Note:

This is a sample report! The purpose of this sample report is solely to show the idea of how the report looks like.

FUNCTIONAL BRAIN MAPPING RESULTS REPORT

Functional Brain State Assessment and Neurofeedback Recommendations

Quantitative Electroencephalography (QEEG), Functional Brain Biomarkers and localization of possible deviations from HBImed normative database with standardized Low-Resolution Electromagnetic Tomography

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Scientific Analysis of an Individual Brain Functioning

(QEEG and ERP)

This report presented an analysis that contained results of analytics and interpretations performed by qualified researchers and is based on the published scientific evidence.

Name/ID	
Birthdate (day, month, year)	01.01.2000
Gender (M - male, F - female)	M
Handedness (R, L)	R

Diagnose

Reason of having Brain Mapping assessment

Medication

Assessment day

Important

This report provides an indication of the general state of the individual brain functioning. The results of this analysis should be considered together with other measures in assessing, diagnosing, and treating clients.

The information described here can be misunderstood by the common person without special education in the field of brain functioning.

The information contained in the present document is not intended to be used as a medical conclusion and should NOT be used as a basis for self-treatment.

The information presented in this report aimed to be used ONLY by the neurofeedback professionals for better understanding of individual pattern of electrophysiological activity of the brain as a guide in terms of providing the most appropriate location and frequency for neurofeedback interventions.

However, there are no guarantees that neurofeedback by itself is going to lead to the resolution of any underlying symptoms. Neurofeedback intervention should be carefully evaluated and constantly monitored.

Please note that the medications can modify EEG findings and ideally the EEG should be taken under as medication free conditions as possible.

With the delivery and reading of this report the referral requesting this service agrees with the terms and conditions and assumes all responsibility for any inconvenience.

Summary of Findings

We would like to point out that the therapeutic approach must be holistic and should include various aspects of life. This implies regarding not only cognition, behavior and emotions, but also biological aspects. How exactly this change-strategy should be designed is far beyond the scope of this report. However, we consider that difficulties must be addressed by a multimodal approach that takes into consideration aspects of both the individual and the surrounding social network.

Based on the extensive analysis of the brain electrical activity, identified QEEG deviations associated with general under activation and functional brain de-regulation due to slow brain maturation especially in the frontal and posterior brain areas involved in the executive control of behavior.

These types of deviations are often presented in the DS patients and associated with symptoms of mental impairment, inattention, increased anxiety and decreased emotion and behavior inhibition control.

Functional Brain Biomarkers:

- Overall decreased of arousal. These types of deviations associated with in ADHD symptoms (inattention, impulsivity, emotonal instability).

Mayer K, Wyckoff SN, Strehl U. Underarousal in Adult ADHD: How Are Peripheral and Cortical Arousal Related? Clin EEG Neurosci. 2016 Jul;47(3):171-9. doi: 10.1177/1550059415577544. Epub 2015 Mar 23. PMID: 25802473.

- An increased index of inattention found to be associated with ADHD symptoms and related with increased level of inattention, problem with emotion control and impulsivity. Increased
- General decreased in coherence associated with decreased functional brain activation state and represent decreased alertness state (drowsiness). Decreased coherence in the frontal areas in the right frontal-temporal areas can be related with symptoms of emotional reactivity, mania, aggression and psychosis. Altered functional connectivity in the motor and prefrontal cortex found in DS.

Brain Electromagnetic Tomography (neuropsychology):

- Deviations in the Medial Frontal Gyrus Frontal Lobe previously associated with childhood trauma.

Zsoldos, K.P. Ebmeier, Chapter 38 - Aging and Psychological Stress, Editor(s): George Fink, Stress: Concepts, Cognition, Emotion, and Behavior, Academic Press, 2016, Pages 311-323

- Abnormalities within Brodmann areas 6 were previously found in patients with ADHD symptoms.

Recommendations

Frequency - Based Neurofeedback protocol:

In eyes opened condition

- Fz/Cz– reinforce activity at (15-18 Hz) with subsequent decrease of low and high activity (3-15 and 18-30 Hz).
- P3/P4– reinforce activity at (12-15 Hz) with subsequent decrease of low and high activity (3-12 and 15-30 Hz).
- C3/C4– reinforce activity at (12-15 Hz) with subsequent decrease of low and high activity (3-12 and 15-30 Hz).

In eyes closed condition (can be done with eye open condition in case of DS)

- O1-O1 – reinforce alpha activity (10 - 12 Hz)
-

tDCS stimulation

Fp1- anode, contralater soulder – cathode

Intensity ≈ 1-2 mA 20-30 min

Biofeedback training (HRV) is recommended

These suggestions are given in according with QEEG results and offered as a starting point for Neurofeedback training. Individual client responses will vary. The specific frequencies, montages, and the sequencing of sessions will likely require modification based on clinical response. Suggestions may be implemented differently depending on instrumentation used.

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Results

Psychological Evaluation

Base on the analysis of the "Personal and clinical data – Questionnaire" symptoms were found in the executive and affective systems.

EEG Description

Description of background EEG	Dominant activity within delta[1] and theta[2] frequency range, EEG is poorly organized with normal amplitude from 30 to 60 μV. Moderate diffuse changes with signs of neurophysiological immaturity.
Pathological signs	No significant abnormalities identified by visual inspection of EEG or by automated spike detection algorithm

Quantitative EEG-analysis (QEEG), comparison with the HBImed normative database

Theta/beta relation Index of inattention		Index of inattention significantly increased = 10 (norm 2)
QEEG analysis	**Eyes open**	Increased level of the relative delta power spectra in the left central and in the right occipital-temporal areas. Increased level of the theta power spectra in the orbital-frontal, frontal, temporal, right central, parietal, and occipital areas.
Asymmetry	**Eyes open**	No significant asymmetry found
Coherence	**Eyes open**	Decreased coherence in the orbital-frontal, frontal, frontal-parietal, parietal and occipital areas in the eyes opened condition and suggest that there is a lack of communication between the sites.

[1]***Deltha rhythm*** is a slow EEG oscillation presented within frequency range 1.5 – 3 Hz that is normally occurs in deep sleep (stage 3 and 4), deeply relaxed states and drowsiness. It is a dominant rhythm in infants up to one year of age. In adults this rhythm can be related with developmental disability or, in case of local presence, reflect physiological abnormalities (traumatic brain injury, stroke, tumor etc.) and coma states.

[2]***Theta rhythm*** is a slow EEG rhythm within frequency band of 3.5-7.5 Hz. This rhythm is normal during the sleep, it is associated with internal focus, daydreaming, fantasizing, meditation. It is normal in children up to 13 years old depending on distribution. Significant increase in the frontal areas can be associated with ADHD symptoms**.**

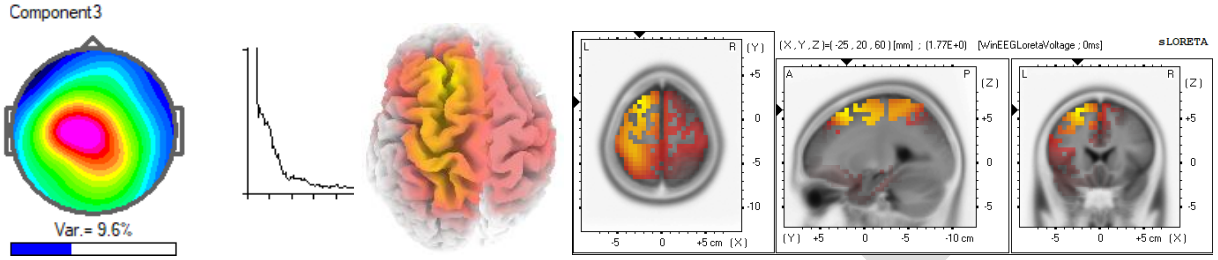
Alpha rhythm is EEG activity within 8-12 Hz. This rhythm occurs when the brain is alert, but relaxed and tranquil. This rhythm is stronger over the occipital areas

Beta rhythm occurs within 13 – 30 Hz. This rhythm is most prominent over frontal areas and associated with thinking, problem solving, decision making etc.

Brain Mapping, sLORETA (Low Resolution Brain Electromagnetic Tomography)

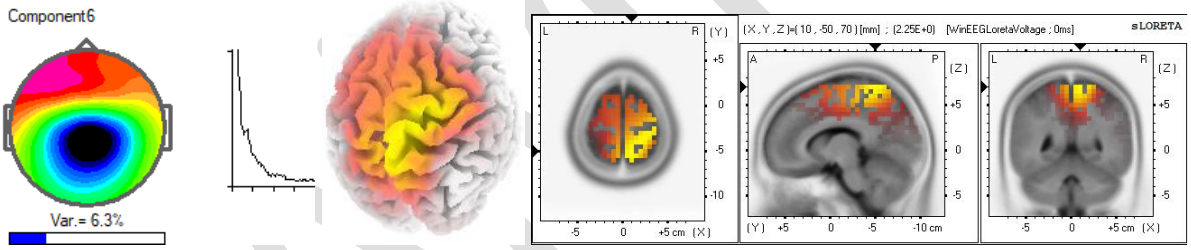
Following deviations were calculated for biggest deviations

In eyes open



(X= -25, Y= 20, Z= 60) (MNI coords) Best Match at 0 mm

Brodmann area 6 Middle Frontal Gyrus Frontal Lobe: BA 6 has a diverse function and is involved in attention control, memory functions, language functions. This brain area is a part of the executive system that become active together with the basal ganglia and cerebellum when movement is planned, initiated and executed. BA6 stores action plans and strategies, recalls motor memories and movement sequences, enabling optimization of movement processes. BA 6 is active during mental arithmetic. BA 6 is a part of the frontostriatal loop, which is involved in planning, control and regulation of somatosensory, emotional and cognitive impulses.



(X= 10, Y= -50, Z= 70) (MNI coords) Best Match at 0 mm

Brodmann area 5 Postcentral Gyrus Parietal Lobe: this area involved in visuospatial processing, including the perception of the personal space and spatial imagery. It is understandable that the secondary sensorimotor cortex participates in processing tool-use gestures, motor imagery, bimanual manipulation, and similar praxic abilities. BA5/7 participate in a circuit underlying imitation of motor learning. It is well established that Functional studies confirm that the superior parietal lobe participates in tactile localization whereas the inferior parietal lobe may be involved in tactile recognition. The superior parietal lobe also seems to participate in other processes, such as rhyme detection and semantic categorization tasks; and, interestingly, temporal context recognition.

Attachment

Introduction

This type of assessment examines the overall pattern of the brain electrical activity (EEG) that reflects the general brain activation state. Functional brain states represent the general brain activation balance, i.e. relationship between excitatory and inhibitory processes. Activation or excitation linked to increase in neuronal activation, whereas inhibition understood as decreased in neuronal activation. The balance between these processes determined the ability to perform and adapt to environmental changes. Persistent imbalance or dysregulation found in a number of pathological conditions and specific changes can be linked to specific psychological and behavioral symptoms.

Description of the QEEG and ERPs data

Procedures of EEG recording and analysis

EEG was recorded by means of the Mitsar (Mitsar, Ltd.) amplifier[1] from 19 electrodes (Fp1, Fp2, F7, F3, Fz, F4, F8, T3, C3, Cz, C4, T4, T5, P3, Pz, P4, T6, O1, O2 sites in the International 10-20 system) with 250 Hz sampling rate in 0.3 – 70 Hz frequency range in the following conditions: 1) eyes opened (EO) – at least 5 minutes, 2) eyes closed (EC) – at least 5 minutes, and 3) a modification of GO/NOO task (20 minutes).

The data were stored on the hard disk in the linked ears reference montage and processed offline by means of WinEEG software. The software is based on the 30 years' experience obtained in the laboratory at the Institute of the Human Brain of Russian Academy of Sciences.

Absolute and relative magnitude spectra and coherences in all conditions computed and compared with the parameters of a corresponding age group from the Human Brain Index (HBI) reference database. The reference database includes data of about 1000 healthy people of 7-89 years old age.

The analysis consists of the following steps:

1) eye movement artifact correction and elimination: a) using spatial filtration technique based on zeroing the activation curves of individual Independent Component Analysis (ICA) components corresponding to horizontal and vertical eye movements, as well as b) excluding epochs with excessive amplitude of EEG and excessive faster and slower frequency activity;

2) Fast-Fourier Transformation (FFT) of the corrected EEG for extracting EEG power and coherence for all 0.25 Hz bins in the frequency band from 0.5 to 30 Hz.

3) computation of event related potentials by averaging EEG over trials for each category of trial and each channel with time resolution of 4 ms.

4) comparison of each extracted electrophysiological and behavioral variable against the corresponding variable computed for a carefully constructed and statistically controlled age-regressed, normative database in which the variables have been transformed and confirmed for their Gaussian distribution.

[1]The analysis software is hardware independent and can read any EEG files recorded in ASCI, European data format (EDF), universal data format (UDF) and NeuroScan data format.

Questionnaires

Personal and clinical data –Questionnaire[2].

Questions	Descriptive Answers	Category
Name (family name, given name)		**General information**
Date of birth (Day/Month/Year)		
Gender (M-male, F-female)		
Handed (L- left, R – right)		
Diagnosis		
Reason of having QEEG assessment		
Medication taken now.[3].		
Source of referral		
Birth trauma and/or hypoxia		**Pre- and post-natal history**
Started to talk too late		
Head trauma (with loss of		
Poor grades in school, poor performance at work		
Often having headaches and/or migraines.		**General Brain Regulation**
Feel weak and passive during daytime		
Sleep-related difficulties		
Abuse alcohol or drugs.		
Perceptual difficulties (paresis, dyslexia, Wernike aphasia, neglect…)		**Sensory system**
Autistic spectrum behavior		
Motor-related difficulties (akenesia, bradokinesia, tremor, rigidity, Broca aphasia…)		**Motor system**
Attention-related difficulties		**Executive system**
Impulsiveness		
Difficulties in correcting behavior		
Psychosis (hallucinations, delusions…)		
Occupied by mostly positive thoughts, manic		

[2] Note that the questions above are not to make a medical diagnosis but to define the brain systems that might be impaired in association with the client's complaints. Thus, the goals of this Questionnaire are 1) focusing on specific problems of the client, 2) selecting a specific test for assessment and 3) eventually choosing the right protocol of neurotherapy or the right medication.

[3] Note that EEG parameters may be compared with the Normative data base if the patient is free of medication or drug for at least one day. Some medications may require more time to be washed out of the brain.

Occupied by mostly negative emotions, depressed		Affective system
Anxious		
Poor memory for recent events		Memory system
Other forms of memory deficit		

Spontaneous EEG

EEG was recorded during relaxation with closed eyes (5 minutes) and opened eyes (5 minutes). From this recording, spectral data was calculated and compared with database population. Database comparison was calculated with weighted montage. Speed – 30 mm/s; Gain - 50 μV; Low cut – 0.53 Hz; High cut – 50 Hz; Notch – 45-55 Hz.

Fragment Eyes open

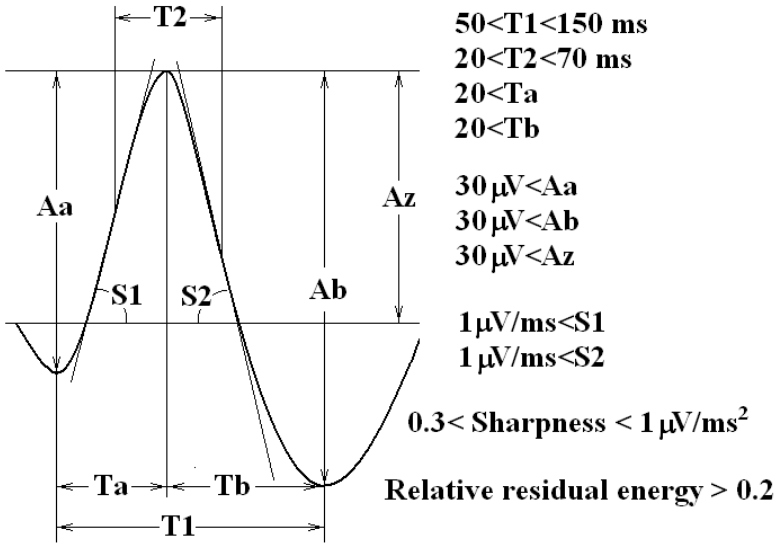
Spike Detection

Result of the visual EEG inspection

Dominant activity within delta1 and theta2 frequency range, EEG is poorly organized with normal amplitude from 30 to 60 μV. Moderate diffuse changes with signs of neurophysiological immaturity.

Search for paroxysms and pathological signs

The method of automated spike detection is based on temporal parameters of spikes as well on spatial location of the corresponding spike dipole[4]. The amplitude-temporal parameters have defined on the basis of comparison spike detection by the program and by experienced experts on the data base of more than 300 EEG recordings in epileptic patients. There are three characteristics that define a spike or a sharp wave in EEG. They are paroxysmal character, high degree of sharpness and short duration. These parameters are presented in Fig[5].



The relative residual energy for dipole approximation of the detected spike is chosen less than 0.2.

For this client the automatic spike detection was performed on EEG in the common average montage for both eyes open and eyes closed conditions.

No significant abnormalities identified by automated spike detection algorithm

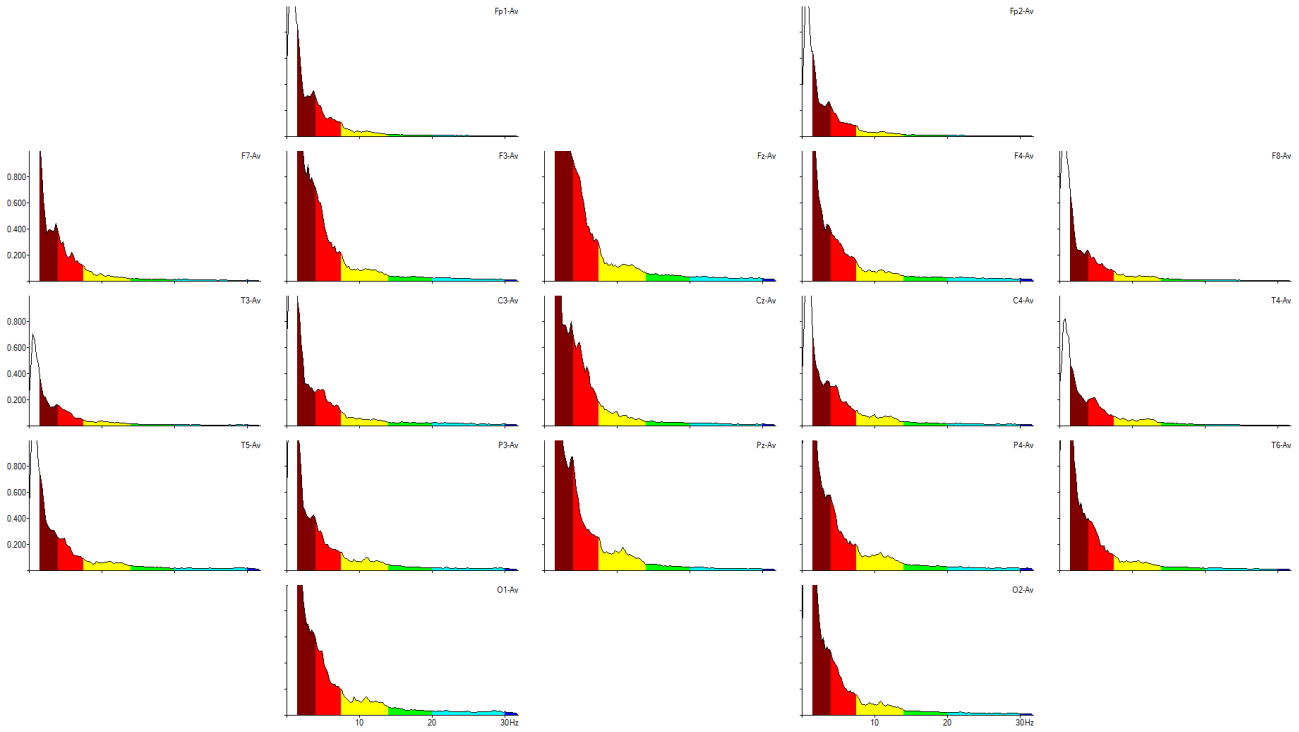
[4] P.Y. Ktonas Automated spike and sharp wave (SSW) detection. In Methods of analysis of brain electrical and Magnetic signals. EEG handbook (revised series, Vol 1) A.S. Gevins and A. Remond (Eds). 1987, Elsevier Science Publishers B.V. 211-241 pp

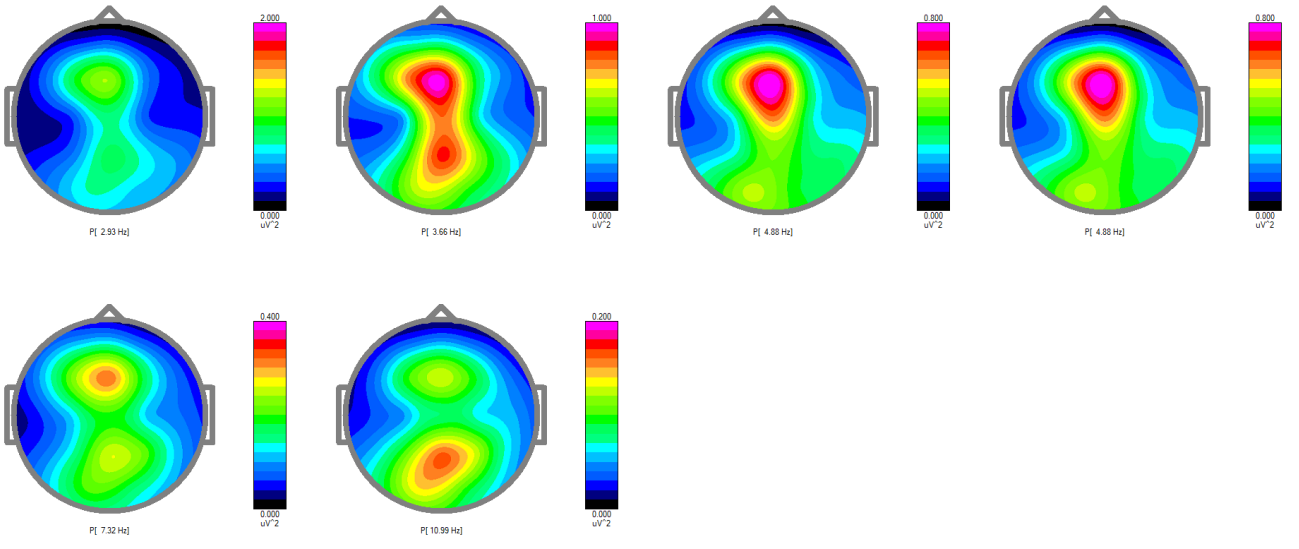
[5] The parameters are taken from the paper Ktonas P.Y. Automated spike and sharp wave (SSW) detection. In Methods of analysis of brain electrical and Magnetic signals. EEG handbook (revised series, Vol 1) A.S. Gevins and A. Remond (Eds). 1987, Elsevier Science Publishers B.V. 211-241 pp.)

QEEG analysis

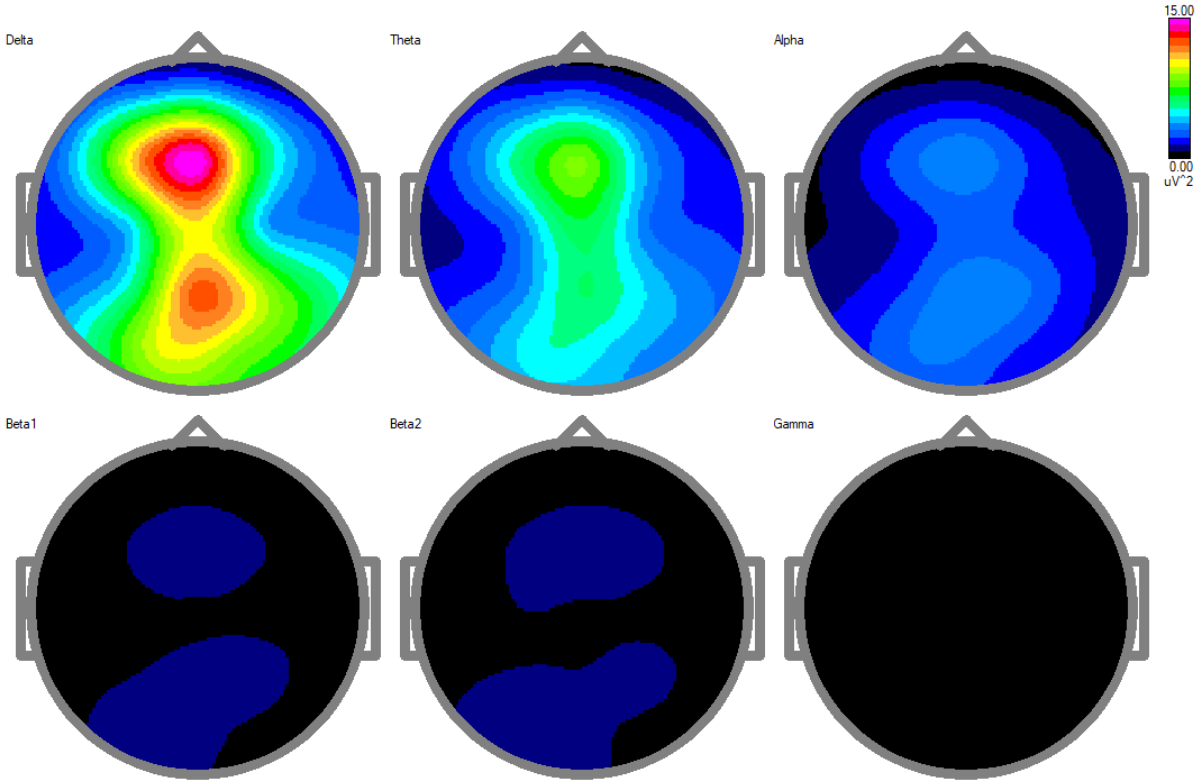
Spectral data: eyes opened

Graphs of EEG power spectra. Absolute spectra power (P)

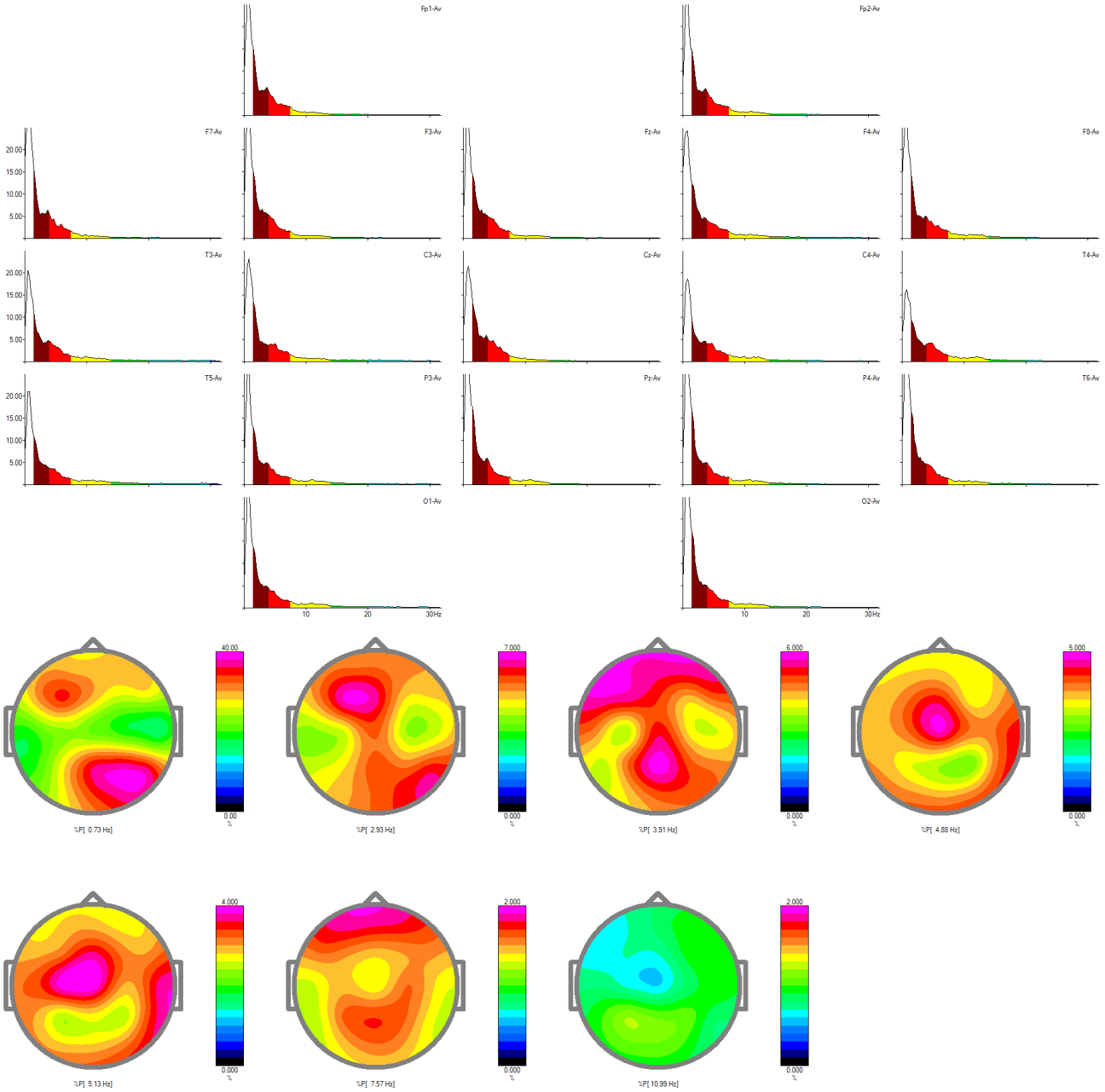




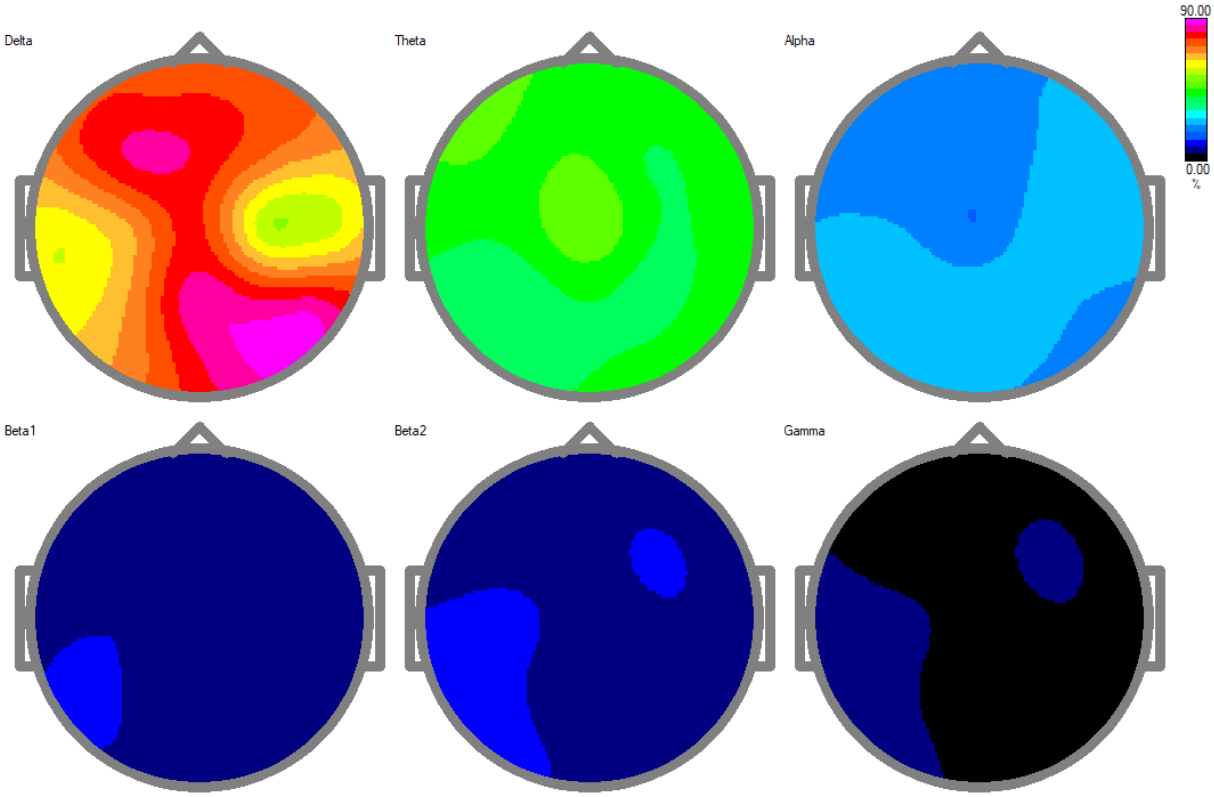
Graphs of EEG power spectra (maps). Absolute spectra power (P)



Graphs of EEG power spectra. Relative spectra power (%P)



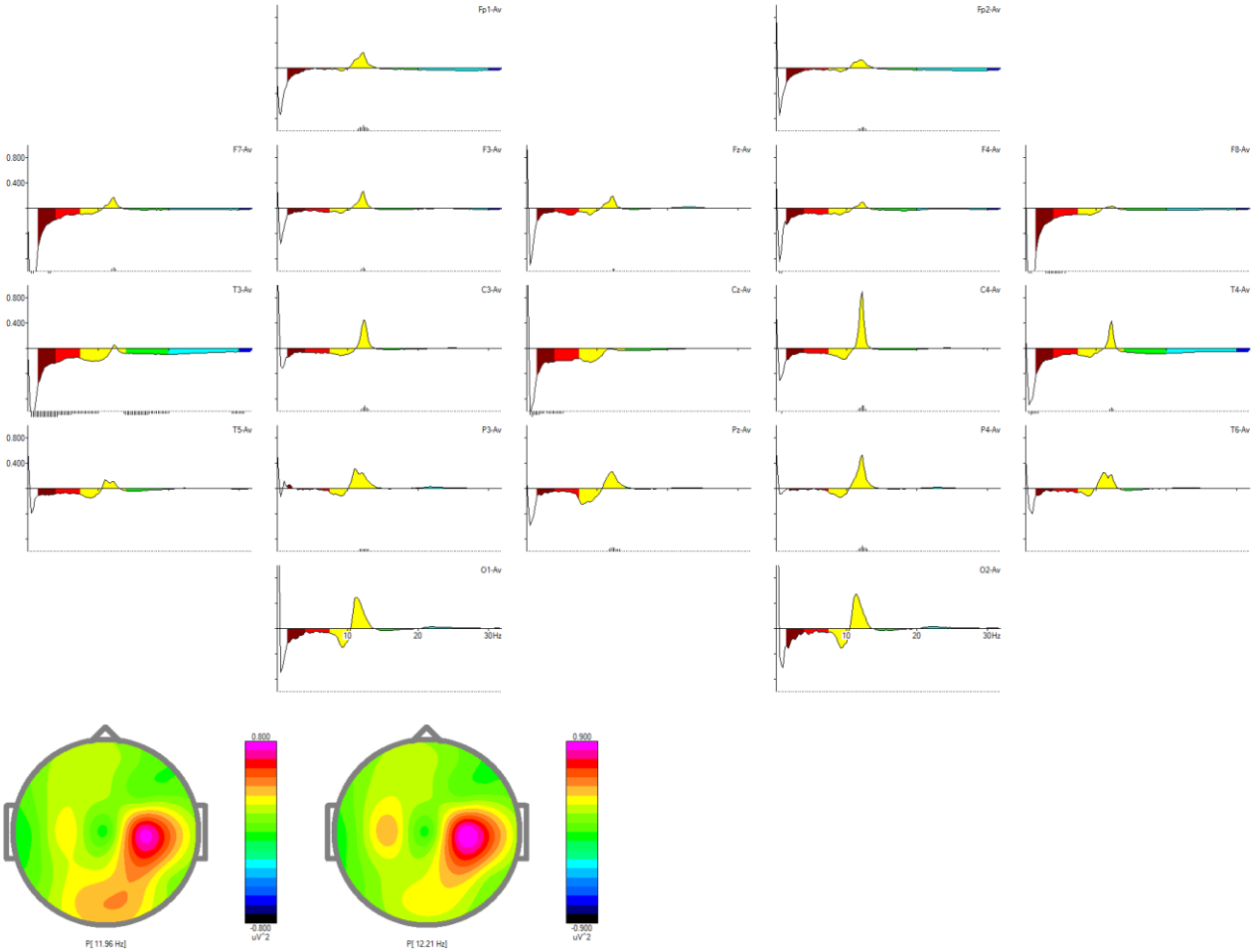
Graphs of EEG power spectra (maps). Relative spectra power (%P)



Comparison with the HBImed reference database

Graphs of EEG power spectra. Absolute spectra power (P)

Bars on the bottom line indicate significant deviations from norm with P Value <0.01 and Z Score > 2.5



Graphs of EEG power spectra. Relative spectra power (%P)

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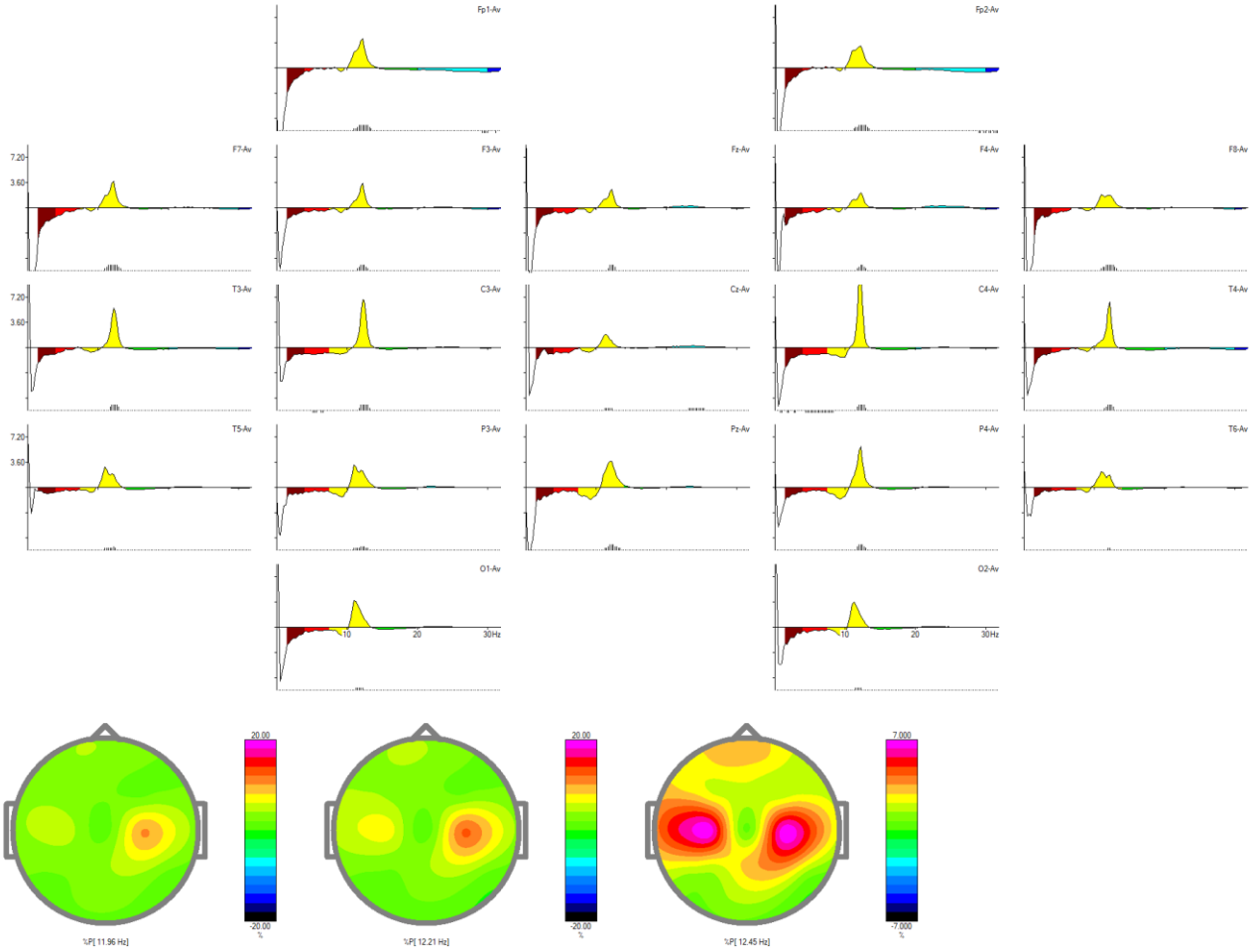
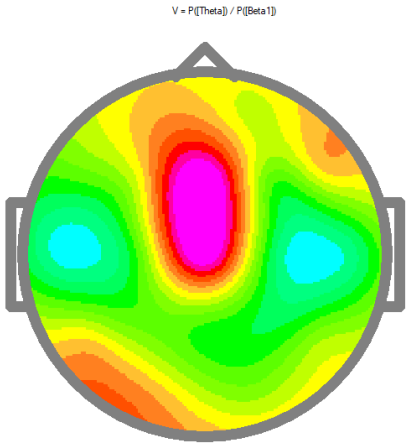


Increased level of the relative delta power spectra in the left central and in the right occipital-temporal areas.

Increased level of the theta power spectra in the orbital-frontal, frontal, temporal, right central, parietal and occipital areas.

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).

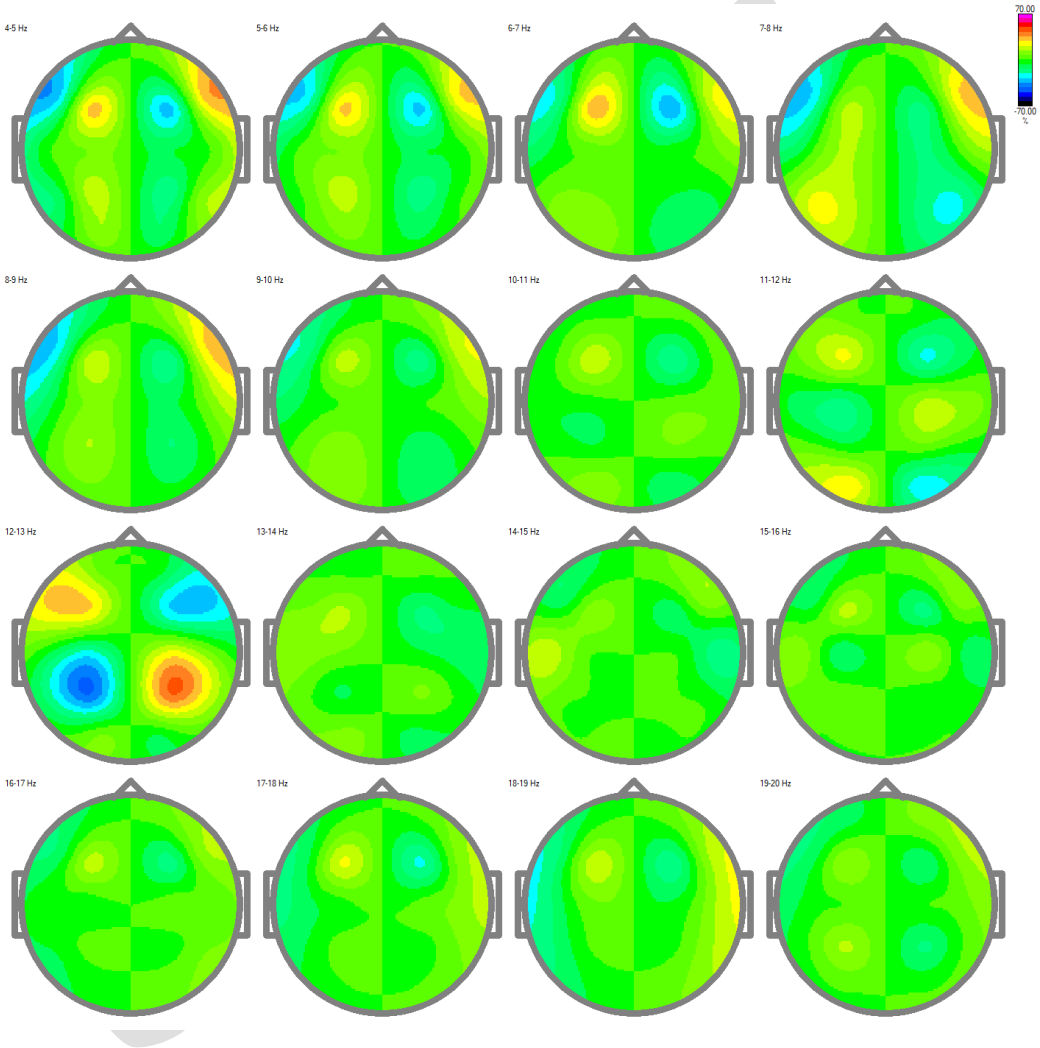
Eyes open condition

Index of inattention significantly increased = 3 (norm 2)

Monastra VJ, Lubar JF, Linden M, VanDeusen P, Green G, Wing W, Phillips A, Fenger TN. Assessing attention deficit hyperactivity disorder via quantitative electroencephalography: an initial validation study. Neuropsychology. 1999 Jul;13(3):424-433.

Asymmetry

Asymmetry more than 70% can be associated with neurological abnormalities. Asymmetry within frontal and temporal areas has been linked to symptoms of depression, negative affect, decreased memory performance and negative disposition symptoms. This was associated with selective cognitive deficit and somatic anxiety with vegetative symptoms of palpitation, panic attach and dizziness.

Asymmetry eyes open:

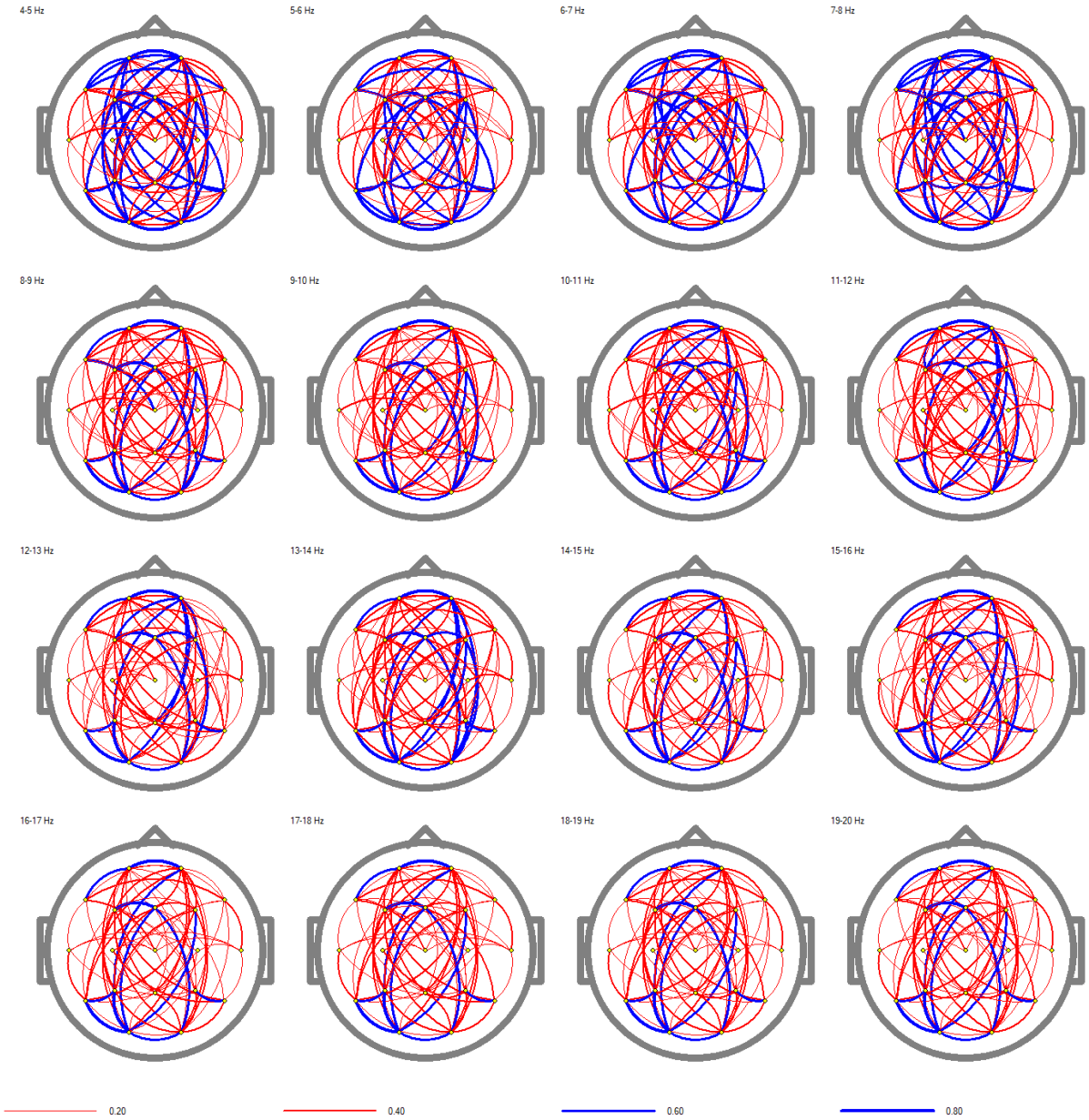


Significant asymmetry in the parietal areas in the eyes open condition.

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 open condition:



Decreased coherence in the orbital-frontal, frontal, frontal-parietal, parietal and occipital areas in the eyes opened condition.