VIENNA TEST SYSTEM

COGNIPLUS

MANUAL

NEUROPSYCHOLOGY
TOOLBOX

Version 01

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CONTENTS

1 INTRODUCTION

Neuropsychological assessment enables impairments of cerebral functioning to be measured and objectivized (Sturm, 2006, 2009). The assessment process depends on the specific purpose of the investigation (e.g. description of the current functional state, follow-up assessment, planning and evaluating rehabilitation measures, occupational rehabilitation, official report).

To carry out an appropriate neuropsychological assessment the clinical neuropsychologist must have a basic knowledge not only of psychological test theory and psychological assessment procedures but also of the fundamentals of neurology, psychiatry, functional neuroanatomy and – where relevant – of psychopharmacology and neurotoxicology. This knowledge is necessary in order to carry out a neuropsychological examination of the patient that is suited to the purpose of the investigation and to interpret the results correctly both psychometrically and in terms of content.

Even precise identification of the type and location of brain damage does not in itself provide sufficient information about the extent and nature of any functional impairment that may be associated with it. The reliable qualitative and quantitative measurement of psychological changes must be undertaken by the clinical neuropsychologist using appropriate psychological and neuropsychological investigative procedures (von Cramon, Mai, & Ziegler, 1995; Lezak et al., 2004; Spreen & Strauss, 1998).

It is also important to assess and document factors that may affect the test results, which may in some cases make specific investigations necessary (see below).

Since 2005 the Gesellschaft für Neuropsychologie (Society for Neuropsychology) has either published guidelines on neuropsychological assessment and therapy (Der Vorstand der GNP et al., 2005) or commissioned (Sturm et al., 2008, 2009; Thöne-Otto et al., 2008; Müller et al., 2008) or approved (Karnath et al., 2008) such guidelines. Among other things, these guidelines set standards for a variety of situations that arise in clinical neuropsychological assessment. Compliance with these standards requires a pool of assessment procedures covering the function areas defined in the guidelines. **The present Neuropsychology Toolbox aims to provide just this – to make available to the neuropsychologist a collection of specific and sensitive tests that can be used to carry out neuropsychological assessment in accordance with the guidelines.**

The assessment tests in the VTS are accompanied in CogniPlus by parallel computer-based therapy modules that can be used to carry out specific training of the cognitive impairments identified using the VTS. The CogniPlus programs are based on up-to-date, scientific knowledge of cognitive functions and the ways in which they can be trained. The realistic design of the training programs makes the everyday relevance of the therapy measure clear to the patient, thereby boosting his motivation to commit to therapy and helping to integrate the progress made in training into everyday life.

2 INTRODUCTION TO NEUROPSYCHOLOGICAL ASSESSMENT

2.1 Evidence of disability

Identifying whether there is a connection between an impairment and a disability requires knowledge (ideally as detailed as possible) of the patient's pre-morbid capacity, because it is only by comparing current and the pre-morbid performance data that any such connection can be established. Pre-morbid capacity can be assessed from the patient's detailed educational history, especially his particular pre-morbid successes and failures, and from his job history. In an ideal case the results of previous detailed neurological and psychological investigations would be available, but usually it is only possible to obtain a rough picture of the patient's pre-morbid condition and ability profile from the educational and work-related information collected during history-taking.
If the patient's performance as currently measured, *by comparison with educational and work-related norm scores,* is significantly below the minimum suggested by the patient's scholastic and occupational achievements, it can be assumed that deterioration of performance has occurred. In addition, by applying neuropsychological knowledge of the connections between impairment and disability the practitioner can generate hypotheses about possible functional disabilities relative to the likely pre-morbid levels and check them against the test results that are actually obtained.

2.2 Follow-up tests

Follow-up tests are intended to identify spontaneous changes in the course of progressive or regressive disease processes and to measure the effects of therapeutic measures.
Such assessments are made by comparing two or more results obtained at different times using the same or equivalent tests. In the case of memory tests follow-up tests should always involve a parallel form of the test originally used; if the same form is used a second time functional changes may be masked by learning effects. Even if parallel tests are used, performance may improve upon repetition of the test as a result of transfer effects and hence independently of the progress of the disease or of therapy.
The standardized tests of the VTS make it possible, by applying the methods of psychometric single-case assessment, to check any changes in test scores between two separate test sessions to ensure that they are not merely a reflection of random fluctuations in performance as a result of the test's measurement error (Huber, 1973).

2.3 Factors that affect test results

Indications of factors that could affect the working of the tests and/or interpretation of the results are obtained from earlier findings, from the history-taking and structured interview and from preliminary behavioral observation (Sturm, 2009). Such factors include:

- *Medication:*
  Sedatives and also stimulants or drugs that affect particular neurotransmitter systems can distort test results.

- *Sight/hearing:*
  Visual impairments, especially hemianopsia and disorders of contrast or color perception, must be taken into account when selecting tests and interpreting findings. If patients need aids such as glasses or hearing aids, these must be worn during the tests. Some tests (such as WAF) provide a separate assessment of sensory abilities.
- *Speech disorders:*
  If a speech disorder is suspected or known to exist, verbal tasks (except of course for assessing and describing the speech disorder per se) should as far as possible be avoided. Multiple-choice tasks and simple yes/no decisions are also unsuitable – non-verbal symbols (e.g. smilies/frownies) to which the patient can point should be used instead.
- *Motor disabilities:*
  Hemiparesis or hemiplegia of the dominant hand, as well as more subtle motor impairments such as coordination problems and impairments of fine motor skills, can considerably restrict motor responses or even make them impossible; the effect is particularly marked if the responses are time-critical. If the test so permits, the tester can take over the motor components of the task, or the task can be performed with the non-dominant hand.

2.4 Analyzing and interpreting the test results

The behavioral observations made during testing (e.g. difficulty understanding the instructions, achievement motivation, willingness to cooperate, fatigue, emotional behavior such as crying, aggressive remarks) must be incorporated into the assessment of results and taken into account in the interpretation.
To detect more subtle disabilities, it can be useful to employ specific methods of *psychometric single-case assessment* (Huber, 1973; Willmes, 1990) when analyzing the results. In principle psychometric single-case assessment addresses the question of whether performance differences observed within an individual performance profile actually reflect performance discrepancies in the patient concerned or are simply the result of chance. A further question is whether the observed differences point in the right direction – i.e. the direction indicated by the hypothesis (e.g. relative impairment of planning and problem-solving ability in comparison to other intellectual functions in patients with suspected impairment of executive functions). This can be tested by using reliability-related critical differences (d_{crit}) between individual test results or planned linear comparisons between test groups that represent different performance areas (e.g. intensity and selectivity aspects of attention). When interpreting the results it is also useful to know with what probability a discrepancy of the observed size would occur in healthy people. In follow-up tests – e.g. for monitoring the effectiveness of therapy – two or more results obtained using the same test can likewise be checked using critical differences to identify non-random changes or changes in the relationship between entire function areas (planned profile comparison, Huber 1973). Information of this sort can be provided only by well standardized, reliable and valid tests, such as those contained in the VTS. Some VTS tests already contain guidance on psychometric single-case assessment (e.g. VLT and NVLT).

The Vienna Test System and CogniPlus enable neuropsychological assessment, treatment and subsequent efficacy analysis to be linked through the use of coordinated content.

Since the corresponding tests and training programs of the VTS and CogniPlus use entirely different material, a reliable distinction can be made between the material-specific learning effect and the generalizable training effect that is being aimed at.

3 USING THE TOOLBOX IN ASSESSMENT AND THERAPY

This section describes key neuropsychological function areas and the tools in the **Neuropsychology Toolbox** that can be used to test them. For each function the relevant therapy program in CogniPlus is also listed. The Toolbox should be viewed as a collection of useful programs for the practising neuropsychologist. It cannot replace the neuropsychologist's clinical expertise and experience, and this manual should not be regarded as a textbook of clinical neuropsychology. The selected investigative tests usually represent different aspects of the function area under consideration. In an individual case, however, the choice of the Toolbox test best suited to the issue under investigation must be left to the neuropsychologically trained user. In addition, the individual manuals for the selected tests provide information in this area that goes far beyond the scope of this Toolbox manual.
A detailed list of all function areas and the associated assessment tests and therapy programs in the Neuropsychology Toolbox will be found in the table at the end of the manual (see Chapter 4). For some function areas several alternative assessment tests are available (see above). For each function area there is also a separate table that provides information on all the relevant tests (and subtests, if any) available in the VTS and associated therapy programs. The Handbuch Neuropsychologischer Testverfahren [Manual of Neuropsychological Tests] (Schellig et al., 2009) and the test-specific manuals provide practice-related test reviews and details of the psychometric properties of the tests contained in the Toolbox that relate to the key areas of attention, memory and executive functions, especially with regard to their standardization, validity and usefulness in neuropsychological investigations. In addition, Chapter 4 of the present manual contains a description of the tasks performed by the tests in the Neuropsychology Toolbox.

Depending on what disorder is suspected, neuropsychological tests should cover the following function areas in accordance with the guidelines given in Chapter 1.

3.1 Basal and higher perception functions

The majority of neuropsychological tests are carried out in the visual modality. It is therefore important to check that the patient has adequate vision (corrected, if necessary), adequate perception of space and contrast and normal color perception. Visual field defects, in particular, can significantly distort the test results and consequently lead to misinterpretation. In cases of doubt, the visual field should be tested using simple finger perimetry or visual field tests such as those in the WAF (Perception and Attention functions Test Battery).
When auditory stimulus presentation is used, the patient's hearing and (if necessary) his ability to discriminate between different tones or sounds should first be checked.

The following tests are available for assessing perception functions:

Function area	Selected test VIENNA TEST SYSTEM	Selected training program COGNIPLUS
> Basal visual functions		
Distinguishing brightness	WAFW/S2	
Distinguishing shapes	WAFW/S3	
> Basal auditory functions		
Auditory differentiation	WAFW/S4	
Distinguishing tonepitch	WAFW/S5	
Distinguishing volume	WAFW/S6	
> Visual field/visual exploration		
Rapid visual search (visual scanning)	LVT/S2	
Visual field/neglect	WAFR/S5	SPACE

3.2 Attention

The detailed assessment of attention functions is particularly important in clinical neuropsychology. If disorders of attention are suspected, the assessment should include at least one test in each of the following areas (Sturm et al., 2008):

- Intensity of attention (e.g. alertness test, if necessary administered once at the start of testing and again at the end to measure fatigue and impairments of resilience)
- Selectivity (e.g. testing the division of attention with separate assessment of the individual task components; testing focused attention if the patient is susceptible to distraction)
- Following damage to the right hemisphere of the brain, particularly in the parietal area, the spatial orienting of attention should always be assessed, even if there is no clinically significant neglect.

Attention functions are also very important in the assessment of fitness to drive after brain injury.
Since the quality of attentional performance often depends to a particularly great extent on the speed of task processing, time measurement is an important aspect of the assessment of basal attention functions (alertness, sustained attention). For this reason computer-based tests for assessing attention have become established in recent years, since as well as analyzing errors such tests can measure time-dependent attention parameters precisely and accurately. Both speed and accuracy of response are necessary to achieve good performance in all selective attention tasks. If significantly slowed reaction times are observed even in simple reaction tasks, impaired reactions in more complex tests of attention (selective, focused, divided attention) should in most cases be interpreted as impairments of the “alertness” function. In this situation the number of errors is the most important factor to be taken into account in assessing selectivity. However, some patients with impaired alertness may display fewer reaction deficits when presented with more complex tasks than in typical “alertness tests”. This is a result of the higher exogenous (bottom-up) stimulation associated with more demanding tasks and should not be interpreted as an indicator of unimpaired cognitive control of intrinsic (internally controlled) alertness.
Testing of attention should be carried out in both visual and auditory modalities in order to provide separate assessments of modality-specific attention abilities. Dissociations of

auditory and visual attention deficits indicate that there are probably specific mechanisms for controlling input in the different modalities. The WAF tests enable attention to be tested on a modality-specific basis. The WAF subtests cover the entire spectrum of attention functions currently considered to be relevant to neuropsychology. Moreover, the WAF function areas are carefully coordinated with the corresponding attention training modules in CogniPlus. WAF is thus a particularly useful tool for measuring specific attention deficits and selecting the appropriate CogniPlus training program. It can also be used at the conclusion of therapy to monitor effectiveness. Trivial practice effects can be ruled out, because although WAF and CogniPlus cover the same attention functions they use completely different task material.
In some situations, however, other Toolbox items in the attention category may also be relevant. For example, for patients with impaired selectivity of attention use of the Determination Test (DT) is particularly recommended if selectivity needs to be measured not just from the stimulus side but also from the reaction side. This may be particularly relevant where fitness to drive is at issue. However, in patients with motor deficits the increased motor strain would have a negative impact here.

Computerized therapy programs that train specific attention functions in realistic everyday situations have proved useful in the treatment of ***attention disorders***. The effectiveness of this approach to therapy has been demonstrated for both vascular and traumatic brain injuries in the post-acute phase (Barker-Collo et al., 2009; Sohlberg et al., 2000; Sturm et al., 1997, 2003) and for patients with multiple sclerosis or epilepsy (Engelberts et al., 2002; Plohmann, 1998). In addition, specific computer-based attention training programs produce more successful long-term results than non-specific computer therapy (Gray et al., 1992). A German-language computer-based therapy program that has been subjected to evidence-based evaluation and is recommended in the guidelines of various professional societies is AIXTENT, on which the CogniPlus attention training programs are based (Sturm et al., 1994, 1997, 2003; Engelberts et al., 2002; Plohmann, 1998). Even after five years of severely impaired alertness it was possible to achieve permanently stable normalization of the alertness function using the CogniPlus alertness training program (Hauke et al, 2011). The planning of targeted and specific therapy of attention disorders must be preceded by careful assessment, since a number of studies have shown that the therapy must be specifically tailored to the deficit that is present (Sohlberg et al., 2000; Sturm et al, 1997).

Cicerone et al. (2000, 2005) published metaanalyses of evidence-based cognitive rehabilitation in the field of attention therapy. They found that the studies demonstrate the effectiveness of specific attention training over non-specific cognitive stimulation, both for patients who have suffered traumatic brain injury and for stroke patients. Therapy should involve training in different sensory modalities and at a range of complexity levels.
There is, however, inadequate evidence of the effectiveness of attention therapy in the early phase of rehabilitation, since the effects of attention therapy cannot be distinguished from those of spontaneous remission.

The following attention-related tests and training programs are available in the Toolbox:

Function area	Selected test VIENNA TEST SYSTEM	Selected training program COGNIPLUS
> Intensity of attention		
Alertness – auditory and visual, intrinsic and phasic	WAFA	ALERT
Vigilance – visual	WAFV/S2	VIG
Vigilance – auditory	WAFV/S4	
Sustained attention – visual	WAFV/S6	VIG
Sustained attention – visual, short form	WAFV/S5	VIG
Sustained attention – auditory	WAFV/S8	
Sustained attention – auditory, short form	WAFV/S7	
> Spatial attention		
Spatial attention – 4 stimulus positions, central cue	WAFR/S1	SPACE
Spatial attention – 8 stimulus positions, central cue, experimental version	WAFR/S2	SPACE
Spatial attention – 4 stimulus positions, peripheral cue	WAFR/S3	SPACE
Spatial attention – 8 stimulus positions, peripheral cue, experimental version	WAFR/S4	SPACE
Neglect	WAFR/S5	SPACE
> Selectivity of attention		
Selective attention – visual, auditory, crossmodal	WAFS	SELECT
Selective attention – adaptive mode	DT/S1	
Selective attention – action mode	DT/S3	
Selective attention – reaction mode	DT/S5	
Focused attention – visual, auditory, crossmodal	WAFF	FOCUS
Focused attention – color/word interference	STROOP/S7	
Divided attention – visual, crossmodal	WAFG	DIVID

3.3 Memory functions

Memory involves a number of function areas and processes that may be specifically affected by a brain injury (Schuri, 2000). Memory deficits can be material- or modality-specific and they depend on the time for which information is retained. In view of the many facets of human memory it is unsurprising that there is no adequate screening test for measuring memory disorders.
It is recommended that a neuropsychological memory assessment includes at least one test for each of the following aspects of memory (Thöne-Otto et al., 2008):

- **Short-term memory/working memory:**
  short-term retention and cognitive manipulation of verbal and figural information
- **Long-term memory:**
  - immediate reproduction of explicit verbal and figural information that exceeds the capacity of short-term memory
  - delayed reproduction of the immediately reproduced information after an interval of 20 – 30 minutes; where possible also after 24 hours.
  - using a learning paradigm (e.g. learning a word list), increase in learning with repetition and depiction of proactive and retroactive interference effects

Testing should involve different recall modalities: free recall, cued recall, recognition.

A differentiated psychometric assessment may in addition require assessment of the following aspects:

- **Orientation** (especially in severely affected patients): physical and geographical, temporal and situational orientation and awareness of self
- **Old memory:**
  - autobiographical memory (with its semantic and episodic components) and memory for public events and details from various stages of life. Subjectively relevant domain-specific knowledge (e.g. specialist work-related knowledge)
- **Prospective memory**: temporally or situationally appropriate memory of tasks that need to be carried out
- **Implicit or non-declarative memory**: priming, procedural learning
- **Incidental learning**: recall of information that the patient has not previously been instructed to learn
- Duration of the post-traumatic amnesia in traumatic brain injury patients

Memory assessment in accordance with the relevant guidelines therefore focuses on the key functions of working memory (see also executive functions) and the creation of new content in explicit long-term memory. If the issue under investigation calls for differentiation – either because of the type of lesion or for specific work-related reasons – more differentiated or additional tests may be needed to assess implicit, prospective or old memory, orientation or incidental learning.
The toolbox of the Vienna Test System enables important memory functions to be measured.
On the basis of critical reviews evidence-based procedures for the ***therapy of long-term memory disorders*** have been identified in recent years (Cicerone et al., 2000; Cicerone et al., 2005; Thöne-Otto, 2010). For patients with mild to moderate memory disorders, especially after traumatic brain injury, one of the methods recommended is training of

compensatory internal aids. To develop domain-specific knowledge in patients with severe memory disorders, the use of effective learning strategies (errorless learning, vanishing cues and spaced retrieval) is helpful.

Computers are being used more and more frequently in memory therapy – with good results (see e.g. Tam & Man, 2004; Dou et al., 2006; Spahn et al., 2010). For example, Dou et el. (2006) and Spahn et al. (2010) found no difference in effectiveness between a training program delivered by computer and one provided by a therapist. Similarly, Tam & Man (2004) found no difference in the effectiveness of different versions of computer-based training delivery (self-paced, with feedback, personalized, visual presentation and control group).

One function area in which computers have been used with success for a number of years is that of working memory. Computer-based programs for ***training executive working-memory functions*** produced improvement in complex cognitive functions including fluid intelligence (Klingberg et al., 2005; Klingberg, Forssberg, & Westerberg, 2002; Olesen, Westerberg & Klingberg, 2004; Posner & Rothbart, 2005; Westerberg & Klingberg, 2007; Jaeggi et al., 2008). According to these authors, crucial factors for the effectiveness of such programs are training at the limit of the individual's ability and the parallel training of different executive functions of working memory. According to Cowan et al. (Halford, Cowan & Andrews, 2007) the tasks used should in addition call extensively on binding processes and on the respondent's attention. Jaeggi et al. (2008) achieved similar results to Klingberg using complex n-back tasks that require continuous updating of verbal and spatial material in working memory. Both computer-based training programs show not just the expected results: the improvements in working memory are generalized to complex cognitive functions. Olesen et al. (2004) also found neurobiological evidence of functional reorganization as a result of training: improvements in working memory were accompanied by increased arousal in the key neural structures of working memory. The training benefited healthy people as well as neurological patients (Westerberg & Klingberg, 2007).

CogniPlus includes or plans to include training programs for the treatment of impairments of both working memory and long-term memory. The computer tasks are designed to target specific memory deficits and meet the criteria for an efficient memory training program, whether in relation to the updating of working memory or the acquisition of strategies for learning names and faces. The special feature of the CogniPlus memory therapy programs is that they not only provide materials for strategy training but teach and practise the strategies themselves.

The following memory-related tests and training programs are available:

Function area	Selected test VIENNA TEST SYSTEM	Selected training program COGNIPLUS
Short-term/working memory		
> Working memory storage processes		
Immediate block span – forwards; start with group of 3, for adults	CORSI/S1	VISP, CODING
Immediate block span – forwards; start with group of 2, for children	CORSI/S2	VISP, CODING
Immediate block span – backwards; start with group of 3, for adults	CORSI/S5	VISP, DATEUP
Immediate block span – backwards; start with group of 2, for children	CORSI/S6	VISP, DATEUP
Immediate block span – forwards; start with group of 3 and supra-block span, for adults	CORSI/S3	VISP, CODING, DATEUP
Immediate block span – forwards, start with group of 2 and supra-block span, for children	CORSI/S4	VISP, CODING, DATEUP
Repeating numbers – forwards	ZN/S1	
> Executive functions of working memory		
Repeating numbers – backwards	ZN/S2	
Visual capacity of working memory – 2-back	NBN/S1	DATEUP, NBACK
Visual capacity of working memory – 3-back	NBN/S3	DATEUP, NBACK
Verbal capacity of working memory – 2-back	NBV/S1	DATEUP, NBACK
Verbal capacity of working memory – 3-back	NBV/S3	DATEUP, NBACK
Information–processing capacity – standard form	PASAT/S1	DATEUP
Information–processing capacity – short form / 2-sec. interval	PASAT/S2	DATEUP
Information–processing capacity – short form / 3-sec. interval	PASAT/S3	DATEUP
Information–processing capacity – children's form	PASAT/S4	DATEUP
Explicit long-term memory		
> Verbal		
Scoring program – CVLT long form 1	CVLT/S1	
Scoring program – CVLT long form 2	CVLT/S2	
Verbal learning test – long form A	VLT/S1	
Verbal learning test – long form B	VLT/S3	
Verbal learning test – short form A	VLT/S2	
Verbal learning test – short form B	VLT/S4	
Memory	IBF/Long-term memory	
> Figural/visual - spatial		
Non-verbal learning test – long form A	NVLT/S1	
Non-verbal learning test – long form B	NVLT/S11	
Non-verbal learning test – short form A	NVLT/S2	
Non-verbal learning test – short form B	NVLT/S12	
Non-verbal learning test – long form A	NVLT/S1	
> Faces – verbal		
Faces/names learning test form A	FNA/S1	NAMES
Faces/names learning test form B	FNA/S2	NAMES
Old memory		
> Semantic long-term memory		
General knowledge	IBF/Verbal intelligence functions	

3.4 Spatial processing

Behavior in space involves a number of spatial perception and orientation abilities of varying complexity. After a brain injury these abilities may be selectively impaired. Spatial disorders can be grouped into four categories on the basis of the aspect of spatial processing that is impaired:

- spatial-perceptive
- spatial-cognitive
- spatial-constructive and
- spatial-topographical impairments.

The spatial-perceptive function area comprises elementary perceptive processes such as perception of position and shape and estimation of length and distance. Spatial-cognitive functions involve mental spatial operations, such as mental rotation or mental change of perspective. Spatial-constructive processes are required when individual elements must be combined manually to form a whole, as when drawing a geometric figure, assembling blocks or wrapping presents. A spatial-constructive disorder is often associated with spatial-perceptive deficits or impairments of working memory or executive functions – the idea that these associated deficits should not occur with a spatial-constructive disorder is being ever more frequently called into question. Spatial-topographical functions are processes that make spatial navigation possible in real or imagined three-dimensional space. They include in particular the ability to picture one's own position in space, which requires the construction of a mental map and frequently also the handling of landmarks. These topographical abilities can be impaired even if there is no damage to the other three spatial function areas. This possibility of selective impairment means that an investigation of spatial processing must involve systematic analysis of all the relevant aspects. Testing should cover basal spatial perception (spatial-perceptive), mental spatial operations (spatial-cognitive), manual design (spatial-constructive) and both real and mental navigation (spatial-topographical).

Computer-based *therapy for visuo-spatial deficits* focuses on treatment of unilateral neglect, restitution of the visual field (Cicerone et al., 2005), visual scanning and simple visual perception functions (Cicerone et al., 2000; Karnath et al., 2008). The SPACE training program is a neglect / visual field training procedure that also trains spatial scanning. In addition the ROTATE program provides a therapy program for the treatment of complex spatial functions.

The following tests and training programs are available for spatial processing:

Function area	Selected test VIENNA TEST SYSTEM	Selected training program COGNIPLUS
> Spatial processing		
Spatial – perceptive	2D	
Spatial – cognitive	3D	ROTATE
Spatial – cognitive, complex	MR	ROTATE

3.5 Planning and control functions (executive functions)

Planning and control functions (executive functions) are metacognitive processes that make goal-directed and situationally adapted behavior possible. As flexible top-down processes they coordinate our action and thought in a goal-directed manner and monitor the progress of our actions and the extent to which they meet the requirements of the situation; however, they are also involved in the goal-setting itself. These processes are always required when learned and automated response and behavior patterns do not suffice – in other words, when the situation requires flexible action. The planning, control and monitoring of our actions involves in essence the following tasks (Karnath & Sturm, 2006): a) exploration of the action environment, b) creation of action models and plans, c) automatic recall and coordination of programs of action in routine situations that have already proved useful, and d) the goal-directed execution of actions and subsequent monitoring of the action through a feedback process, with correction of any discrepancies between action plan and actual behavior that may be found. The basis of these complex cognitive functions is considered to be the executive processes of working memory (Baddeley 1986; Goldman-Rakic, 1995; Courtney, 2004; Hillary et al., 2006): the updating, shifting, inhibition and monitoring of contents.
If executive dysfunctions are suspected, the assessment should include at least one test of each of the following function areas (Müller et al., 2008):

- working memory (see Memory Functions)
- monitoring
- cognitive fluency and flexibility
- planning and problem-solving thinking

For assessing *inductive reasoning* the Toolbox provides alternative tasks from INSBAT and IBF.

Limiting executive functions to cognitive processes does not do justice to the complexity of human behavior. Where patients are affected by executive dysfunctions it is equally important for the neuropsychological examination to include assessment of emotional, motivational and behavioral abnormalities (which may include unrealistic self-assessment) and comprehensive questioning of relatives (see Emotionality/Affect).

According to the guidelines on neuropsychological therapy of 2008 (Müller et al., 2008), no evaluated computer-based therapy programs for the ***treatment of disorders of executive functions*** were then available on the market; the programs contained in CogniPlus for improving planning and action skills and controlling inhibition therefore represent a new development.

The following tests and training programs for the executive functions are available:

Function area	Selected test VIENNA TEST SYSTEM	Selected training program COGNIPLUS
> Inhibition		
Inhibition – stop signal - form A	INHIB/S1	HIBIT
Inhibition – go/nogo - form A	INHIB/S3	HIBIT
Inhibition – cued go/nogo - form A	INHIB/S5	HIBIT
Inhibition – behavioral shift -form A	INHIB/S7	HIBIT
Inhibition – behavioral shift and inhibition - form A	INHIB/S9	HIBIT
Inhibition – stop signal - form B	INHIB/S2	HIBIT
Inhibition – go/nogo – form B	INHIB/S4	HIBIT
Inhibition – cued go/nogo – form B	INHIB/S6	HIBIT
Inhibition – behavioral shift - form B	INHIB/S8	HIBIT
Inhibition – behavioral shift and inhibition - form B	INHIB/S10	HIBIT
Cognitive interference, color/word	STROOP/S7	
Cognitive interference – congruent/incongruent	STROOP/S8	
> Action planning and problem-solving thinking		
Problem-solving thinking – form A	SPM/S1	
Problem-solving thinking – form B	SPM/S7	
Action planning		PLAND
> Fluency and flexibility		
Cognitive flexibility	PERSEV	
Verbal fluency	INSBAT/verbal fluency	
> Inductive and deductive reasoning		
Inductive reasoning – matrices, Standard Form A	SPM/S1	
Inductive reasoning – matrices, Standard Form B	SPM/S7	
Inductive reasoning – matrices, difficult	SPMPLS	
Inductive reasoning – continuing number sequences/“rule of three” problems	IBF/Numerical intelligence functions	
Form logic / inductive reasoning	FOLO	
Inductive reasoning – easy/children, form A	CPM/S1	
Inductive reasoning – easy/children, form B	CPM/S3	
Verbal deductive reasoning	INSBAT/Verbal deductive reasoning	

3.6 Sensorimotor abilities and motor planning

Assessment of sensorimotor coordination and fine motor skills involves testing:

- static steadiness
- the precise control of slow guiding movements of the arm and hand
- ballistic target movements, and
- rapidly oscillating finger and hand movements.

For the assessment of disorders of higher motor skills, in particular of the planning and execution of movement sequences (apraxia), see below.

The following tests and training programs are available for sensorimotor skills:

Function area	Selected Test VIENNA TEST SYSTEM	Selected training program COGNIPLUS
> Motor/sensorimotor coordination		
Eye-hand coordination	SMK/S1	VISMO
Fine motor skills – finger, hand, arm	MLS/S2	VISMO

3.7 Processing numbers and calculating

A thorough assessment of number-processing and calculating functions should cover all the following areas (Der Vorstand der GNP et al., 2005):

- (automated) counting of small quantities and counting backwards
- transcoding between different notation systems (Arabic numerals, number words), i.e. writing Arabic numerals (and number words) from dictation, writing Arabic numerals as words, converting written number words into Arabic numerals, reading Arabic numerals and number words aloud
- availability of an internal semantic size representation of number, i.e. size comparisons between numbers (times, money) in various notations, arranging numbers on a number line, estimating the number of things
- ability to use arithmetical signs, arithmetical facts (mental arithmetic using the basic arithmetical operations) and arithmetical procedures (written arithmetic using the basic arithmetical operations)
- When warranted by the patient's level of education, use should also be made of text tasks (e.g. involving calculation of percentages, rule of three), completion of number sequences and simple algebraic tasks.

For the assessment of computational ability the Toolbox provides alternative tasks from INSBAT and IBF.

The following tests for assessing number processing and computational ability are available:

Function area	Selected test VIENNA TEST SYSTEM
Continuing numerical series /"rule of three" problems	IBF/Numerical intelligence functions
Computational estimation	INSBAT/Computational estimation
Arithmetical competence	INSBAT/Arithmetical competence

3.8 Specific neuropsychological function disorders (aphasia, apraxia, neglect)

In patients with clearly localized brain lesions (e.g. after strokes or focal trauma) there is a likelihood of futher specific neuropsychological function disorders, the investigation of which forms part of the neuropscychological assessment.

- Lesions of speech-related areas of the left cerebral hemisphere can lead to systematic speech disorders that come under the heading of aphasia. In patients whose aphasia

has improved significantly or whose speech impairments do not yet result in clearly aphasic symptoms, more subtle speech disorders can be verified using tools such as word fluency tests that have been calibrated on healthy subjects.

- For the assessment of disorders of higher motor skills, in particular of the planning and execution of movement sequences (apraxia), structured clinical tests are available (see Poeck, 2006; Goldenberg, 2009).
- Failure to perceive one side of the visual field (hemineglect) can be tested using standardized neglect tests (in the VTS the WAFR subtest of the WAF).

The following tests and training programs are available for the testing and training of hemineglect and visual exploration disorders:

Function area	Selected test VIENNA TEST SYSTEM	Selected training program COGNIPLUS
> Visual field/visual exploration		
Rapid visual search (visual scanning)	LVT/S2	
Visual field/neglect	WAFR/S5	SPACE

3.9 Emotionality/affect

Assessment of the patient's affective/emotional state after a brain injury can be crucial to rehabilitation. On the one hand, brain injuries can be an organic cause of emotional dysregulation; on the other, anxieties and in particular depressive symptoms can develop as a reaction to organically caused impairments and handicaps. Frequently too little attention is paid to the close connection between affective/emotional mood and cognitive performance. The assessment of depressive symptoms is particularly important for neuropsychological assessment since such symptoms can have a marked adverse effect on cognitive functions and can give the appearance of brain-organic function disorders, especially in the areas of attention and memory.
Frequently observable affective/motivational impairments are disorders of motivation (apathy, hypobulia), anxiety, irritability, aggression, euphoric and sub-euphoric moods and sub-clinical and manifest depressive disorders.

Questionnaires and assessment scales are the principal means used to assess affective disorders that are not immediately clinically apparent or to monitor the progress of known disorders. Assessing a patient's present affective state as either pathological or non-pathological requires the patient's pre-morbid emotional personality structure to be known. Usually, however, objective information on this is lacking, and the range within which traits can still be regarded as normal is considerably larger for emotional characteristics than it is for ability parameters. There is also a risk that genuine organically caused symptoms (such as headaches, dizziness, tachycardia) will produce conspicuous scale scores on personality questionnaires – in particular depression inventories – and lead to erroneous interpretation of these questionnaires (e.g. as evidence of a manifest depressive disorder). Meaningful use of these tests in neuropsychological assessment therefore presupposes detailed knowledge of the symptoms of underlying organic ailments that may be present.

The following tests for assessing emotionality/affect are available:

Type of disorder	Selected test VIENNA TEST SYSTEM
> Depression	
Depression inventory	BDI II
> Anxiety	
Anxiety inventory	BAI

4 THE NEUROPSYCHOLOGICAL TEST AND TRAINING PROGRAMS OF THE NEUROPSYCHOLOGY TOOLBOX – AN OVERVIEW

This section provides a summary of the tasks contained in the programs in the Neuropsychology Toolbox. Further details of the psychometric properties of the tests contained in the Toolbox, especially with regard to their standardization, validity and usefulness in neuropsychological investigations, can be found in the practice-related test reviews in the Handbuch Neuropsychologischer Testverfahren [Manual of Neuropsychological Tests] (Schellig et al., 2009) and in the individual test-specific manuals in the Vienna Test System.

4.1 Attention functions

Intensity of attention	
Alertness (WAFA)	This test consists of 6 subtests in which a black circle and/or a 1 kHz tone is presented. The respondent must react as quickly as possible to the target stimulus. There are two intrinsic tasks (reaction tasks without cue), two phasic cross-modal tasks (with the cue in the different modality to the target stimulus) and two phasic unimodal tasks (cue in the same modality as the target stimulus).
Vigilance/sustained attention (WAFV)	WAFV consists of four subtests, of which two test sustained attention (auditory/visual) and two vigilance (auditory/visual). The visual subtests display gray squares that sometimes get darker. The auditory subtests use sound signals that sometimes get quieter. The respondent must react to any change in the signal properties. In the sustained attention subtests stimulus changes occur in 30% of cases; in the vigilance subtests they occur in only 5% of cases.
CogniPlus training program – intensity of attention	
ALERT: Alertness training	The ALERT training program trains the alertness dimension of attention – the ability to control the intensity of attention cognitively and maintain it. The client is driving along a road on a motorcycle. He must carefully observe the stretch of road in front of him and press the reaction key as quickly as possible when obstacles appear.

VIG: Vigilance and sustained attention training	The VIG training program trains the attention functions of sustained attention and vigilance – the ability to sustain attention over a lengthy period of time even under highly monotonous stimulus conditions. The client is driving along a straight and monotonous country road. His task is to react by pressing a button when an overtaking vehicle suddenly brakes in front of him.
Spatial attention	
Spatial attention (WAFR)	This test consists of five subtests. In the first four subtests triangles that point towards the edge of the screen are shown in four or eight positions on the screen. As soon as one of the triangles lights up, the client must react. Depending on the test form, warning stimuli are also presented; these provide correct or incorrect cues to the position of the illuminating stimuli. The fifth subtest uses white circles on a black screen; at irregular intervals the circles light up either on one side of the screen or simultaneously in both halves of the visual field. Depending on the position of the illuminated circles, the client must press the left or right reaction key or both keys simultaneously.
CogniPlus training program – spatial attention:	
SPACE: Neglect/field of view training	The SPACE training program was created for patients with hemineglect but it can also be used successfully with patients who have an impairment of the visual field. It aims to improve the visuo-spatial directing of attention and visual exploration; it is used in cases of neglect to train the specific ability to direct attention to stimuli on the contralesional side of the field of vision. The task is to follow a camera's finder on the screen and to press the reaction button as soon as the finder captures an object. In the early stages of therapy this search process is assisted by spatial cues and warning signals designed to heighten attention.
Selectivity of attention: a) *Selective attention* (reaction according to a defined criterion):	
Selective attention (WAFS)	WAFS consists of three subtests: unimodal visual, unimodal auditory and cross-modal. In the first subtest the respondent is presented with squares, circles and triangles whose brightness may change. He must react

	only to changes in squares and circles. In the auditory subtest the respondent is presented with tones at three different pitches; the loudness of the tones may change. The task is to respond to changes in high and low sounds while ignoring changes in the sounds of medium pitch. The cross-modal subtest makes use of circles, squares and high and low sounds. The respondent must respond only to changes in the brightness of the circles and the volume of low tones.
Determination Test (DT)	Optical and acoustic stimuli are presented to which the respondent must react by pressing special keys or operating foot pedals. There are three forms of stimulus presentation: 1) Action Mode: there is no fixed working time for each item. The next stimulus does not appear until the current one has been worked. 2) Reaction Mode: The next stimulus appears after a fixed period of time. 3) Adaptive Mode: The working time depends on the way in which the last eight items were worked.
CogniPlus: training programs – selective attention	
SELECT: Selective attention	The SELECT training program trains selective attention - the ability to respond quickly to relevant stimuli and to suppress inappropriate responses. The client travels through a tunnel in a mine car. He must react to certain figures, noises, or figure/noise combinations that suddenly occur.

Selectivity of attention b) *Focused attention* (application of attention in the face of distraction):	
Focused attention (WAFF)	WAFF consists of three subtests: unimodal visual, unimodal auditory and cross-modal. In the first subtest (unimodal visual) black circles or squares are presented on two channels (one above the other). Sometimes the shapes become lighter. The client must react whenever a circle in one of the two stimulus channels changes its brightness twice in succession. In the unimodal auditory subtest a tone signal is presented against a curtain of noise (babble of voices), The client must react when the tone signal becomes softer twice in succession. In the cross-modal subtest auditory stimuli (tones) and visual stimuli (squares) are presented simultaneously. The client must react when the square becomes lighter twice in succession.

Color/word interference (STROOP)	Forms S1, S7 and S10 of this test contain four item groups. Initially the names of colors are shown on the screen in gray type. The task is to press the color key that corresponds to the color named (blue, red, green, yellow). Colored bars are then shown on the screen. In this task the client must press the key of the same color as the bar on the screen. In the third task the color tasks appear on the screen in the color that corresponds to the meaning of the word; the client must again press the corresponding color key. In the fourth task color words again appear on the screen but this time the color of the lettering conflicts with the meaning of the word. The client must now press the key of the same color as the color of the lettering on the screen. The three test forms S1, S7 and S10 differ in their input medium. In Form S8 only the last two tasks are presented. (see also Executive Functions)
CogniPlus: training programs – focused attention	
FOCUS: focused attention	The FOCUS training program trains focused attention – the ability to respond only to relevant stimuli despite a large number of distracting stimuli. The client is traveling in a boot on a subtropical river that flows through a varied landscape. His task – depending on the training form – is to respond only to particular animals or noises, ignoring the numerous distracting auditory and visual impressions.

Selectivity of attention: c) *Divided attention*	
Divided attention (WAFG)	WAFG consists of a unimodal visual subtest and a cross-modal subtest. In the unimodal visual subtest the respondent must monitor two visual stimulus channels that are displayed one above the other. Dark squares and circles are shown. The client must react if one of the figures shown becomes brighter twice in succession on the same channel. The cross-modal subtest uses shapes and tones. The client must react if one of the figures shown becomes brighter or the tone signal becomes softer twice in succession on the same channel.
CogniPlus: training programs – divided attention	
DIVID: Divided attention	The DIVID training program trains divided attention -

	the ability to concentrate on different subtasks simultaneously. The client assumes the role of a security guard at an airport. He must monitor various scenes on up to three control monitors At the more difficult levels he must also listen to loudspeaker announcements and the ringing of a telephone. He must react quickly to events that have been defined as critical.

4.2 Memory

4.2.1 Short-term / working memory

Working memory storage processes	
Corsi Block Tapping (CORSI) (S1-S4)	Nine blocks are shown on the screen. Each item involves a hand icon that moves about the screen, tapping on a certain number of blocks in a particular order. The client must then tap the blocks in the same or reverse order. The length of the sequence to be tapped increases in the course of the test. The test terminates as soon as three successive sequences have been tapped incorrectly.
Repeating Numbers (ZN) (S1)	Through his headphones the client hears number sequences that are read aloud by the computer. His task is to repeat these sequences verbally in the correct order (S1). The test administrator assesses the correctness of the respondent's answers. The length of the sequences increases as the test proceeds. The test terminates as soon as none of the sequences of a particular length is repeated correctly.
Executive processes of working memory	
Repeating Numbers (ZN) (S2)	Through his headphones the client hears number sequences that are read aloud by the computer. His task is to repeat these sequences verbally in the reverse order. The test administrator assesses the correctness of the respondent's answers. The length of the sequences increases as the test proceeds. The test terminates as soon as none of the sequences of a particular length is repeated correctly.
Paced Auditory Serial Addition Test (PASAT)	Number sequences are presented in the auditory mode. The last number must be added to the next one and the result spoken out loud. The time pressure increases in the course of the standard test – but not in

	the newly developed versions.
NBack Verbal (NBV)	Letter sequences are presented in the visual mode. The client's task is to indicate whether the letter currently displayed is the same as the last-but-one letter (Forms S1-S2) or the last but two (Forms S3-S4).
NBack Non-verbal (NBN)	Sequences of hard-to-visualize shapes are shown in the visual mode. The client's task is to indicate whether the figure currently displayed is the same as the last-but-one figure (Forms S1-S2) or the last but two (Forms S3-S4)
CogniPlus training programs – focused attention	
CODING: Spatial coding	The CODING training program provides practice in spatial coding and monitoring processes, with an emphasis on spatial working memory. A number of vehicles are seen driving across a bridge; they briefly disappear from view and reappear at the other end of the bridge. While they were out of sight some of the vehicles have changed their place in the spatial arrangement. These vehicles must be identified.
DATEUP: Updating	The DATEUP training program trains the executive updating function of working memory. Updating is the ability to renew memory contents in a controlled and goal-directed manner. The program trains the updating function using tasks of three types that are widely described and well confirmed in the literature: running tasks, keep-track tasks and N-back tasks. The client watches butterflies in a natural setting. From time to time one butterfly lands in a meadow or sandy area and another starts its flight, etc. At irregular intervals the client is asked a question. Depending on the type of task, the client must now highlight one or more butterflies – for example the last but one butterfly, the last two butterflies or the last of each of three different butterfly types.
NBACK: Updating – visual	The NBACK training program the trains ability of working memory to retain information and continuously update it. It uses the N-back design. The client views photographs of different subjects one by one on the screen. His task is to determine whether the current picture matches the one that immediately preceded it or (depending on level) the one that appeared two or three pictures previously.

VISP: Rehearsal-Training	The VISP training program trains spatial rehearsal – the repeated, sequential directing of attention to certain positions. The client has a bird's-eye view of a number of ships on the ocean. In turn, some of the ships are highlighted During the delay phase the client should let his gaze wander between the highlighted ships and direct his attention in turn to the positions of the highlighted ships. He must then reproduce the order in which the ships were highlighted.

4.2.2 Explicit long-term memory

Verbal	
California Verbal Learning Test (CVLT)	Lists of words are read aloud to the client several times. After each reading the respondent must reproduce as many words as possible through free recall. After the fifth presentation there is a break. After the break the words must again be reproduced through free recall. This is done first without assistance; afterwards a higher-level semantic term is provided as an aid. Finally, the words that have been presented must be identified among a number of other words.
IBF– Long-term Memory subtest	The client is first given a list of goods to learn; the list includes the brand name, product, price and country of origin. After a break of at least 20 minutes, questions are asked about the list.
Verbal Learning Test (VLT)	Verbal learning by the recognition method. Meaningless syllables are shown on the screen. For each item the respondent is required to state whether he is seeing the item for the first time or whether it has occurred previously. Assessment of dual encoding ability. To assess material-specific learning disorders, the NVLT should be administered at the same time.
Figural / visual-spatial	
Non-verbal Learning Test (NVLT)	Non-verbal learning by the recognition method. Non-verbal items are presented on the screen. For each item the respondent is required to state whether he is seeing the item for the first time or whether it has occurred previously. Assessment of dual encoding ability. To assess material-specific learning disorders, the VLT should be administered at the same time.

Faces – verbal	
Face Name Association Test (FNA)	Learning associations between faces and names by the learn-and-check method and recalling the names when shown the pictures (cued recall) after 30 minutes.
CogniPlus training program – long-term memory	
NAMES: Learning faces and names	The NAMES training program enables the client to practise effective strategies for learning people's names and associating them with faces. In NAMES the client is instructed to remember the names of individuals. The program provides hints on learning and graduated aids for recalling the information. At the most advanced difficulty levels groups of individuals are introduced by a speaker (scenarios: meeting new colleagues, party). This is intended to simulate a real-life situation in which names must be remembered in a short period of time and thus facilitate transfer to everyday life.

4.2.3 Old memory

Semantic old memory	
IBF – Verbal Intelligence Functions subtest, Part A	A sentence must be completed by selecting the right option from a list (e.g. an illiterate person cannot read aloud from a book)

4.3 Executive functions

Inhibition	
Color/word interference (STROOP)	Forms S1, S7 and S10 of this test contain four item groups. Initially the names of colors are shown on the screen in gray type. The task is to press the color key that corresponds to the color named (blue, red, green, yellow). Colored bars are then shown on the screen. In this task the client must press the key of the same color as the bar on the screen. In the third task the color tasks appear on the screen in the color that corresponds to the meaning of the word; the client must again press the corresponding color key. In the fourth task color words again appear on the screen but this time the color of the lettering conflicts with the meaning of the word. The client must now press the key of the same color as the color of the lettering on the screen.

	The three test forms S1, S7 and S10 differ in their input medium. In Form S8 only the last two tasks are presented. (see also Focused Attention)
Response inhibition (INHIB)	This test contains ten test forms designed as five pairs of parallel forms. The tests in each pair involve the same type of task. In forms S1 and S2 (stop signal), arrows are shown on the screen. The client's task is to state whether the arrow that has just been shown pointed to the left or to the right. If a sound was played immediately after the arrow was shown, the client must not react. In forms S3 and S4 (go/nogo), a sequence of circles and triangles appears on the screen. The client must press a button only in response to triangles: the reaction to the circles must be inhibited. In forms S5 and S6 (cued go/nogo) the client must react to a particular pair of adjacent stimuli but not to any other stimulus combinations; the reaction to these other stimulus combinations must be inhibited. In forms S7 and S8 (behavioral shift A) sequences of two different shapes are shown. In each case one of the figures occurs frequently and the other occasionally. Each of the two figures requires a different reaction. Incorrect reactions must be avoided. Forms S9 and S10 (behavioral shift B) involve the same type of task as forms S7 and S8 but include a third, less frequent stimulus type that requires no reaction.
CogniPlus training program – response inhibition	
HIBIT: Response Inhibition	The HIBIT training program trains response inhibition – the ability to suppress unwanted reactions. The client assumes the role of a post-office employee who must sort letters and packages as quickly and accurately as possible by pressing a button. He must look out for specific features (e.g. the presence of a stamp) that indicate when he must react and when he must not react. Four different scenarios make different demands on the client's ability to suppress a reaction.
CogniPlus training program – planning and action skills:	
PLAND: Planning and action skills	In the PLAND training program the client undertakes planning tasks and thus practises action and planning skills.

	The aim is to carry out a series of tasks in the most efficient order. The starting point is a list of tasks and a virtual street map on which various buildings are marked. The client must decide on the order in which he will carry out the tasks and visit the buildings so as to meet all the specified criteria.
Fluency and flexibility	
Perseveration Test (PERSEV)	A number of circles are shown on the screen. At regular intervals a tone is played. The client's task is to tap the circles in time with the tones. The circles can be tapped in any order.
INSBAT - Verbal Fluency subtest	A noun must be formed from the given letters.
Inductive / deductive reasoning	
Raven's Matrices Tests (SPM, SPMPLS, CPM)	Matrices Test: completing a 3x3 matrix according to logical rules
IBF – Verbal Intelligence Functions subtest, Part A	Continuing sequences (identifying regularities), continuing number sequences Continuing number sequences
Form Logic / Inductive Reasoning (FOLO)	Continuing sequences (identifying regularities), continuing logical sequences of shapes
INSBAT – Verbal Deductive Reasoning subtest	Logical reasoning: working syllogism tasks

4.4 Basal and higher visual, auditory and motor functions

Basal visual functions	
WAFW, visual tests	In order to exclude the possibility that visual impairments may influence the processing of the stimuli used in WAF, thus impeding reliable assessment, WAFW can be used before the start of an assessment to determine whether the respondent has the perceptual ability necessary for completion of the visual WAF tests. There is a form for distinguishing brightness and a form for distinguishing shape.
Basal auditory functions	
WAFW, auditory tests	In order to exclude the possibility that auditory impairments may influence the processing of the stimuli used in WAF, thus impeding reliable assessment, WAFW can be used before the start of an assessment

	to determine whether the respondent has the perceptual ability necessary for completion of the auditory WAF tests. There are separate forms for distinguishing tonepitch, distinguishing loudness and auditory differentiation.

Visual field / visual exploration	
Visual Pursuit Test (LVT)	The client presses two buttons simultaneously in order to view a jumble of eight lines that reach from top to bottom of the screen. The end of a line at the top of the screen is marked with an arrow. The client must state as quickly as possible where this line ends at the bottom of the screen.
Spatial attention (WAFR) S5: Visual field and neglect	The fifth subtest uses white circles on a black screen; at irregular intervals the circles light up either on one side of the screen or simultaneously in both halves of the visual field. Depending on the position of the illuminated circles, the client must press the left or right reaction key or both keys simultaneously.
CogniPlus training program – visual exploration:	
SPACE: Neglect/visual field training	The SPACE training program was created for patients with hemineglect but it can also be used successfully with patients who have an impairment of the visual field. It aims to improve the visuo-spatial orienting of attention and visual exploration (see also Spatial Attention)

Spatial processing	
Spatial - perceptive	
Visualization (2D)	The screen shows a bar that contains one or more gaps. Below are a number of segments. While under time pressure the client must state which segments fill the gap.
Spatial – cognitive	
Spatial Orientation (3D)	The screen shows a figure composed of several blocks. An arrow on the screen points to the figure from a particular direction. The client must state what the figure would look like from the indicated direction. The task is worked under time pressure.
Mental Rotation (MR)	The screen shows a complex three-dimensional figure and a depiction of this figure from a particular

	perspective (the target perspective). The client must position a camera in such a way that this target view of the figure is obtained.
CogniPlus training program – mental rotation	
ROTATE: Mental rotation	The ROTATE training program trains the ability to visualize a three-dimensional object from a two-dimensional depiction so that the object can then be mentally rotated. The screen shows various 3D objects that must be compared with reference pictures. Various parameters such as the angle of rotation, the direction of rotation and the complexity of the figures are systematically varied over the various difficulty levels.

Processing numbers and calculating / "computational reasoning"	
IBF – Numerical Intelligence Functions subtest, Part B	Solving textual calculation problems
INSBAT – Computational Estimation subtest	A calculation is presented together with four numbers. The client must state which of the four numbers is closest to the result of the calculation.
INSBAT – Arithmetical Competence subtest	A calculation must be performed.

Motor skills/sensorimotor coordination	
MLS (Motor Performance Series)	Various motor tasks must be performed using special hardware.
SMK (Sensomotor Coordination)	The segment of a circle moves unpredictably in three-dimensional space. The client's task is to maneuver this segment to an identified target position, compensating for the movements that it makes.
CogniPlus training program – sensorimotor coordination:	
VISMO: Visuomotor coordination	The VISMO training program trains visuomotor coordination - the ability to coordinate hand and arm movements through visual monitoring. The client's task is to observe the night sky and keep a particular object – a satellite, planet or spaceship – within the telescope's finder (a circle on the screen). Since the object is moving across the sky as it is being watched, the client must actively track it with the finder. The aim is not to lose the object from the finder.

Estimation of time	
ZBA – Time and Movement Anticipation	Estimating time intervals

4.5 Emotionality

Emotionality/affect	
BAI	BAI Beck Anxiety Inventory
BDI II	Beck Depression Inventory

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