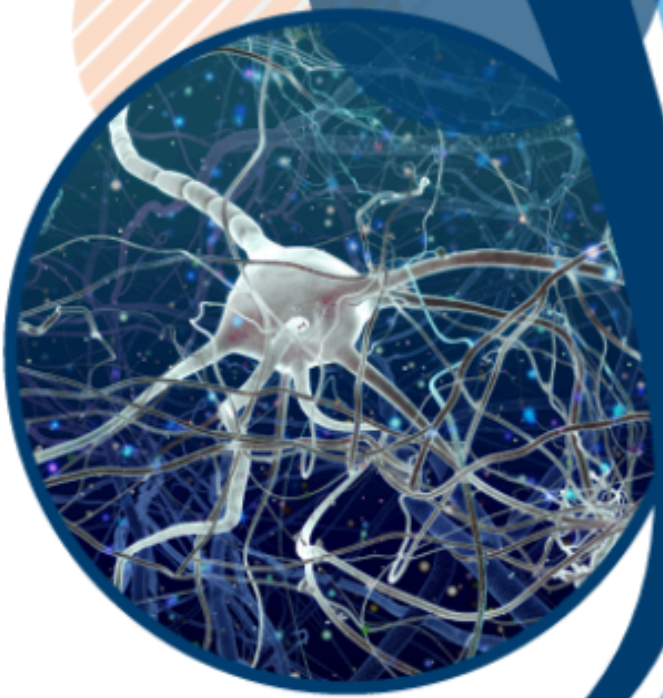
SADAR PSYCHOLOGICAL AND SPORTS CENTER

BIOMARKER EVALUATION REPORT



610.933-9440
www.sadarpsych.com
Philadelphia, PA, USA

Executive Summary of Results and Recommendations

Name:	Adult Sadar	Date of birth: Sex:	MM.DD..1986 female
Recording Date:	02.17.2026	Referred by:	Sadar Psychological
Medication(s)	None		
Evaluator	Andrea Meckley Kutyana, PhD, BCN, BCB, QEEG-T		
Reason for evaluation	Re-Evaluation for disability for State benefits and Social Security		

SUMMARY OF FINDINGS

Questionnaire	Significant Self-Reported Responses
Amen	The answers indicate a slight level of strain for Adult Sadar in the basal ganglia, also a high level of strain in cingulate cortex, temporal lobes, prefrontal cortex and deep limbic system.
van Deusen	Functions that have been allocated to the left hemisphere are significantly more affected. Functions of the left medial temporal lobe are strongly affected. Both functions of the right parietal cortex and the right superior temporal lobe are strongly affected. Functions of the prefrontal cortex are strongly affected.
ADHD	Criteria met for inattention and hyperactivity. Criteria for over-focusing are increased.

Screening	Within Normal Limits	Areas of Deficit
CNS Vital Signs	No	Psychomotor speed and Cognitive flexibility (Low Average); Verbal Memory, Visual Memory, and Processing Speed (Low); Composite Memory (Very Low)

VISUAL CONTINUOUS PERFORMANCE TASK

Data	Within Normal Limits	Statistically Significant
Omission	Yes	These results suggest adequate attention and inhibitory control to perform a simple, routine task for around twenty minutes. Faster than typical response times.
Commission	Yes	
Reaction Time	Yes	
Reaction Time Variability	Yes	

NEUROLOGIST EEG FINDINGS: Within Normal Limits: Yes

Description: During the waking state, a robust widespread posterior dominant rhythm (PDR) was an intermittent rhythmic and symmetric, bioccipital rhythm, though with only minimal attenuation in the EO condition, and frequency and amplitude ranges of 10.0-11.5 Hz, and 20-80 uV, respectively. Remaining

background activities consisted of similar frequency, relatively lower amplitude rhythms, essentially symmetrically distributed, with a widespread physiologic anterior-to-posterior amplitude gradient demonstrated. Drowsiness and sleep were not demonstrated. No abnormal paroxysmal, focal, or lateralizing findings, nor epileptiform discharges, were noted.

This EEG is without diagnostic abnormality for age in the awake state.

qEEG FINDINGS

Results	Description
High amplitude alpha	Alpha activity is found to be high in amplitude and remains prominent in all conditions, maximal in the left parietal regions (Brodmann area 5)
Frontal slowing	Increased 5-8 Hz is noted in the frontal regions (Brodmann area 10)
Theta/beta Ratios	Theta/beta ratios are increased, maximal in the frontal region in all conditions
Reduced arousal	The Arousal Index is significantly reduced in all conditions
Introversion	Increased internalization during stressful situations
Vigilance	Low inner stability

EVOKED RESPONSE POTENTIALS

Components	Early potentials		Mid potentials		Late potentials	Specific pattern
	Amplitude	Latency	Amplitude	Latency		
Visual Input			-	-	reactivation	N1 Stress Marker Yes
Auditory Novelty			low	early	-	
Left Association Areas	high	-	high	early	-	
Right Association Areas	high	-	high	-	Long-lasting high amp	
Left Memory	-	-	high	-	-	
Right Memory	-	-	-	-	-	
Engagement	-	-	-	early	-	N2 Attention Marker Yes
Inhibition/Suppression	-	early	-	-	-	
Monitoring	-	early	-	early	-	
Working Memory						
Slow Wave Activity						

DISCUSSION:

There are several patterns of interest in Adult's evaluation. First, she has a healthy alpha rhythm at 10.50 Hz with eyes closed. However, this activity is very high in amplitude, maximal in the left parietal region and frontally, and remains prominent with eye opening and during the task, likely contributing to the reduced arousal index. Alpha is considered the brain's idling rhythm and is typically found between 9-11 Hz. In general, higher amplitude alpha can indicate a more internally oriented state, making it more difficult to process external stimuli. This is consistent with the central-sensory index which shows predominantly decreased values across all conditions, indicating increased internalizing processing, especially in stressful situations, which aligns with the overall pattern of reduced activation and suggests a tendency toward

introversion and internal focus rather than external orientation. The alpha activity also does not attenuate with eye opening or during the task this can suggest a failure to regulate arousal and can have a negative effect on attention allocation, processing efficiency, visual memory processing, and integrating visual, auditory, and somatosensory information, as a result individuals can feel overwhelmed in some situations. Second, dysreguation is noted frontally with increased alpha and increased 5-8 Hz (Brodmann area 10) contributing to the increased theta/beta ratios. This activity reflects frontal midline theta activity, which serves as a neuromarker for limbic dysregulation and stress-related processes, reflecting potential difficulties in cognitive control, working memory, anxiety regulation as well as executive functioning.

The evoked potentials overall suggest a profile of heightened early sensory gating and efficient initial cognitive processing with robust frontal inhibitory control, but reduced sustained attentional resources during late processing stages, particularly in parietal regions, which may reflect difficulties in resource allocation or emotional burden affecting enduring cognitive engagement. Also of interest the patterns suggest a sensitivity towards stress; low activation of auditory cortical networks that could indicate auditory processing issues; intense emotional-holistic processing, which is usually associated with strong emotional processes resulting in intense emotional feelings, thoughts and behaviors; high degree of emotional control often with behaviors and other processes aimed at managing emotions are observed (possibly a compensatory mechanism); inconsistency in work habits; and fast appraisal of behaviors and actions.

Finally, in terms of attention and the ability to regulate while performing tasks the evaluation reveals her performance was very good with faster than typical response times on task. However, the vigilance measure suggests significant effort is needed to perform at this level. Adult demonstrates slightly increased slope values across most conditions, suggesting elevated resource access during testing, potentially reflecting increased internal tension or activation. Notably, all conditions show markedly increased variability, indicating substantial internal instability during test execution. Segment analysis reveals particularly concerning patterns in reorganization/reset and relaxation phases, with diminished slopes suggesting insufficient cortical reorganization and relaxation capacity, which may lead to exhaustion and fatigue. The NoGo condition shows the highest resource demands with very steep slopes in early segments, indicating excessive effort during perception and memory processes (consistent with memory deficits on the CNSVS). Overall, the pattern suggests heightened internal activation combined with poor stability and inadequate recovery mechanisms during sustained attention tasks.

SUMMARY OF RECOMMENDATIONS

MEDICATION

Recommended	Comments
No	This neurobiological constellation does not lend itself to any recommendations for medication.

RECOMMENDATIONS FOR THERAPEUTIC INTERVENTIONS

Lifestyle	Recommended	Modifications Recommended
Daily Life	Yes	Routine and structure
Sleep	Yes	Review sleep hygiene, biofeedback
Diet	Yes	Review guidelines
Exercise	Yes	Meet daily minimum recommendations
Drugs/Alcohol	No	
Electronics	Yes	Limit to 2 hours per day

Biofeedback	Recommended	
EEG	Yes	Detailed information can be found in the recommendations section in the report
Heart Rate Variability	Yes	
Pir-HEG	Yes	
EMG	Yes	

Home Training	Recommended	
Wild Divine	Yes	Detailed information can be found in the recommendations section in the report

Additional	Recommended	Comments
Psychotherapy/Coaching	Yes	

Index of Contents

I. Introduction 7

II. Questionnaires 8

1. Questionnaire: Personal and clinical data 8
2. Questionnaire: Symptoms and Cortical Networks (Amen) 9
3. Questionnaire van Deusen 10
4. ADHD-Questionnaire 11

III. Neuropsychological Measures: 12

1. Performance 12

IV. Evidence-based investigation by measuring neurophysiological brain functions (functional neurophysiology, biomarkers): 14

1. Spontaneous EEG 14
2. Spike Detection 16
3. Evoked Potentials (in continuous performance task) 34
4. Event related potentials – ERPs 41
5. Diagnostic-Algorithms 44

A. ADHD-Diagnose-Index 44

B. Emotion regulation, including mood modulation. 45

V. Recommendations 47

1. Medication 47
2. Everyday Life/Work 47

VI. Appendix 50

I. Introduction

Important notice: qEEG and evoked potential assessment do not replace a medical-clinical checkup. They solely serve to generate comparable physiological data in different cognitive states. No neurologic diagnostic statement will be made. A neurologic assessment must be done by a licensed Neurologist.

Procedure: EEG recording was computed according to the 10-20 placement using 19 scalp electrode caps. Brain electrical activity was digitally recorded on a NeuroAmp x23 System, using a linked ears reference montage. Impedances of less than 5k Ohms were achieved at all sites before recordings were initiated and kept >5k Ohms at all times during recording. The signal was digitally processed by a quantitative topographic analysis system (ERPrec software), band passed from 1-50Hz, and saved on a local disc.

The client was seated 1.5m in front of a display monitor. The EEG was recorded in relaxed condition with eyes closed (EC) and eyes opened (EO) for 10 Minutes each and saved. After a short break, a visual or auditory continuous performance task (ACPT/VCPT) was presented on the monitor and performed during recording (task condition). The data was saved separately.

The digitized data is run through an artifact program where eye blinks, movement and other artifacts are identified and removed. The data is then manually processed for artifacts and important transients are marked.

Corrected digital recording of the client is run through a mathematical program called Fourier-Transformation. This procedure analyzes the recorded brain waves and expresses the recordings as a mathematical function - time as a function of frequency - known as its frequency spectrum. To evaluate the data there are diverse descriptive and statistical repetitions which are performed to provide a spectral analysis, topometric analysis, covariance analysis, and comparisons between the states of data acquisition. The data collected is compared and evaluated against a known FDA approved database.

This report aims to present the results and conclusion of this analysis. Also, therapeutic recommendations are given, according to dysfunction and cortical organization of the client's brain. The presented results are to be handled with caution, as they represent a momentary picture of a whole complex system.

The graphs represent an approximation of the source generator in the cortex calculated through mathematical procedures. Hence the calculated localization can differ from the real source. Therefore, expert knowledge based on functional neuronal models should ultimately determine the clinical relevance of these findings.

II. Questionnaires

1. Questionnaire: Personal and clinical data

General information

- Name (family name, given name) or code: **Sadar, Adult**
- Date of birth (Day. Month. Year): **21.07.1986**
- Gender (M-male, F-female): **F**
- Handed (L- left, R – right, ambidextrous): **R**
- Reason of having QEEG/ERP assessment: **Re-Evaluation for disability for NJ State benefits and Social Security**
- Medication taken now: **None**
- Referral source: **Sadar Psychological**

Pre- and post-natal history

- Birth trauma and/or hypoxia: **None**
- Early development, such as started to talk/walk too late: **None**
- Head trauma (with loss of consciousness): **Concussion in high school**
- Poor grades in school, poor performance at work: **Yes, needed tutoring throughout her schooling**

General Brain Regulation

- Often having headaches and/or migraines: **None**
- Feels weak and passive during daytime: **None**
- Sleep-related difficulties: **When anxious**
- Abuses alcohol or drugs: **None**
- Has history of seizures: **None**

Sensory system

- Perceptual difficulties in vision, hearing, touch…such as dyslexia, paresis, neglect…: **None**
- Difficulties in social interaction and communication, autistic spectrum: **Yes**

Motor system

- Motor-related difficulties, such as fine motor, tremor, rigidity, apraxia…: **None**

Executive system

- Attention difficulties: **Yes**
- Impulsiveness: **Occasional**
- Difficulties in correcting behavior: **Yes**
- Psychosis (hallucinations, delusions…): **None**

Affective system

- Occupied by mostly positive thoughts, manic: **Occasional**
- Occupied by mostly negative emotions, depressed: **None**
- Anxious: **Definitely**

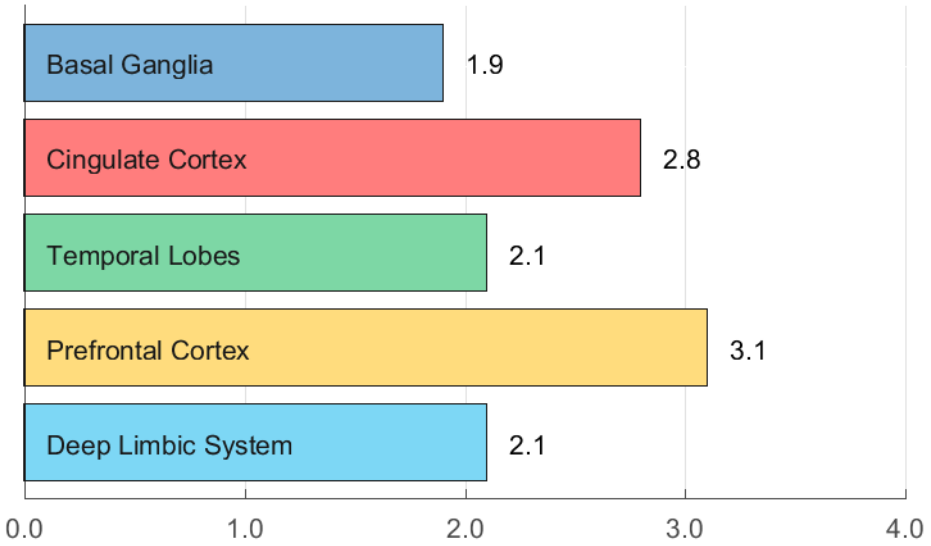
Memory system

- Poor memory for recent events: **Yes**
- Other forms of memory deficit: **None**

2. Questionnaire: Symptoms and Cortical Networks (Amen)

The relations between answers to the questions of the everyday functioning questionnaire and different brain structures have been researched. The figure below shows the weight of stressors on each structure as identified by the patient. As answering styles are highly variable between individuals, it cannot be stated if the stressor is significantly impairing everyday functioning or not. Nonetheless it is interesting to observe the differences between various structures. Results greater than 1.6 are potentially significant.

Graphic summary:



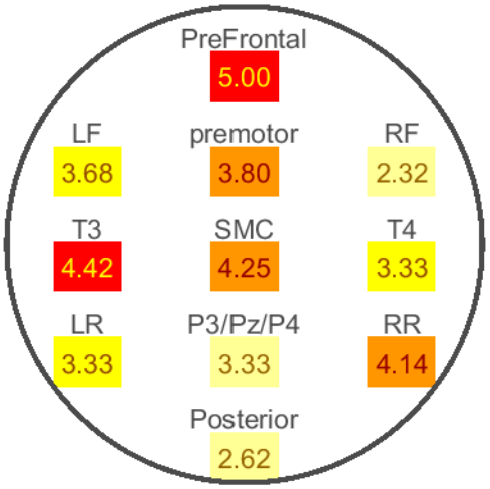
The answers indicate a slight level of strain for Adult Sadar in the basal ganglia , also a high level of strain in cingulate cortex, temporal lobes, prefrontal cortex and deep limbic system.

- The cingulate system goes from the frontal cortex (anterior part) over the medial cingulate cortex and to the posterior cingulate cortex (precuneus). Functions are affected by cognitive and emotional contents. In this context monitoring functions are required, like internal flexibility (vs rigidity). Dysfunctions of the cingulate system influence all other cortical areas. The serotonin system is widespread along the cingulate cortex. The cingulate system receives information from the thalamic anterior nuclei.

- The temporal lobe is involved in different processes of information processing. The posterior superior temporal cortex processes and stores information, the medial temporal cortex is involved in higher level sensory integration. The medial temporal lobe receives (emotional) information from the orbitofrontal and dorsolateral prefrontal cortex, also from specific nuclei of the insula. Once all dimensions of information have been processed, it is sent to the hippocampus via the entorhinal cortex.

- The attentional, emotional and executive system's networks achieve a special significance in the prefrontal cortex. The prefrontal cortex is the conductor of the brain, determining functions like planning, direction and control of actions. The prefrontal cortex receives information from all sensory modalities and deep limbic structures.

3. Questionnaire van Deusen



The relations between answers to the questions of the everyday functioning questionnaire and various brain regions have been researched. Clients are asked to rate themselves on various thoughts, emotions, and behaviors along a 7-point Likert scale. The figure below shows the degree of effect on each of eleven brain regions based on the client's ratings. As answering styles are highly variable between individuals, it cannot be stated if the effect is significantly impairing everyday functioning or not. Clinical correlation is needed. Nonetheless it is interesting to observe the differences between various regions. Red and orange results are potentially significant.

Summary of results:

- Functions that have been allocated to the left hemisphere are strongly affected.
- Functions of the left medial temporal lobe (difficulties with information processing e.g. reading or orthography) are strongly affected.
- Both functions of the right parietal cortex and right superior temporal lobe (holistic thinking, emotional attachment, estimating, appraising the meaning of something (synthesis processes)) are strongly affected.
- Functions of the prefrontal cortex (attention, emotional regulation, executive functions) are strongly affected.

4. ADHD-Questionnaire

Type	Question	Score
Type 1	**Combined ADHD-Type** → *Questions on Attention & Hyperactivity* Meets criteria for *Inattentiveness* questions as well as *Hyperactivity/ Impulsivity* questions.	**12**
	Inattentiveness Questions → *Questions on Attention* 6 (5) or more ratings of 3 or 4 are required to diagnose this type; with more than 4 such ratings suggesting this type of ADD.	**6**
	Hyperactivity-/Impulsivity Questions → *Questions on Hyperactivity* 6 (5) or more ratings of 3 or 4 are required to diagnose this type; with more than 4 such ratings suggesting this type of ADD.	**6**
Type 2	**Inattentive ADD** → *Questions on Attention* 6 (5) or more values of 3 or 4 are required to diagnose this type; with more than 4 such ratings suggesting this subtype of ADD; but not 6 or more such ratings for *Hyperactivity-/Impulsivity* questions.	6
Type 3	**Over focused ADD** → *Questions on Over Focusing* Meets criteria for *Inattentiveness*, as well as 6 or more such ratings in *Over Focusing* questions.	**10**
Type 4	**Emotion regulation Comorbidity** → *Questions on Emotion regulation* Meets criteria for *Inattentiveness*, as well as 12 or more such ratings in *Emotion regulation* questions.	5

Adult Sadar meets the cut-off (5) for inattention and hyperactivity, therefore according to DSM V the diagnosis of ADHD (314.01 (ICD: F90.2)) can be made. However, the impairment caused by the symptoms must be present in at least two settings (e.g. at work and family) and there must be clear evidence of clinically significant impairment in social or occupational functioning. Additionally, the symptoms do not occur exclusively during the course of a Pervasive Developmental Disorder, Schizophrenia, or other Psychotic Disorder and are not better accounted for by another mental disorder. Furthermore, the criteria for over-focusing are increased.

III. Neuropsychological Measures:

1. Performance

Performance was recorded during the visual continuous performance task (VCPT). The measures can be interpreted regarding impulsivity (commission errors), attention (omission errors, missed trials), reaction times (msec) and variability of reaction times.

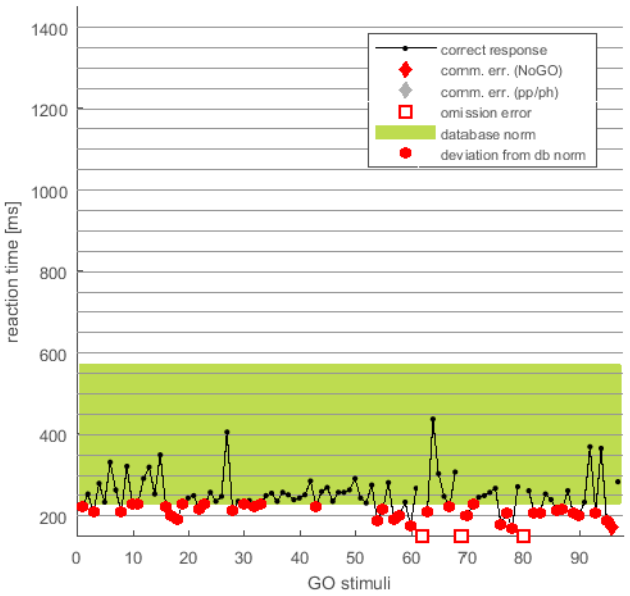
Visual Continuous Performance Task (VCPT):

Group name	Correct	Omission	Commission	RT	VR(RT)
a-a GO	96.9 %	3 (0.539)	0	248 (0.140)	4.9 (0.161)
a-p NoGO	98.9 %	0	1 (0.718)	-	-

Number of processed trials: **381** (a-a GO: **96**, a-p NoGO: **91**, p-p: **96**, p-h: **98**)

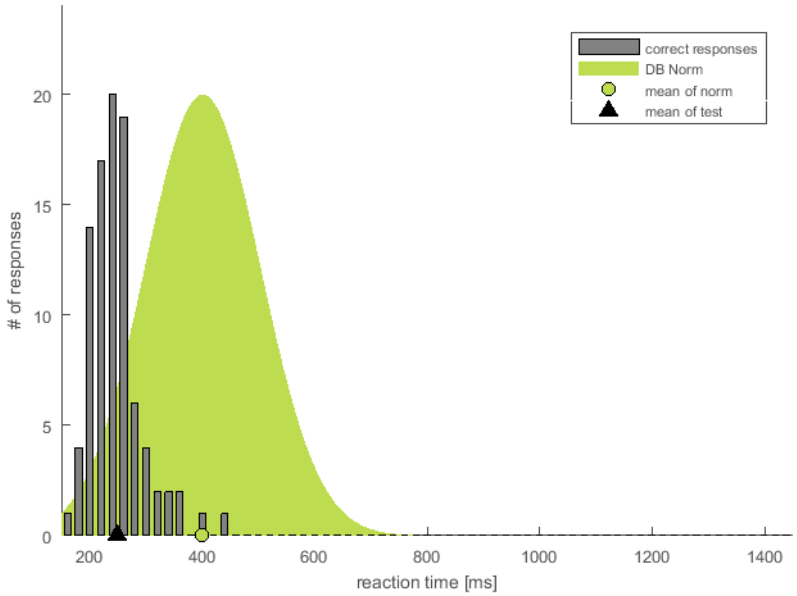
The values of Adult Sadar are within the norm with respect to Attention, Impulsivity, Reaction time and Response consistency. The patient demonstrates reaction times that are consistently fast and stable, remaining well within the normative range (green area) throughout the entire task duration, with an average reaction time of 248 msec that is similar to peers. Error analysis reveals minimal errors with only 3 omission errors in the GO condition and 1 commission error in the NoGO condition, both within normal limits, indicating adequate sustained attention and impulse control. The distribution of errors across the test intervals shows no systematic pattern of increasing errors toward the end, suggesting maintained vigilance without significant fatigue effects, and the low variability in reaction times (4.9) reflects consistent attention and stable alertness throughout task performance. Overall, the click profile indicates intact functioning of the alerting, orienting, and executive attention networks, with no evidence of reduced alertness, distractibility, or impulsivity, representing a pattern of fast, consistent working with well-preserved concentration ability and attention performance across all measured parameters.

Figure 1: below, reaction times are presented over time. Red dots represent reaction times below or above database (DB) norm levels. Black dots represent correct responses, red squares omission errors (inattentiveness) and red crosses commission errors (impulsivity).



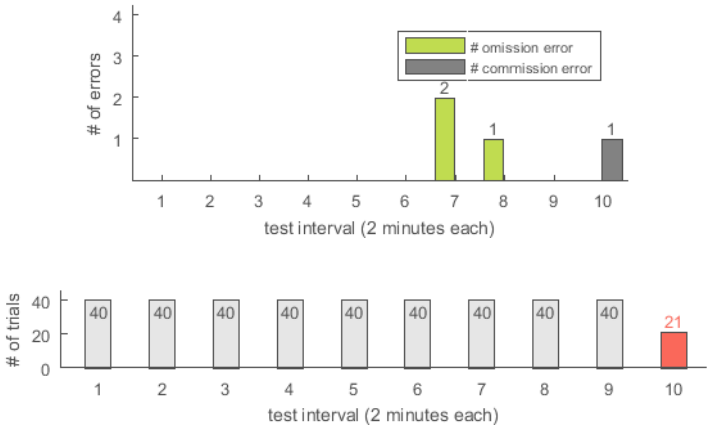
The analysis of Adult Sadar's reaction times compared to peers (green area) show a good consistency in reaction time.

Figure 2: below, reaction times are represented as a function of occurrence. The distribution of grey bars indicates how stable the reaction times were (variability of reaction times). Wide distributions show unstable performance, while narrow distributions can be interpreted as stable performance. The green area indicates the database norm.



The average reaction time of Adult Sadar (black triangle) is similar to peers (green dot).

Figure 3: below, the distribution of errors over time (intervals of 2 min) is illustrated. More errors towards the end of the task indicate growing fatigue in the course of performance.



There are 3 errors throughout the entire test.

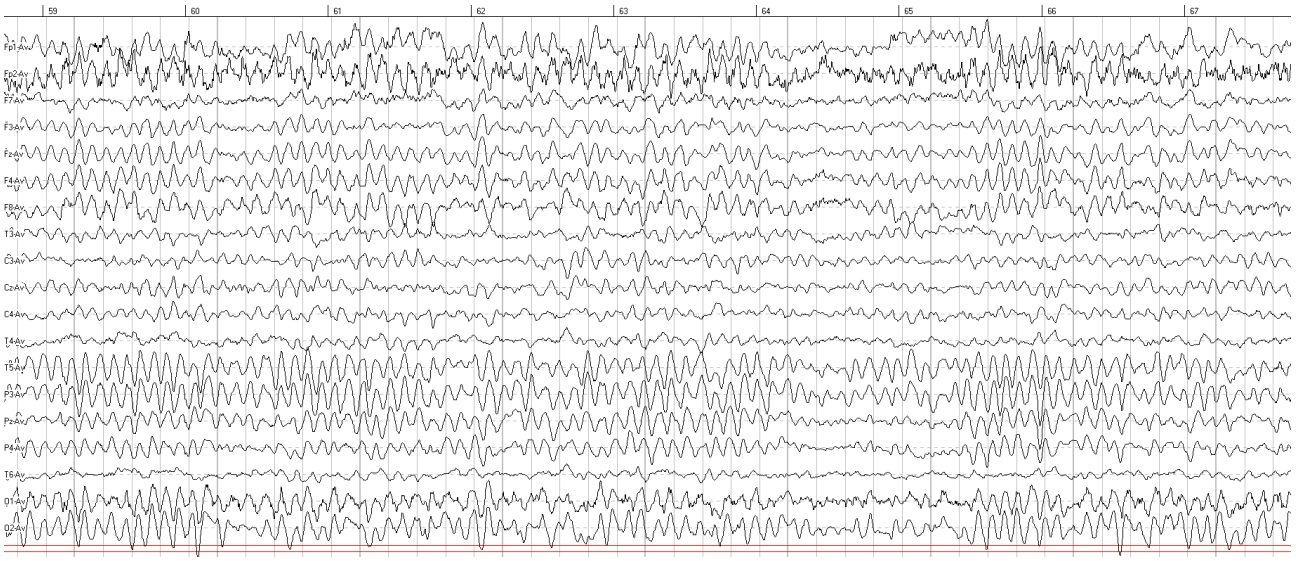
IV. Evidence-based investigation by measuring neurophysiological brain functions (functional neurophysiology, biomarkers):

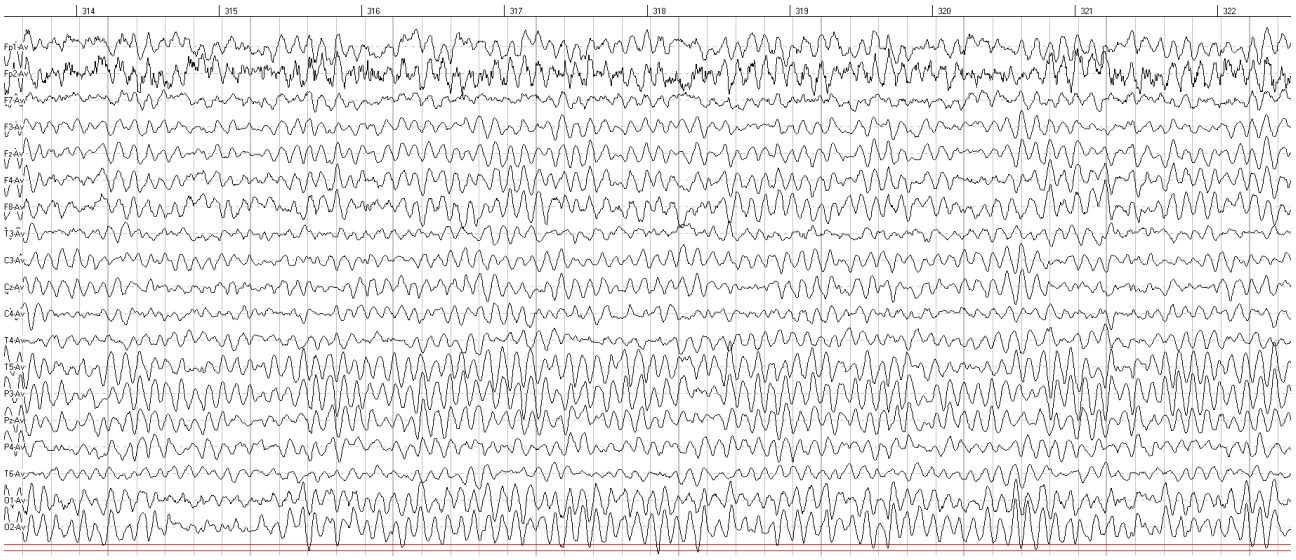
1. Spontaneous EEG

EEG was recorded during relaxation with closed eyes (10 minutes) and opened eyes (10 minutes). From this recording, spectral data was calculated and compared with database population. Database comparison was calculated with weighted montage.

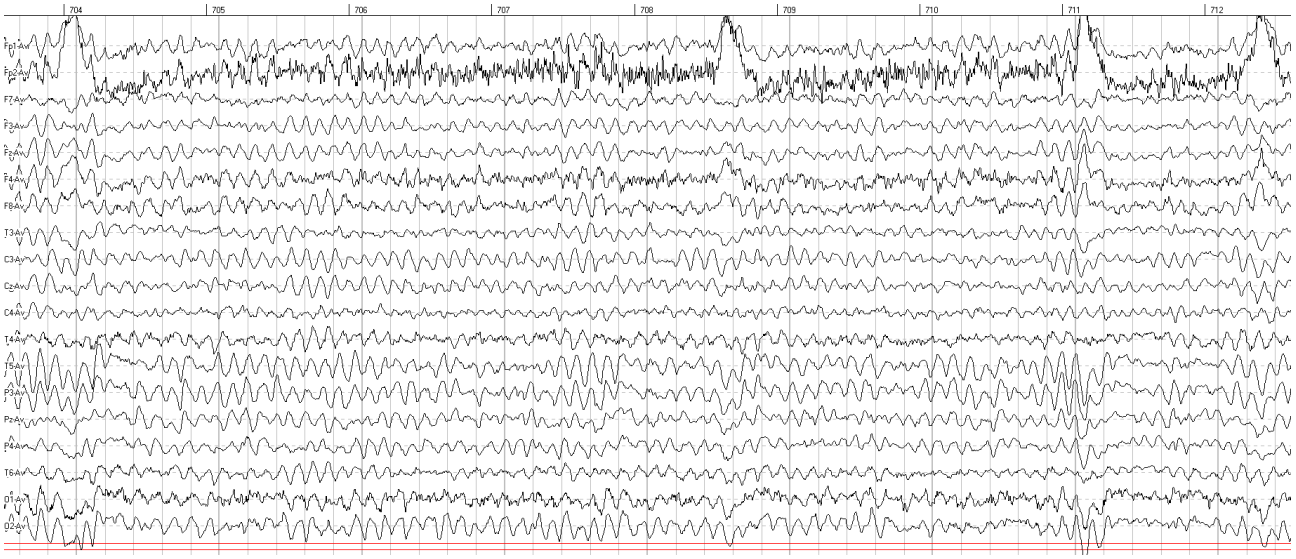
Fragment:

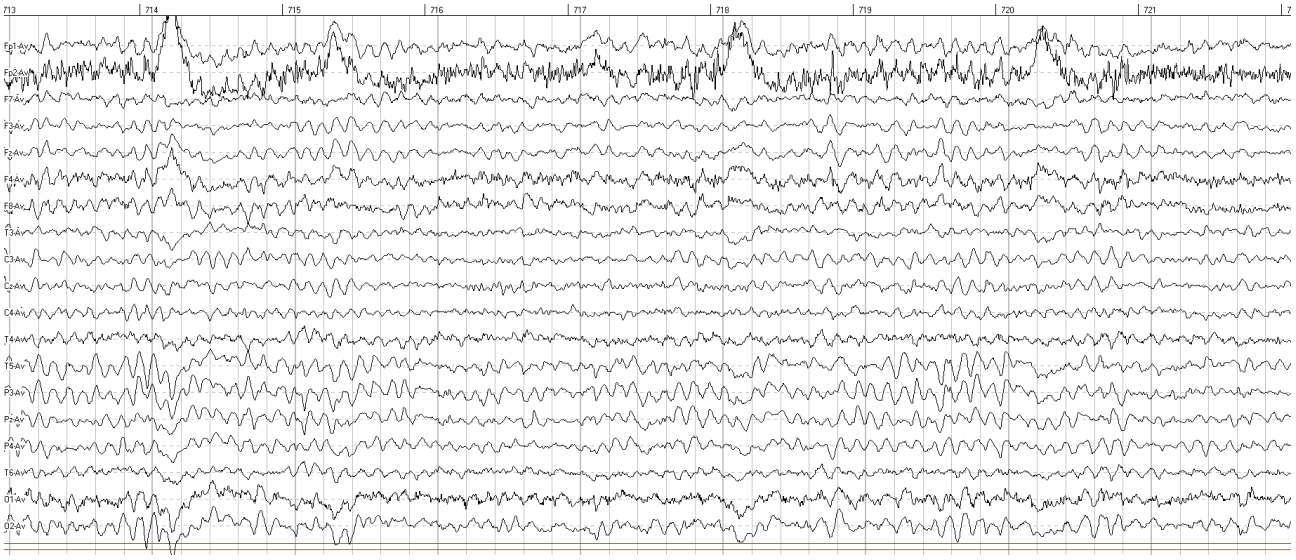
Eyes Closed





Eyes Open


704
705
706
707
708
709
710
711
712
Fp1-Av
Fp2-Av
F7-Av
F3-Av
Fz-Av
F4-Av
F8-Av
T3-Av
C3-Av
Cz-Av
C4-Av
T4-Av
T5-Av
P3-Av
Pz-Av
P4-Av
T6-Av
O1-Av
O2-Av

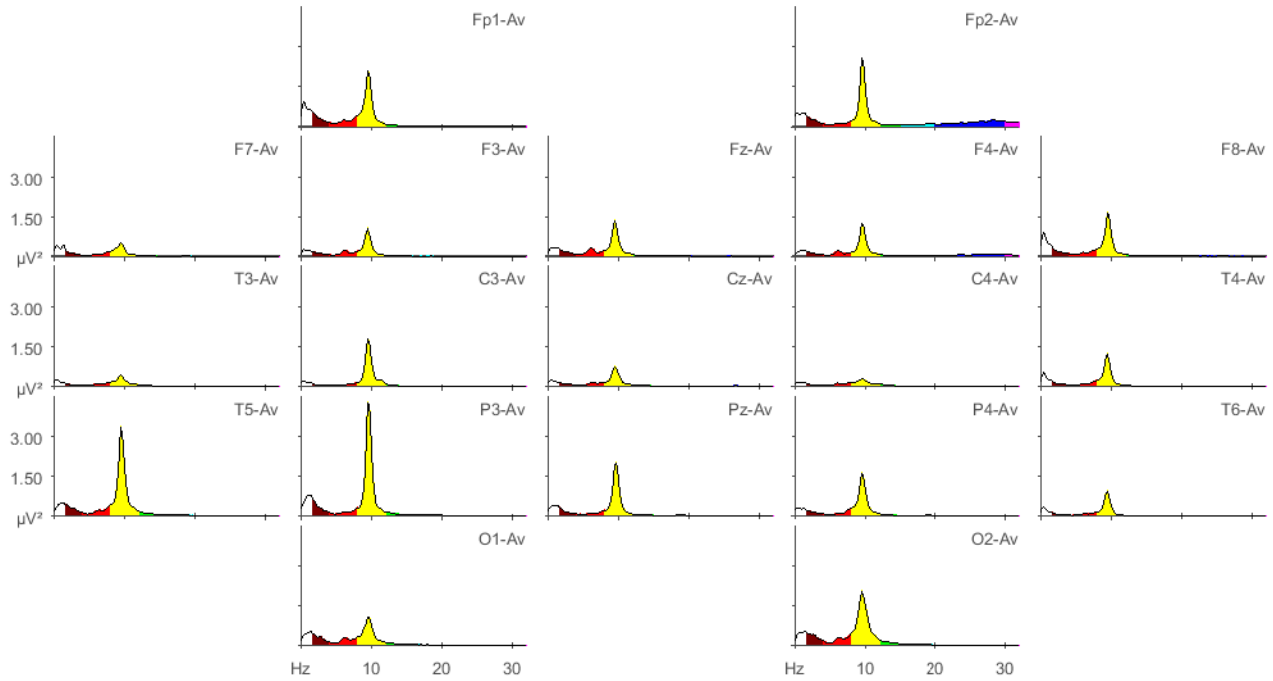

713
714
715
716
717
718
719
720
721
Fp1-Av
Fp2-Av
F7-Av
F3-Av
Fz-Av
F4-Av
F8-Av
T3-Av
C3-Av
Cz-Av
C4-Av
T4-Av
T5-Av
P3-Av
Pz-Av
P4-Av
T6-Av
O1-Av
O2-Av

2. Spike Detection

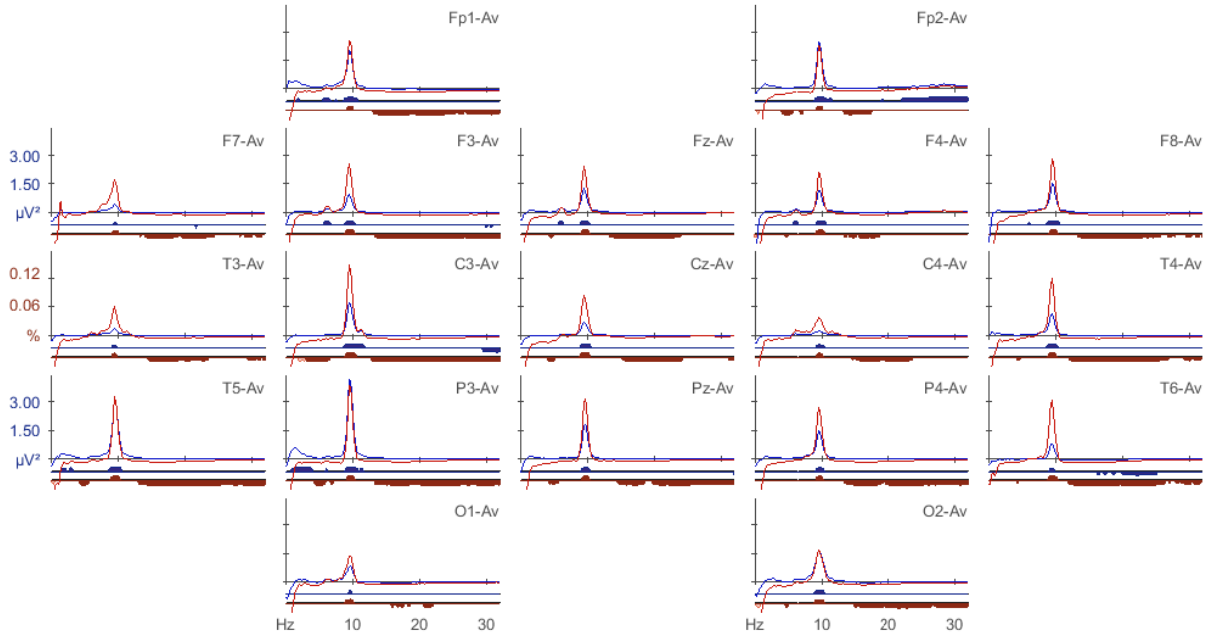
Spikes are sharp transient waves representing interictal epileptiform activity in the brain. The spike detection procedure uses morphological filtering of EEG signals in order to detect such transient activity and separate it from normal background waves.

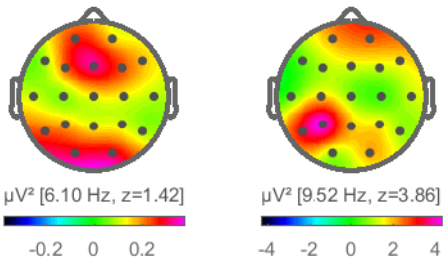
These recordings were read by a neurologist so this procedure was not applied in this analysis.

Spectral data: eyes opened (9:38)

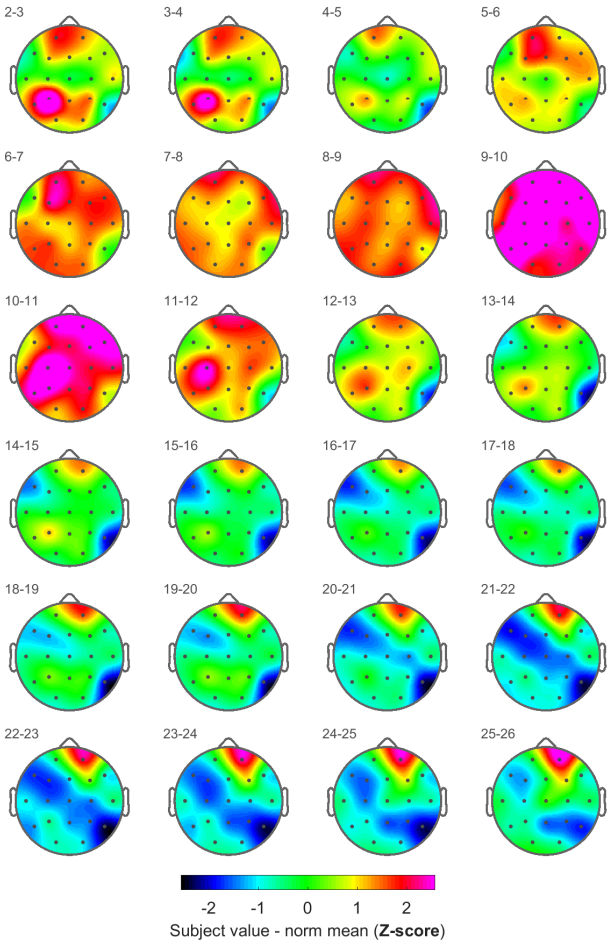


comparison with reference data: Difference (blue: absolute, red: relative). Bars on the bottom line indicate significant deviations from norm.

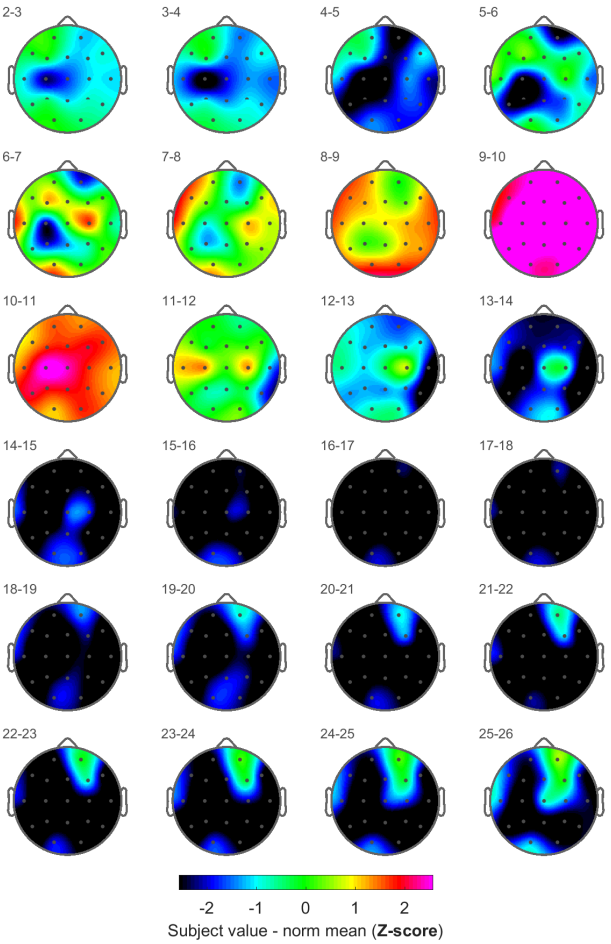




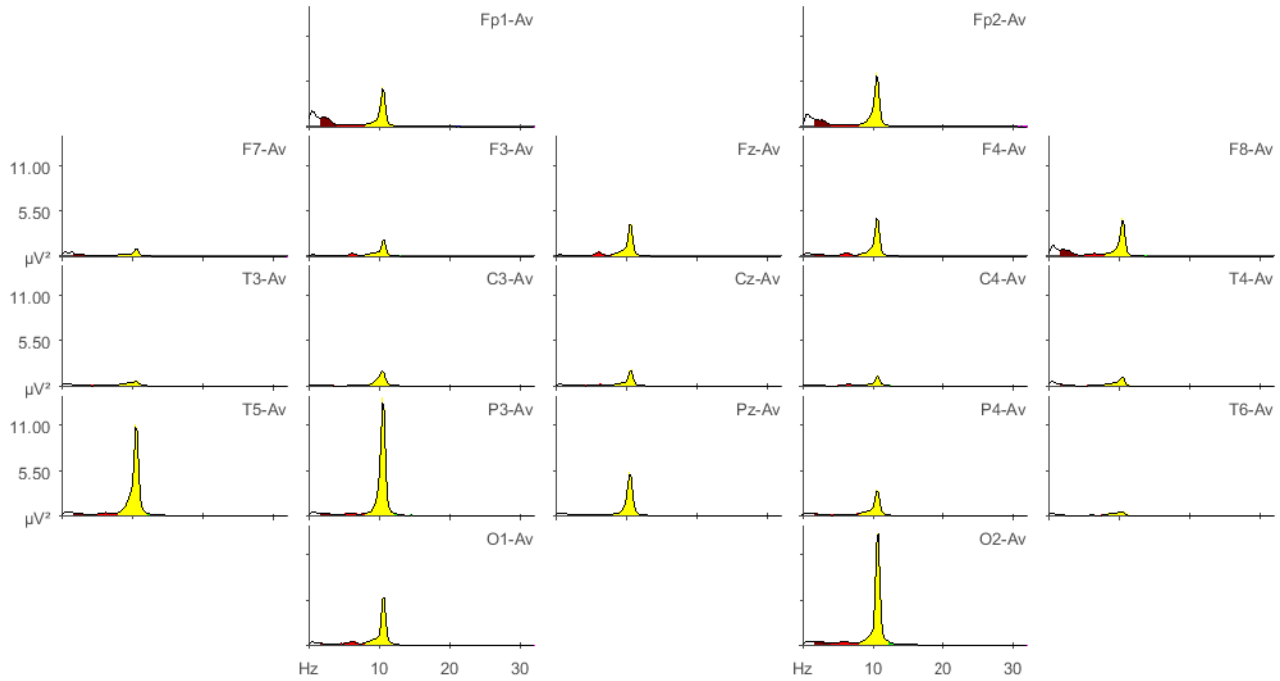
Database - Subject (absolute):



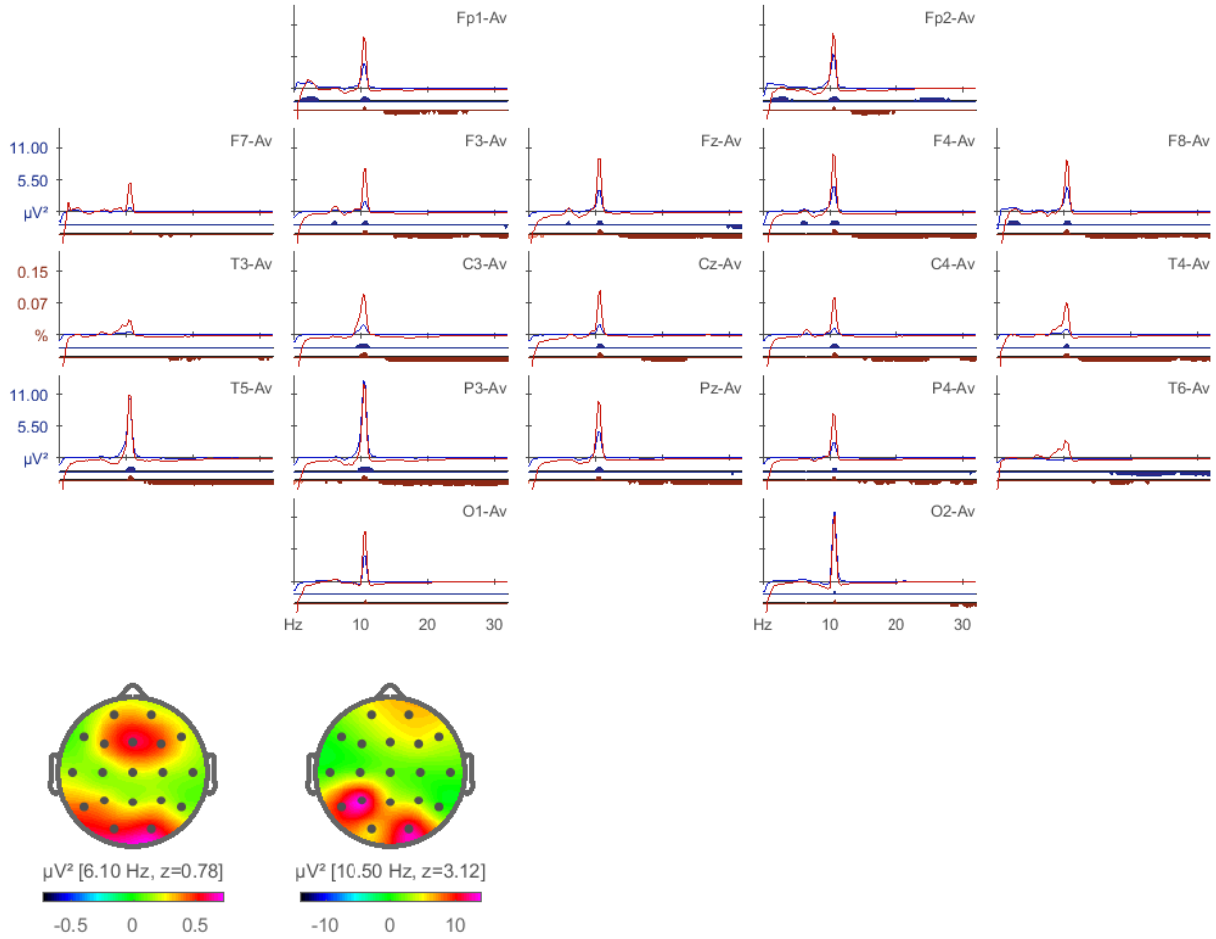
Database - Subject (relative):



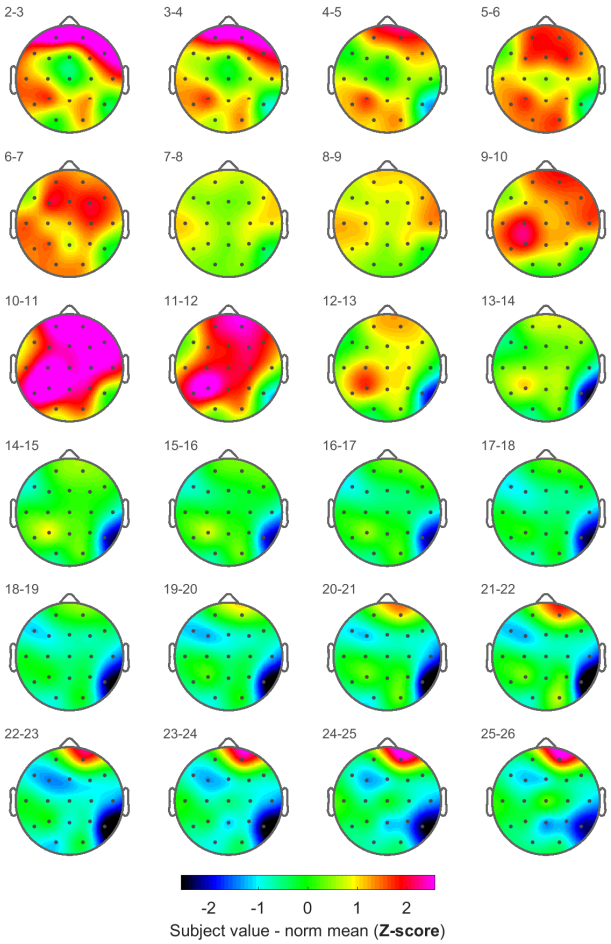
Spectral data: eyes closed (9:38)



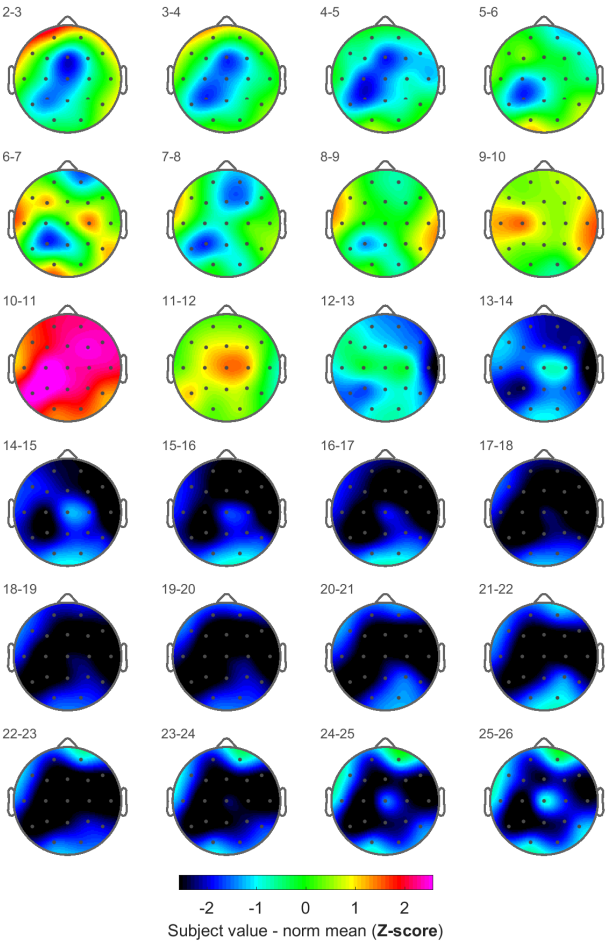
comparison with reference data: Difference (blue: absolute, red: relative). Bars on the bottom line indicate significant deviations from norm.



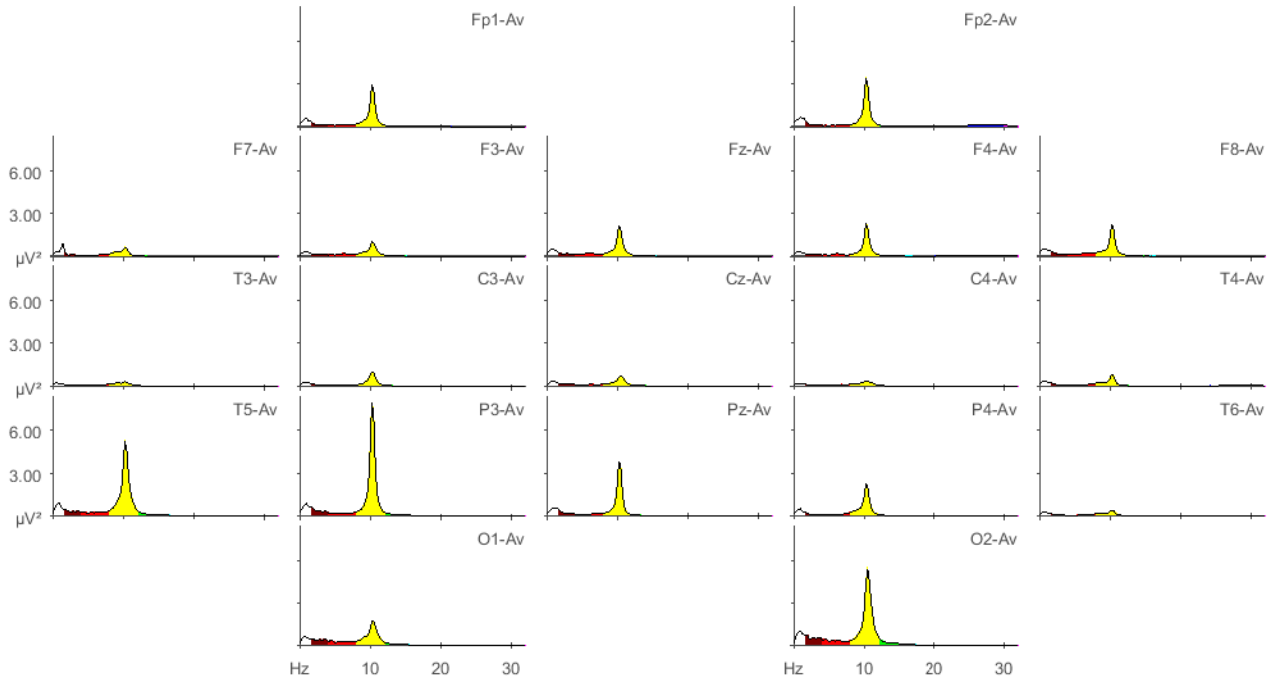
Database - Subject (absolute):



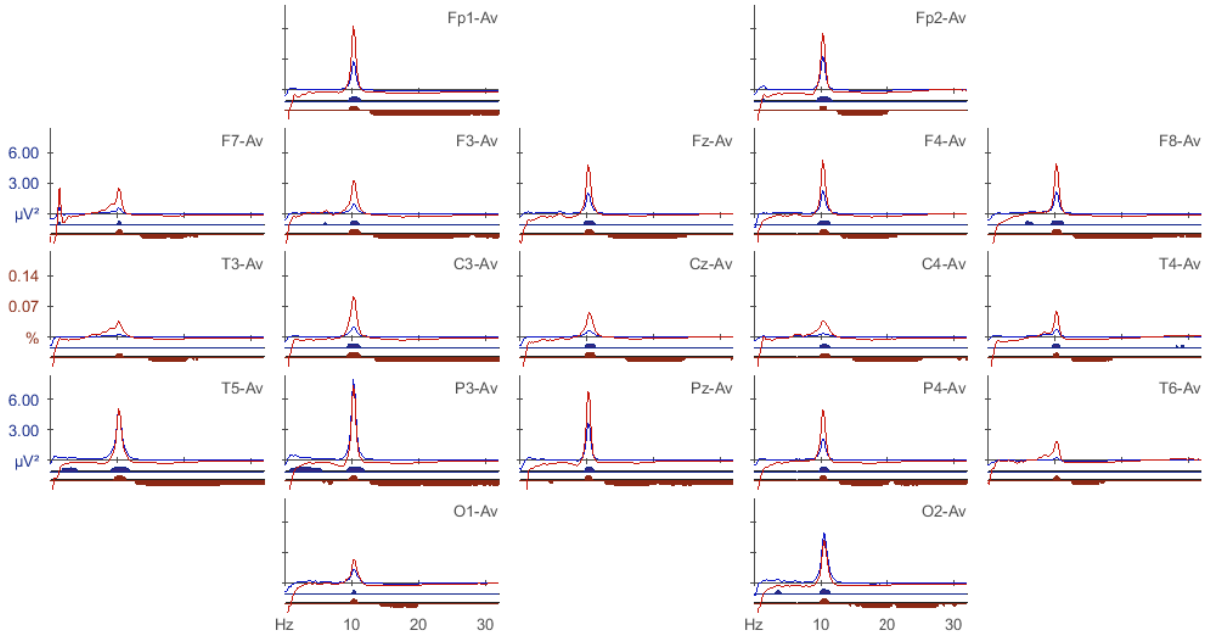
Database - Subject (relative):

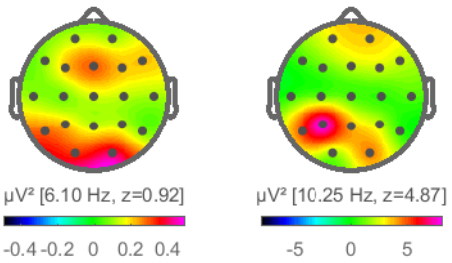


Spectral data: VCPT (20:25)

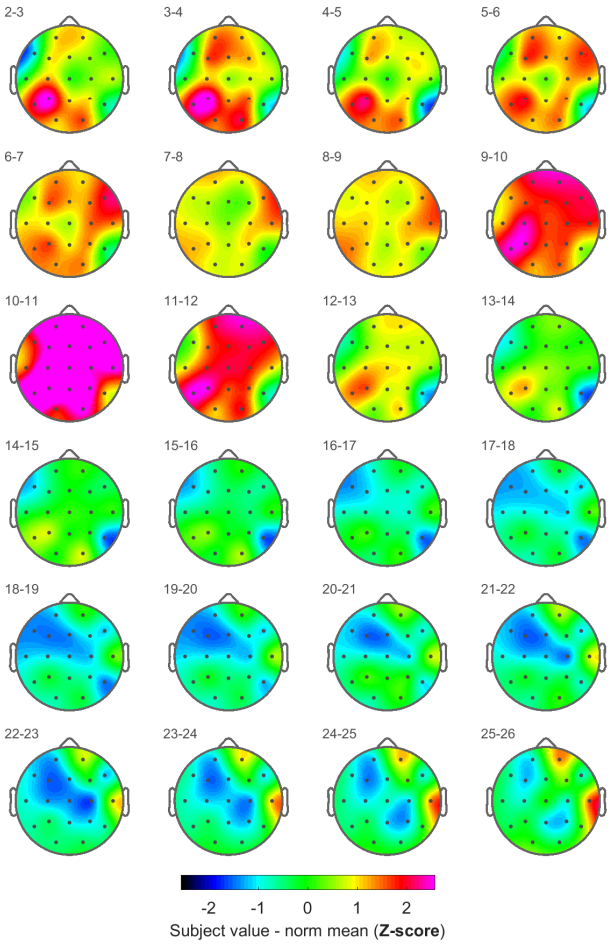


comparison with reference data: Difference (blue: absolute, red: relative). Bars on the bottom line indicate significant deviations from norm.

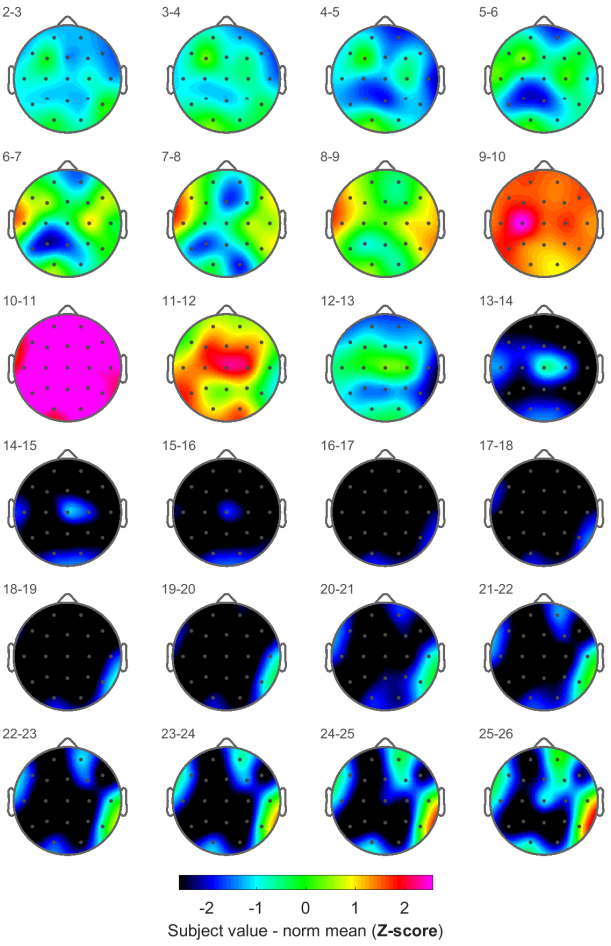




Database - Subject (absolute):



Database - Subject (relative):

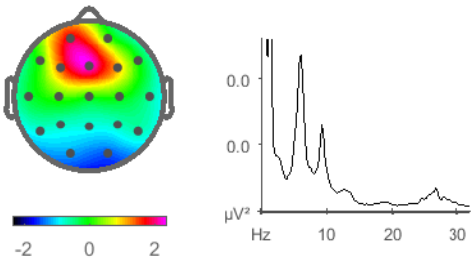


Spectral Data Summary:

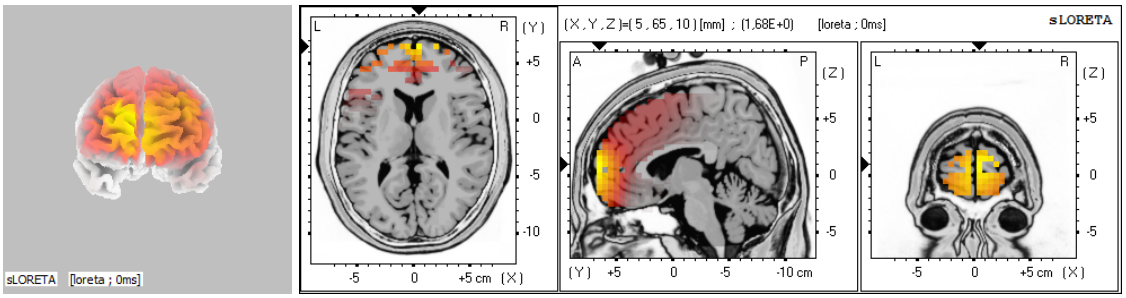
The quantitative EEG analysis revealed three significant frequency spectrum deviations warranting clinical attention. During eyes-open recording, elevated activity at 6.10 Hz was detected at F3 (Z-score=2.88), representing frontal midline theta activity, which serves as a neuromarker for limbic dysregulation and stress-related processes, reflecting potential difficulties in cognitive control, working memory, and anxiety regulation. Additionally, eyes-open recording demonstrated increased activity at 9.52 Hz on P3 (Z-score=3.86) within the parietal low alpha range (7.5-10 Hz), suggesting possible alterations in spatial attention allocation and cognitive processing efficiency. Eyes-closed conditions revealed elevated activity at 10.50 Hz on P3 (Z-score=3.12) in the parietal high alpha band (10-12 Hz), which may relate to visual memory processing, cognitive state regulation, or compensatory mechanisms. The presence of frontal midline theta excess indicates limbic system dysregulation and heightened stress markers, consistent with disrupted coordination of frontal brain regions involved in executive functioning. The bilateral parietal alpha deviations suggest asymmetric or inefficient allocation of attentional resources and potential alterations in cortical activation patterns. These findings collectively point to functional disturbances in frontoparietal networks subserving attention, cognitive control, and emotional regulation. Further clinical correlation is recommended to determine the functional significance of these electrophysiological abnormalities in the context of the patient's presenting symptoms and cognitive profile.

The graphs represent an approximation of the source generator in the cortex calculated through mathematical procedures. Hence the calculated localization can differ from the real source. Therefore, expert knowledge based on functional neuronal models should ultimately determine the clinical relevance of these findings.

Following deviations were calculated (EO):
1. frequency: 6.10 Hz
Graph of the independent component of this activity:

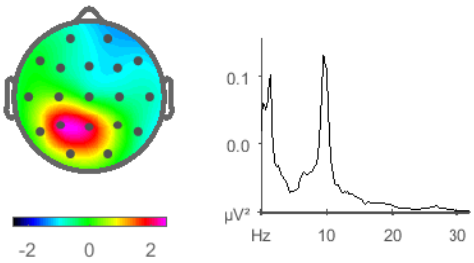


sLORETA localization Brodmann area 10 (Medial Frontal Gyrus, Frontal Lobe)

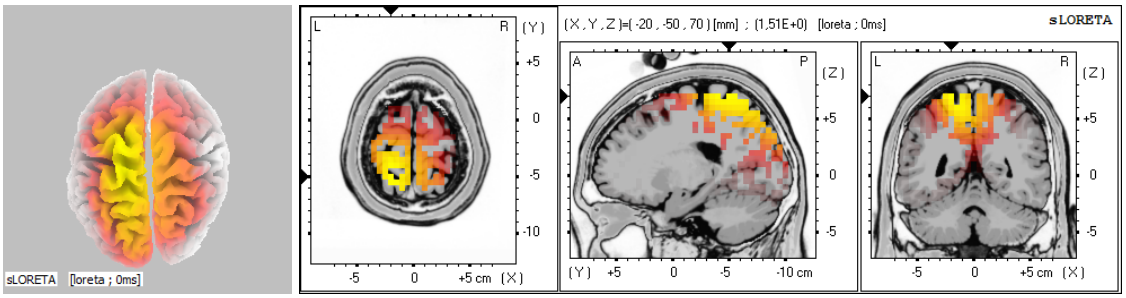


Brodmann area 10: Is part of the anterior (rostral) prefrontal cortex (PfC) and represents the frontal association area. This area is involved in executive functions by participating in task management, planning and monitoring of actions. In this sense, BA 10 is responsible for adjusting the initial plan according to outcomes, considering several things at a time and integrating external stimuli with internal thought processes.

2. frequency: 9.52 Hz
Graph of the independent component of this activity:



sLORETA localization Brodmann area 5 (Postcentral Gyrus, Parietal Lobe)

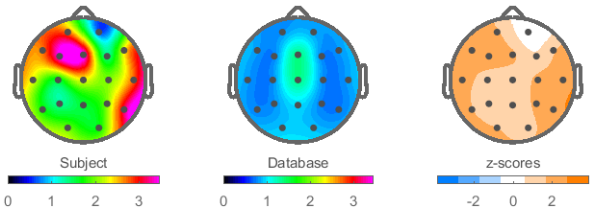


Brodmann area 5: In this area the inner picture of our body is represented. BA 5 is active during tactile object recognition. The posterior-parietal associative cortex is formed by BA 7 and 40,

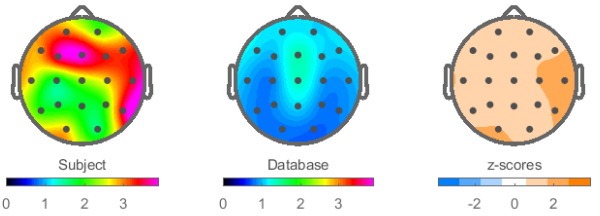
and is responsible for the integration of visual, auditory and vestibular information, enabling the localize of objects in space. This spatial perception is the basis for directed eye, hand and body movements.

Theta/Beta-Ratio

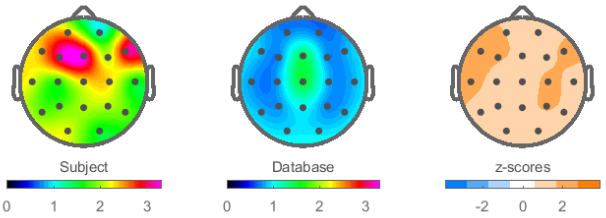
The Theta/Beta ratio gives an index as to the quality of an individual's ability to pay attention. This ratio is negatively correlated with age, as it is expected to be larger in younger children, smaller in adulthood and rises again in later adulthood. This is measured in a GO/NOGO Test where it is expected that a higher ratio will produce more errors. This ratio has been demonstrated in the research of Monastra (Monastra et. al., 1999).



Eyes open



Eyes closed



VCPT

Version	v01	v01	v01
Eyes open	**Fz**	**Cz**	**Pz**
Subject (Stanine)	**3.46** (96.9% | 9)	**2.32** (86.2% | 7)	**1.58** (84.5% | 7)
Eyes closed	**Fz**	**Cz**	**Pz**
subject (Stanine)	**3.9** (94.1% | 8)	**2.34** (80.3% | 7)	**1.82** (76.4% | 6)
VCPT	**Fz**	**Cz**	**Pz**
Subject (Stanine)	**3.29** (93.2% | 8)	**2.29** (79.3% | 7)	**2.03** (91.6% | 8)

Arousal

This index represents the arousal caused by the vegetative nervous system. It is specifically the parietal and occipital branch projected from the insula to the respective regions. The index is calculated separately for each hemisphere. The patient's index is set in bold; the arousal index of the age group is shown in parentheses. Scientific papers on this index are being prepared. Preliminary results show that this index hints at patient's level of apathy, lethargy, unrest, and stress. The higher the value, the higher the inner unrest.

Version	v10	v10
Eyes open	**O1 relative** **Left hemisphere**	**O2 relative** **Right hemisphere**
Subject (stanine)	**0.28** (0.1% | 1)	**0.96** (0.6% | 1)
Eyes closed	**O1 relative** **Left hemisphere**	**O2 relative** **Right hemisphere**
Subject (stanine)	**-1.71** (1.9% | 1)	**-1.62** (2.4% | 1)
VCPT	**O1 relative** **Left hemisphere**	**O2 relative** **Right hemisphere**
Subject (stanine)	**0.62** (0.9% | 1)	**0.70** (1.2% | 1)

Arousal in relationship to focusing

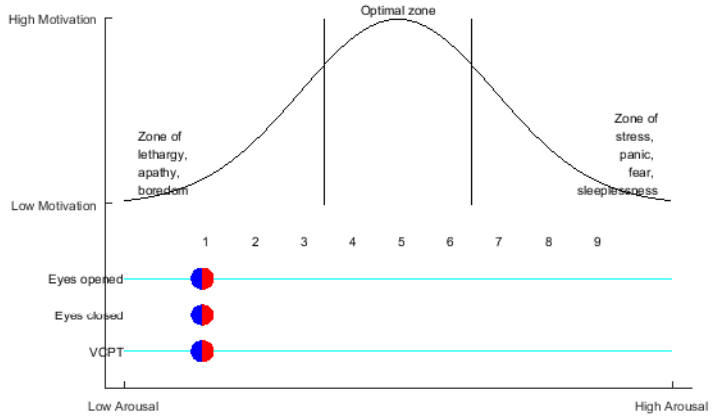


Figure 1: Arousal-Index of the left hemisphere (blue) and the right hemisphere (red) in eyes opened, eyes closed and VCPT.

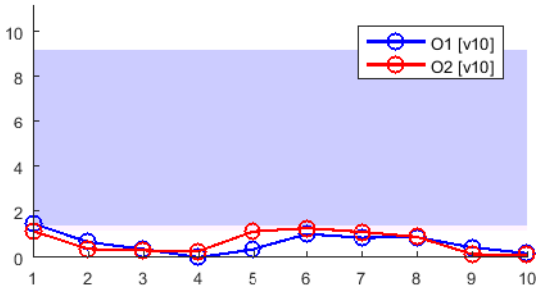
Compared with peers, Adult Sadar shows in all conditions significantly reduced values. These values indicate significantly lower activation. This often leads to a lack of motivation and a lowered willingness towards effort. In unsecure situations, Adult Sadar might express fears and misgivings. One observes depressive mood modulation as well as significant unreal perception of everyday life. Often, compensation is sought through external stimulation (gaming, other excessive behaviors). This behavior yields a bearable internal level of activation. Reduced activation often leads to loss of focus.

The patient demonstrates slightly increased to increased slope values across most conditions (Go: 6, NoGo: 7, Ignore: 5, Ignore + Novelty: 5), suggesting elevated resource access during testing, potentially reflecting increased internal tension or activation. Notably, all conditions show markedly increased variability (stanine 9), indicating substantial internal instability during test execution. Segment analysis reveals particularly concerning patterns in reorganization/reset (Go segment 4: slope 5, NoGo segment 4: slope 6, Ignore + Novelty segment 4: slope 3) and relaxation phases (Go segment 5: slope 4, NoGo segment 5: slope 5), with diminished slopes suggesting insufficient cortical reorganization and relaxation capacity, which may lead to exhaustion and fatigue. The NoGo condition shows the highest resource demands with very steep slopes in

early segments (segment 1: stanine 9), indicating excessive effort during perception and memory processes. Overall, the pattern suggests heightened internal activation combined with poor stability and inadequate recovery mechanisms during sustained attention tasks.

Arousal modulation during VCPT

A VCPT recording lasts around 21 minutes. This data was split into 10 equally long epochs, with each epoch lasting for around 125 seconds. Arousal was measured for each epoch. Left hemisphere (O1) and right hemisphere (O2) were recorded separately.

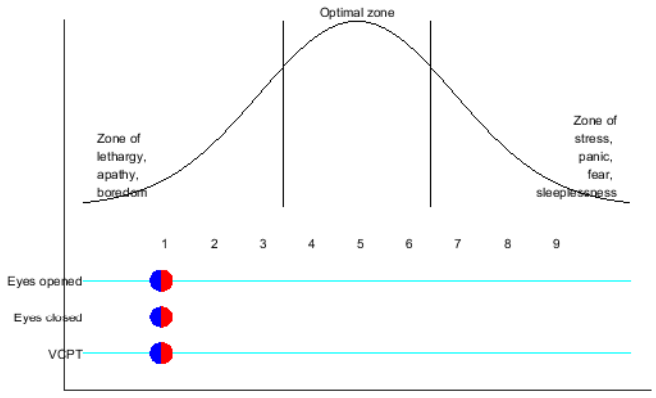


For Adult Sadar, both hemispheres are synchronized.

Central-sensory Index (relative power, beta-gamma squared); CSI

The central sensory index reflects the organization and functioning of the somatosensory areas. They receive information from many different systems: thalamic nuclei, basal ganglia, limbic system and cingulate system. Functionally, the CSI gives clues to the way of processing: low values are associated with increased introspection/introversion, high values with increased external orientation or extraversion. In children, the CSI provides important information regarding processing in a stimulus-intensive context. In adults, essential indications on the dimension anxiety/internal excitement can be obtained. The scientific publication is still pending.

Version	v01	v01
Eyes open	**Left hemisphere**	**Right hemisphere**
Subject (Stanine)	**0.22** (0% | 1)	**2.04** (1.9% | 1)
Eyes closed	**Left hemisphere**	**Right hemisphere**
Subject (Stanine)	**0.51** (0% | 1)	**1.25** (0.5% | 1)
During VCPT	**Left hemisphere**	**Right hemisphere**
Subject (Stanine)	**1.35** (0% | 1)	**1.88** (0.9% | 1)

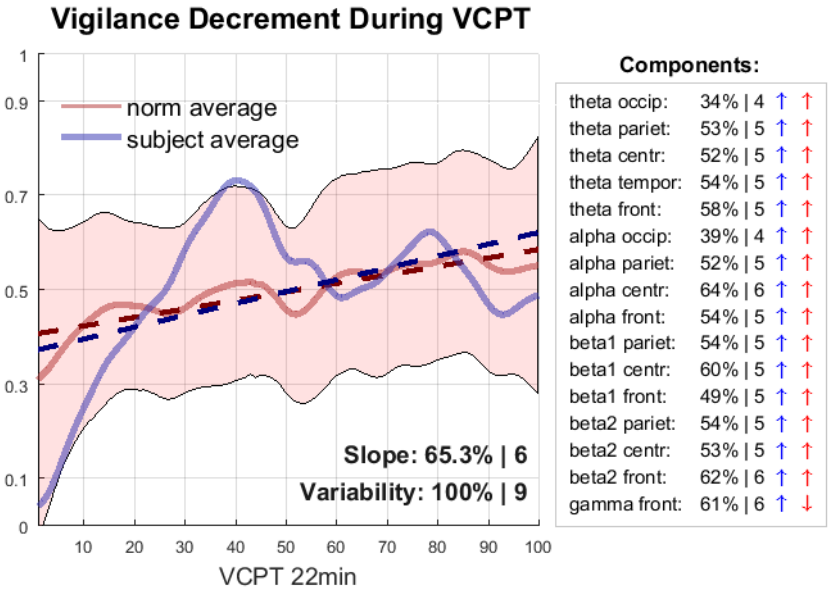


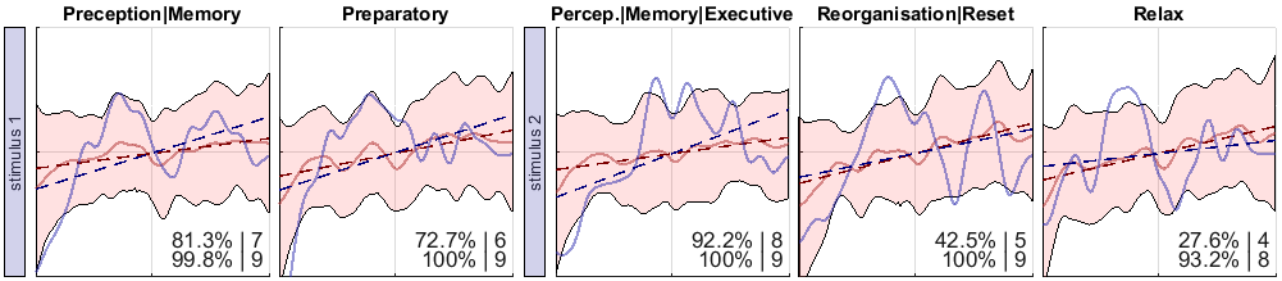
Vigilance and Vigilance decrement

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

- Flat regression curve (Stanine: 1,2,3) show low resource load, low resources (low inner power) and low inner control (low prediction) (Assumption: ADHD, PTSD)
- Steep regression curve (Stanine: 7,8,9) show high resource load, high resources (high inner tension) and high inner control (high prediction) (Assumption: OCD, high tension, Depression, Anxiety)
- Low variability (Stanine: 1,2,3) means too high inner stability (Assumption: Rigidity, Autism)
- High variability (stanine: 7,8,9) means low inner stability (assumption: ADHD, PTSD)

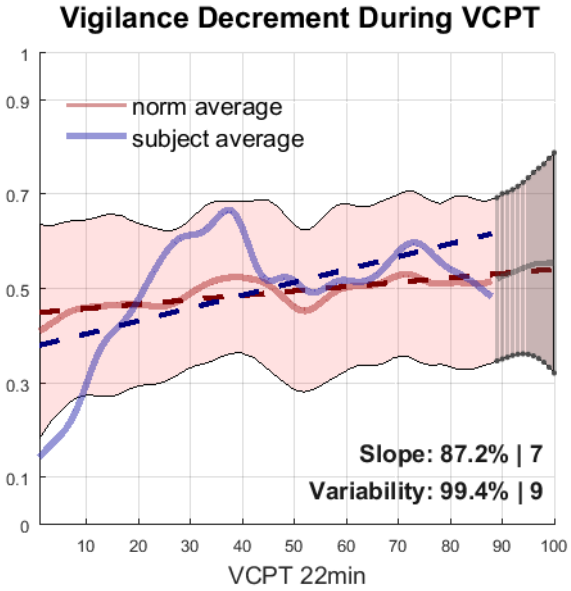
Go

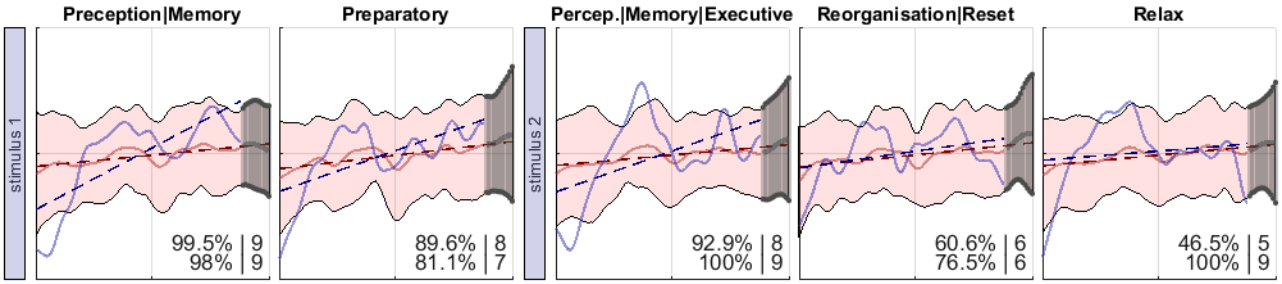




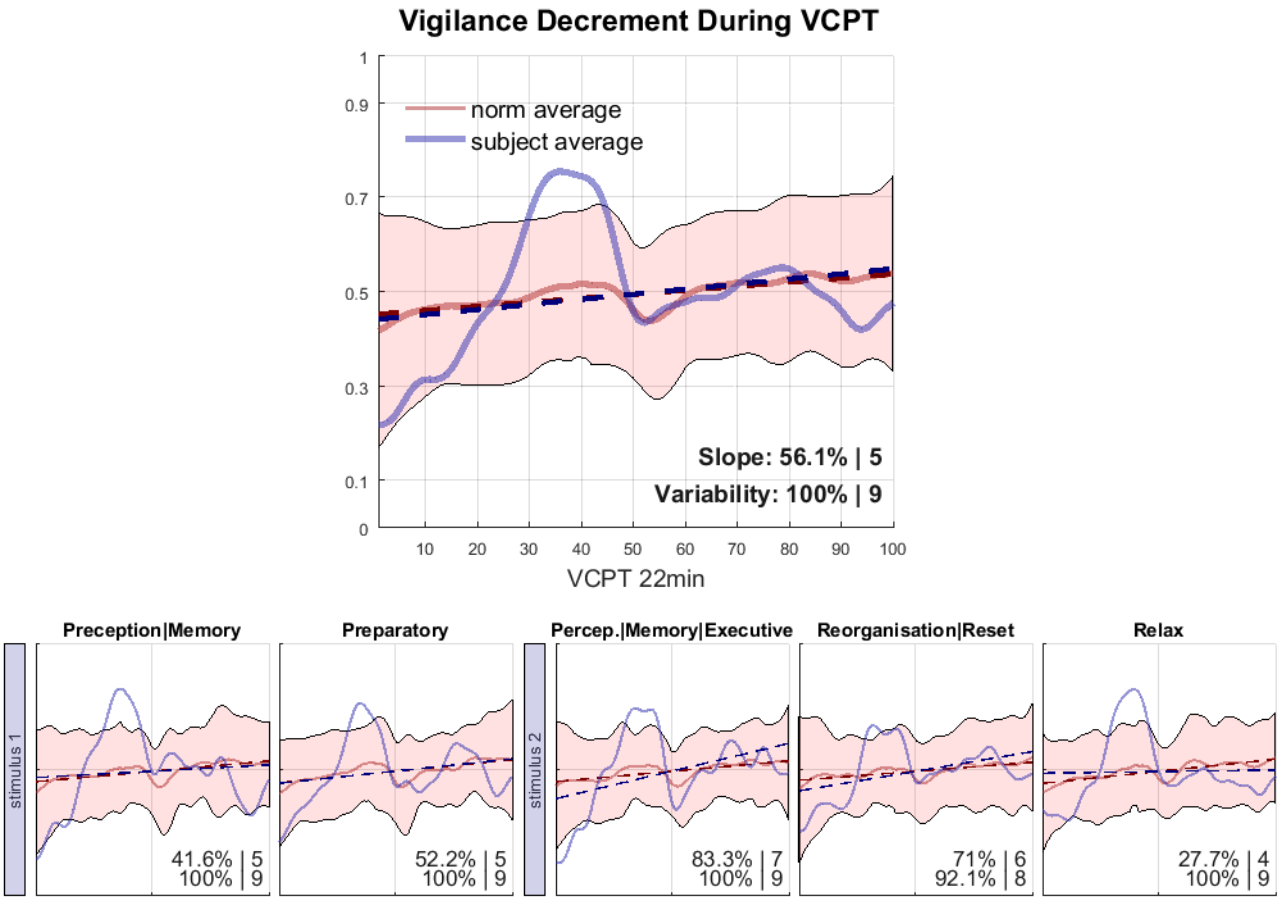
theta occip:	16% | 3	↓↑	theta occip:	71% | 6	↑↑	theta occip:	13% | 3	↓↑	theta occip:	54% | 5	↑↑	theta occip:	30% | 4	↓↑
theta pariet:	81% | 7	↑↑	theta pariet:	65% | 6	↑↑	theta pariet:	26% | 4	↓↑	theta pariet:	75% | 6	↑↑	theta pariet:	19% | 3	↓↑
theta centr:	44% | 5	↑↑	theta centr:	65% | 6	↑↑	theta centr:	24% | 4	↓↑	theta centr:	79% | 7	↑↑	theta centr:	47% | 5	↑↑
theta tempor:	80% | 7	↑↑	theta tempor:	53% | 5	↑↑	theta tempor:	26% | 4	↓↑	theta tempor:	75% | 6	↑↑	theta tempor:	32% | 4	↑↑
theta front:	70% | 6	↑↑	theta front:	69% | 6	↑↑	theta front:	39% | 4	↑↑	theta front:	84% | 7	↑↑	theta front:	24% | 4	↓↑
alpha occip:	46% | 5	↑↑	alpha occip:	64% | 6	↑↑	alpha occip:	23% | 4	↓↑	alpha occip:	42% | 5	↑↑	alpha occip:	24% | 4	↓↑
alpha pariet:	77% | 6	↑↑	alpha pariet:	56% | 5	↑↑	alpha pariet:	62% | 6	↑↑	alpha pariet:	52% | 5	↑↑	alpha pariet:	18% | 3	↓↑
alpha centr:	71% | 6	↑↑	alpha centr:	69% | 6	↑↑	alpha centr:	73% | 6	↑↑	alpha centr:	54% | 5	↑↑	alpha centr:	50% | 5	↑↑
alpha front:	73% | 6	↑↑	alpha front:	69% | 6	↑↑	alpha front:	50% | 5	↑↑	alpha front:	59% | 5	↑↑	alpha front:	20% | 3	↓↑
beta1 pariet:	65% | 6	↑↑	beta1 pariet:	55% | 5	↑↑	beta1 pariet:	72% | 6	↑↑	beta1 pariet:	45% | 5	↑↑	beta1 pariet:	31% | 4	↑↑
beta1 centr:	65% | 6	↑↑	beta1 centr:	72% | 6	↑↑	beta1 centr:	65% | 6	↑↑	beta1 centr:	43% | 5	↑↑	beta1 centr:	52% | 5	↑↑
beta1 front:	56% | 5	↑↑	beta1 front:	58% | 5	↑↑	beta1 front:	45% | 5	↑↑	beta1 front:	49% | 5	↑↑	beta1 front:	36% | 4	↓↑
beta2 pariet:	60% | 5	↑↑	beta2 pariet:	57% | 5	↑↑	beta2 pariet:	50% | 5	↑↑	beta2 pariet:	66% | 6	↑↑	beta2 pariet:	36% | 4	↓↑
beta2 centr:	20% | 3	↓↑	beta2 centr:	87% | 7	↑↑	beta2 centr:	82% | 7	↑↑	beta2 centr:	25% | 4	↓↑	beta2 centr:	45% | 5	↑↑
beta2 front:	73% | 6	↑↑	beta2 front:	54% | 5	↑↑	beta2 front:	62% | 6	↑↑	beta2 front:	68% | 6	↑↑	beta2 front:	54% | 5	↑↑
gamma front:	67% | 6	↑↓	gamma front:	51% | 5	↑↓	gamma front:	58% | 5	↑↓	gamma front:	68% | 6	↑↓	gamma front:	61% | 6	↑↓

NoGo

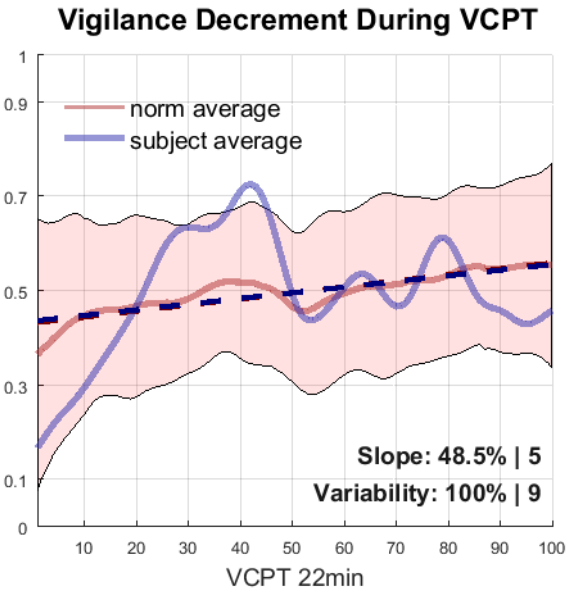


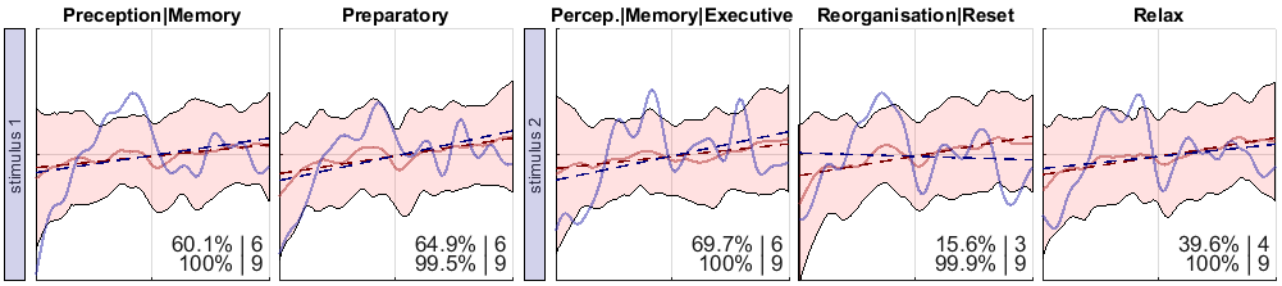


Ignore



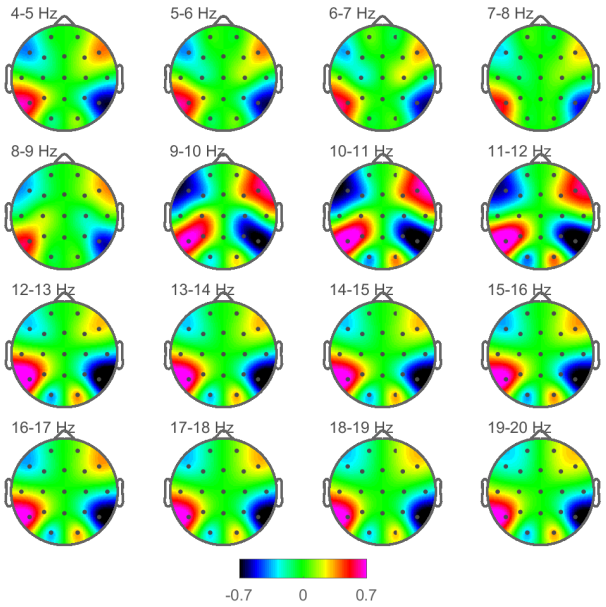
Ignore + Novelty



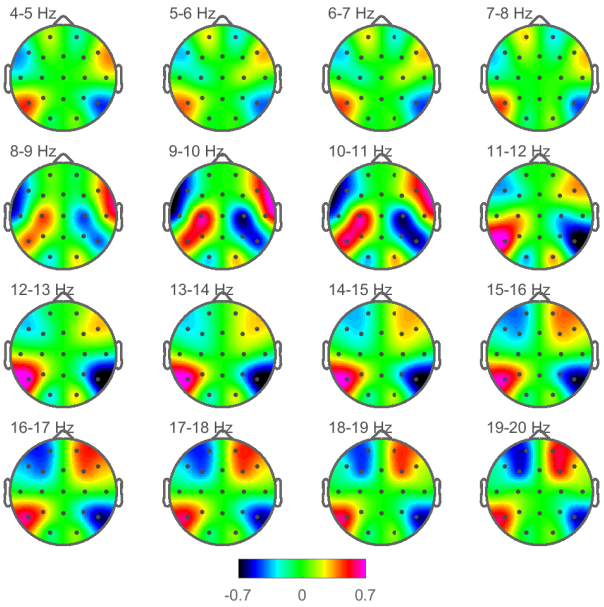


Asymmetry

Asymmetry eyes closed:

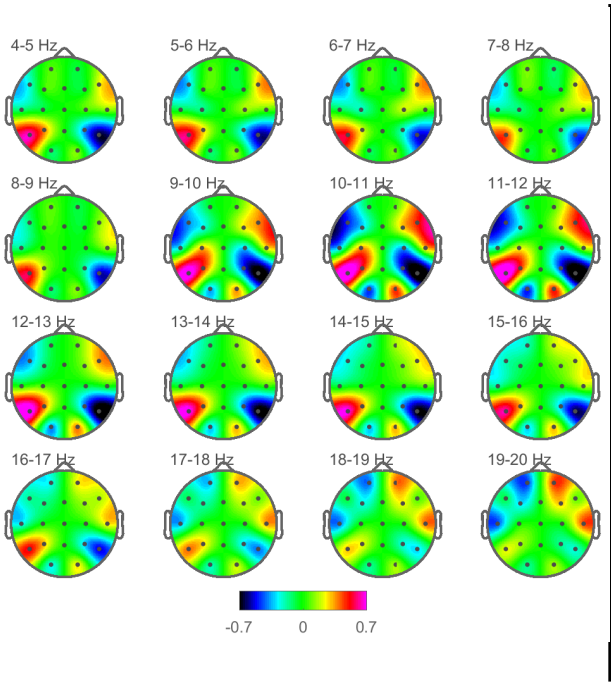


Asymmetry eyes open:



Asymmetry VCPT:

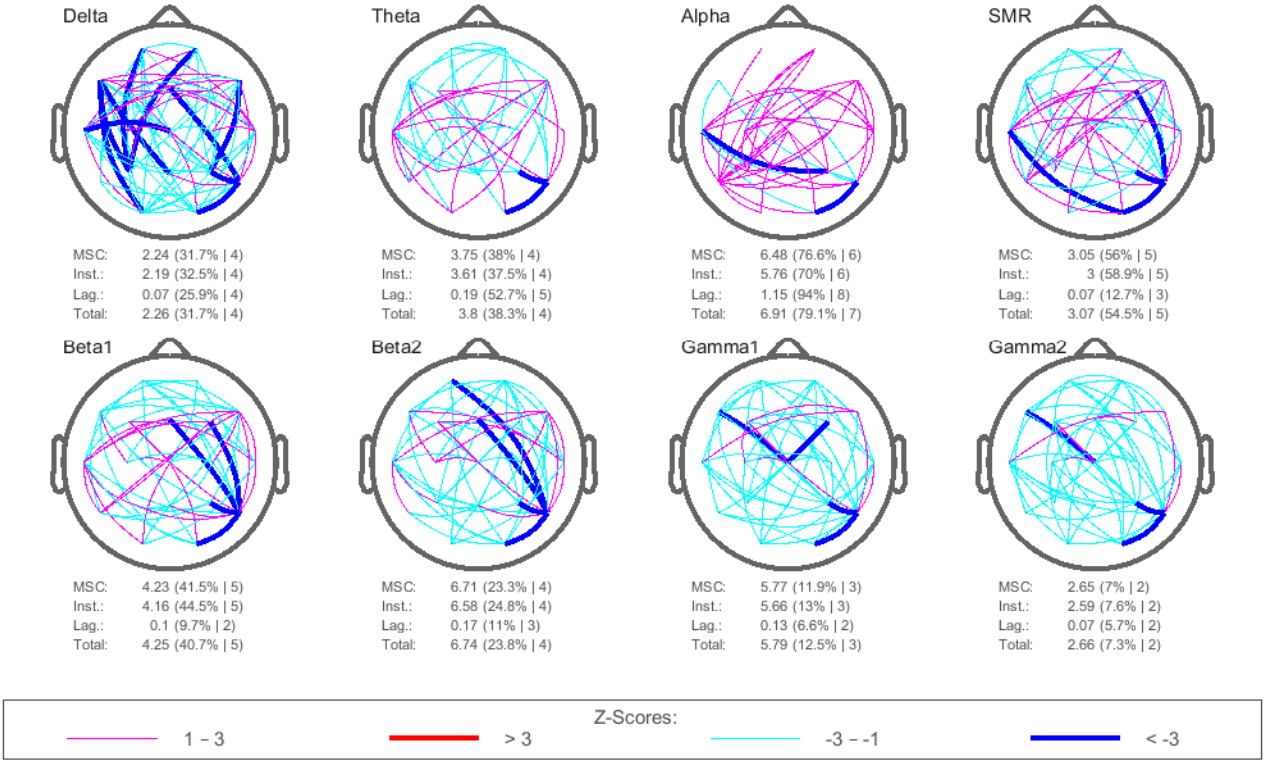
Without significant findings


4-5 Hz
5-6 Hz
6-7 Hz
7-8 Hz
8-9 Hz
9-10 Hz
10-11 Hz
11-12 Hz
12-13 Hz
13-14 Hz
14-15 Hz
15-16 Hz
16-17 Hz
17-18 Hz
18-19 Hz
19-20 Hz
-0.7
0
0.7

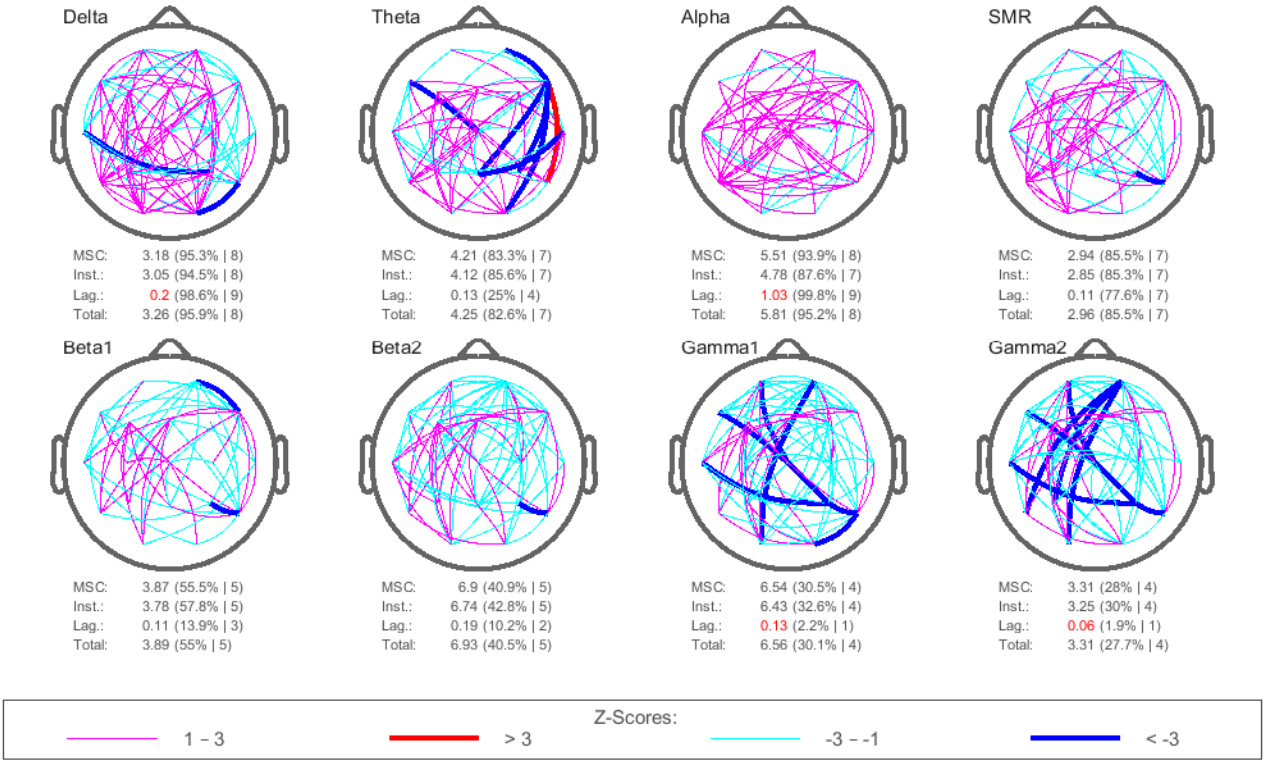
Coherence

The coherence analysis is a measure of the relationship of various structures in the cortex. The coherence analysis provides a ratio of the correlation of a specific frequency range. Violet and red lines represent excessive positive correlations, light blue and dark blue lines represent excessive negative correlations. Excessive positive correlations suggest that there is over-communication between the sites. Excessive negative correlations suggest that there is a lack of communication between the sites.

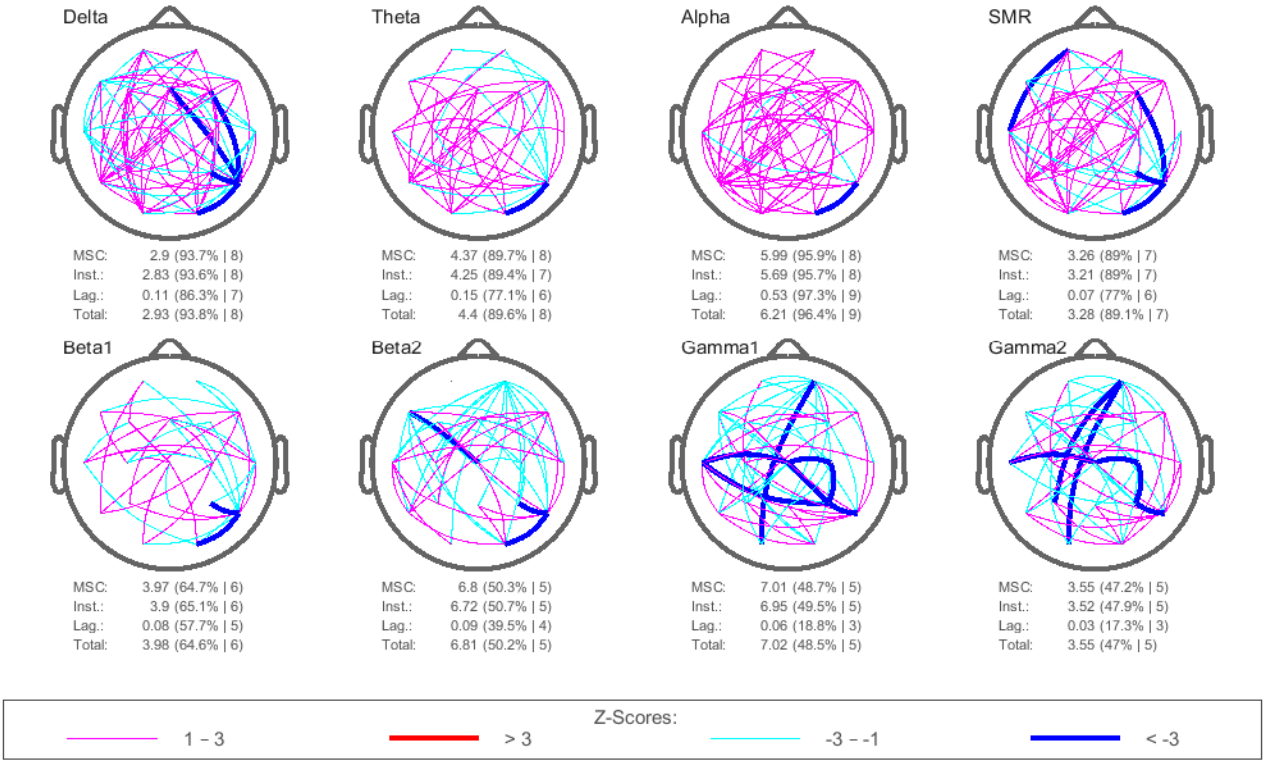
Coherence in eyes closed condition:



Coherence in eyes open condition:



Coherence in VCPT condition:



Without significant findings

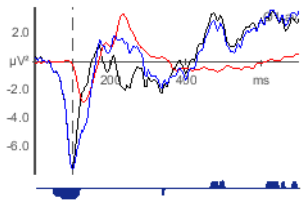
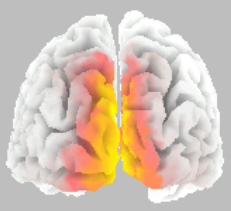
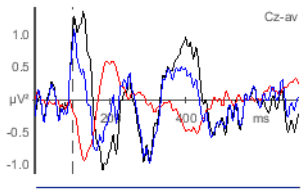
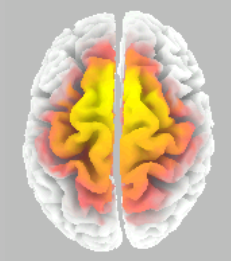
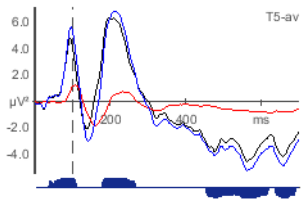
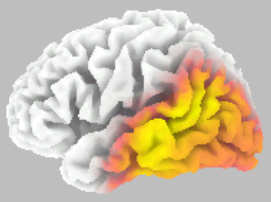
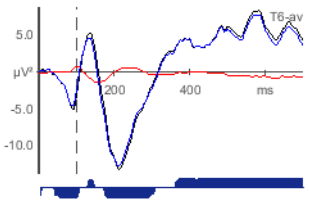
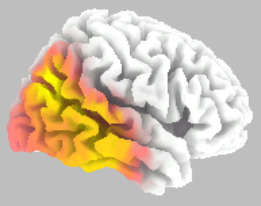
3. Evoked Potentials (in continuous performance task)

The images of the evoked potentials are relevant to information processing in different regions of the brain during the presentation of simple stimuli. In the various potentials, only specific neuronal groups and networks are involved.

Comparison of the components with database:

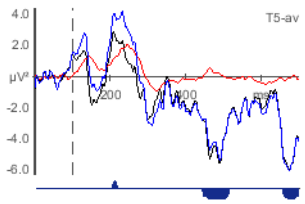
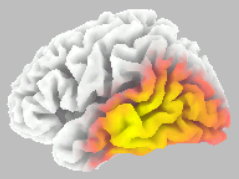
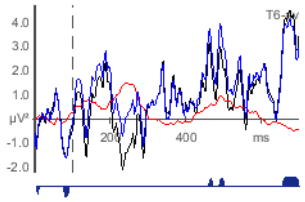
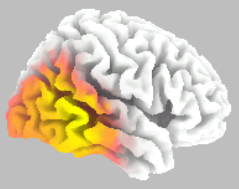
Input areas:

blue: client/red: database/black: difference (significance)

P1N1 Visual Input		*Brodmann area 19* *Cuneus* *Occipital Lobe* *Best Match at 5mm* *Brodmann area 18* *Cuneus* *Occipital Lobe*	
N1P2 Auditory 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*	

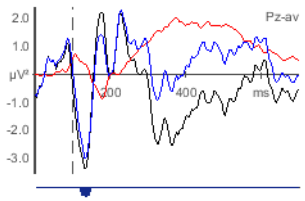
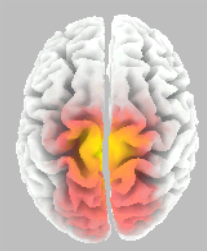
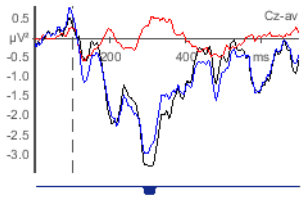
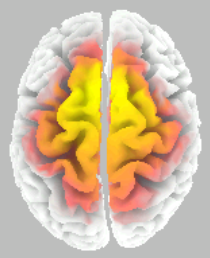
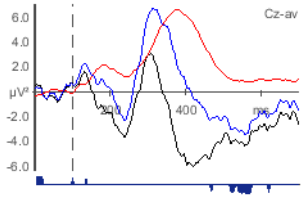
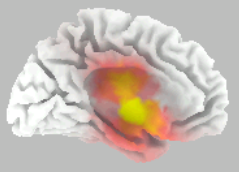
Memory areas:

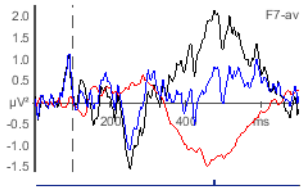
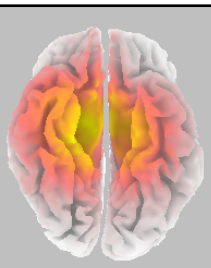
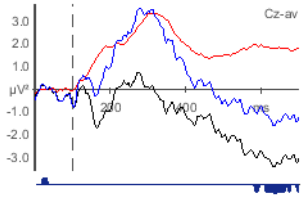
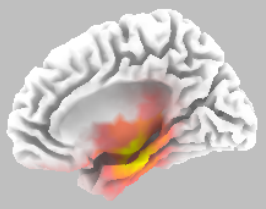
blue: client/red: database/black: difference (significance)

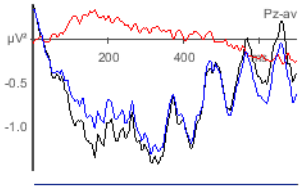
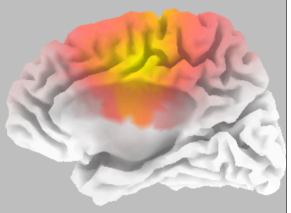
V com TL left Memory areas		*Brodmann area 21* *Middle Temporal Gyrus* *Temporal Lobe* *Best Match at 7mm* *Brodmann area 22* *Middle Temporal Gyrus* *Temporal Lobe*	
V com TR right Memory areas		*Brodmann area 21* *Middle Temporal Gyrus* *Temporal Lobe* *Best Match at 5mm* *Middle Temporal Gyrus* *Temporal Lobe*	

Executive function areas:

blue: client/red: database/black: difference (significance)

P3b Engagement		*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 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* *Parahippocampus Gyrus* *Limbic Lobe* *Best Match at 5 mm* *Brodmann area 28* *Parahippocampal Gyrus* *Limbic Lobe*	
SW PHC Slow Wave Activity This component reflects a part of limbic system activity		*Brodmann area 28* *Parahippocampal Gyrus* *Limbic Lobe* *Best Match at 5 mm* *Brodmann area 34* *Parahippocampal Gyrus* *Limbic Lobe*	

CNV Bereitschaftspotenzial Readiness Potential		*Brodmann area 24* *Cingulate Gyrus* *Limbic Lobe* *Best Match at 7 mm* *Brodmann area 6* *Medial Frontal Gyrus* *Frontal Lobe* *Lobe*	

Shown are various deviations from the norm:

P1N1 - Visual Input:
Mid potentials: N1
Late potentials: Reactivation

N1P2 - Auditory Novelty:
Mid potentials: Early latency, Low amplitude (negative &positive)

P1N1 vTL - left Association areas:
Early potentials: High amplitude (negative &positive)
Mid potentials: Early latency, High amplitude (negative &positive)

P1N1 vTR - right Association areas:
Early potentials: High amplitude (negative &positive)
Mid potentials: High amplitude (negative &positive)
Late potentials: Long-lasting high amplitude

V com TL - left Memory areas:
Mid potentials: High amplitude (negative &positive)

P3b - Engagement:
Mid potentials: Early latency, N2

P3a - Inhibition/Suppression:
Early potentials: Early latency

P4 monCC - Monitoring:
Early potentials: Early latency
Mid potentials: Early latency

P1N1 - Visual input

The activation of primary visual areas informs about the quality of picture decoding into neurophysiological signals.

Mid potentials

N1- amplitude occipital: in several studies[123] high N1 amplitudes have been identified as stress markers. High N1 amplitudes have been found in stress patients exhibiting a high level of dissociation, these were traumatized patients.

Late potentials

Late activations are observed, which are probably associated with inaccurate early neuronal activations. The second activation occurs because of insecurity and control and is likely to affect serial perceptual functions. The effects can be seen in perceptual performance, e.g. reading (slow reading, frequent guessing of text contents, etc.).

N1P2 - Aud. Novelty

The Novelty stimulus is a good indicator of reactions towards unexpected auditory stimuli. During the task this stimulus is presented in 100 trials together with the picture of a person, but no behavioral reaction is required.

Mid potentials

Early latencies indicate that Adult Sadar's brain reacts faster than others to the unexpected sound. This could reflect a high predisposition to hasty reactions in everyday life. Often (but not necessarily) hasty reactions are accompanied by poor impulse control. Hasty reactions have been evolutionarily attributed to hunters, as fast reactions were essential for survival.

Low amplitudes indicate low activation of involved cortical networks. This could indicate an inability to activate simultaneously two sensory channels/modalities (auditory-visual) or a reduced sensitivity to perceived auditory input.

P1N1 vTL - Left association areas

The association areas in the left superior temporal cortex and left parietal cortex receive input from the occipital cortex and other secondary sensory areas. Here information is integrated and processed with the influence of frontal control functions. This association process is defined through complex mechanisms with the goal of generating concepts that can be recognized in the future. This construction process is highly individual and is influenced by many factors including genes, biology and learning processes. According to the lateralized functions that have been attributed to the left hemisphere, in these association areas mostly detail recognition and analytic processes are promoted. **The left hemisphere is particularly relevant in speech, reading, writing and detailed calculation. Furthermore, the left hemisphere is involved in speech comprehension by enabling detailed listening.**

Early potentials

[1] Klimova, 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).
[2] 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.
[3] 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.

The activity of left **early** potentials is related to sensory processing functions that are not under cognitive control and probably are triggered by excitatory mechanisms of sensory registration.

In Adult Sadar, high amplitudes in early potentials of left association processes are observed. This leads to intense activation. In other words, left association processes are preponderant. This gives an idea about the processing style; however, these processes are dysfunctional because an overly detail-oriented approach causes fast abatement, exhaustion, or functional disorders (e.g. slow information processing).

Mid potentials

Mid potentials of the association areas relate to sensory-cognitive processing functions; the main goal of these is sustaining the information processing. By maintaining the energy in association areas, the mid potentials are formed, which is why these are associated with attention processes.

Early latencies and high amplitudes in mid potentials of left association areas indicate that sensory-cognitive functions of the aforementioned skills proceed fast and intensively. This leads in Adult Sadar to fast left sided accentuated processing.

P1N1 vTR - Right association areas

The association areas in the right superior temporal cortex and right parietal cortex receive input from the occipital cortex and other secondary sensory areas. Here information is integrated and processed with the influence of frontal control functions. This association process is defined through complex mechanisms with the goal of generating concepts that can be recognized in the future. This construction process is highly individual and is influenced by many factors including genes, biology and learning processes. According to the lateralized functions that have been attributed to the right hemisphere, in these association areas mostly synthesis and holistic orientation are promoted. **The right hemisphere is particularly relevant in spatial recognition and orientation, recognition of emotional content and patterns, tactile-kinesthetic processing, musical experience and cultural techniques, as it is involved in estimation of time and space.**

Early potentials

The activity of right **early** potentials is related to sensory processing functions that are not under cognitive control and probably are triggered by excitatory mechanisms of sensory registration.

In Adult Sadar, high amplitudes in early potentials of right association processes are observed. This leads to intensive activation: in other words, right association processes are preponderant. This gives an idea about the processing style, however these processes are dysfunctional because association processes are emotionally loaded even when there is no reason for it. This results in unnecessary intense emotional conflicts.

Mid potentials

Mid potentials of the association areas relate to sensory-cognitive processing functions; the main goal of these is sustaining the information processing. By maintaining the energy in association areas, the mid potentials are formed, this is why these are associated with attention processes.

High amplitudes in mid potentials of right association areas indicate that sensory-cognitive functions of the aforementioned skills proceed intensely. This leads in Adult Sadar to intense emotional-holistic processing, which is usually associated with strong emotional processes. The result is often intense emotional feelings, thoughts and behaviors.

Late potentials

Late potentials of association processes are related to control of constructive processes and are affected by emotional factors like security or insecurity. Emotional regulation is in this way essential for the outcome of constructive processes.

In Adult Sadar, long lasting high amplitudes in late potentials are observed. This is associated with high activation of right sided monitoring processes which is usually associated with a high degree of emotional control. Often behaviors and other processes aimed at managing emotions are observed.

V com TL - Left memory areas

The memory areas in the left superior temporal cortex and left parietal cortex store information from association areas. These processes are influenced by frontal control functions. The process that happens in memory areas is partially identical to what happens in association areas, namely comparison operations that aim at recognizing percepts. The process of recognition is influenced by time and content. Understanding and learning is possible because of memory retrieval. According to brain lateralization research, the functions that are attributed to the left hemisphere in terms of memory are involved in the following skills: **Speech, reading, writing and detail-oriented calculation. The left hemisphere is also relevant for speech comprehension and detail-oriented listening.**

Mid potentials

Mid potentials of the memory areas relate to sensory-cognitive processing functions; the main goal of these is sustaining memory retrieval operations. By maintaining the energy in memory areas, the mid potentials are formed, this is why these are associated with attention processes.

High amplitudes in mid potentials of left memory areas indicate that sensory-cognitive functions of the aforementioned skills proceed intensely. This leads in Adult Sadar to intense detail-oriented memory retrieval, which is usually associated with excessive monitoring. The result is often exhaustion.

P3b - Activation operation

Executive functions/activation: There are two kinds of activation that are regulated by the Reticular formation: tonic and phasic activation. The tonic system of the reticular formation regulates through the hypothalamus the excretion of (nor-)adrenalin and serotonin neurotransmitters, what leads to long lasting tonic activation and modulation of cortical activity, e.g. influencing the day-night cycle.

The center of the phasic system is located in the medial thalamus and is responsible for short-term activation of singular parts of the cortex, what is basically the activity we are measuring. Reticular structures are thin layers that cover the thalamic nuclei of sensory organs that send projections to the cortex. Non-specific reticular structures are activated here through convergent sensory pathways. The thalamus works as a switchboard of information and has a less general effect upon the cortex compared to the reticular formation; instead, the thalamus exerts a selective effect upon specific cortical areas, being able to concurrently activate some areas and shielding others.

The activation operation is relevant as it enables goal-oriented performance. Hereby the cortex is optimally activated in order to achieve the desired goals. We differentiate among early, mid and late phases of activation.

Mid potentials

Mid potentials of the activation operation relate to sensory-cognitive processing functions, which aim at achieving specific goals. Maintaining the level of energy for other functions (perception, memory, monitoring) is the basic element of mid potentials of the activation operation.

Early latencies in mid potentials indicate that sensory-cognitive functions of the aforementioned skills proceed very fast. Fast activation of cognitive-sensory functions can be advantageously applied in reactions of everyday life. But these happen to be dysfunctional when related to overhasty activation as specific sensory-cognitive functions are developed without endurance.

The salient negative peak in this component is a pattern we have observed in people with pronounced ADHD. The related function seems to be defined by inconsistency in work habits.

P3a - Inhibition/Suppression

Executive functions/inhibition/suppression/selection: This function is highly relevant not only for motor and cognitive (perceptual) control, but also for emotional behavior. Inhibition is a fundamental function of neuronal networks, which regulate the planning, execution and control of different processes. These

functions are involved in all processes as inhibition (suppression) of processes represents a fundamental part of neurobiological networks. The **Inhibition** phenomenon works by influencing a neuron through an impulse that prevents the occurrence of an action potential, meaning that it impedes the firing of the neuron. Synaptic inhibition can occur either pre- or postsynaptic inhibition. This inhibition function is localized in the fronto striatal loop (cortex-basal ganglia-thalamus-cortex).

Early potentials

Early potentials of inhibition/suppression are related to sensory processing functions that are not under cognitive control. The inhibition function of early potentials pertains mainly to the monitoring of sensory assimilation and processing modalities.

Short latencies of the inhibition/suppression function indicate that sensory operations happen and are controlled early in the process. This sometimes leads to overhasty activation of sensory input areas.

p4 monCC - Conflict monitoring

Executive functions/Monitoring: Like all executive functions, this function is essential for everyday functioning as it enables assessing one's performance and processes. The anterior cingulate cortex occupies about 2/3 of the medial surface in frontal lobes, located ventral, rostral and dorsal to the corpus callosum: a fiber tract that connects both hemispheres. The anterior cingulate cortex corresponds to the Brodmann areas 24, 25 and 32. In the context of executive functions the anterior cingulate cortex is involved in conflict solving between competing responses and arbitrary selection of action alternatives. Furthermore, this structure is involved in learning processes together with basal ganglia, assessing different action alternatives according to relevance. Within the anterior cingulate cortex two parts can be further differentiated: a rostral-ventral area that becomes activated in response to emotional conflicts, and a dorsal area that is more related to controlling cognitive functions. Even if this function is not entirely clear yet, it can be said that through this network a comparison operation takes place: by comparing one's actual behavior (emotional, cognitive, behavioral performance) with the expected outcomes.

Early potentials

Early potentials of conflict monitoring influence preparatory functions of sensory assimilation. Hereby emotional constitution and strain exert an important impact on several sensory functions.

In Adult Sadar short latencies of early potentials in conflict monitoring are observed. This indicates that sensory operations are influenced early by functions of the anterior cingulate cortex. This pertains to emotional regulation and monitoring of different action alternatives.

Mid potentials

Mid potentials of conflict monitoring are influenced by different functions of the limbic system and vegetative nervous system. The limbic system proceeds over the amygdala/insula to the hippocampus, and from here to anterior nuclei of the thalamus, influencing the anterior cingulate cortex. According to the definition of the anterior cingulate cortex the functions of mid potentials of this component are defined by the monitoring of different action alternatives.

In Adult Sadar, early latencies in mid potentials of conflict monitoring are observed. This indicates that the final appraisal of the work process happens fast.

4. Event related potentials - ERPs

Total number of trials: **381** (a-a GO: **96**, a-p NoGO: **91**, p-p: **96**, p-h: **98**, +: **187**, -: **194**, a-p-a-a: **0**)
Number of processed trials: **377** (a-a GO: **93**, a-p NoGO: **90**, p-p: **96**, p-h: **98**, +: **187**, -: **194**, a-p-a-a: **90**)

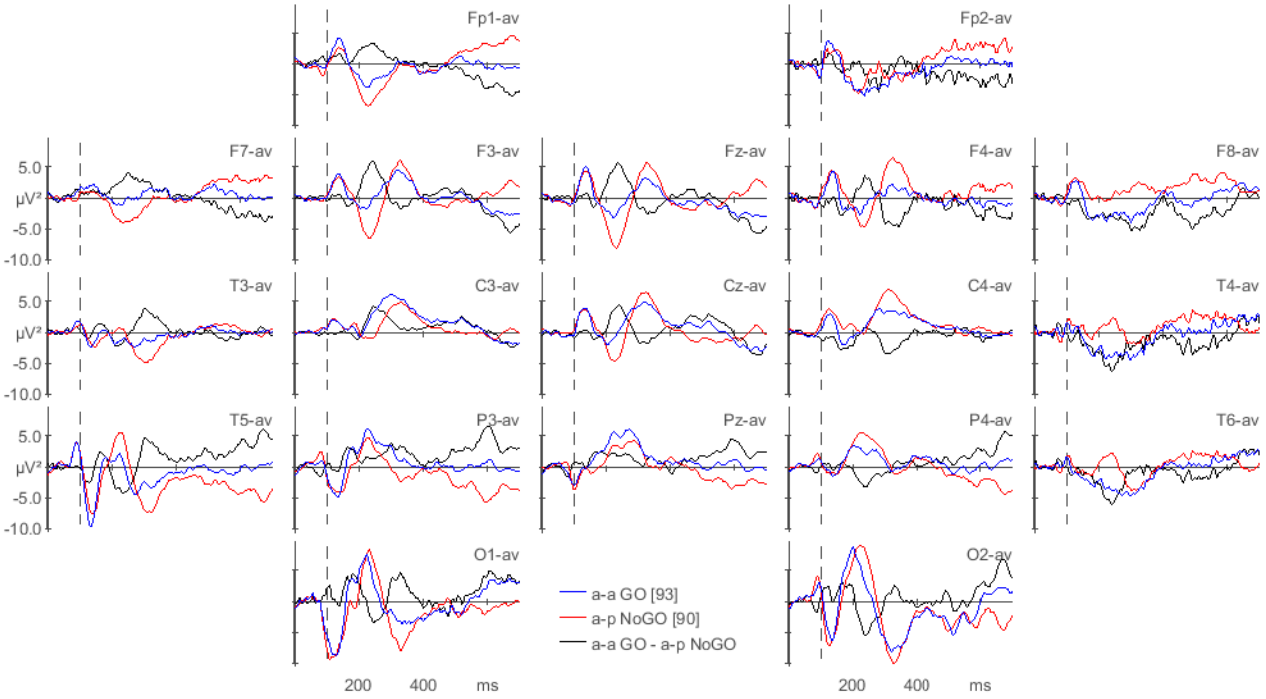
ERP Components

Comparison of the client's GO and NoGO ERPs computed for the second stimulus.

ERPs in the GO-NoGO task computed for GO, NoGO stimuli and ERP differences (GO- NoGO) are presented below.

blue: GO/red: NoGO data/black: difference curve (GO-NoGO)

GO-NoGO:



Differences between GO-condition and NOGO-condition are observed in central cortex and superior temporal cortex. This indicates an ability to perceptually discriminate different situations.

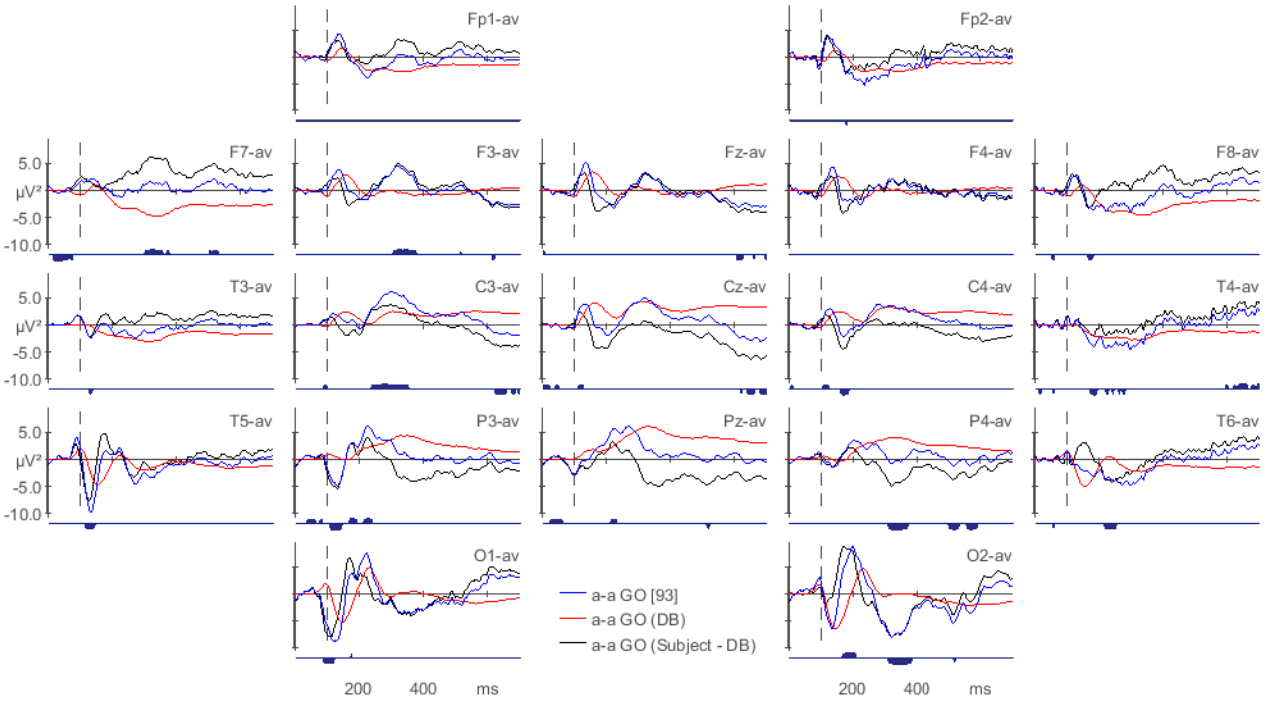
Simple ERPs

Comparison with the normative ERPs computed for the second stimulus.

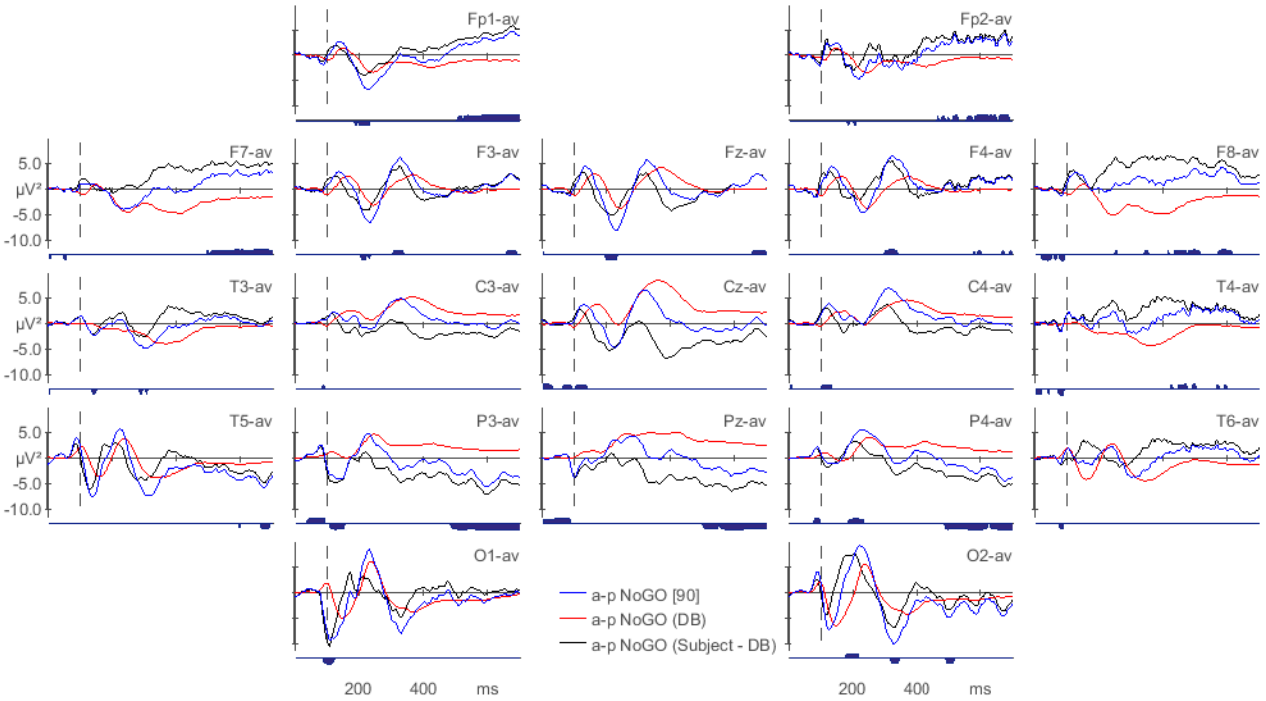
ERPs in the GO-NoGO task computed for GO, NoGO and Novelty (p-h) stimuli are presented on the next pages.

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

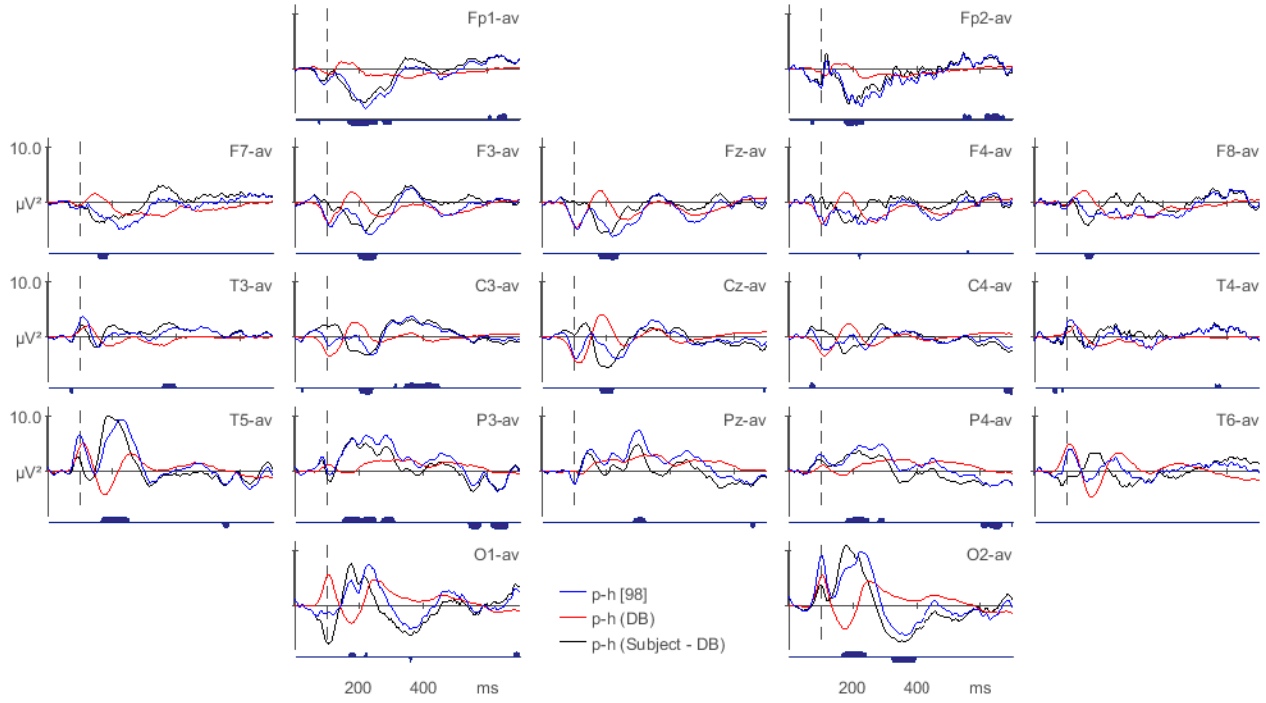
GO condition:



NoGO condition:



Novelty condition (p-h):



5. Diagnostic-Algorithms

According to the medical tradition, a diagnosis is to be made on the one hand by the reported suffering of the patients and, on the other hand, by evidence-based, objective diagnostic procedures. Focusing on neurophysiological characteristics implies that norms have been defined by a meticulous method according to scientifically recognized criteria and compared with patient groups. The patients included in the patient groups were all diagnosed by the usual criteria of the diagnostic and statistical manual (gold standard) as well as by experts. This allows a reliable definition of the patient group and its subtypes.

Psychopathology varies according to age and shows different characteristics depending on age group. Therefore, the patient groups must 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 affects patient groups to attention disorders, learning disabilities, autism, depression, schizophrenia, obsessive-compulsive disorder, slight traumatic brain injury and stress disorders (patients after heart attack). For each of these patient groups, algorithms are developed for various age groups using complex statistical methods (big data, learning machines). For each individual patient, the probability of matching to the different patient groups can therefore be calculated using the algorithms. So far, there are algorithms for attention disorders as well as stress disturbances. Further algorithms follow 2017/2018.

Such an extended approach can provide support for diagnostics and statements regarding sensitivity and specificity. The probability of the diagnosis being accepted in percentages is calculated and output in the individual case. It is recommended that these markers be clinically validated in individual cases. However, the result of the algorithm comparison is not the clinical diagnosis!

It is clinically evident that diagnoses are a generalization and thus always an approximation to the actual, individually very different processes and circumstances of the individual humans. This is currently the best possible representation of a membership of a patient group. Our data, which are not yet used in clinical studies so far, help to better characterize the characteristics and to differentiate between the subtypes with consequences for prognosis and therapeutic measures, which is a step closer to the individual as a matter of fact. To this extent, it must also be emphasized once again that the information of the neurophysiological constellations represents a complementary mosaic piece of the findings which extends the previous diagnostics. It is also clear that the demarcation to other patient groups is necessary. This will be all the more possible, the more algorithms of other patient groups are present and the patient's affiliation to existing patient groups can be defined as precisely as possible. It is also clear that the quality of the algorithms is closely linked to patient numbers and patients in general. The higher the number of patients, the clearer the patient's diagnosis, the better the algorithms. Since the present algorithms are dynamic variables, they will be constantly updated over time.

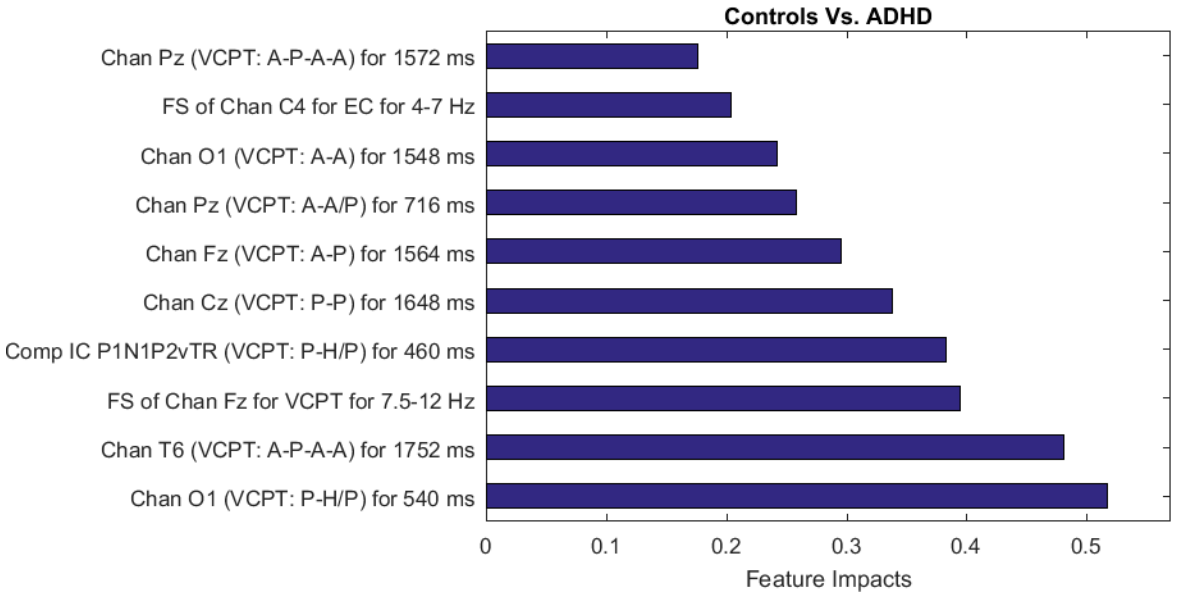
A. ADHD-Diagnose-Index

The ADHD algorithm or ADHD index was realized in the context of the CH-ADHS project on three different samples. The following algorithm was used: Regularized Logistic Regression.

Adult Sadar belongs to the age group 18 - 67.

For Adult Sadar the following probability of belonging to this group is shown:

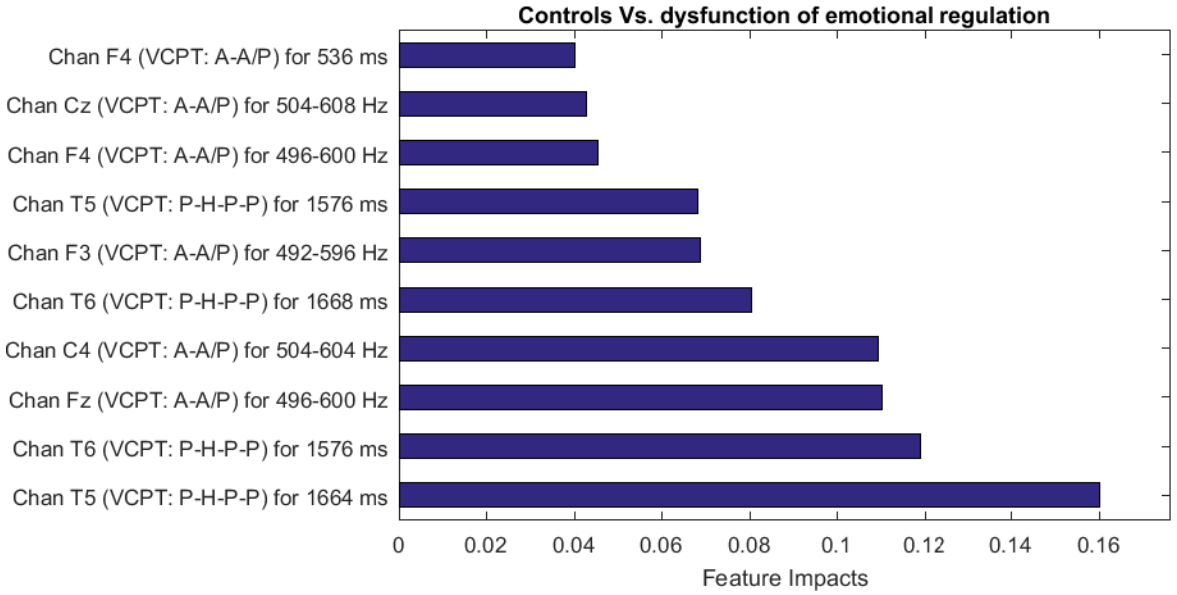
ADHD: 75% - Moderate match



B. Emotion regulation, including mood modulation.

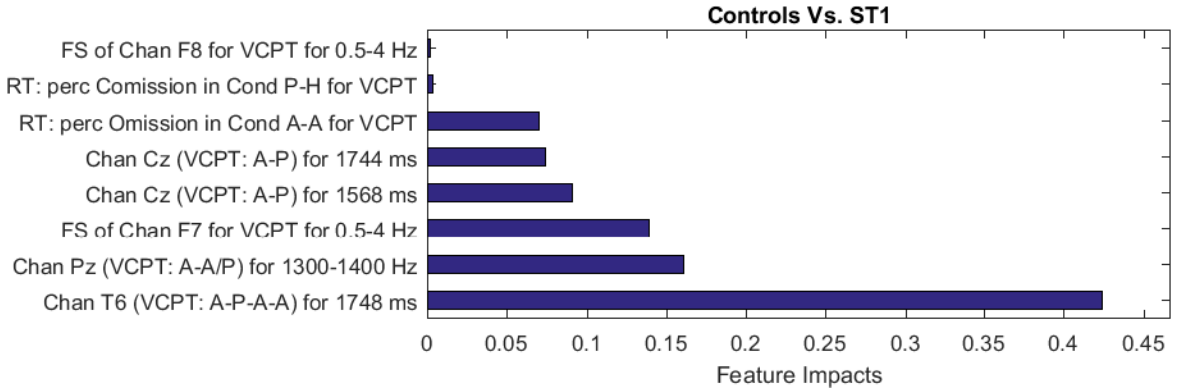
For Adult Sadar the following probability for the presence of deviance in Emotional regulation is calculated:
Emotion regulation index: 60%

The following features are particularly significant:

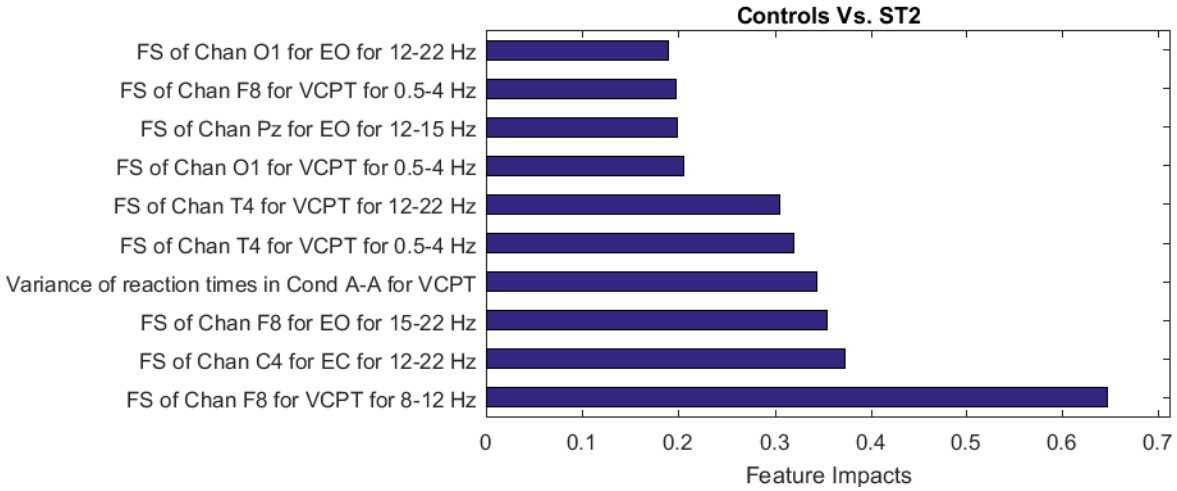


Subtypes

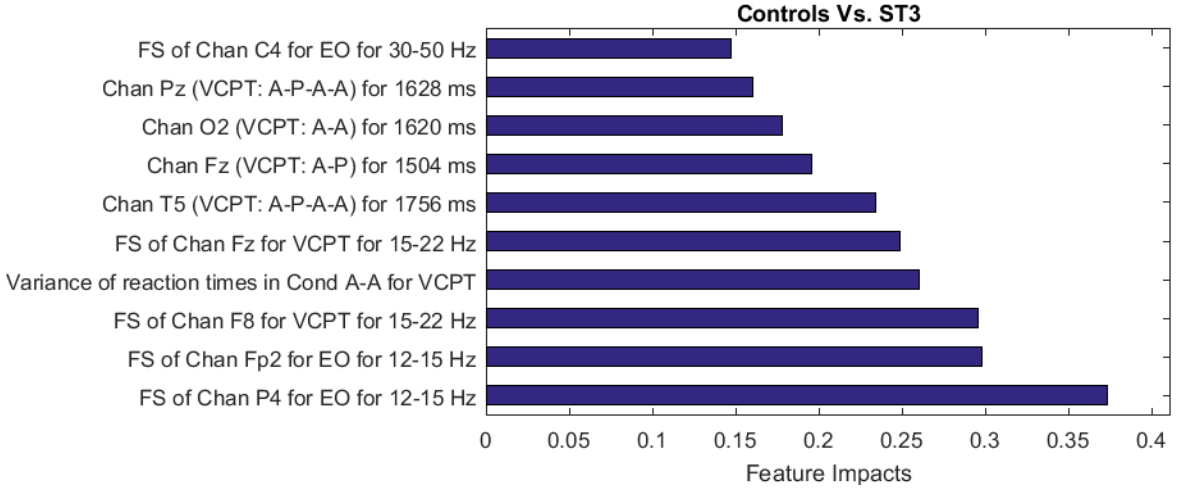
ST1: 37% - No match with dysfunctional ADHD networks



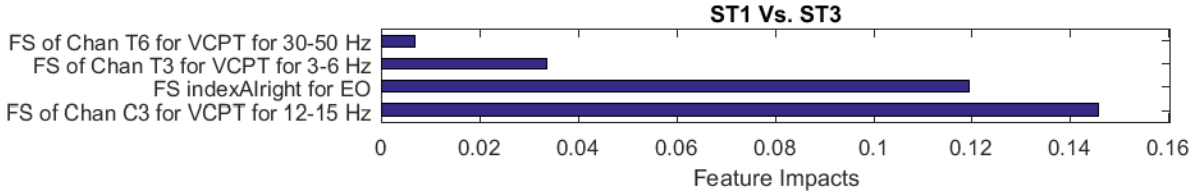
ST2: 26% - No match with dysfunctional ADHD networks



ST3: 17% - No match with dysfunctional ADHD networks



ST3 (ST1vsST3): 49% - Increased match with dysfunctional networks of the prefrontal cortex (vs. limbic system)



V. Recommendations

We would like to point out that the therapeutic approach must be holistic and include various aspects of life. This means that in addition to cognitive, behavioral and emotional aspects, a person's physiology must also be considered. An all-inclusive change strategy is beyond the scope of this report. However, we believe that difficulties must be addressed in a multi-modal approach that takes into consideration a variety of aspects involved in the individual. The recommendations that follow seek to do that within the scope of the information provided by the results of this evaluation.

1. Medication

These medication recommendations are based merely on the reported neurobiological parameters. Different people react differently to medication. Side effects are especially hard to predict. This profile does not lend itself to medication recommendations. The responsibility for any given medication lies in the hands of the prescribing medical doctor.

2. Everyday Life/Work

General statement: Our basic principle is that a high degree of neurobiological change is possible. Thanks to worldwide intensive research in the field of neuroplasticity, we know that new neuronal connections can be formed in every area if the right information is given. Personalized interventions are listed which are based on research and rated highly as potential facilitators of change.

Daily Life: Given Adult's complex neurodevelopmental profile, treatment must address multiple neurophysiological targets through personalized interventions. The primary focus should be on psychoeducation for self-management, developing awareness of the interaction between attention deficits, social-communication challenges, and anxiety symptoms, with emphasis on arousal modulation strategies. Stress management techniques are essential given the elevated limbic theta activity and high cingulate cortex strain, requiring specific training in recognizing and modulating emotional responses to prevent escalation of anxiety symptoms. Structured daily routines and environmental modifications should be implemented to compensate for executive dysfunction and support her need for predictability, which is particularly important given the autistic spectrum features and over-focusing tendencies.

The following structured activities can be considered:

Structured Daily Routines with Visual Time Anchors: Given the elevated frontal theta activity and reduced internal activation, implementing consistent daily schedules with visual time markers (wall calendars, phone reminders) can compensate for diminished internal motivation. Establishing fixed times for work, meals, exercise, and rest creates external structure that reduces cognitive load on prefrontal executive systems. The fast and stable reaction times observed indicate preserved capacity to respond to external cues, making this approach particularly suitable.

Strategic Energy Management through Activity Pacing: The vigilance analysis revealed markedly increased variability and insufficient cortical reorganization capacity, suggesting vulnerability to mental fatigue. Breaking cognitively demanding tasks into 25-30 minute intervals with 5-10 minute breaks prevents depletion of attentional resources. During breaks, engaging in brief physical movement or sensory grounding exercises (stretching, cold water on face, brief walk) supports cortical reset and maintains performance quality throughout the day.

Leveraging Hyperfocus Periods for Priority Tasks: The over-focusing tendency and strong frontal inhibitory control can be channeled productively by scheduling high-priority or complex tasks during naturally occurring periods of deep concentration. Creating distraction-free environments during these windows maximizes the benefit of intense focus while minimizing interruptions that trigger cognitive inflexibility.

Anxiety-Responsive Cognitive Flexibility Training: The elevated cingulate strain and reduced Lempel-Ziv complexity indicate neuronal rigidity. Practicing deliberate perspective-shifting exercises when noticing mental loops—such as writing down three alternative interpretations of a situation or physically changing location when stuck on a problem—gradually builds cognitive flexibility. This addresses both the anxiety symptoms and the perseverative thinking patterns.

Somatic Regulation through Rhythmic Movement: The decreased arousal values and increased internalizing processing suggest benefit from regular physical activity that enhances internal activation. Engaging in rhythmic exercises (walking, swimming, cycling) for 20-30 minutes daily supports dopaminergic and noradrenergic regulation, directly addressing the reduced motivation and effort willingness while providing natural stress reduction.

Social Communication Preparation Strategies: Given the social interaction challenges, preparing brief mental scripts or conversation frameworks before social situations reduces real-time processing demands. Identifying one or two trusted individuals for regular social contact provides predictable, lower-stress opportunities for connection that support emotional regulation without overwhelming social-cognitive systems.

Sleep: Sleep hygiene optimization is critical given the reported sleep difficulties when anxious, requiring specific protocols for bedtime routines, sleep environment modification, and relaxation techniques to improve the insufficient cortical reorganization and relaxation capacity demonstrated in the vigilance analysis. More information can be found on the Sadar Psychological Services website (https://sadarpsych.com/take-care-of-your-brain/sleep/). Sleep is expected to improve by incorporating good sleep hygiene practices and biofeedback.

Diet: She could reportedly benefit from less sugar, soda, and carbs and more fruits and vegetables. The following guidelines are offered for consideration. There is considerable science suggesting that a diet higher in protein (leaner meat, eggs, fish and dairy products) and lower in simple carbohydrates (sugar, rice, pasta, potatoes, flour and bread) improves concentration and general brain function. Meals that are primarily simple carbohydrates (breakfast cereal, pastry, pasta, French fries, etc.) cause an initial rapid surge in blood sugar making the individual more hyperactive. Soon thereafter, there is a rapid fall in blood sugar leading to mental fatigue. Meals with more protein and complex carbohydrates (vegetables, fruits and whole grains) keep blood sugar more stable, give steady energy and reduce chances of storing excess fat.
There is significant evidence that increasing Omega-3 oil benefits learning, helps stabilize mood and helps overall wellness. A good source of this is oily fish such as salmon and tuna, although there is significant controversy regarding mercury contamination of ocean raised, farm raised and even canned fish. An alternative is fish oil capsules and/or fish oil liquid supplements. These can be found in most health food sections and are not expensive. Our research review shows that fish oils produced in triglyceride form are the best source of Omega-3, when taken as recommended on the bottle. Vitamin D3 is also being recommended by the scientific community as being important for efficient brain functioning. For example, it is recommended at the Amen Clinics in addition to Omega-3 fatty acids. It is important to have one's D3 level checked and discuss supplementation with a qualified practitioner before beginning such supplementation.

Exercise: Our recommendation is to reach a point where you engage in moderate or greater physical activity/exercise for thirty minutes or more at least five days a week.

Drugs/Alcohol: Not reported to be an issue.

Electronic Screen Use: The general recommendation is to limit screen time to 2 hours a day.

3. Other Recommendations

Psychotherapy/Coaching: Making several lifestyle changes can feel stressful if an individual is already experiencing over arousal and anxiety. Working with a therapist who can break down these changes into manageable pieces and encourage these efforts may be beneficial in the long term.

Biofeedback:

sEMG Biofeedback: sEMG is a measure of the electrical signals produced by the muscles during contraction. Excessive muscle tension is often an indication of over arousal of the central nervous system and can also fuel over activation. Excess muscle tension can contribute directly to numerous symptoms such as chronic headaches and muscle soreness. Given the muscle tension noted in the EEG recordings, several sessions of sEMG biofeedback may be useful to facilitate self-regulation training.

Heart Rate Variability (HRV) is a measure of the beat-to-beat variations in heart rate. HRV is an important indicator of both physiological resiliency and behavioral flexibility, reflecting the individual's capacity to adapt effectively to stress and environmental demands. It is a skill that can be learned and practiced to improve health, performance, and overall well-being. This technique, once learned and practiced, can give Adult a way to regulate arousal. The more balance in the autonomic nervous system, the easier it is to concentrate and to control one's emotions and behaviors.

Neurofeedback: EEG Biofeedback (also called neurofeedback, neurotherapy, or neurobiofeedback) is a type of biofeedback that uses real-time measurements of brainwaves (EEG) to provide a signal that can be used by a person to receive feedback about brain activity, often with a goal of controlling and enhancing central nervous system activity.

During training, sensors are placed on the scalp and then connected to sensitive electronics and computer software that detect, amplify, and display specific brain activity. Resulting information is fed back to the trainee virtually instantaneously with the conceptual understanding that changes in the feedback signal indicate whether or not the trainee's brain activity is within the designated range.

Based on this feedback, changes in brain patterns occur and are associated with positive changes in physical, emotional, and cognitive states. Often the trainee is not consciously aware of the mechanisms by which such changes are accomplished although people routinely acquire a "felt sense" of these positive changes and often are able to access these states outside the feedback session. Generally, trainees do not experience adverse effects.

If EEG-bf is pursued, the following protocols are recommended:

1. Cz-A2 or C3-A1 inhibit 4-7 Hz, 9-11 Hz and 22-36 Hz; reward 12-15 Hz or higher depending on site and response).
2. P3-A1 inhibit 4-7 Hz, 9-11 Hz and 22-36 Hz.
3. Fz-A1 inhibit 4-7 Hz, 9-11 Hz, and 22-36 Hz; reward 13-16 Hz or higher depending on response.

pirHEG (passive infrared Hemoencephalography): pirHEG involves wearing an infra-red sensor over one's forehead. This allows for the reading and the feeding back of the amount of blood flow occurring in the regions of the prefrontal and frontal lobes. Blood flow is an indication of the amount of metabolic activity. When the metabolic activity in the frontal and prefrontal areas increases, executive brain functioning occurs. Outcomes include improved attention, improved mental flexibility, improved emotional/behavioral control, improved planning and organization, etc. This type of training has been referred to as a type of

neurofeedback as it impacts the functioning of the brain. Its' strength, relative to forms of EEG biofeedback, is its focus on frontal lobe functioning.

Home Training Options:

Wild Divine is a computer software program that you control with your heart rate variability. The program - developed by a team of doctors and spiritual leaders - artfully combines state-of-the-art technology with beautiful visuals, soothing sounds and effective meditation and breathing techniques to help you master your body's natural ability to counter the effects of stressful situations and live a happier, more balanced life. https://wilddivine.com/. There are also several apps available for smart phones which can be explored by searching: HRV telephone apps. Two of the better known are Inner Balance and Elite, but there are many others available. These options can be considered if Adult seems to need ways to facilitate regular practice of the HRV breathing technique. This is something that needs to be practiced on a regular basis to enjoy the maximum benefits it has to offer.

All decisions regarding the implementation of these suggestions are the responsibility of the individual practitioner. I recognize the utility of ongoing consultation and welcome discussion of the clinical progress of individual patients, or related questions and suggestions.

Andrea Meckley Kutyana, Ph.D., M.A.
Licensed Psychological Associate

Mitchell M. Sadar, Ph.D.
Licensed Psychologist

HBImed AG
Brain Diagnostics

Dr. Andreas Müller

Portions of this report have been generated with AI assistance drawing from HBImed specific research and have been reviewed and approved by the report signees.

VI. Appendix

Amen Questionnaire:
Symptoms rated 'frequently' (3) and 'very frequently' (4):

- Frequent feelings of nervousness or anxiety (3)
- Periods of nausea or upset stomach (3)
- Tendency to predict the worst (3)
- Fear of dying or doing something crazy (3)

- Avoid places for fear of having an anxiety attack (3)
- Conflict avoidance (3)
- Excessive fear of being judged or scrutinized by others (3)
- Lack of confidence in your abilities (3)
- Shy or timid (3)
- Easily embarrassed (3)
- Tendency to be oppositional or argumentative (4)
- Excessive or senseless worrying (3)
- Upset when things do not go your way (3)
- Tendency to have repetitive, negative thoughts (3)
- Intense dislike for change (3)
- Trouble shifting attention from subject to subject (3)
- Trouble shifting from one task to another (3)
- Difficulties seeing options in situations (3)
- Tendency to hold on to own opinion and not listen to others (3)
- Tendency to get locked into a course of action whether or not it is good (3)
- Needing to have things done a certain way or you become upset (3)
- Others complain that you worry too much (3)
- Tend to say no without thinking about the question first (3)
- Tendency to predict fear (3)
- Often misinterpret comments as negative when they are not (3)
- Irritability tends to build, then explodes, then recedes, often tired after a rage (3)
- Difficulties understanding a reading text (3)
- Feeling tired, sluggish or slow moving (4)
- Loses things (4)
- On the go or acting as if "driven by a motor" (4)
- Talking excessively (4)
- Blurting out answers before questions have been completed (4)
- Fails to give attention to details or makes careless mistakes (3)
- Trouble sustaining attention in routine situations (i.e. homework Chores, paperwork) (3)
- Trouble listening (3)
- Fails to finish things (3)
- Poor organization for time or space (such as backpack, room, desk, Paperwork) (3)
- Forgetful (3)
- Poor planning skills (3)
- Lack clear goals or planning (3)
- Difficulty expressing feelings (3)
- Difficulty expressing empathy for others (3)
- Excessive daydreaming (3)
- Feeling apathetic or unmotivated (3)
- Difficulty playing quietly (3)
- Difficulty waiting your turn (3)
- Interrupting or intruding when others are speaking (3)
- Impulsive (saying or doing things without thinking first) (3)
- Difficulty learning from mistakes. Tends to make same mistakes over and over again. (3)
- Negativity (3)
- Low energy (3)
- Excessive guilt (3)
- Sleep changes (too much or too little) (3)
- appetite changes (too much or too little) (3)
- Difficulties with concentration (3)

van Deusen Questionnaire:
Symptom intensity rating:

Symptoms rated 'frequently' (6) and 'very frequently' (7):

- Easily distracted from task (7)
- Talks excessively or very little (7)
- Can't make up mind (6)
- Doesn't organize tasks well (6)
- Starts but doesn't finish (6)
- Loses/misplaces things (6)
- Dislikes new situations (6)
- Unmotivated (6)
- Just goes through life (6)
- Stuck in routine ways of doing things (6)
- Greatly disturbed by disorder (6)
- Can't stop unpleasant, repetitive thoughts (6)
- Stubborn (6)
- Argues for the sake of arguing (6)
- Blames others (6)
- Can't stay on task to completion (6)
- Difficulty following spoken instructions (6)
- Hard time following discussions (6)
- Misunderstands what people say (6)
- Quickly forgets heard information (6)
- Makes careless calculation errors (6)
- Can't perform multi-step calculations (6)
- Doesn't understand math concepts (6)
- Loses routine items often (6)

ADHD-Questionnaire:
Summary of high and very high rated behaviors (● Attention, ● Hyperactivity/Impulsivity, ● Emotion regulation and ● Over Focusing):

- struggles to keep order (room, table, school bag, filing cabinets, etc.) (4)
- executes instructions only partially and cannot finish work (starts tasks, loses focus easily, easily distracted, cannot finish tasks, assignments or duties in the workplace) (3)
- avoids or is reluctant or unwilling to do work that requires prolonged mental effort (such as schoolwork or homework or for teenagers and adults: report writing, filling out forms, checking of longer reports) (3)
- loses items needed for tasks or activities (homework, pencils, books, tools, wallets, keys, forms, glasses, cell phone, train and bus tickets) (3)
- easily distracted by external stimuli (for teenagers and adults' unsuitable thoughts) (3)
- is forgetful in daily activities (for teenagers and adults: Callbacks are forgotten, bills are not paid, deadlines not met) (3)
- has difficulties during quiet activities (often excessively loud during a game, leisure and social activities) (4)
- is "on the go" or often acts as if he was "forced" (feels uncomfortable to be still for a long time: in a restaurant, during meetings, presentations, others (teachers, friends, colleagues, partners) experience the agitation and complain about it (4)
- speaks excessively (4)
- fidgets with hands or feet or squirms in the chair (3)
- is often restless, in situations when remaining seated is expected (leaves his seat in the classroom, in the workplace) (3)
- blurts out answers before the question is finished (for teenagers and adults complete the sentences of others and are erratic in conversations) (3)
- sensitive to noise, light, clothing, or contact (4)

- has periods of increased talkativeness (4)
- seems anxious or fearful (3)
- requests his / her own way, even if others repeatedly say "no" (3)
- tendency to have "grandiose", unrealistic thinking (3)
- worries excessively or with no reason (4)
- is excessively organized, always wants to regulate all details in advance (4)
- likes absolutely no changes (4)
- has a tendency to jealousy, envy (4)
- struggles to shift attention from one thing to another (4)
- difficulty seeing different options / possibilities in a situation (4)
- tendency to cling to their own ideas and not to listen to others (4)
- continues to provide a once exercised / initiated action, even if it is not successful (4)
- wants things to be done in a certain way, is otherwise very annoyed (4)
- others complain that she / he worries too much (4)