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Investigation report

Created for:	XY
	01.01.1991, m
On behalf of:	Dr. med. Z
Date report:	17.05.2024
Diagnostic interview:	xx

Investigation report

Reason for assignment, current situation, problems

Initial situation:

Diagnosis / problem definition: He has drive problems

Medication currently being taken (type of medication, dosage, duration of medication) : [no answer]

Referral by : Dr. med. Z

Question from referring physician: Question not quite clear, multiple concussions (7x) of a professional ice hockey player EEG, NP?

Medical history and further information:

Current living arrangements Family, partner, siblings: [no answer]

Birth trauma and/or hypoxia: [no answer]

Early childhood development, e.g. hearing, vision, motor skills, speech, cleanliness development, eating behavior: He was not aware of any special developmental features or weaknesses in early childhood. Unfortunately, he had not had a very intact family and wanted to leave it at a young age. The ice hockey team had always been his family.

Illnesses and injuries, especially head injury (with unconsciousness): [no answer]

School grades, work attitude, motivation: [no answer]

Current development status: [no answer]

Currently important information: [no answer]

Problem definition:

Individual (problem): During his professional ice hockey career, he had suffered many injuries, including 7 concussions. 1st & 2nd in the 2012 season, these were quite severe and he recovered after a long time, then 3-4 lighter concussions over the years, finally the 7th and last concussion in 2020, which was very severe. After 11 months of therapy at the Concussion Center, he was unable to return to sport. He then had to stop his career, fell into a hole and developed a depression, which he is still in. He lost everything as a result of the 7th concussion. Cognitively, he quickly loses track of parallel demands and forgets something. He does best one thing at a time. He is not slower in his reactions. He has difficulty focusing in conversations for long periods of time. His ability to concentrate is gone after 1/2 a day, after which he notices a drop in performance. Planning and organizing the most important everyday tasks are no more difficult for him than before. The other deteriorations have been present since the last concussion. He has not done anything physically in the last 2 years, he has changed physically and this bothers him. Emotionally, he is still not well. He lacks drive, most recently he received venalafaxine from Dr. Hitz, he takes 150mg/day.

Educational and professional context: He completed 12 years of education up to his commercial diploma. He played ice hockey professionally until the age of 29. After the 7th concussion and the end of his career, he was at the RAV for 1 year and without a job. In 8/2023 he started an apprenticeship as a chef. The stressful, hectic work in the kitchen was not suitable, as it aggravated the complaints he has had since the concussion.

Findings (interview & questionnaire, performance, biomarkers)

Questionnaire

- **Depression questionnaire:** The BDI-II score is 24 - an indication of moderate depression.
- **Anxiety questionnaire:** The BAI score is 9 - an indication of mild anxiety.
- **Everyday strategies and brain areas:** (self): The responses show no significant expression in the basal ganglia, cingulate system, temporal lobe and prefrontal cortex areas. However, the area of the deep limbic system indicates significantly increased stress. The subjectively perceived suffering in these areas is high and clinically relevant.
- **Symptom checklist SCL-90 according to Derogatis, Eich, Gamma:** The scales Depressiveness, Phobic Anxiety and Obsessiveness are most affected.
- **Sensitivity questionnaire for adults:** The overall results show that the topic of high sensitivity is not significant for XY.

Performance (test psychology, neuropsychological examination)

- **Neuropsychological examination (Candit)**: Die Untersuchung umfasste Untertests zur Konzentration, zur Wahrnehmung, zur Einschätzung von emotionalen Situationen sowie zum ganzheitlichen Abschätzen von Zahlen und Zeitvorgaben. Die untersuchten Funktionen werden von XY meist im Rahmen der Norm bearbeitet. Schwierigkeiten zeigen sich bei>>>>>>>.
- **Visual Concentration Progression Test (VCPT):** XY's scores for attention, impulsivity, reaction time and work consistency are within the norm.

Functional neurophysiology, biomarkers:

- Raw data: The automatic review of the EEG revealed no evidence of epileptiform activity or pathological focal findings. The findings by the neurology specialist are still pending. We will contact you in the event of any abnormalities.
- Spectral data: slightly increased alpha activity.
- Diagnostic algorithms: The calculation of the indices for XY resulted in the following:

  ADHD index: ADHD: 52%#
  ADHD index (with behavioral data from VCPT): ADHD: 54%#
  The ADHD index shows a slightly higher correlation of brain functions with those of a larger group of patients diagnosed with attention deficit disorder.

  Emotion regulation index: Emotion regulation index: 49%
  The emotion regulation index shows a slightly increased correspondence of brain functions with those of a larger group of patients with a diagnosed emotion regulation disorder (depression, anxiety, insecurity).

- **Functional analysis: functional ADHD subtypes:** ST1: 28%; ST2: 36%; ST3: 33%; ST3 (ST1vsST3): 49%;
  Functional network analysis provides information on the functioning of cortical and subcortical networks, which have a direct impact on attention and related performance.

Subtype definition:
- Network_1: Attention, executive functions
- Network_2: Arousal, cingulate functions (adaptability)
- Network_3: Emotional regulation, also emotional impulse breakthroughs
- For children (up to 11 years):
- Network 4: Inhibition of development

Summarized assessment of the findings IA Driven report:

The examination at BrainARC-Zurich on 17.05.2024 shows overall indications of a mild to moderate depressive episode as well as neurophysiological abnormalities that could be related to stress and post-traumatic stress after multiple concussions

XY, 33 years old, was referred by Dr. med. K. Hitz for neuropsychological examination and EEG due to multiple concussions (7x) during his career as a professional ice hockey player. He reported drive problems, cognitive difficulties with parallel demands, difficulty focusing for long periods of time and an exhausted ability to concentrate after half a day. These deteriorations have been present since the last concussion in 2020. He had to abandon his career and fell into depression. He is currently taking venlafaxine 150mg/day.

Interviews and questionnaire: The questionnaire on *everyday strategies and brain areas shows* a significantly increased load in the deep limbic system. The scales Depressiveness, Phobic Anxiety and Compulsiveness are most affected in the *SCL-90.* The *BDI-II shows* moderate depression and the *BAI* mild anxiety. The *sensitivity questionnaire for adults* shows no evidence of significant high sensitivity.

Psychological and neuropsychological tests: In the *Concentration Progression Test (VCPT),* the values for attention, impulsivity, reaction time and work consistency are within the norm.

Evidence-based study using measurements of neurophysiological brain functions: The *emotion regulation index* of 49% indicates a slightly increased agreement with a disorder of emotion regulation.

The *spectral data* show a slightly increased alpha activity in resting situations, which indicates cortical underactivation and reduced arousal. The *arousal index* is elevated during the VCPT, consistent with a stressful situation. The *central sensory index* is unremarkable.

Analysis of the *evoked potentials* reveals abnormalities with high amplitudes of N1 in the occipital visual input. This can be interpreted as a marker for stress and post-traumatic stress. In addition, there are high amplitudes in the auditory novelty condition with late reactivation, high amplitudes of the main potentials on the left side in the association areas and shortened latencies on the right side with late reactivation.

Discussion of the findings: XY was referred by Dr. Z for a neuropsychological assessment and an EEG for drive problems and cognitive difficulties following multiple concussions. He grew up in a less intact family. He completed 12 years of education up to a commercial diploma and played ice hockey professionally until 29. After his career ended in 2023, he began an apprenticeship as a chef, but working in the kitchen aggravated his symptoms.

The examination at BrainARC Zurich in May 2024 revealed indications of a mild to moderate depressive episode and neurophysiological abnormalities that could be related to stress and post-traumatic stress following multiple concussions. There were hardly any neuropsychological abnormalities. The EEG shows increased alpha activity as a sign of cortical underactivation and reduced arousal. This is consistent with the reported drive difficulties.

Evoked potentials show particularly high occipital amplitudes of N1 as a possible marker for stress and post-traumatic stress. Studies have shown that multiple concussions are associated with an increased risk of chronic stress symptoms, anxiety and depression (Esopenko & Levine, 2015; Smith et al., 2019). In this

context, the high N1 amplitudes are discussed as an electrophysiological correlate of sensitization and hyperreactivity of neuronal networks (Moore et al., 2006; Tremblay et al., 2014). In addition, there are markers for increased monitoring, hypersensitivity, right-emphasized fast and left-emphasized detail-oriented processing, which, together with the reduced arousal, can lead to rapid exhaustion.

Basis of the findings with Pubmed, basic scientific literature:

Esopenko, C., & Levine, B. (2015). Aging, neurodegenerative disease, and traumatic brain injury: the role of neuroimaging. Journal of Neurotrauma, 32(4), 209-220.

Moore, R. D., Broglio, S. P., & Hillman, C. H. (2014). Sport-related concussion and sensory function in young adults. Journal of Athletic Training, 49(1), 36-41.

Smith, D. H., Johnson, V. E., Trojanowski, J. Q., & Stewart, W. (2019). Chronic traumatic encephalopathy-confusion and controversies. Nature Reviews Neurology, 15(3), 179-183.

Tremblay, S., Henry, L. C., Bedetti, C., Larson-Dupuis, C., Gagnon, J. F., Evans, A. C., ... & De Beaumont, L. (2014). Diffuse white matter tract abnormalities in clinically normal ageing retired athletes with a history of sports-related concussions. Brain, 137(11), 2997-3011.

Discussion of the measures: *Everyday strategies (psychoeducation):* Developing an awareness of fluctuations in arousal and arousal modulation through targeted activation and deactivation. Structuring the daily routine and break management to avoid overload. Application of stress management strategies.

Medication: Due to the reduced arousal in resting situations with increased stress reactivity under stress, an optimization of antidepressant medication, possibly switching to an active substance with a more activating, anxiolytic and stress-reducing effect, such as vortioxetine, would be an option (Sanchez et al., 2015).

Non-drug treatment: Psychotherapy with trauma-focused cognitive-behavioral elements to address the post-traumatic stress associated with the concussions and end of career would be indicated. Neurofeedback training, particularly alpha-theta protocols, have been shown to be effective in improving depressive symptoms and post-traumatic stress in concussions and mild traumatic brain injury (Bennett et al., 2018). In addition, mindfulness-based approaches, light therapy and moderate endurance training can have a positive influence on depressive symptoms.

Diagnoses

- Depressive episodes as a result of the concussions
-

Recommendations

Bei der obigen Konstellation können Empfehlungen auf 3 unterschiedlichen Ebenen empfohlen werden: Alltagsstrategien, Medikation und Therapiemöglichkeiten. Die Empfehlungen erfolgen aufgrund der beschriebenen Befunde. Die Massnahmenplanung und die daraus folgende Unterstützung bei XY soll ganzheitlich erfolgen und die verschiedensten Aspekte des Lebens beinhalten. Dazu gehören nebst dem sozialen Netzwerk die Berücksichtigung von Denken, Handeln und Fühlen aber auch der biologischen Aspekte. Es macht Sinn, entsprechend den Schwierigkeiten mittels eines multimodalen Ansatzes zu operieren, der sowohl die Aspekte der Person als auch jene des sozialen Netzwerkes berücksichtigt.

- Everyday life/everyday strategies:
- Medication: According to information and instructions from ZZ, medical management BrainARC ZH

- Therapy options:

I would like to thank you for the trust you have placed in me, hope that this information has been of service to you and remain with kind regards

First name Last name
Federally recognized psychotherapist, FSP

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I. Introduction

Interview and questionnaire

The standardized questionnaires used here are self-assessment or external assessment procedures for evaluating a certain behavior or state of mind in a given period of time. The scores are assessed in comparison with the age group in relation to a certain threshold value and presented in different ways. The choice of questionnaire depends on the individual question.

Performance (test psychology, neuropsychological tests)

The standardized test procedures used here are selected on the basis of the research question and explained in the corresponding section.

Quantitative electroencephalogram (qEEG), biomarkers

Preliminary remark: A qEEG and the evoked potentials do not replace a medical-clinical examination, but serve to generate and compare physiological data in psychologically different performance states. No diagnoses are made with regard to neurological abnormalities. A neurological examination must be carried out by a neurologist.

Technical data:

Electrode cap: Electrocap (www.electro-cap.com); Electrode arrangement: international 10-20 system, reference assembly; Amplifier: NEUROAMP X23 and NEUROAMP II device recorded; Impedance: <5kΩ; Software: ERPrec; Band pass filter: 1Hz - 50Hz; Sampling rate: 250

Conditions: relaxed rest with eyes closed (EC), relaxed rest with eyes open (EO), approx. five minutes each, continuous visual (VCPT) or auditory (ACPT) performance test

Processing: artifact cleaning, Fourier transformation, application of various descriptive and statistical methods, comparison with reference database and patient groups

Reference database: HBI database, approx. 1000 healthy subjects from Switzerland, Russia and Norway, 7-89 years, 2/3 adults, 1/2 women
Patient groups: Attention deficit disorder, stress disorder (diagnosed according to the standard criteria of the diagnostic and statistical manual (gold standard) and additionally by experts)

II. Questionnaire

1. Questionnaire on personal and clinical data

General information

- Name (surname, first name) or code: **Camperchioli Luca**
- Date of birth (day.month.year): **22.01.1991**
- Gender (M-male F-female): **M**
- Diagnosis / problem definition: **He has drive problems**
- Question from referring physician: **Question not quite clear, multiple concussions (7x) of a professional ice hockey player EEG, NP?**
- Referral by : **Dr. med. K. Hitz**

Symptomatology

- Individual (problem): **During his professional ice hockey career, he had suffered many injuries, including 7 concussions. 1st & 2nd in the 2012 season, these were quite severe and he recovered after a long time, then 3-4 lighter concussions over the years, finally the 7th and last concussion in 2020, which was very severe. After 11 months of therapy at the Concussion Center, he was unable to return to sport. He then had to stop his career, fell into a hole and developed a depression, which he is still in. He lost everything as a result of the 7th concussion. Cognitively, he quickly loses track of parallel demands and forgets something. He does best one thing at a time. He is not slower in his reactions. He has difficulty focusing in conversations for long periods of time. His ability to concentrate is gone after 1/2 a day, after which he notices a drop in performance. Planning and organizing the most important everyday tasks are no more difficult for him than before. The other deteriorations have been present since the last concussion. He has not done anything physically in the last 2 years, he has changed physically and this bothers him. Emotionally, he is still not well. He lacks drive, most recently he received venalafaxine from Dr. Hitz, he takes 150mg/day.**
- Educational and professional context: **He completed 12 years of education up to his commercial diploma. He played ice hockey professionally until the age of 29. After the 7th concussion and the end of his career, he spent 1 year with the RAV and was without a job. In 8/2023 he started an apprenticeship as a chef. The stressful, hectic work in the kitchen was not suitable, as it aggravated the complaints he has had since the concussion.**

Pre-birth and birth Injuries and illnesses, current situation

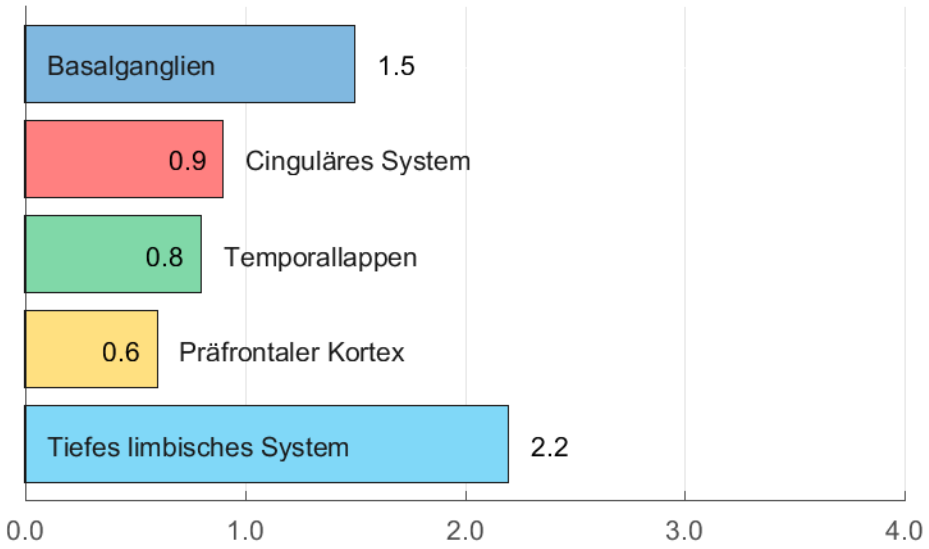
- Early childhood development, e.g. hearing, vision, motor skills, speech, cleanliness development, eating behavior: **He was not aware of any special developmental features or weaknesses in early childhood. Unfortunately, he had not had a very intact family and wanted to leave it at a young age. The ice hockey team had always been his family.**

2. Questionnaire on everyday stress and brain structures (AMEN)

Filled in by: yourself

The answers to the questions in the questionnaire on everyday stress were examined for their connection to various brain structures and assigned to the corresponding structures. The following graph shows the intensity of the corresponding strain on the individual structures. As the response behavior is generally very different, it is not possible to say whether the stress is generally considered to be severe or not. However, the differences between the various structures are interesting.

Summary graphic:



The responses do not show any significant manifestation in the basal ganglia, cingulate system, temporal lobe and prefrontal cortex. The area of the deep limbic system, however, indicates significantly increased stress. The subjectively perceived suffering in these areas is high and clinically relevant.

- The limbic system is the carrier of emotional energy and functions. In this questionnaire, questions such as low energy or hopelessness are assigned to this system. Concentration difficulties arise indirectly due to high distractibility, which is triggered by emotional issues.

Compilation of the pronounced and very pronounced behaviors. Values in brackets correspond to the frequencies in everyday life (3 frequently, 4 very frequently).

- Increased muscle tension (headache, trembling or sore muscles) (3)
- Sweating (including hot flushes) or cold hands (3)
- Avoiding conflicts (3)
- Weak motivation (3)
- Great concern about what others think of me/him/her (3)
- Shyness or shy (3)
- Getting upset when things don't go as planned (3)
- Tendency to repeat negative thoughts (3)
- Capriciousness (3)
- Low energy, low energy level (3)
- Weak interest in others (3)
- Feeling of hopelessness about the future (3)

- Feeling of dissatisfaction or boredom (3)
- Deep self-esteem (3)
- Hardly any interest in sexuality (3)

3. Depression questions BDI-II

The BDI-II (Beck Depression Inventory) is a clinical questionnaire that measures the severity of a depressive illness. The score for this questionnaire is 24, which according to this questionnaire is an indication of moderate depression.
List of symptoms:

- Sadness - *I am often sad.*
- Pessimism - *I am more despondent about the future than usual.*
- Feelings of failure - *When I look back, I see a lot of failures.*
- Loss of pleasure - *I can hardly enjoy the things I used to enjoy any more.*
- Guilt - *I often feel guilty about things I have done or should have done.*
- Self-rejection - *I have lost confidence in myself.*
- Self-reproach - *I am more critical of myself than usual.*
- Crying - *I cry more now than I used to.*
- Restlessness - *I am more restless than usual.*
- Loss of interest - *I have less interest in other people or things than usual.*
- Inability to make decisions - *I find it more difficult than usual to make decisions.*
- Worthlessness - *I consider myself less valuable and useful than usual.*
- Loss of energy - *I have less energy than usual.*
- Changes in sleeping habits - *I sleep a little more than usual.*
- Irritability - *I am much more irritable than usual.*
- Change in appetite - *My appetite is a little worse than usual.*
- Difficulty concentrating - *I can't concentrate as well as usual.*
- Exhaustion or fatigue - *I am too tired or exhausted for many of the things I usually do.*
- Loss of sexual interest - *I am now much less interested in sexuality.*

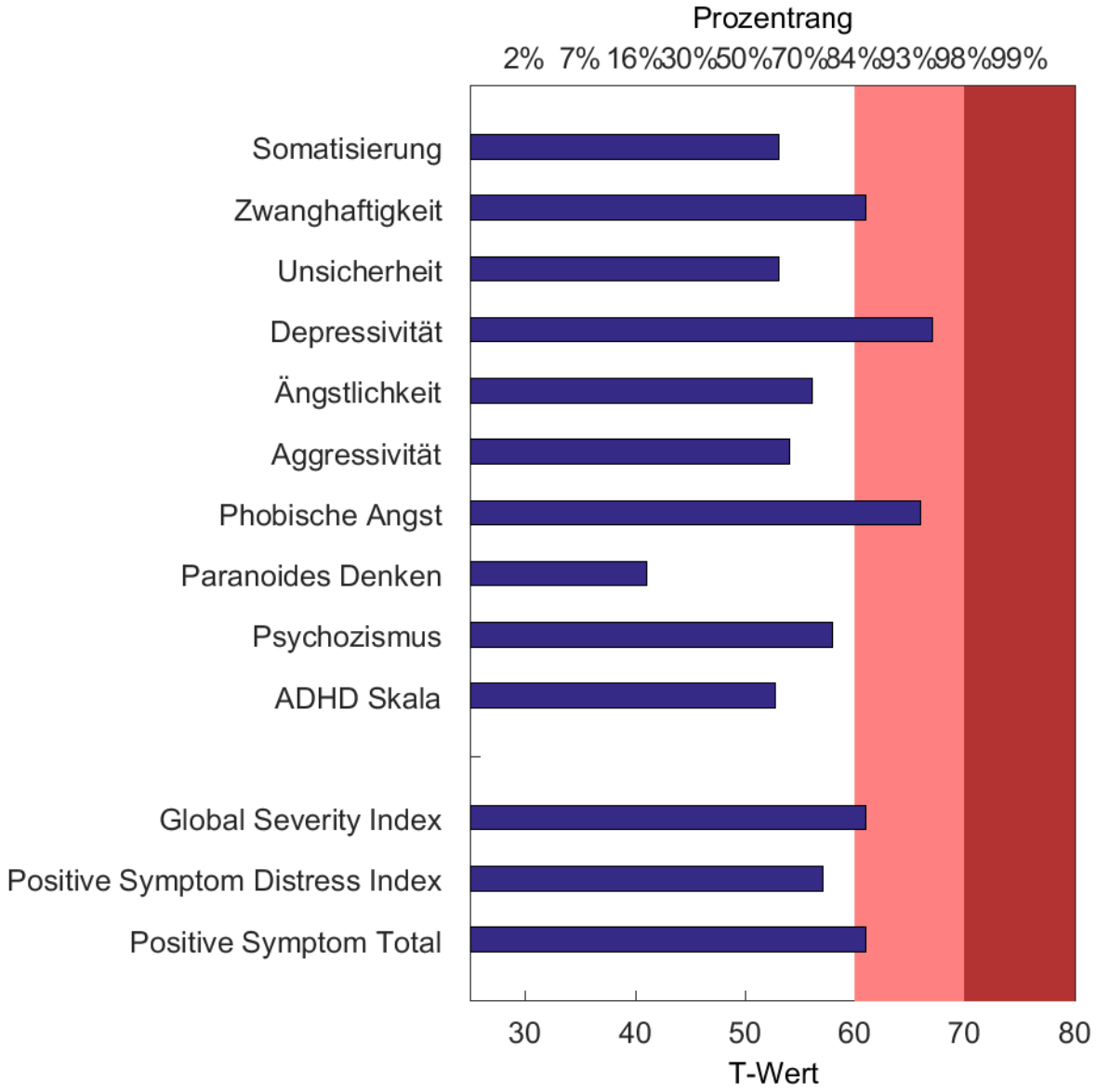
4. Anxiety questions BAI

The BAI (Beck Anxiety Inventory) is a clinical questionnaire that measures the severity of an anxiety disorder. The score for this questionnaire is 9, which according to this questionnaire is an indication of mild anxiety.
List of symptoms:

- Feeling of heat - *Medium*
- Unable to relax - *Little*
- Nervous - *Medium*
- Stomach and intestinal complaints - *Little*
- Feeling of weakness - *Little*
- Sweating - *Medium*

5. SCL90 - Questionnaire

The SCL-90®-S measures a person's subjectively perceived impairment due to physical and psychological symptoms within a period of seven days to the present day. It is one of the most frequently used self-assessment methods worldwide for recording psychological stress.



Symptom checklist SCL-90 according to Derogatis, Eich, Gamma, Summary: The scales Depressiveness, Phobic Anxiety and Compulsiveness are the most affected.

The following scales are conspicuous:

- The SCL90 scale "Compulsiveness" is slightly conspicuous. People with high scores suffer from recurring unpleasant thoughts, words or ideas that they cannot get out of their heads, memory difficulties, anxiety due to carelessness and negligence, the feeling that it is difficult for them to get started, the need to do everything very slowly to make sure everything turns out right, the compulsion to recheck what they are doing again and again, difficulties in making decisions, emptiness in the head, concentration difficulties or compulsive repetition of the same activities such as touching, counting and washing.
- The SCL90 scale "Depressiveness" is slightly conspicuous. People with high scores suffer from a reduction in their interest or pleasure in sexuality, lack of energy or slowness in movement or thinking,

thoughts of taking their own life, a tendency to cry, fear of being caught or caught out, self-reproach about certain things, feelings of loneliness, melancholy, a feeling of having to worry too much, a feeling of not being interested in anything, a feeling of hopelessness about the future, a feeling that everything is very stressful or a feeling of being worthless.

- The SCL90 scale "Phobic anxiety" is slightly conspicuous. People with high scores suffer from fear in open places or on the street, fear of leaving the house alone, fear of traveling by bus, streetcar, subway or train, the need to avoid certain things, places or activities because they are frightened by them, aversion to crowds, e.g. when shopping or at the cinema, nervousness when left alone or fear of fainting in public.
- The SCL90 scale "Global Severity Index" is slightly conspicuous. The GSI (Global Severity Index) measures the fundamental psychological stress.
- The SCL90 scale "Positive Symptom Total" is slightly conspicuous. The PST (Positive Symptom Total) provides information on the number of symptoms in which stress is present.

6. Psychiatric illnesses in the family

	Child(ren)	Siblings	Mother	Father	Other	unknown
ADHD						**x**
Other attention or hyperkinetic disorder						**x**
Disorder of social behavior						**x**
Autism						**x**
Asperger's						**x**
Tic disorder						**x**
Depression			**x**	**x**		
Bipolar (manic-depressive) disorder						**x**
Anxiety disorder						**x**
Panic disorder						**x**
Agoraphobia						**x**
Social phobia						**x**
Specific phobia						**x**
Obsessive-compulsive disorder						**x**
Sleep disorders						**x**
Eating disorder		**x**	**x**			
Schizophrenia / psychosis						**x**
Borderline personality disorder						**x**
Alcohol abuse						**x**
Drug abuse						**x**
Suicidal tendencies						**x**
Epilepsy						**x**

7. Sensitivity questionnaire for adults:

The "Sensitivity Questionnaire for Adults", which was specially developed to examine the level of sensitivity, comes from the book by Elaine A. Aron. The questionnaire is designed to help better understand behavior, thinking and feeling.

If twelve or more of the statements were answered with "yes" (answers: "often", "very often"), the topic of high sensitivity is probably important. However, no psychological test is so precise that high sensitivity can be based on this result alone. If only 4 or 5 of the above statements apply, but to an extreme extent (answer: "very often"), it may also be justified to describe the topic as significant.

The following statements were reported to an extreme extent, which may imply a sensitive condition:

- Question 12: I try very hard to avoid mistakes and not to forget anything.

The total score is: 11.

The overall results show that the topic of high sensitivity is not significant.

III. Performance (test psychology, neuropsychological examination)

1. Neuropsychological test battery

Neuropsychological examination using Candit

The neuropsychological examination using Candit covers the areas of concentration/attention, learning/memory, number processing, perception, complex executive functions, emotional processing and processing speed. Below is a summary of the results, sorted by results within the norm compared to peers (middle column), below average results (left column) and above average results (column on the right).

Placeholder: candit

Neuropsychological examination, summary: Die Untersuchung umfasste Untertests zur Konzentration, zur Wahrnehmung, zur Einschätzung von emotionalen Situationen sowie zum ganzheitlichen Abschätzen von Zahlen und Zeitvorgaben. Die untersuchten Funktionen werden von XY meist im Rahmen der Norm bearbeitet. Schwierigkeiten zeigen sich bei>>>>>>>.

2. Concentration progression test (VCPT)

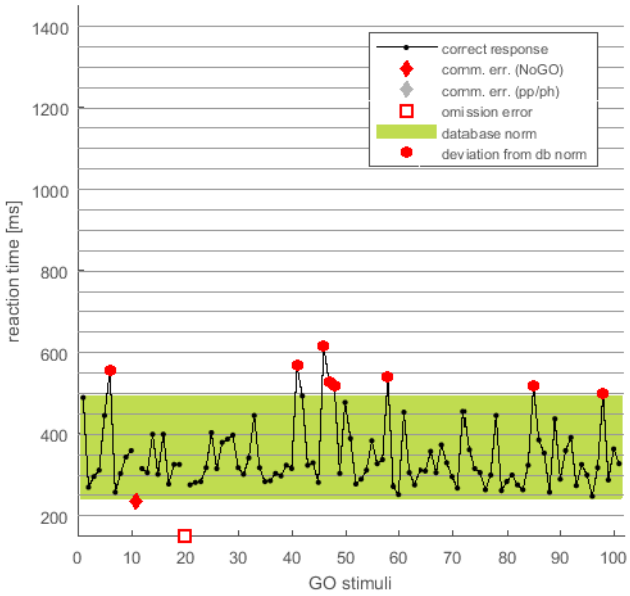
The signals were recorded during the concentration test. These can be evaluated with regard to unrecognized target stimuli, missed target stimuli, reaction time and variability of reaction time. From this, indications can be derived regarding attention, impulsivity, reaction time and work consistency.

VCPT:

Groupname	Correct	Attention	Impulsiveness	Response time	Workconsistency
a-a GO	99.0 %	1 (1.297)	0	347 (0.777)	8.2 (0.986)
a-p NoGO	99.0 %	0	1 (1.069)	-	-

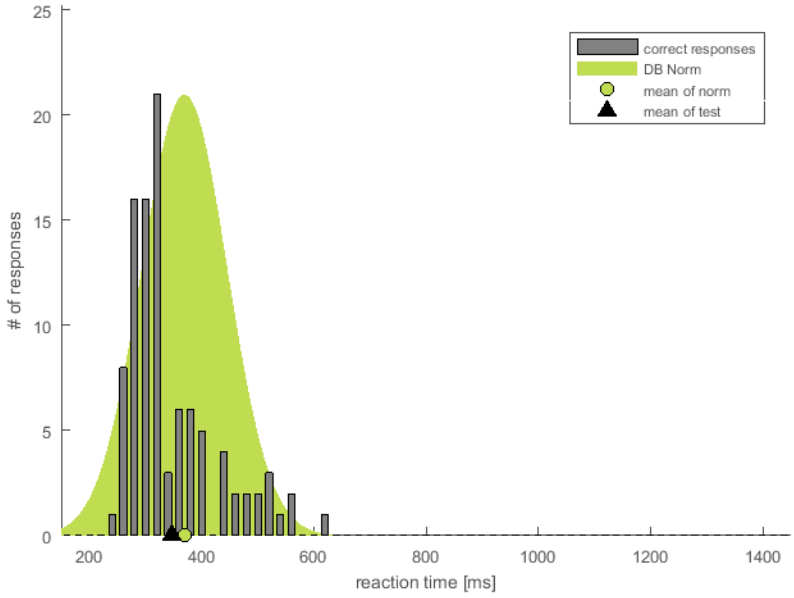
XY's scores for attention, impulsivity, reaction time and work consistency are within the norm.

Illustration 1The following figure shows the reaction times over time. The red dots indicate reactions outside the norm (deviation from db norm). Very high deviations mean long reaction times. The attention errors (omission errors) are shown at the bottom with small red squares, the impulsivity errors (commission errors) are also shown with small red crosses.



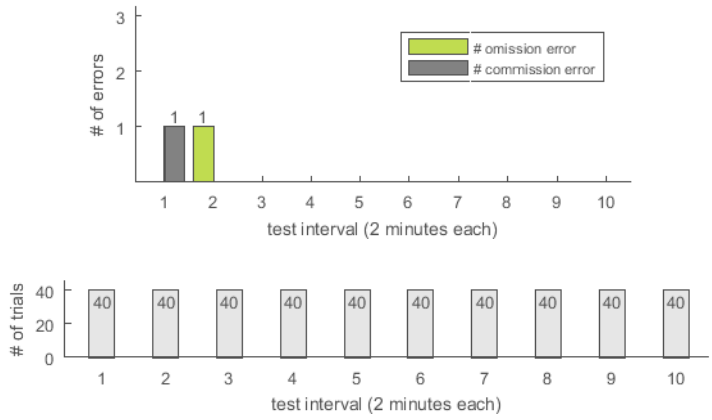
The analysis of XY's reaction times shows a good consistency of reaction times compared to his peers (green area).

Illustration 2The following figure shows the reaction times as a frequency diagram. The outliers to the right are particularly interesting. These indicate inconsistency in the work process. Very many and high bars outside the normal range (green) indicate a higher inconsistency.



The average reaction time of XY (black triangle) is approximately the same compared to his peers (green dot).

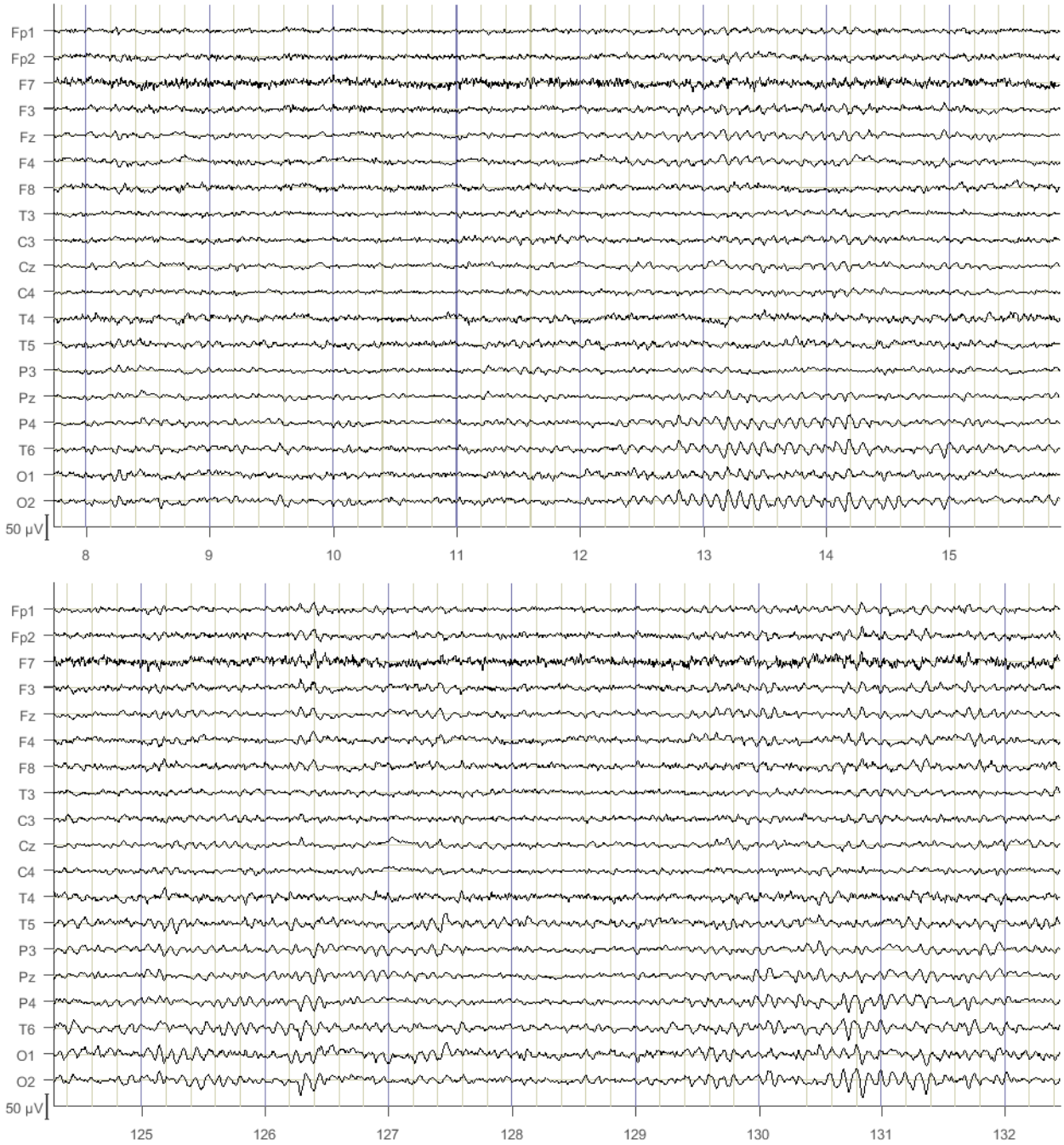
Illustration 3The following graph shows the errors in attention (omission error) and impulsivity (commission error) over the course of the test in intervals of 2 minutes each. Higher values towards the end of the test indicate fatigue during the test.



There are 2 errors over the entire course of the test.

IV. Evidence-based investigation of neurophysiological brain functions

1. Spontaneous EEG[1]



[1] An EEG was recorded for about 4 minutes in the resting state (eyes open, eyes closed). Spectrograms were calculated from this EEG. The data were compared with the reference database of the population of the same age. Montage: Weighted montage. The comparisons with the database were carried out in this montage.

2. Spike detection

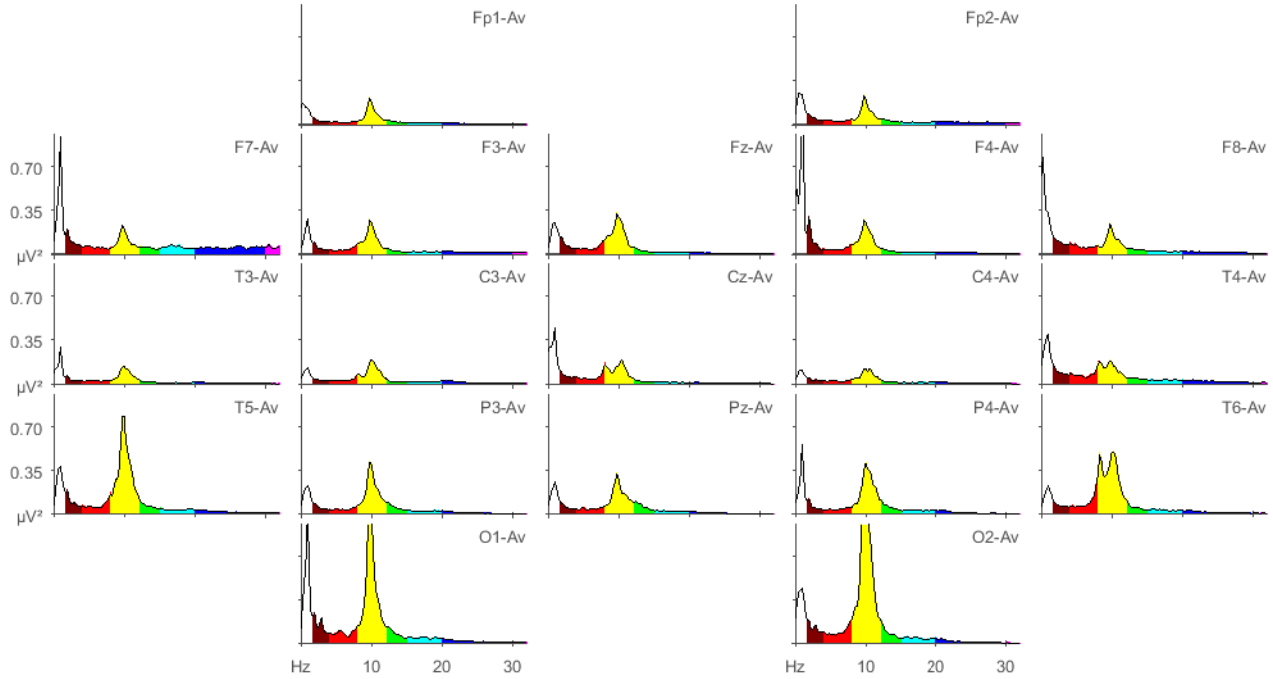
Spikes are spiky, transient waves that represent interactive epileptiform activity in the brain. The spike detection procedure uses morphological filtering of EEG signals to detect such transient activity and to separate it from the normal background waves.

Eyes closed
No significant events were identified.

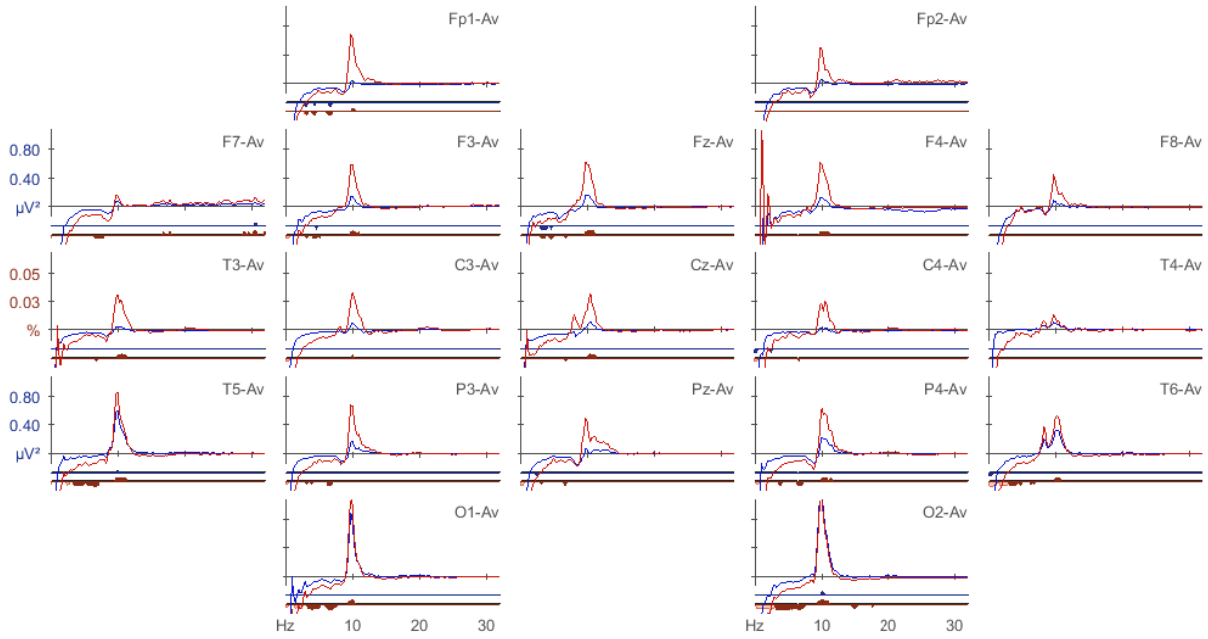
Eyes open
No significant events were identified.

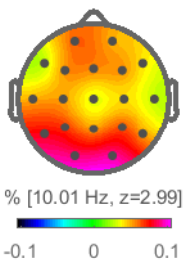
3. Spectral data:

Eyes open (4:55)

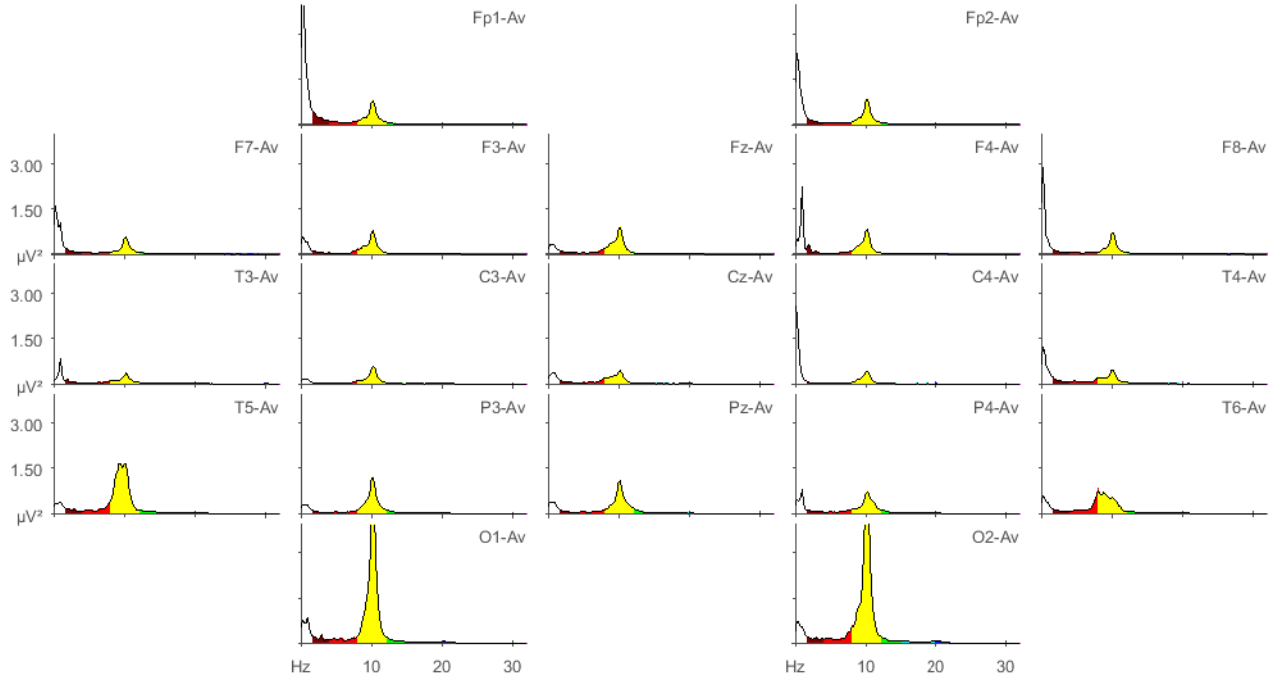


Comparison with reference data: Difference curve (blue: absolute, red: relative). Bars on the lower line indicate significant deviations from the norm

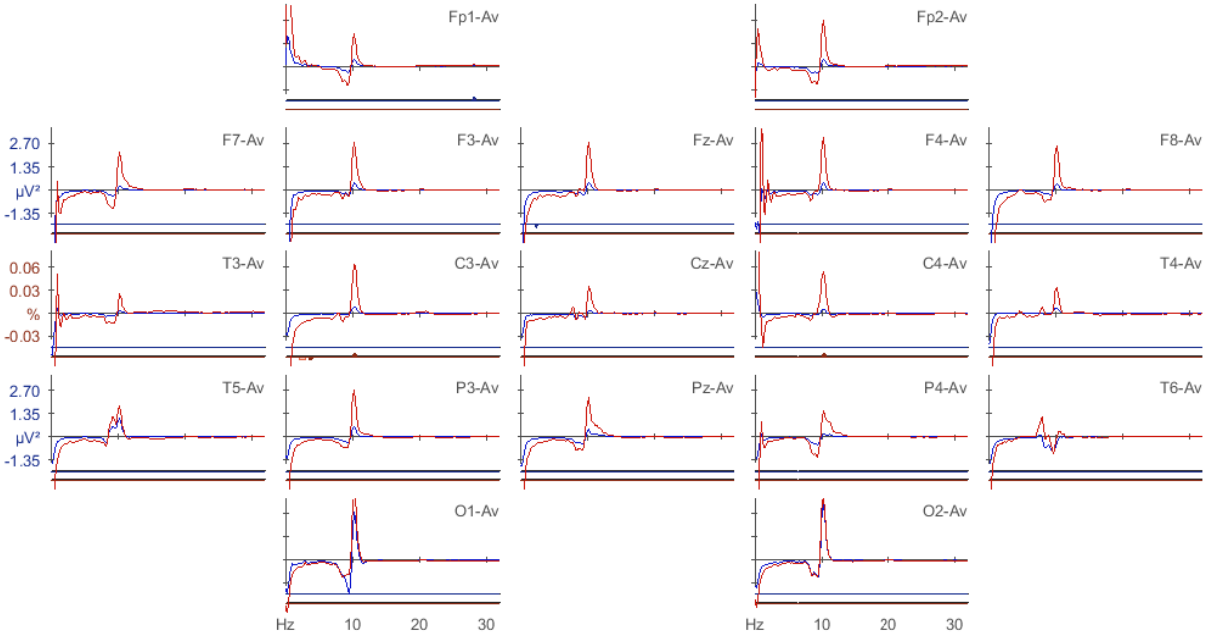


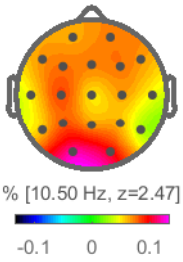


Spectral data: Eyes closed (5:01)

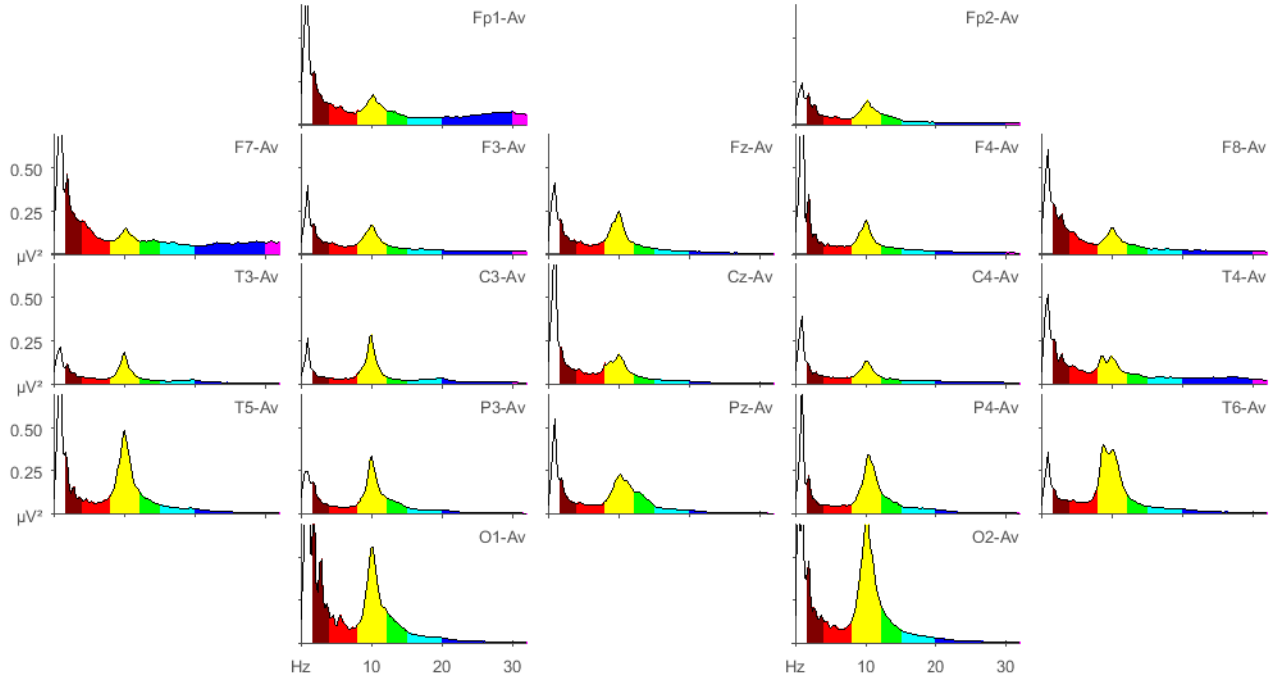


Comparison with reference data: Difference curve (blue: absolute, red: relative). Bars on the lower line indicate significant deviations from the norm

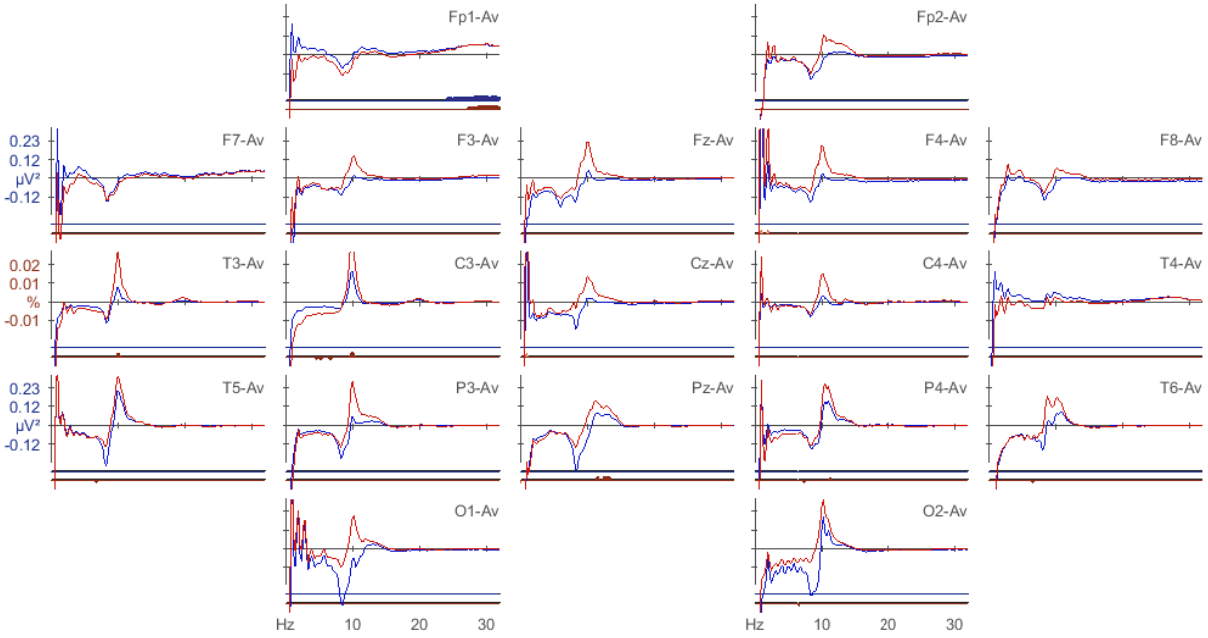


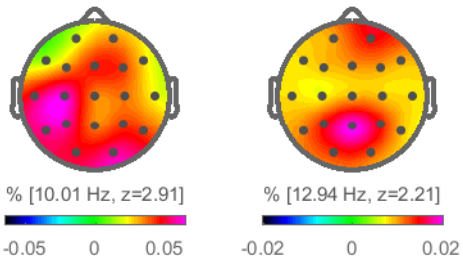


Spectral data: VCPT (20:30)



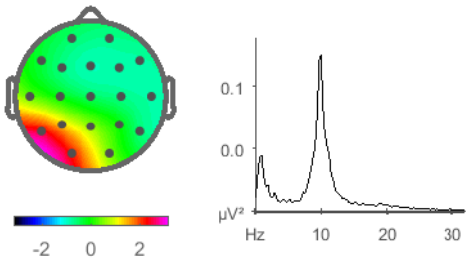
Comparison with reference data: Difference curve (blue: absolute, red: relative). Bars on the lower line indicate significant deviations from the norm



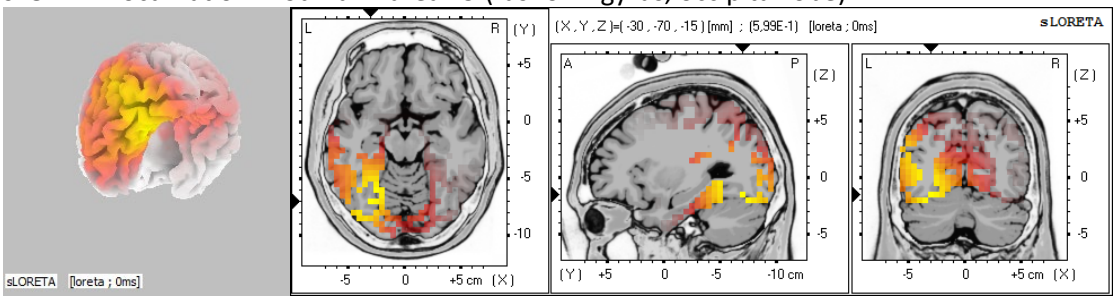


The graphics represent an approximation of the origin of the signals in the cortex based on mathematical methods. The localization may deviate from the actual origin under certain circumstances. The clinical relevance must be assessed by an expert using models of the neuronal functional relationships.

The following anomalies were identified (EO):
1st frequency: 10.01 Hz
The independent component analysis of this activity shows the following distribution:



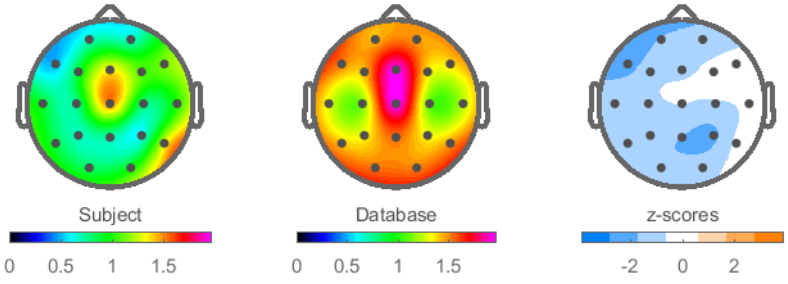
sLORETA localization Brodmann area 19 (fusiform gyrus, occipital lobe)



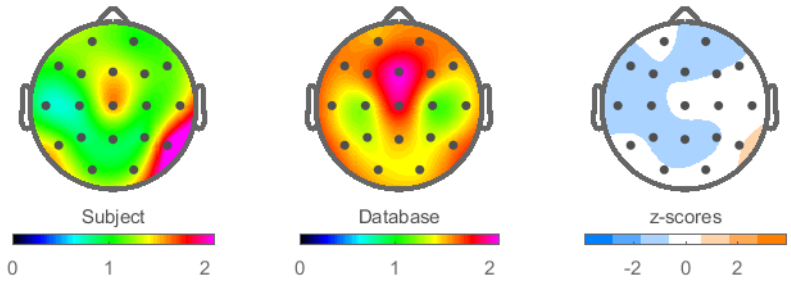
Brodmann area 19: Located in the occipital lobe and represents the visual association cortex or extrastriate cortex. Three areas V3, V4 and V5 can be distinguished in BA 19: V3 receives afferents from BA 18. It determines movement information of rough shapes and helps to recognize familiar shapes. V3 is involved in visual attention control. V4 processes color. By means of a white balance, it makes it possible to reliably recognize a certain color (color constancy), regardless of its hue, which is caused by wavelength shifts in different lighting conditions. V5 corresponds to the MT (Movement territory) area. Together with MST (medial superior temporal area = V5a), it reacts to movement and directions of movement.

Theta/beta ratio

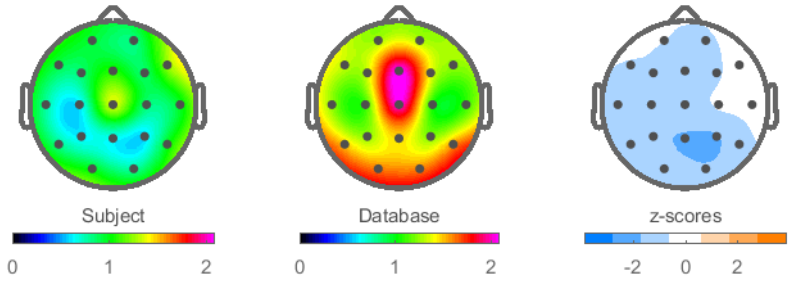
The theta/beta ratio is called the inattention index because the ratio is negatively correlated with age (the older the age, the smaller the ratio of theta and beta) and positively correlated with errors in continuous performance tests such as the GO/NOGO test (the higher the ratio, the more errors). In certain ADHD subtypes, the ratio is elevated compared to healthy individuals. This ratio was described by Monastra (Monastra, 1999). However, the accuracy of this ratio in adults is limited.



Eyesopen



Eyes closed



During concentration progress test

Version	v01	v01	v01
Eyes open	**Fz**	**Cz**	**Pz**
Subject (Stanine)	**1.35** (20.1% | 3)	**1.51** (28.5% | 4)	**0.72** (4.4% | 2)
Eyes closed	**Fz**	**Cz**	**Pz**
Subject (Stanine)	**1.46** (22.8% | 4)	**1.6** (35.9% | 4)	**0.97** (17.8% | 3)
During concentration progress test	**Fz**	**Cz**	**Pz**
Subject (Stanine)	**1.06** (6.8% | 2)	**1.36** (18.1% | 3)	**0.65** (3.4% | 1)

Arousal modulation, arousal level, arousal

The following index represents the arousal that is triggered by arousal. These are the parietal and occipital branches, which are projected from the insula into the corresponding regions. The calculations are made separately for the two hemispheres. (The numbers in bold are the individual values, the numbers in brackets are the values of the reference group of peers). The scientific papers on this index are currently being prepared. The initial results show that it is a general index that provides information on the apathy/lethargy - restlessness/stress dimension. The higher the value, the greater the inner restlessness.

Version	v10	v10
Eyes open	**O1 relative Left hemisphere**	**O2 relative Right hemisphere**
Subject (Stanine)	**3.42** (21.1% | 3)	**2.19** (5.0% | 2)
Eyes closed	**O1 relative Left hemisphere**	**O2 relative Right hemisphere**
Subject (Stanine)	**0.51** (23.3% | 4)	**0.46** (18.1% | 3)
During concentration progress test	**O1 relative Left hemisphere**	**O2 relative Right hemisphere**
Subject (Stanine)	**4.10** (41.9% | 5)	**3.09** (23.3% | 4)

Arousal as a function of focusing ability

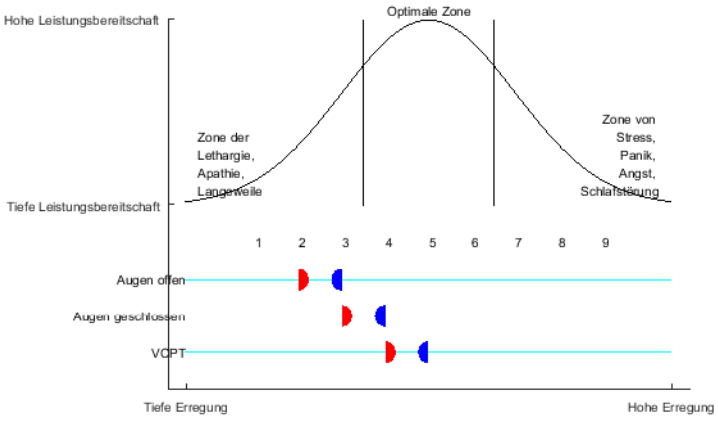
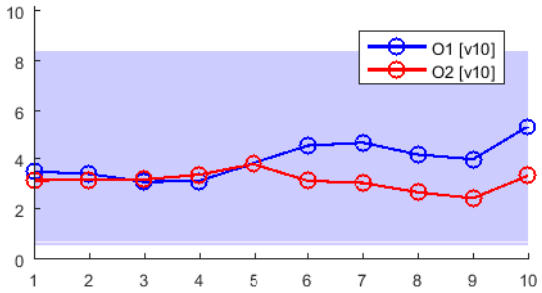


Figure 1Arousal index of the left hemisphere (blue) and the right hemisphere (red) in eyes open, eyes closed and VCPT.

Concentration progression test, excitation modulation in the course of the test

The concentration progression test lasts a total of 21 minutes. There were 10 equally long epochs of approx. 125 seconds each. The excitation level was measured during these epochs. The two hemispheres are recorded separately (O1: (blue) left-sided hemisphere. O2: (red) right-sided hemisphere).

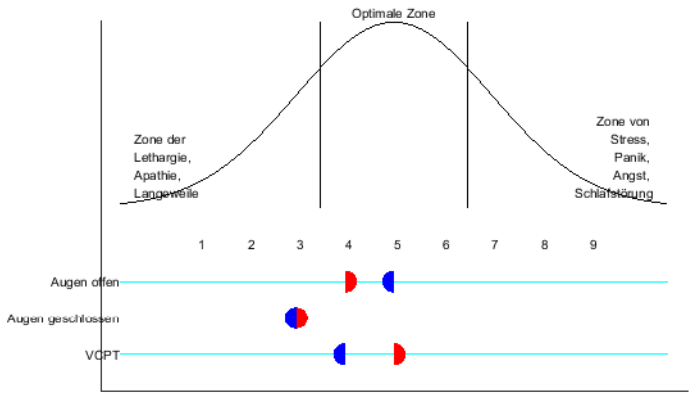


A typical progression can be observed with XY. The hemispheres are synchronized.

Central sensory index (relative power, beta-gamma squared)

The central sensory index reflects the organization and functioning of the somatosensory areas. These receive information from many different systems: thalamic nuclei, basal ganglia, limbic system and cingulate system. Functionally, the ZSI provides information on the type and manner of processing: low values are associated with increased introspection/introversion, high values with increased outward orientation or extraversion. In children, the ZSI provides important information regarding processing in a stimulus-intensive context. In adults, significant information can be obtained on the anxiety/internal arousal dimension. The scientific publication is still pending.

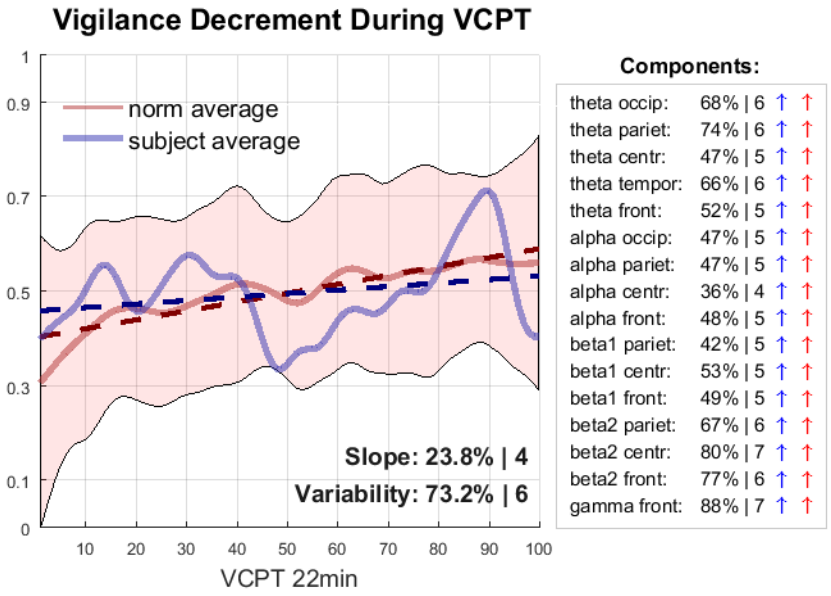
Version	v01	v01
Eyes open	**Left hemisphere**	**Right hemisphere**
Subject (Stanine)	**2.4** (51.7% | 5)	**2.27** (28.9% | 4)
Eyes closed	**Left hemisphere**	**Right hemisphere**
Subject (Stanine)	**1.9** (20.9% | 3)	**1.93** (20.2% | 3)
During concentration progress test	**Left hemisphere**	**Right hemisphere**
Subject (Stanine)	**2.34** (37.6% | 4)	**2.35** (41% | 5)



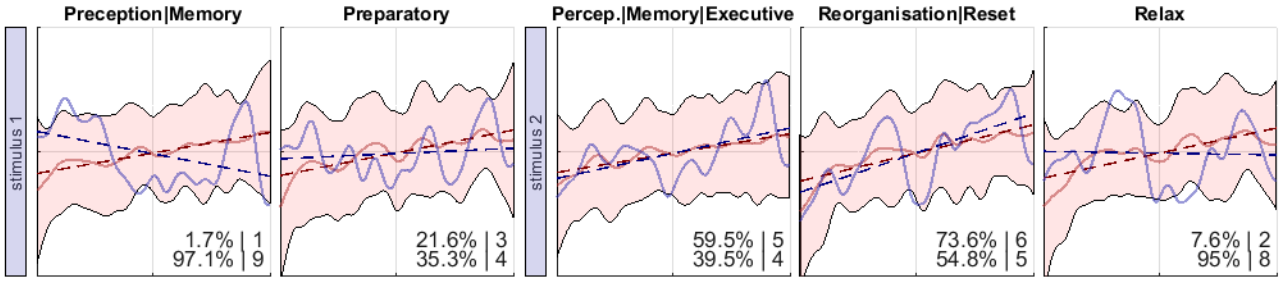
Vigilance Decrement

Vigilance refers to the inner, unconscious readiness that enables tasks to be solved: it is the state of heightened and permanent readiness to react. It is important to be able to maintain this state over a long period of time. During the concentration progression test, vigilance means maintaining this readiness to react adaptively over a long period of time in accordance with the requirements. According to the resource model, the readiness to react can only be maintained for as long as resources are available. Rising curves therefore indicate that resources can be called up, while falling curves indicate low resource call-up. A detailed analysis has shown that the readiness to react does not have to be maintained uniformly during the task. Depending on the requirements during task solving, more or fewer resources are called up. For this purpose, the solution process was divided into 5 segments: 1. perception, memory; 2. preparation; 3. perception, memory, action; 4. reset/reorganization; 5. relaxation. The individual data is compared with that of peers in terms of intensity of resource retrieval (slope) and stability of the solution process (variability).[2]

Go

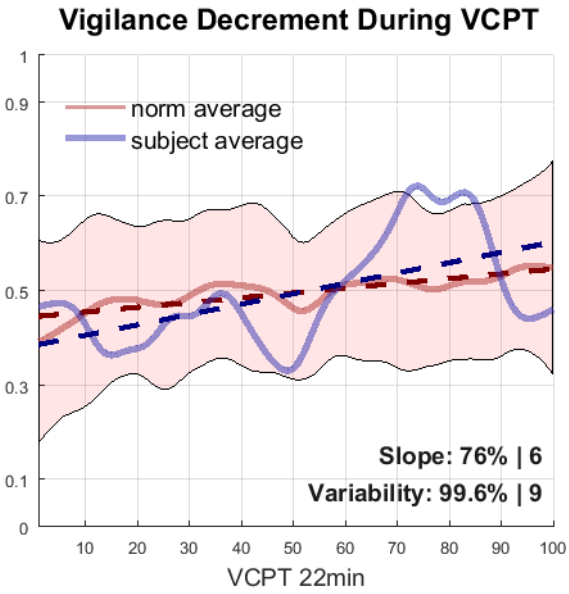


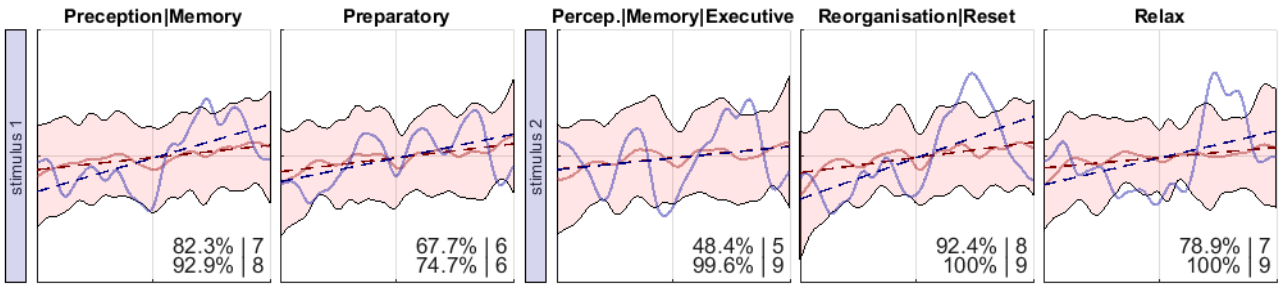
[2] Pershin, I: Candrian, G., Münger, M.; Rostami, M; Eich, D.; Müller, A.: Vigilance decrement described by the time-on-task effect in EEG activity during a cued Go/NoGo task. International Journal of Psychophysiology, 2022.



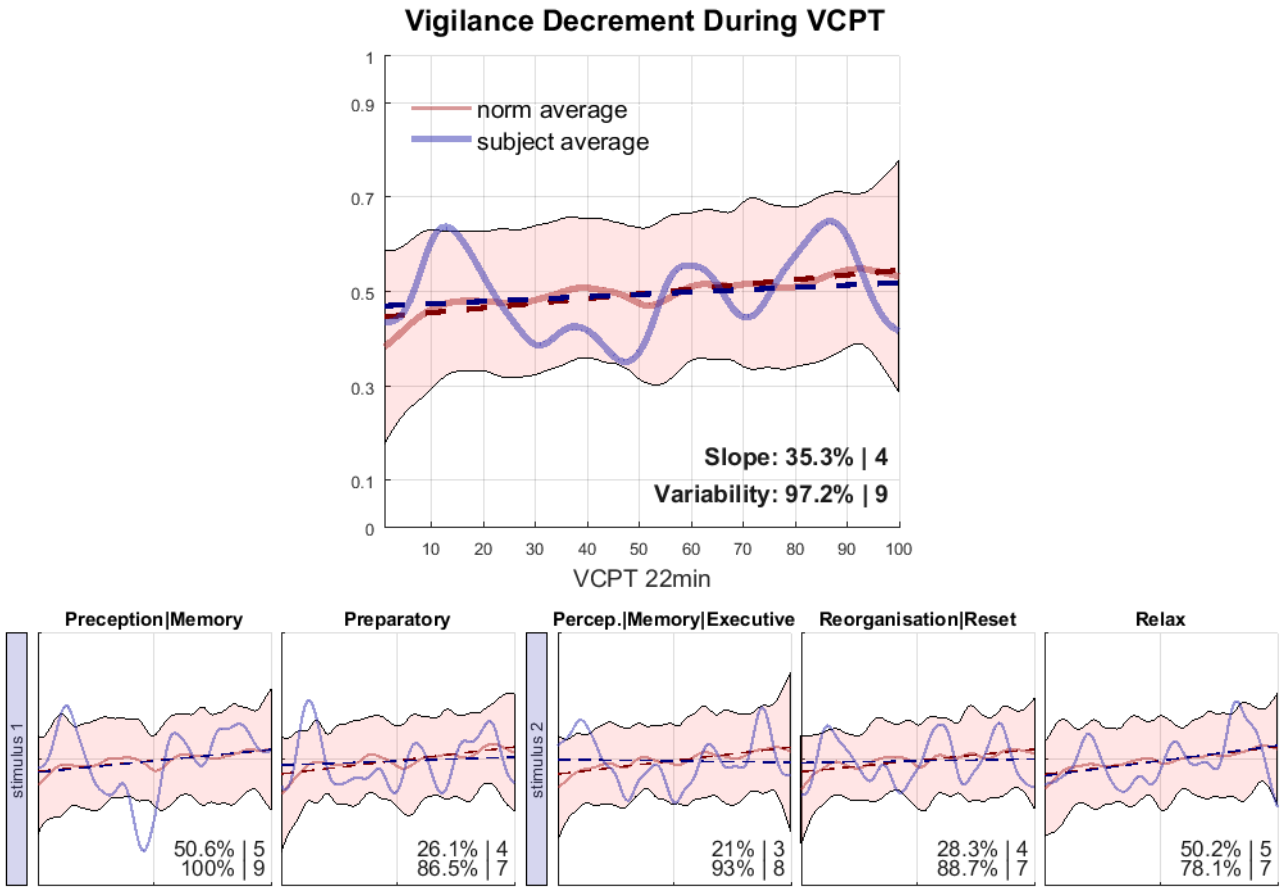
theta occip:	34% | 4	↓↑	theta occip:	82% | 7	↑↑	theta occip:	66% | 6	↑↑	theta occip:	92% | 8	↑↑	theta occip:	55% | 5	↑↑
theta pariet:	41% | 5	↓↑	theta pariet:	39% | 4	↓↑	theta pariet:	86% | 7	↑↑	theta pariet:	96% | 8	↑↑	theta pariet:	81% | 7	↑↑
theta centr:	30% | 4	↓↑	theta centr:	44% | 5	↑↑	theta centr:	51% | 5	↑↑	theta centr:	63% | 6	↑↑	theta centr:	48% | 5	↑↑
theta tempor:	25% | 4	↓↑	theta tempor:	59% | 5	↑↑	theta tempor:	82% | 7	↑↑	theta tempor:	80% | 7	↑↑	theta tempor:	79% | 7	↑↑
theta front:	17% | 3	↓↑	theta front:	71% | 6	↑↑	theta front:	56% | 5	↑↑	theta front:	79% | 7	↑↑	theta front:	38% | 4	↑↑
alpha occip:	17% | 3	↓↑	alpha occip:	49% | 5	↑↑	alpha occip:	59% | 5	↑↑	alpha occip:	85% | 7	↑↑	alpha occip:	27% | 4	↑↑
alpha pariet:	18% | 3	↓↑	alpha pariet:	13% | 3	↓↑	alpha pariet:	69% | 6	↑↑	alpha pariet:	94% | 8	↑↑	alpha pariet:	36% | 4	↑↑
alpha centr:	25% | 4	↑↑	alpha centr:	30% | 4	↑↑	alpha centr:	42% | 5	↑↑	alpha centr:	62% | 6	↑↑	alpha centr:	26% | 4	↑↑
alpha front:	15% | 3	↓↑	alpha front:	51% | 5	↑↑	alpha front:	62% | 6	↑↑	alpha front:	82% | 7	↑↑	alpha front:	31% | 4	↑↑
beta1 pariet:	11% | 3	↓↑	beta1 pariet:	18% | 3	↓↑	beta1 pariet:	54% | 5	↑↑	beta1 pariet:	97% | 9	↑↑	beta1 pariet:	22% | 3	↓↑
beta1 centr:	13% | 3	↓↑	beta1 centr:	46% | 5	↑↑	beta1 centr:	74% | 6	↑↑	beta1 centr:	87% | 7	↑↑	beta1 centr:	44% | 5	↑↑
beta1 front:	3% | 1	↓↑	beta1 front:	64% | 6	↑↑	beta1 front:	79% | 7	↑↑	beta1 front:	93% | 8	↑↑	beta1 front:	19% | 3	↓↑
beta2 pariet:	47% | 5	↑↑	beta2 pariet:	56% | 5	↑↑	beta2 pariet:	76% | 6	↑↑	beta2 pariet:	92% | 8	↑↑	beta2 pariet:	53% | 5	↑↑
beta2 centr:	44% | 5	↑↑	beta2 centr:	87% | 7	↑↑	beta2 centr:	96% | 9	↑↑	beta2 centr:	82% | 7	↑↑	beta2 centr:	74% | 6	↑↑
beta2 front:	55% | 5	↑↑	beta2 front:	91% | 8	↑↑	beta2 front:	70% | 6	↑↑	beta2 front:	93% | 8	↑↑	beta2 front:	63% | 6	↑↑
gamma front:	95% | 8	↑↑	gamma front:	82% | 7	↑↑	gamma front:	79% | 7	↑↑	gamma front:	87% | 7	↑↑	gamma front:	93% | 8	↑↑

NoGo

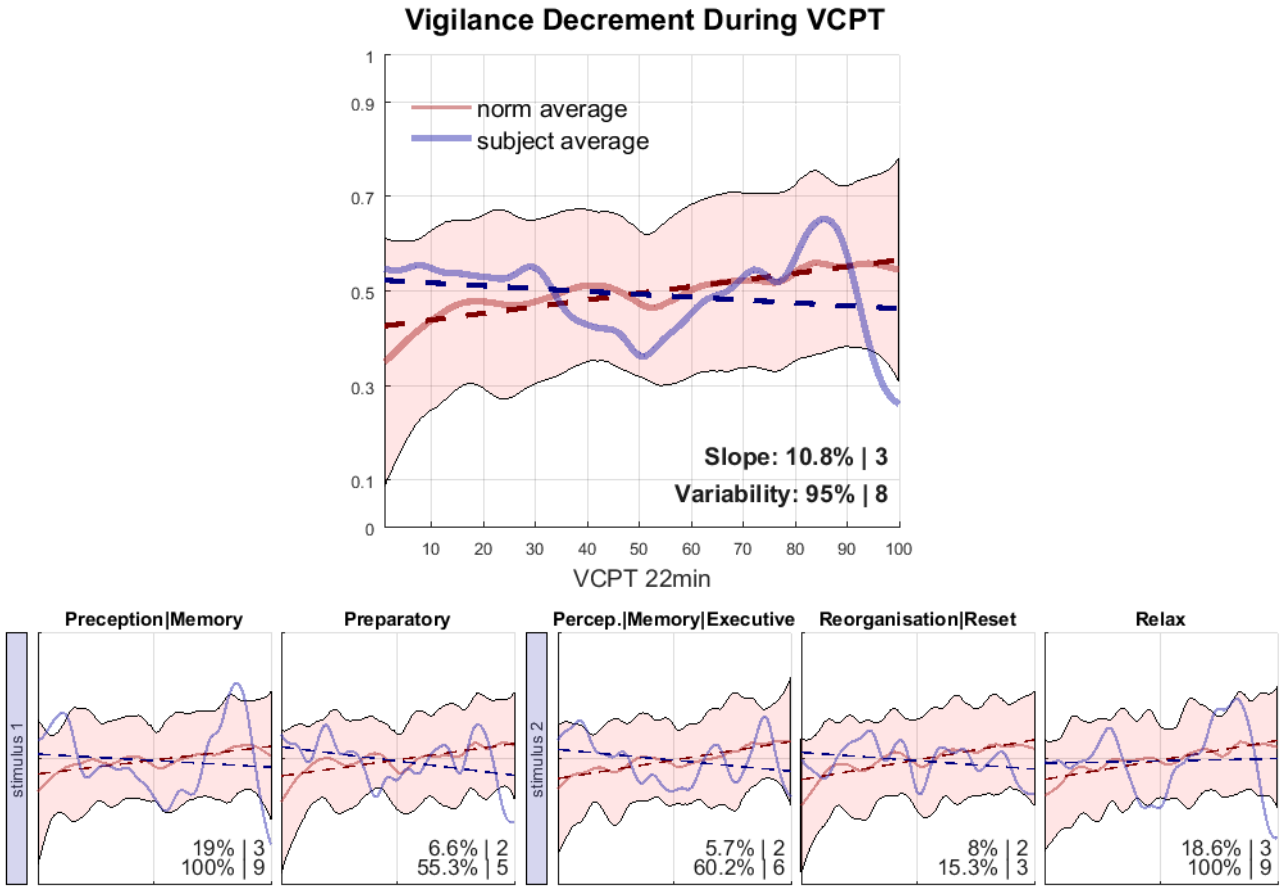




Ignore



Ignore + Novelty



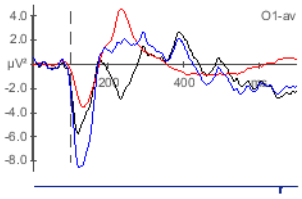
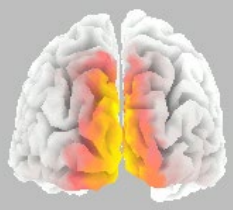
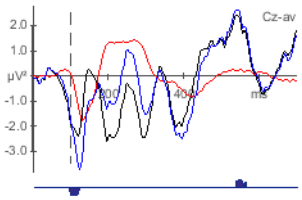
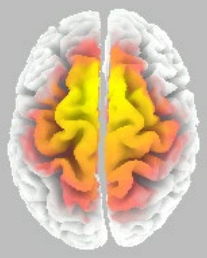
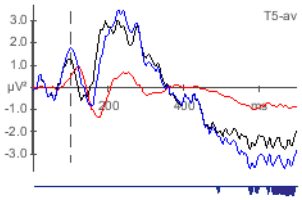
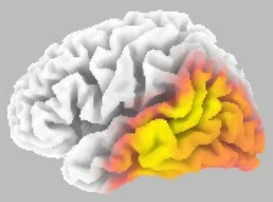
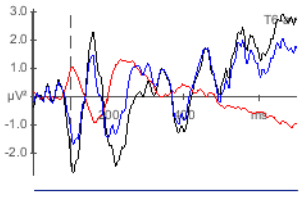
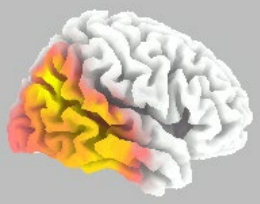
4. ICA Evoked potentials in the concentration progression test

The evoked potentials map the information processing processes and provide information on the way in which information is processed in different regions of the brain during the processing of simple stimuli. Only specific neuron groups and networks are involved in the generation of the various potentials.

Comparison of the components with reference data:

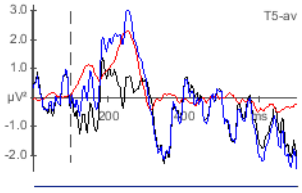
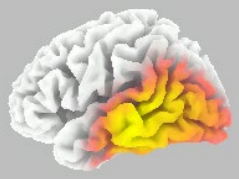
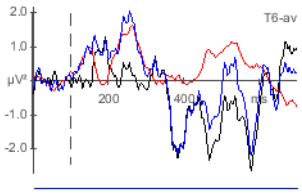
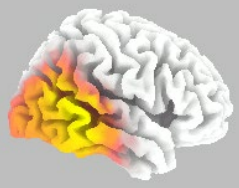
Input areas:

blue: subject/red: reference data/black: difference (significance)

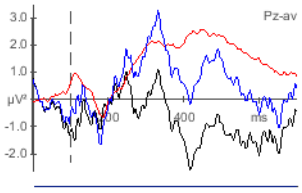
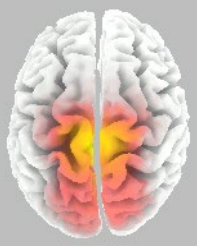
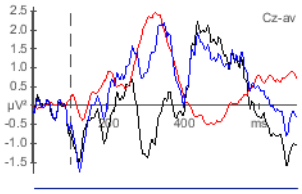
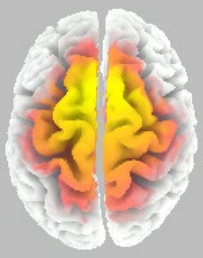
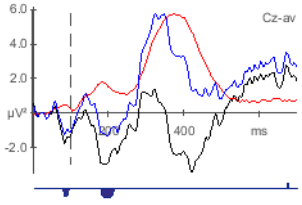
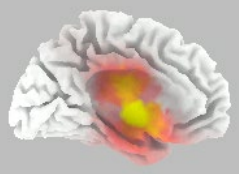
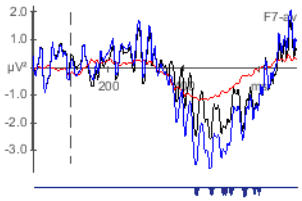
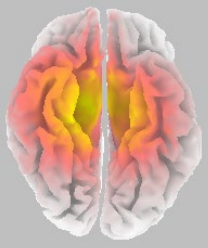
P1N1 Visual input		*Brodmann area 19* *Cuneus* *Occipital lobe* *Best Match at 5mm* *Brodmann area 18* *Cuneus* *Occipital lobe*	
N1P2 Aud. Novelty		*Brodmann area 6* *Superior frontal gyrus* *Frontal lobe* *Best Match at 17mm* *Brodmann area 8* *Superior frontal gyrus* *Frontal lobe*	
P1N1 vTL Left association areas		*Brodmann area 22* *Superior temporal gyrus* *Temporal Lobe* *Best Match at 7mm* *Brodmann area 40* *Supremargial gyrus* *Temporal Lobe*	
P1N1 vTR Right association areas		*Brodmann area 39* *Angular Gyrus* *Parietal lobe* *Best Match at 9mm* *Brodmann area 40* *Inferior parietal lobule* *Parietal lobe*	

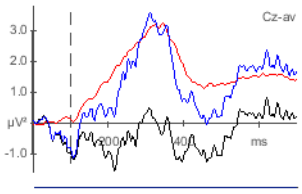
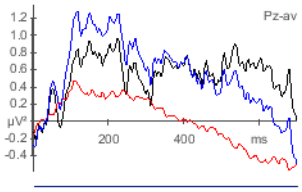
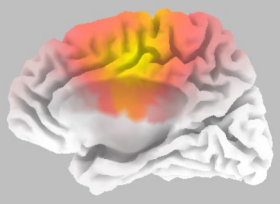
Storage areas:

blue: test subject/red: reference data/black: difference (significance)

V com TL Left storage areas		*Brodmann area 21* *Middle Temporal Gyrus* *Temporal Lobe* *Best Match at 7mm* *Brodmann area 22* *Middle Temporal Gyrus* *Temporal Lobe*	
V com TR Right storage areas		*Brodmann area 21* *Middle Temporal Gyrus* *Temporal Lobe* *Best Match at 5mm* *Middle Temporal Gyrus* *Temporal Lobe*	

Executive functions: blue: test subject/red: reference data/black: difference (significance)

P3b Activation operation		*Brodmann area 6* *Medial frontal gyrus* *Frontal lobe* *Best Match at 5mm* *Brodmann area 5* *Paracentral Lobule* *Frontal lobe*	
P3a Inhibition/suppression		*Brodmann area 6* *Superior frontal gyrus* *Frontal lobe* *Best Match at 17mm* *Brodmann area 8* *Superior frontal gyrus* *Frontal lobe*	
P4 monCC Conflict monitoring		*Brodmann area 25* *Anterior Cingulate* *Limbic Lobe* *Best Match at 15mm* *Brodmann area 34* *Subcallosal gyrus* *Frontal lobe*	
P4wmF Working memory		*Brodmann area 34* *Parahippocampal gyrus* *Limbic Lobe* *Best Match at 5 mm* *Brodmann area 28* *Parahippocampal gyrus* *Limbic Lobe*	

SW PHC Slow rhythmic activity This component maps part of the limbic system		*Brodmann area 28* *Parahippocampal gyrus* *Limbic Lobe* *Best Match at 5 mm* *Brodmann area 34* *Parahippocampal gyrus* *Limbic Lobe*	
CNV Readiness potential		*Brodmann area 24* *Cingulate gyrus* *Limbic Lobe* *Best Match at 7 mm* *Brodmann area 6* *Medial Frontal Gyrus* *Frontal lobe* *Lobe*	

There are various deviations from the norm:

P1N1 - Visual input:
Main potentials: N1

N1P2 - Aud. Novelty:
Main potentials: High amplitudes (negative & positive)
Late potentials: reactivation

P1N1 vTL - Left association areas:
Main potentials: High amplitudes (negative & positive)

P1N1 vTR - Right association areas:
Early potentials: Early latency
Main potentials: Early latency
Late potentials: reactivation

P3a - Inhibition/Suppression:
Late potentials: reactivation

CNV - Readiness **potential**
Main potentials: High amplitudes (negative & positive)

P1N1 - Visual input

The activations in the primary visual input areas provide information on the way in which images are decoded into neurophysiological signals.

Main *potentials*

N1 - Occipital amplitude: In various studiesKlimova, A., R. A. Bryant, L. M. Williams, and K. L. Felmingham. "Dysregulation in Cortical Reactivity to Emotional Faces in Ptsd Patients with High Dissociation Symptoms." Eur J Psychotraumatol 4 (2013).Shackman, A. J., J. S. Maxwell, B. W. McMenamin, L. L. Greischar, and R. J. Davidson. "Stress Potentiates Early and Attenuates Late Stages of Visual Processing." J Neurosci 31, no. 3 (Jan 19 2011): 1156-61.Yang, J., M. Qi, L. Guan, Y. Hou, and Y. Yang. "The Time Course of Psychological Stress as Revealed by Event-Related Potentials." Neurosci Lett 530, no. 1 (Nov 14 2012): 1-6. identified the importance of increased N1 amplitudes as a stress marker. For example, it was shown that increased N1 amplitudes occurred more frequently in highly dissociated stress patients, i.e. patients who were severely traumatized.

N1P2 - Aud. Novelty

The novelty stimulus is a good indicator of responses to an unexpected auditory stimulus. During the test, the stimulus is presented 100 times in conjunction with pictures of people. However, no behavioral responses are required.

Main *potentials*

High amplitudes mean that the brain reacts excessively to the sound. We see this more often in people with hypersensitivity.

Late potentials

Late reactivation can also be observed. Late reactivation often occurs in connection with increased monitoring. The source analysis suggests that this activity is generated in the anterior cingulate cortex of XY. Excessive monitoring processes are often a sign of hypersensitivity. High amplitudes (hypersensitivity) and excessive monitoring processes are often seen with excessive perception of pain, for example.

P1N1 vTL - Left association **areas**

The association areas in the left-sided superior temporal cortex and the left-sided parietal cortex receive information from the occipital cortex with its own association areas and at the same time the processes are influenced by frontal control mechanisms. The association process is defined by complex mechanisms that aim to create shapes that can be recognized. This construction process is highly individual and is influenced by genetic, biological and learning processes. According to the functions that research on hemispheric specialization ascribes to the left hemisphere, analysis processes and detail recognition are primarily driven on the left side. **The left hemisphere is particularly important for speaking, reading and writing and for detail-oriented arithmetic. The left hemisphere is equally important for understanding language and for detail-oriented listening**.

Main *potentials*

The main potentials of the association areas relate to the sensory-cognitive parts of the functions that are aimed at the sustainability of processing. Maintaining the energy in the association areas forms the main potentials and is accordingly associated with attention processes.

High amplitudes in the main potentials of the left association areas mean that the sensory-cognitive functions of the skills described above run intensively. This leads to intensive detail-oriented processing in XY, which is often accompanied by increased control. The consequence of this is often exhaustion.

P1N1 vTR - Right association **areas**

The association areas in the right-sided superior temporal cortex and the right-sided parietal cortex receive information from the occipital cortex with its own association areas and at the same time the processes are influenced by frontal control mechanisms. The association process is defined by complex mechanisms that aim to create shapes that can be recognized. This construction process is highly individual and is influenced by genetic, biological and learning processes. According to the functions that research on hemispheric specialization ascribes to the right hemisphere, synthesis and holistic orientation are primarily driven on the right side. **The right hemisphere is of particular importance in recognizing and finding one's way in space, in recognizing emotional patterns and content, in the development of tactile-kinesthetic processing, in musical experience and in cultural techniques through the ability to estimate space, time and size, through the imaginative comprehension of units**.

Early potentials

The activity of the right-sided **early** potentials concerns the sensory parts of the functions that are not subject to cognitive control and are probably triggered in particular by excitation mechanisms of the sensory reception of information.

In XY, we observe very short latencies in the early potentials of the right-sided association processes. This means rapid activation, i.e. the right-sided association processes are set in motion early.

Main *potentials*

The main potentials of the association areas relate to the sensory-cognitive parts of the functions that aim to ensure the sustainability of processing. Maintaining the energy in the association areas forms the main potentials and is accordingly associated with attention processes.

Early latencies in the main potentials of the right-sided association areas mean that the sensory-cognitive functions of the skills described above run quickly. This leads to fast, right-sided processing in XY.

Late potentials

The late potentials of the association processes concern the control of one's own constructions and are influenced by emotional factors such as security and uncertainty. Emotion regulation is a decisive factor for the outcome of the construction process.

XY shows a reactivation of the right-sided association areas. This is accompanied by increased activation of the right-sided control processes, which is often associated with slower but intensive emotional processing in everyday life.

P3a - Inhibition/Suppression

Executive functions/inhibition/suppression/selection: This function is crucial for the control of motor, cognitive (perceptual) and emotional behaviors: the planning, design, control and monitoring of processes are controlled by these networks. These functions are involved in all processes because the inhibition (suppression) of processes is a fundamental act of the neurobiological networks. The phenomenon of **inhibition is** the influencing of a nerve cell by an impulse that does not stimulate this neuron to form an action potential, but inhibits it and thus weakens the signal transmitted by this neuron. In the case of synaptically mediated inhibition, a distinction is made between pre- and postsynaptic inhibition. The inhibition function of the executive system can be localized to the frontostriatal loop. (cortex - basal ganglia - thalamus - cortex - loop).

Late potentials

The late potentials of suppression and inhibition are influenced by emotional components, which flow into decision-making, for example. The monitoring function is also involved.

The reactivation of the suppression and inhibition process in the information processing process is an expression of difficulties in relation to the course of the selection processes. Decision-making processes are part of this.

CNV - standby **potential**

The readiness potential is an indicator of the activation and preparation processes for the next stimulus. The initiation of a motor movement is important here. It is measured in the central parietal cortex. See Walter, Cooper, et al (1964); Gaillard, A.W.; Näätänen, R. 1976); Thigpen, N.N., Keil, A. (2017). The readiness potential has an early component that is modulated by noradrenergic systems and a late component that is thought to be related to motor readiness and under dopaminergic control (see Rohrbaugh, et al 1986; Birbaumer, et al, 1990).

Main *potentials*

High amplitudes mean that the brain prepares itself more intensively for the next stimulus.

5. Evoked potentials - ERPs

Total number of trials: **400** (a-a GO: **100**, a-p NoGO: **100**, p-p: **100**, p-h: **100**, +: **200**, -: **200**, a-p-a-a: **0**)
Number of trials processed: **397** (a-a GO: **99**, a-p NoGO: **98**, p-p: **100**, p-h: **100**, +: **199**, -: **200**, a-p-a-a: **98**)

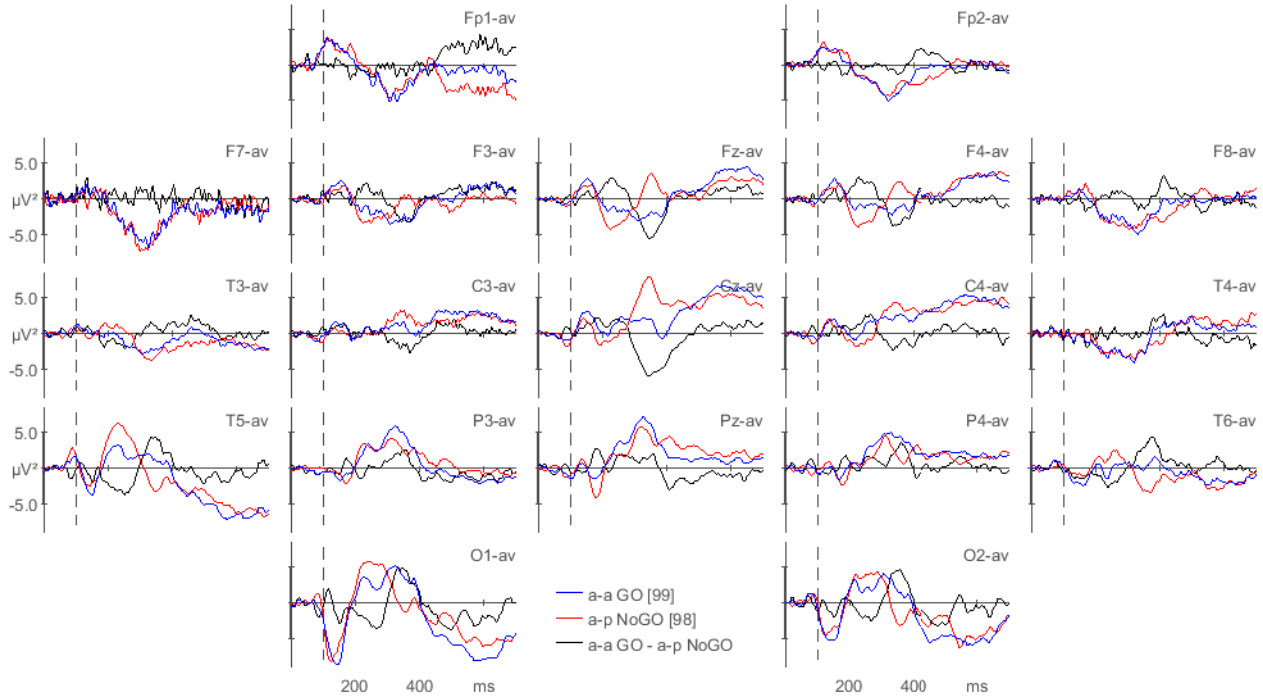
ERP components

Comparison of the ERPs of the different conditions GO, NoGO and their difference GO-NoGO (without database comparison).

ERPs of the VCPT, calculated for the second stimuli of the conditions GO, NoGO and their difference (GO-NoGO) are shown below.

blue: GO /red: NoGO /black: Difference (GO-NoGO)

GO-NoGO:



There are differences between the GO condition and the NOGO condition in the central cortex and the superior temporal lobe. This is an indication that different situations can be perceived in a differentiated way.

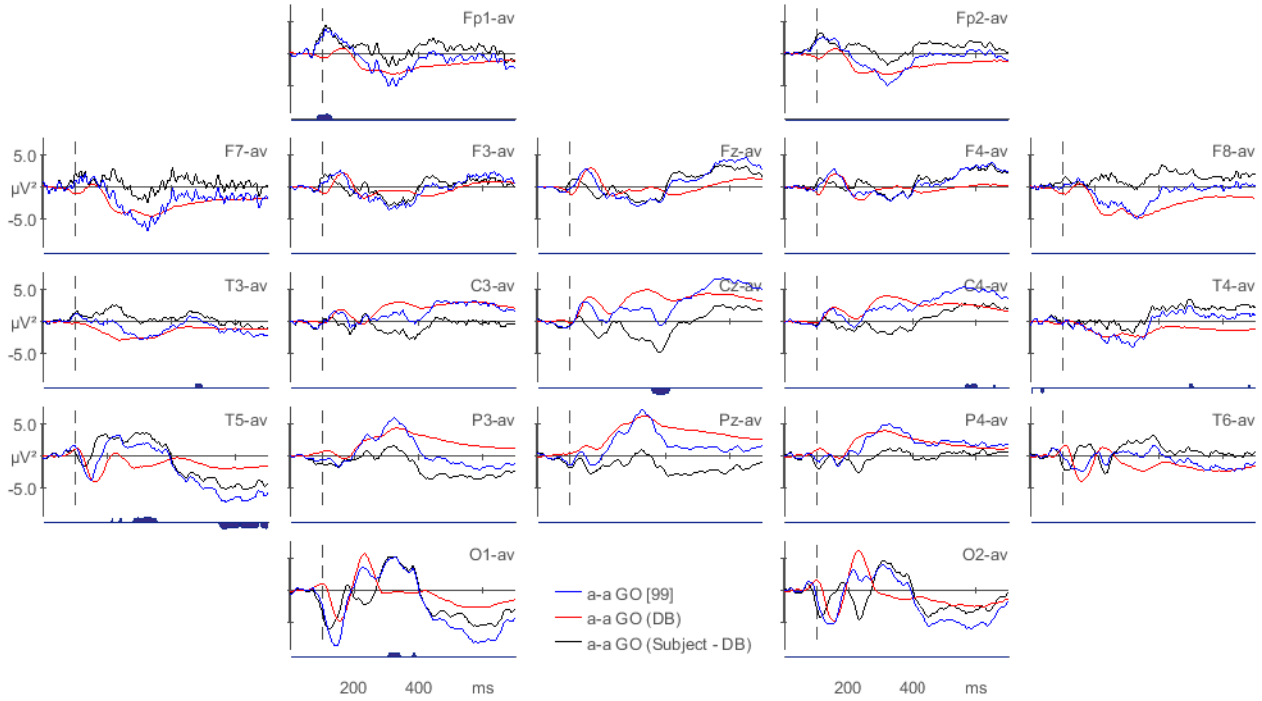
Simple ERPs

Comparison with the ERPs of the norm database, presentation of the second stimulus.

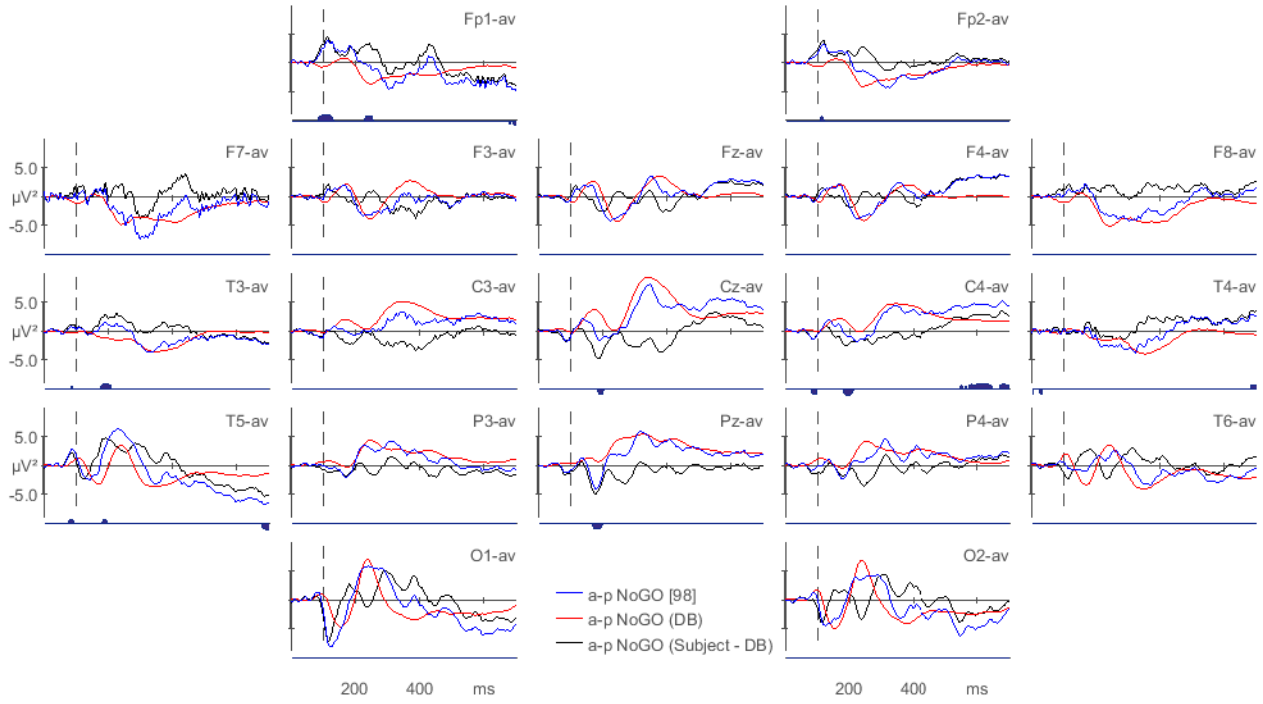
ERPs of the VCPT calculated for the second stimuli of the GO, NoGO and Novelty Stimulus (p-h) conditions are shown below.

blue: test subject/red: reference data/black: difference (significance)

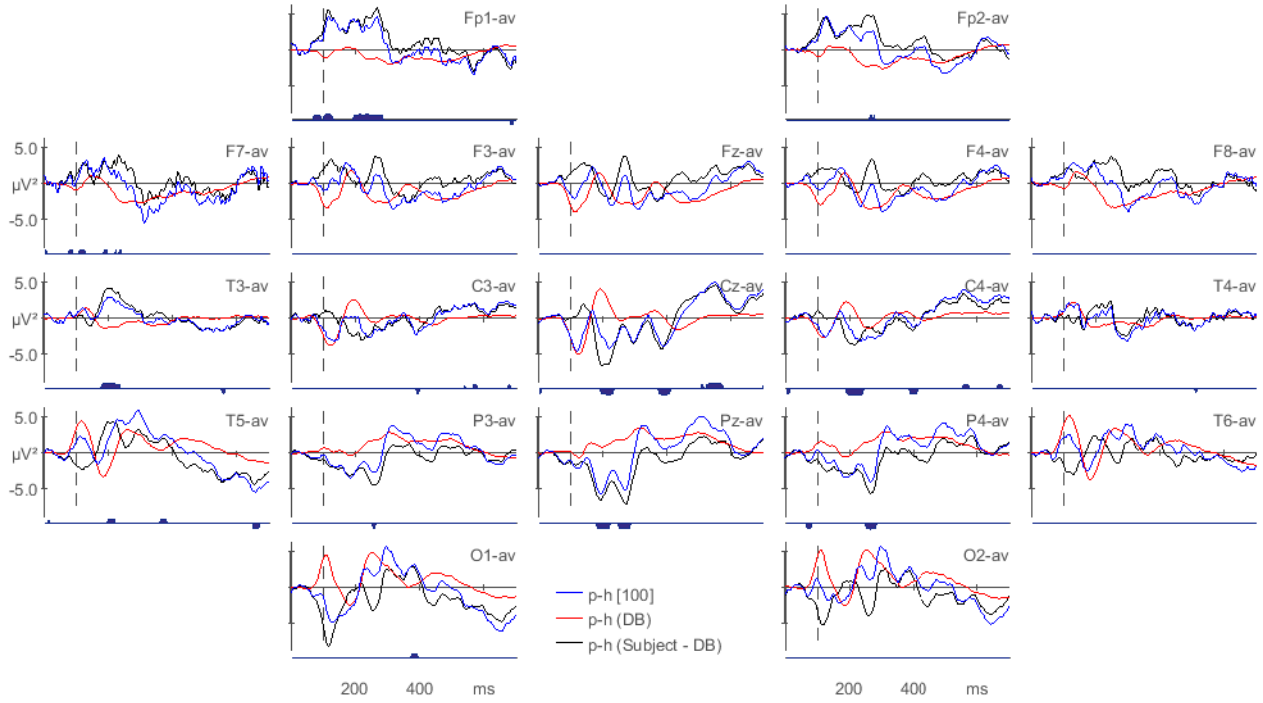
GO condition:



NoGO condition:



Novelty condition (p-h):



In the novelty condition, the subject is presented with a sound together with a picture. The sound appears unplanned, so that a novelty condition occurs, i.e. the brain reacts to an unexpected stimulus. The sound is received by the primary auditory areas (BA 41,42 and partly BA 22) (between T3 and C3 on the left and T4 and C4 on the right). These areas then project to the frontal cortex and the central cortex. The dorsal branch of auditory processing is measured in the central cortex. This gives an indication of the intensity of auditory processing. The amplitude level provides information on the sensitivity, the latency (temporal occurrence) on the speed of perception. Late potentials are generated by the medial cingulate areas and provide information about monitoring.

6. Diagnostic algorithms

In accordance with medical tradition, a diagnosis should be based on the patient's complaint on the one hand and on evidence-based, objectified diagnostic procedures on the other. The focus on neurophysiological characteristics presupposes that norms have been defined by a careful procedure according to scientifically recognized criteria and compared with patient groups. The patients included in the patient groups were all diagnosed according to the established criteria of the diagnostic and statistical manual (gold standard) and additionally by experts. This enables a reliable definition of the patient group and its subtypes.

Psychopathology varies according to age and shows different characteristics depending on the age group. For this reason, the patient groups must also be divided into age groups. For each age group, the corresponding biomarkers are calculated and validated within the age group. This is done according to the following procedure: Several hundred patients from several patient groups were subjected to standardized scientific examinations. This concerns patient groups with attention disorders, learning disorders, autism, depression, schizophrenia, obsessive-compulsive disorders, mild traumatic brain injuries and stress disorders (patients after heart attacks). For each of these patient groups, algorithms are developed for different age groups using complex statistical methods (big data, learning machines). The algorithms can therefore be used to calculate the probability of matching the various patient groups for each individual patient. Algorithms for attention deficit disorders and stress disorders are currently available. Further algorithms will follow in 2017/2018.

With such an extended approach, support for diagnostics as well as statements regarding sensitivity and specificity can be achieved. The probability of the diagnosis being correct as a percentage is calculated and displayed in each individual case. It is advisable to validate these markers clinically in each individual case. However, the result of the algorithm comparison is not the clinical diagnosis!

It is clinically evident that diagnoses are a generalization and therefore always only an approximation of the actual, individually very different processes and circumstances of each person. This is currently the best possible representation of a patient group. Our data, which have not yet been used in clinical studies, help to better understand the characteristics and to develop a differentiation based on the subtypes with consequences for prognosis and therapeutic measures, which comes one step closer to the individual approach and still takes into account empirical values and neurophysiological laws. In this respect, it must be emphasized once again that the information on the neurophysiological constellations represents a complementary piece of the diagnostic mosaic that expands on the previous diagnostics. It is also clear that differentiation from other patient groups is necessary. This will be all the more possible the more algorithms of other patient groups are available and thus the more precisely a patient can be defined as belonging to existing patient groups. It is also clear that the quality of the algorithms is closely linked to the number of patients and patients in general. The higher the number of patients, the clearer the patients' diagnoses, the better the algorithms. As these algorithms are dynamic variables, they will constantly adapt over the course of time. (See also: Müller A, et al.; 2019)[3]

A. ADHD diagnosis index

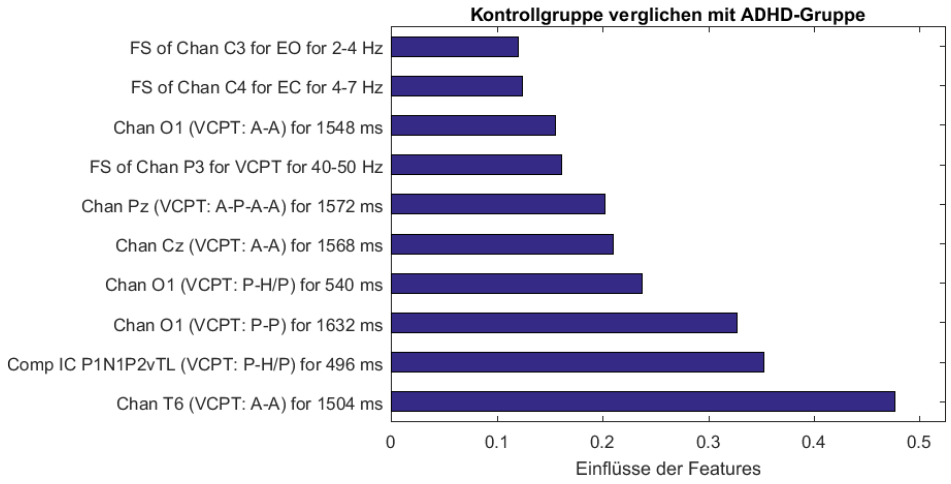
The ADHD algorithm or ADHD index was realized as part of the CH-ADHS project on three different samples. The following algorithm was used here: Regularized logistic regression#.

XY belongs to the age group 18 - 67#.

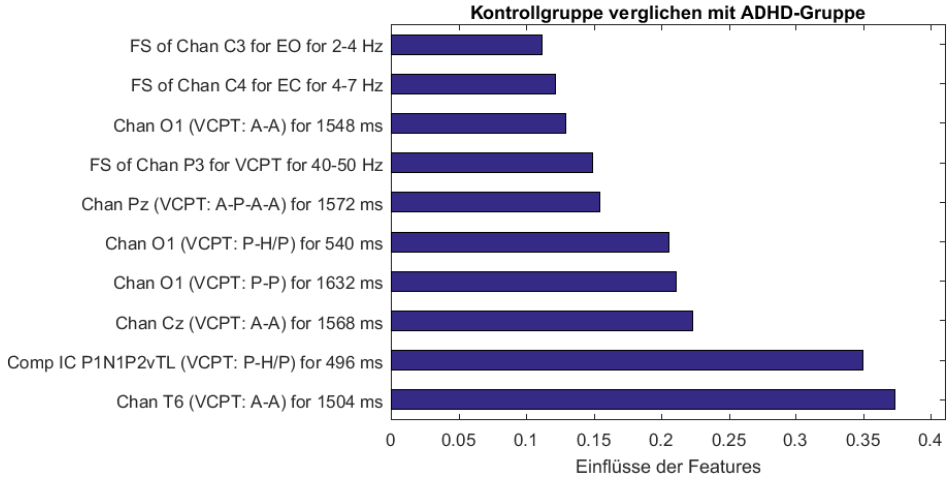
[3] Müller, A., Vetsch, S., Pershin, I., Candrian G., Baschera, GM., Kropotov, J., Kasper, J., Abdel Rehim, H., Eich, D.: EEG/ERP-based biomarker/neuroalgorithms in adults with ADHD: Development, reliability, and application in clinical practice. World journal for Biological Psychiatry, 2019.

For XY, the probability of belonging to this group is as follows:

ADHD: 52%#



(with behavioral features) ADHD: 54%#

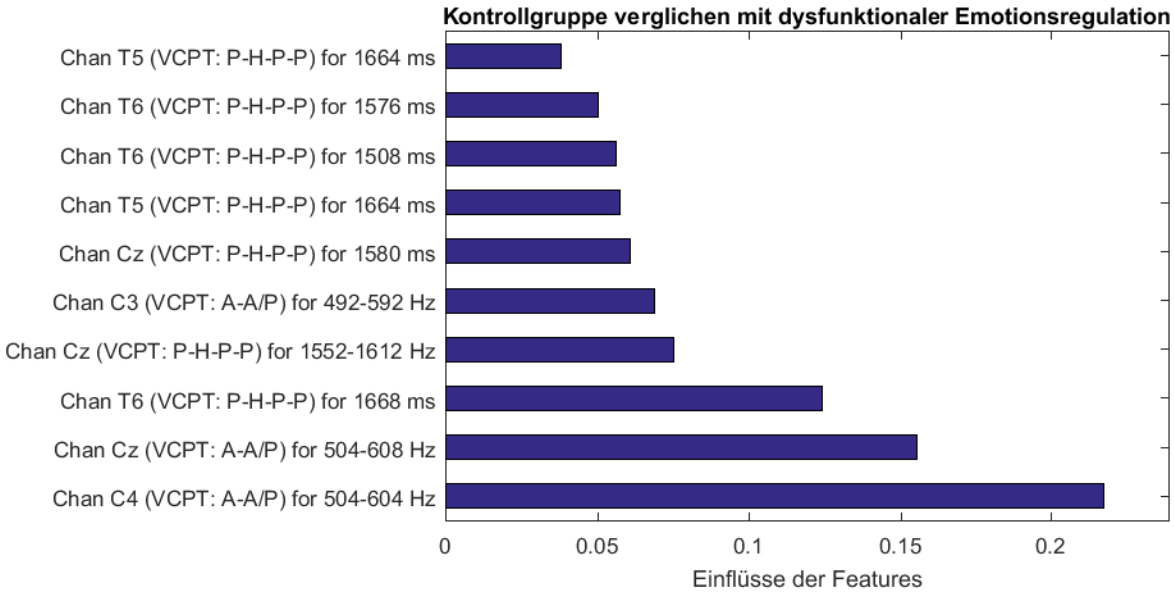


B. Emotion regulation, including depressive mood modulation

For XY, the probability of an emotionally dysfunctional episode is as follows:

Emotion regulation index: 49%

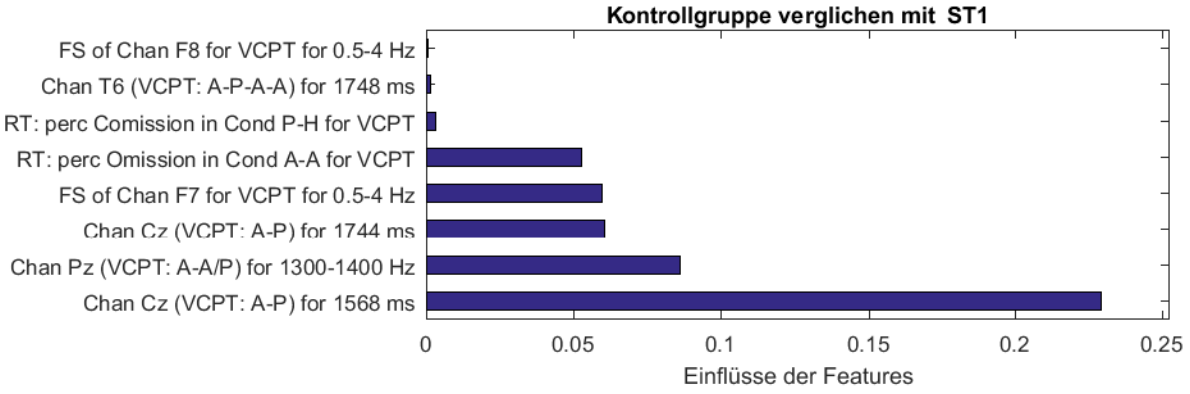
The following features are particularly important:



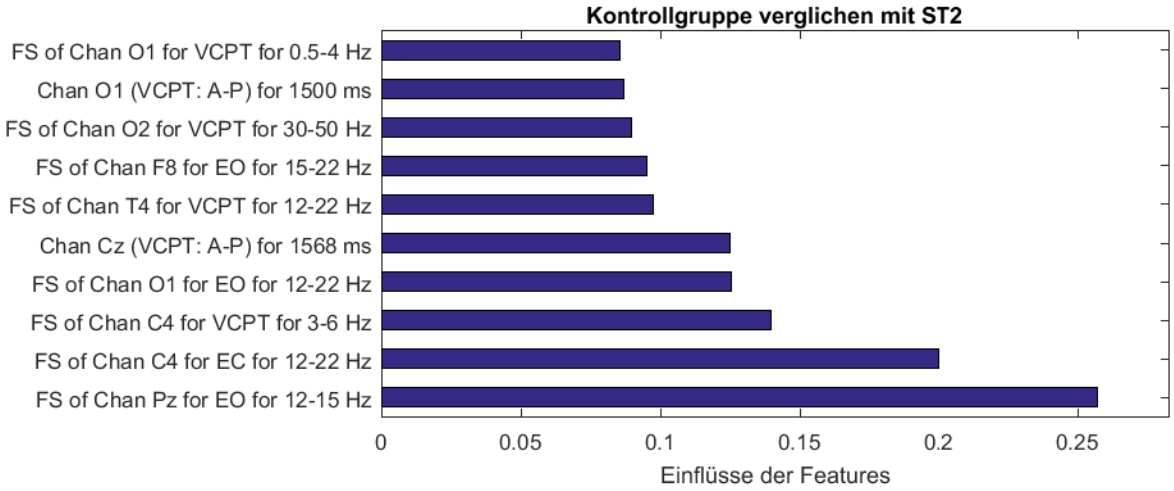
C. Functional network analysis - subtypes

[description]

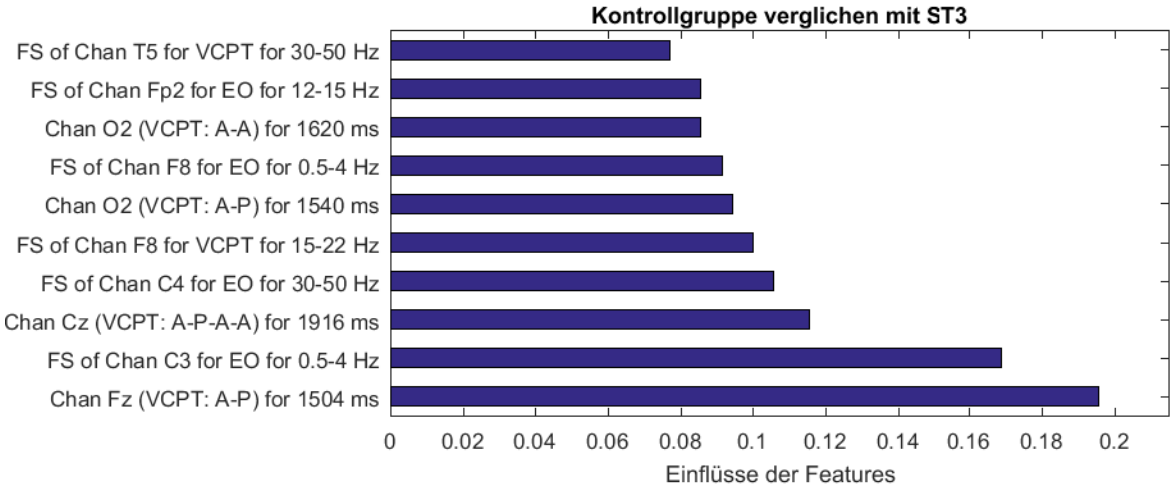
ST1: 28%



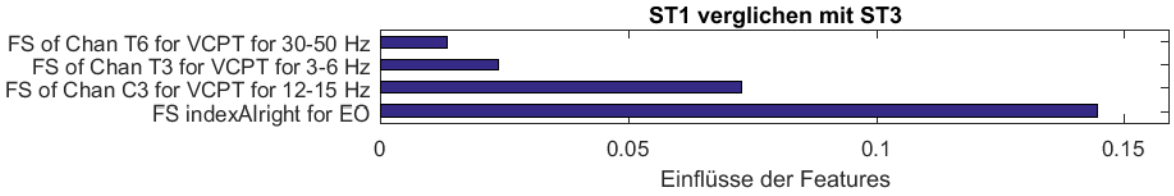
ST2: 36%



ST3: 33%



ST3 (ST1vsST3): 49%



V. Recommendations

Bei der obigen Konstellation können Empfehlungen auf 3 unterschiedlichen Ebenen empfohlen werden: Alltagsstrategien, Medikation und Therapiemöglichkeiten. Die Empfehlungen erfolgen aufgrund der beschriebenen Befunde. Die Massnahmenplanung und die daraus folgende Unterstützung bei XY soll ganzheitlich erfolgen und die verschiedensten Aspekte des Lebens beinhalten. Dazu gehören nebst dem sozialen Netzwerk die Berücksichtigung von Denken, Handeln und Fühlen aber auch der biologischen Aspekte. Es macht Sinn, entsprechend den Schwierigkeiten mittels eines multimodalen Ansatzes zu operieren, der sowohl die Aspekte der Person als auch jene des sozialen Netzwerkes berücksichtigt.

1. Everyday life/profession

General: Our recommendations are based on a high degree of neurobiological change potential. Thanks to intensive, worldwide research in the field of neuroplasticity, we know that the formation of new neuronal connections is possible in all areas, provided that the brain and the various networks are supplied with the right information. In the following, following the principles of personalized intervention, some possibilities are shown which have been researched and are of great importance in change processes.

###TB:HBI_Recommendations###

2. Medication

The medication recommendations made here are based purely on neurobiology. Different people also react completely differently to medication. Side effects in particular are difficult to assess. The responsibility for administering the medication ultimately lies with the prescribing doctor.

According to information and instructions from Prof. Dr. med. Dominique Eich, Medical Director Brain-ARC ZH.

3. Additional recommendations

Psychotherapeutic coaching: The approach of psychotherapeutic coaching combines methods and attitudes of psychotherapeutic work (behavioral therapy) with the goal-oriented and structured nature of controlling coaching work. Understanding is combined with binding agreement. This often leads to new insights into one's own actions and abilities. These new insights lead to new possibilities in everyday life and the attribution of skills and abilities changes. This method can be combined well with neurostimulation techniques.

Behavioral therapy with and without equipment support/neurofeedback:

Behavioral therapy methods are originally based on learning theory. The basic idea is that disorder-related behavior is learned and can be unlearned or that more appropriate ways of thinking and behaving can be learned. In the meantime, behavioral therapy has been further developed in many ways and differentiated into various methods. A special feature of the behavioral therapy method is that it helps patients to help themselves. The focus is on providing the patient with methods to empower them to overcome their psychological complaints after gaining an insight into the causes and history of their problems. Generalized non-specific anxiety, increased inner arousal, attention difficulties, hypersensitivity and intense stress can be addressed particularly well.

Neurofeedback/biofeedback is a further development of behavioral therapy and a comparatively newer method and is therefore still controversial in some circles. The principle is simple: the states in the brain are made transparent to the patient by means of feedback on the screen. This teaches the patient to recognize their inner states and to influence them. In the USA, the Association of American Pediatricians has awarded this method a so-called Level 1 effect, which is classified as having the same effect as medication. On the other hand, the European Association of Neurologists has not yet recognized the effectiveness of the method. Payment for the therapy must be agreed with the treating therapist in each individual case.