standard degression (variability) of the reaction time can provide information on

the stability of the performance.

If the reaction time is slowed down during the test, this may be an indication for rapid fatigability.

A significant increase of the reaction times with warning sound indicates a reduced intrinsic alertness.

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