HASOMED

# RehaCom®

Cognitive therapy

## Screening:
## Spatial Numbers Search

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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).

**⚠ 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 data analysis of screening results is available in the RehaCom manual, Chapter "Screening and Diagnostics".

The Spacial Numbers Search screening module is used for testing a patient's basal cognitive performance speed and selective attention. The test can be used for screening of visual neglect as well.

The basal cognitive performance speed is associated with those skills which are described as fluid intelligence, perceptual-speed ability, or processing speed. The screening is used to measure a patient's cognitive performance speed, basically capturing the speed component.

The term *selective attention* refers to the ability to focus on relevant characteristics of a set of stimuli over a short period of time and to ignore or suppress irrelevant stimuli at the same time.

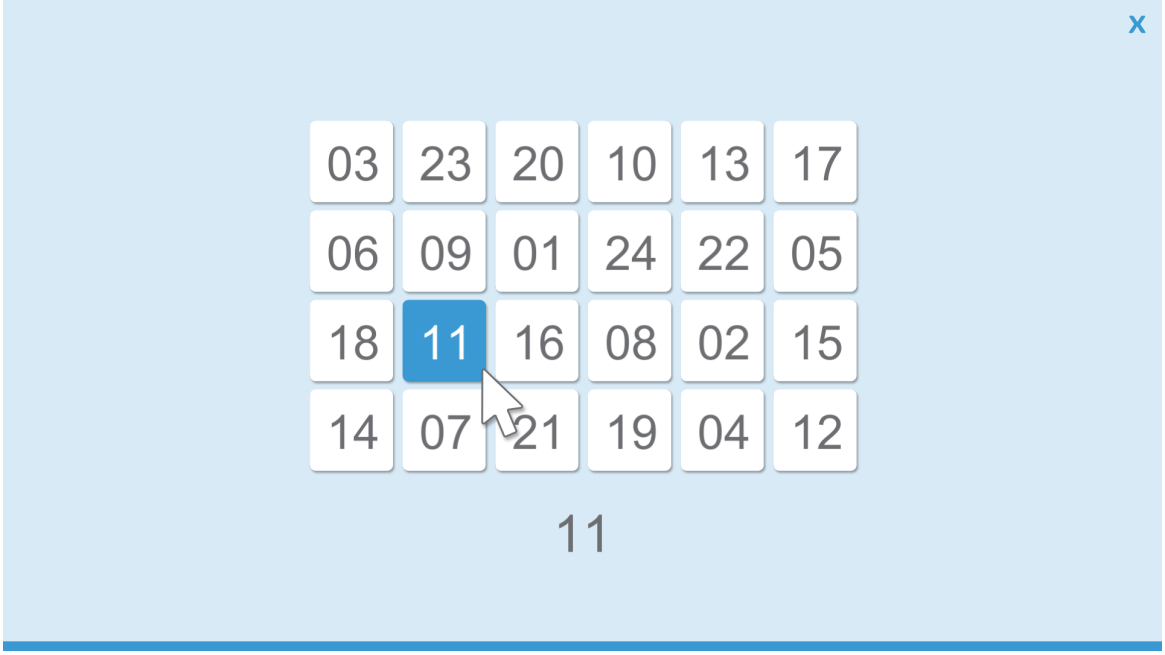


Fig. 1: Structure during the screening

The task is similar to the popular Number Connection Test (NCT) or Trail Making Test (TMT). The primary development focus for the test was not the screening of visual field disorders and neglects but the interpretation of attention-controlled flexibility and information processing speed. The similar TMT-B Test with letter-number changes (A1B2C3) is considered an executive measure of flexibility/ adaptation capability.

While the Spatial Numbers Search screening module can help check for visual neglect, the Visual Field and Visual Scanning screening modules are more suitable for the screening of visual field disorders and neglects.

# 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 (MA), 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 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 present only in case 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 patient has to find the numbers from 1 to 24 in ascending order on a grid.

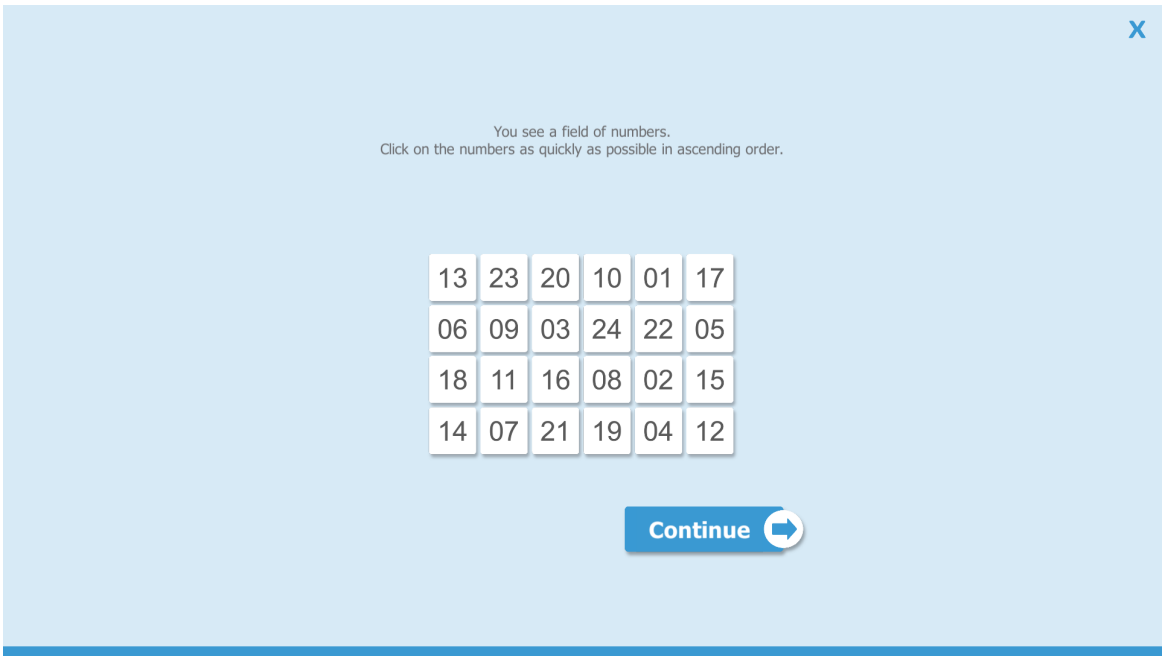


Fig. 2: Instructions w ith sample combination

The consecutive numbers are not adjacent. The visual search and exploration across the entire number field is necessary.

# 4 Implementation and Duration

The test starts with an exercise. Only the numbers 1 to 5 are used in the exercise.

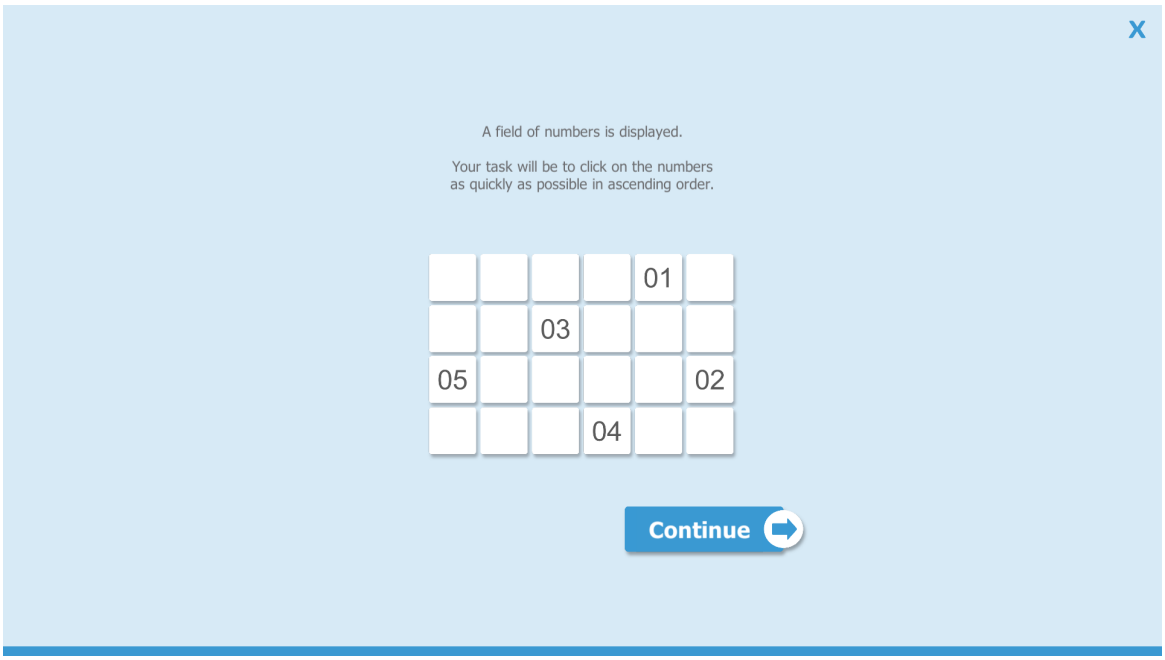


Fig. 3: Instructions with exercise combination

If a number is selected out of sequence, a message displays that provides further instructions to the patient. Once the exercise is complete, the screening starts.

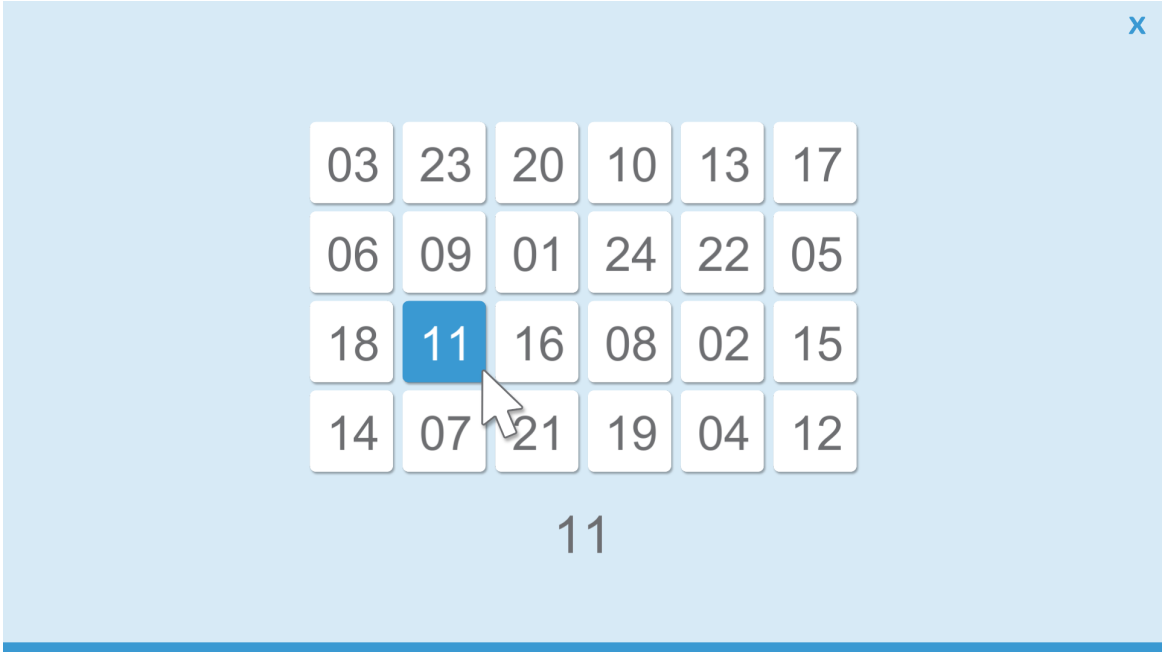


Fig. 4: Structure during the screening

The user has to select the numbers from 1 to 24 in increasing order on the screen. The next number in the sequence is shown underneath the number field.

Patients with neglect might have problems finding numbers on the edge of the field. If a number is not found within 20 seconds, the search continues with the next number.

**Duration**

maximum of 8 min. (without practice)

# 5 Data analysis

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

In the Spatial Numbers Search screening module, three Z-values are calculated.

**Z-value 1: Working speed**
Median of all search times

**Z-value 2: Attention**
A linear regression is calculated over all search times.

An increase of the regression line suggests that a patient's attention performance declines during the training.

**Z-value 3: Neglect / Hemianopsia**
Average search times in the right and left half of the screen are compared. An obvious slowdown on one side indicates either a neglect or an hemianopsia.

## 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 Spacial Numbers Search 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).

The detailed analysis allows the presentation of a maximum of three results at the same time. The first and the last fully completed screening is preselected; however, you can change the selection by clicking the checkbox next to the date of results you wan to see. The display in the diagrams changes accordingly. The background color of each row of results corresponds to the line color in the table and the color of the time bars in the diagram for the lateral preference (see Fig. 6).

**Working speed**: Based on the median of the search times (Z-value 1), the working speed can be evaluated in comparison to the normative sample. If the reaction speed in comparison with the normative sample is slowed, this can provide information on diminished cognitive performance speed and reduced selective attention performance.

The percentile rank is presented after the Z-value in parentheses. The given value is an approximation based on the Gaussian normal distribution.

**Marc Testpatient** B-Day.: 01/01/2000

HASOMED RehaCom® **Spatial Numbers Search**

| | Date | Mistakes | Omissions Left/Right | Avg. Reac. Time Left/Right [ms] | Median Reac. Time [ms] | Z Value Working speed | Z Value Attention | Z Value Neglect/Hemianopsia |
|---|---|---|---|---|---|---|---|---|
| | 05/02/2016 | 1 | 0/0 | 1716/2125 | 1047 | 1.14 (87.2%) | -0.73 (23.4%) | -0.95 (17.2%) |

Norm Working speed (Average value: 1651 ms; Standard deviation: 531 ms) - Median reaction time
Norm Attention - Slope of the reaction times over the wanted numbers
Norm Neglect/Hemianopsia - Slope of the reaction times over the columns

Fig. 5: results of screening "Spatial Numbers Search"

The diagram for the lateral preference shows every search time on the position in the number field. The bars at the end of the rows and columns graphically represent the mean value of the reaction times in the particular row or column. Increased search times in certain areas indicate a visual neglect or hemianopsia in this area.

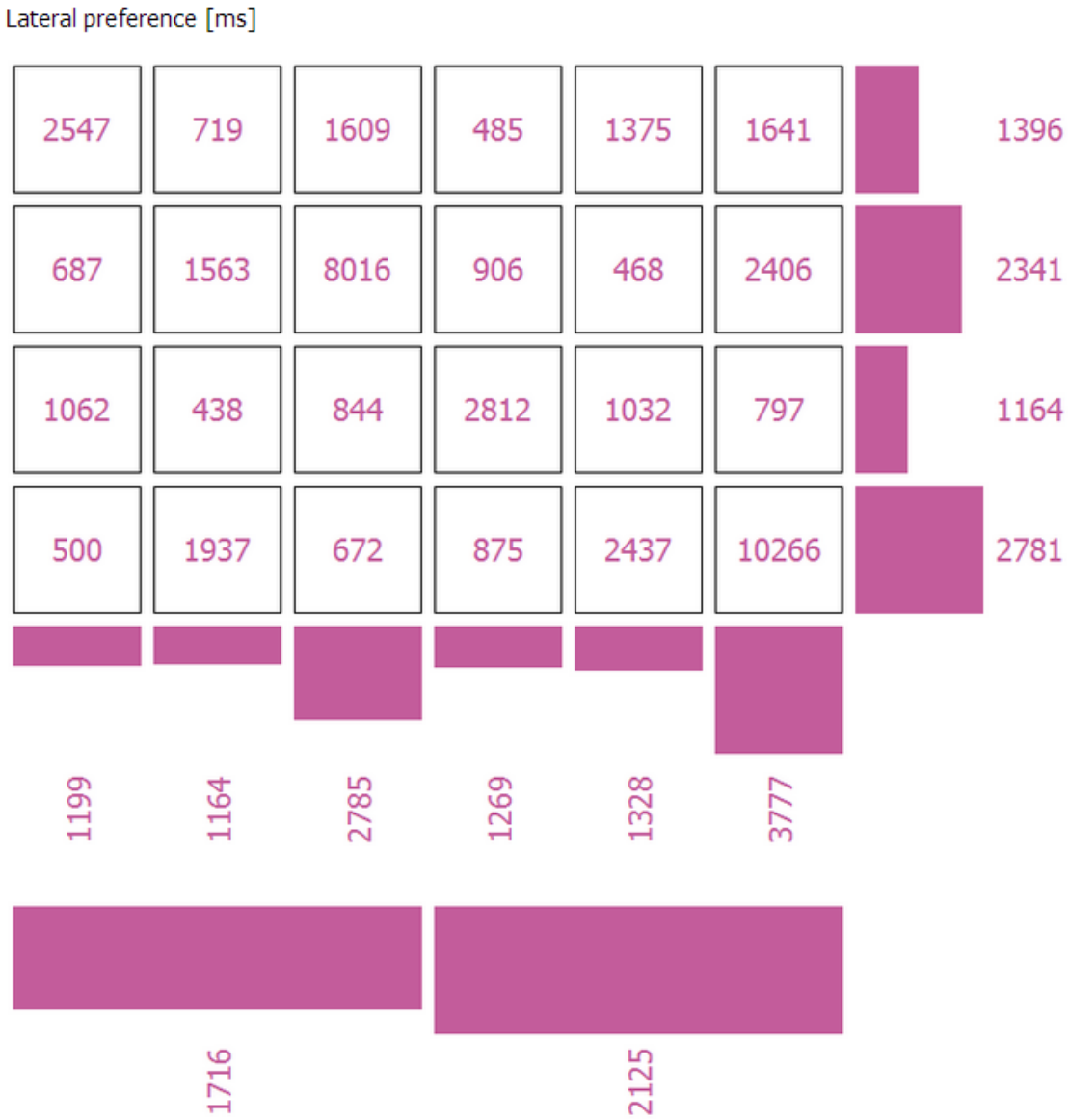


Fig.6: Detailed view of the lateral preference

## Result evaluation:

The number field requires different performance components

1) Discover stimuli in the central and peripheral visual field
2) Ability for shifting the focus of attention
3) Eye movement control
4) Cognitive search strategies

Depending on the type of disorder, performance components can be affected differently. Hemianopsia without neglect mainly affects point 1, neglect affects mainly point 2 but can also affect point 3, and Balint's syndrome and Balint-Holmes syndrome affect mainly point 3 but can also affect point 4. The search strategies (line by line, column by column, unsystematically, randomly) form the executive part.

Patients with hemianopsia without neglect, in case of compensation because of head-eye-movement, cope with the task more slowly.

Neglect patients having problems with the shift of attention focus are probably even slower. An important point for the progress of these patients is that they are able to cognitively "count" and therefore their search remains target-oriented and feedback-controlled.

Patients without any visual field defect can be below average if they have deficits of cognitive flexibility or cognitive processing speed, which means that they are more conspicuous in the area of attention performance. For these patients, it is advisable to continue with an attention screening and to perform therapy modules for attention training afterwards.

The lower diagram in the "Details" window shows the search times (in ms) for each number in sequence. If the search time increases near the end of the screening, a possibly declining attention performance is assumed.

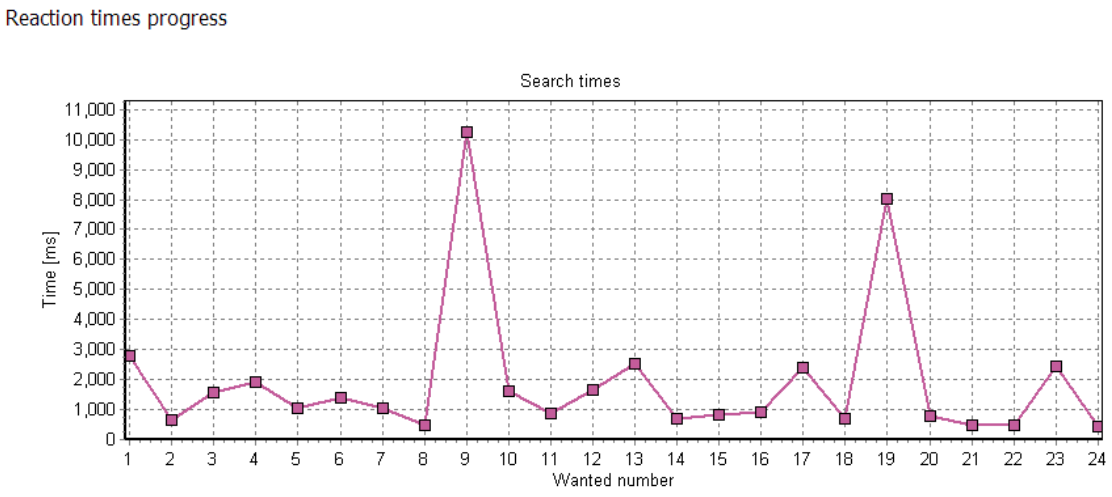


Fig. 7: Reaction time course

**Therapy recommendations:**

Because the screening results depend a lot on the disorder of the respective subject it is not possible to give a general therapy recommendation:

- For patients suffering from neglect or hemianopsia, an additional screening with Visual Field and Visual Scanning should be performed. After that, therapy should be performed using the RehaCom modules Saccadic Training, Overview and Reading, and Visual Attention.
- If cognitive slowing is evident but without visual field deficit, an attention screening should take place next (e.g., Alertness, Selective Attention, Divided Attention) and therapy training afterwards (e.g., Reaction Behavior and Responsiveness).
- In case of slowing in geriatric environment the module Mental Activation should be used.

**Norms:**

The screening was standardized with over 200 healthy test persons aged 10 to 82 years (state September 2014).

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