

1. Case study: epileptic spike and wave discharges monitored in EEG after cannabis withdrawal

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We present a 34-year-old female patient with a 14-year history of cannabis abuse, currently during cannabis withdrawal, showing an abnormal EEG-pattern without any corresponding clinical symptoms. This case study being an up-to-date topic with DSM-5 including the diagnosis of cannabis withdrawal for the first time.

2. Predictive value of depression and neurocognitive impairment on auditory N100 latency in schizophrenia

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Numerous studies have found N100 amplitude deficits in schizophrenia, which are thought to reflect impairment in early auditory sensory processing and initial selective attention, and several authors investigated its relationship with positive symptoms. Instead, on latency of N100, few data have been reported and the findings are not robust. Until now, no investigation focused on N100 latency and its relations with psychopathology and cognitive deficits in schizophrenia. In the context of a multicentre study of the Italian Network for Research on Psychoses, we attempt to disambiguate the contribution of psychopathology and cognitive impairment on N100 latency in schizophrenia. ERPs were recorded, during an auditory odd-ball task, in 115 chronic stabilized subjects with schizophrenia (SCZ) and 63 healthy controls (HC). Psychopathology, neurocognitive functions and extrapyramidal side effects were measured by state of art instruments. Multiple stepwise linear regression analyses were used to determine the variables that predicted N100 latency for standard and target stimuli. Depression, parkinsonism, positive and disorganization dimensions, neurocognitive composite score and negative symptom domains were used as independent variables. SCZ did not differ from HC with respect to the latency of N100 for both stimuli. Regression models revealed that independent predictors of N100 latency were depression for standard tones ($B=0.256$, $p=0.010$) and neurocognitive composite for target tones ($B=-0.211$, $p=0.026$). Our results showed that speed of early processing was differently affected by depression and global cognitive impairment in SCZ, suggesting their involvement in poor activation of complex networks of the auditory cortical areas.

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3. Corticolimbic functional connectivity mediates the relation among early-life stress and suicidality in 5-HTTLPR s-carriers bipolar patients

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The relationship between early-life stress (ELS) and suicide in Bipolar Disorder (BD) has been widely investigated. The serotonin transporter genotype moderates this relation, indeed SLC6A4 (5-HTTLPR) S-carriers, compared to LL, present higher stress sensitivity that increase their suicide risk (Benedetti et al., 2014). Disregulation of corticolimbic functional connectivity (FC) is involved in pathophysiology of depression and BD, also related to suicidality and affected by ELS (Vai et al., 2014). Here we investigate the effect of 5HTTLPR on corticolimbic FC in BD-depressed patients, deepen a possible role of FC in mediating the detected relationship between ELS and suicidality in S-carriers. By using 3.0 T fMRI we found a significant interaction of 5HTTLPR and task condition (faces vs controlcondition) on FC between left-Amygdala and dorsolateral prefrontal cortex and anterior cingulate cortex in 64 BDpatients (CONN toolbox, cluster-size $pFDR < 0.05$): S-carriers showed higher positive FC, compared to LL, during emotional processing, suggesting a reduced prefrontal control on Amygdala activity. Mediation and moderation analysis on extracted Z-scores of FC were performed (5000 bootstrapped-samples, 95%-CI), showing that the relationship between ELS (Social-Readjustment-Rating-Scale) and FC, and this latter and suicide (item-3, HDRS-21) were moderated by genotype: in S-carrier, ELS increase FC, which subsequently increase suicidality. A significant mediation of FC between ELS and suicidality was confirmed in s-carrier, but not in LL. This results suggest that the S-carrier proneness to stress could be accounted by the interaction between gene and ELS on brain. Imaging-genetics of early stress could improve our understandings and treatments of BD.

4. Relationship between P3a and real-life functioning in subjects with chronic schizophrenia

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The impairment in different areas of real-life functioning represents a key aspect of schizophrenia. Different studies reported a relationship between functioning and P3a, an event-related potential associated with the automatic engagement of attention and novelty processing. However, the nature of this association is not very clear, as literature findings were not controlled for possible

confounds, such as cognitive impairment which might be crosscorrelated with both functioning and P3a. P3a for pitch- (p-P3a) and duration-(d-P3a) deviants stimuli were recorded in 125 chronic subjects with schizophrenia (SCZs) and in 61 healthy controls (HCs), recruited within the add-on EEG study of the Italian Network for Research on Psychoses. Within SCZs, we assessed functioning (using the Specific Level of Functioning Scale, SLOF), psychopathology and neurocognition. Multiple regression was used to investigate relationships between SLOF and P3a, age, gender, duration of illness, neurocognitive composite score of the MATRICS Consensus Cognitive Battery, Calgary Depression Scale for Schizophrenia total score, negative symptom domains of the Brief Negative Symptom Scale, positive and disorganization dimensions of the Positive and Negative Syndrome Scale (PANSS). Compared to HCs, SCZs showed a reduced amplitude of p-P3a and d-P3a. Linear regression demonstrated that p-P3a amplitude ($\beta=.329$, $p<.001$), avolition-apathy domain ($\beta=-.207$, $p=.019$) and PANSS positive dimension ($\beta=-.183$, $p=.038$) predicted the SLOF social acceptability domain, controlling for cognitive impairment and severity of the other psychopathological dimensions. Our results suggested that dysfunctions in the attention-mediated auditory processing are associated with social acceptability but not with other aspect of functioning such as instrumental and interpersonal skills.

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5. Non-Negative Matrix Factorization Reveals Resting-State Cortical Alpha Network Abnormalities in the First Episode Schizophrenia-Spectrum

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Background: Although subtle structural gray and white matter abnormalities are present in first episode psychosis, little is known about neural oscillatory dynamics during early illness. Pathophysiology of functional connectivity, thought to be a central factor in the emergence of psychosis, can be measured through network activity of alpha oscillations which may facilitate long-range communication between distal brain regions. Methods: Five minutes of resting Magnetoencephalography (MEG) were collected from 31 individuals with first-episode schizophrenia-spectrum psychosis (FESz) and 22 healthy controls (HC). Source activity was computed for the cortical surface and parcellated into 40 Brodmann areas per hemisphere. The first principal component for each region was Hilbert-transformed within the alpha range, and non-negative matrix factorization was applied to determine network architecture based on single-trial phase-locking values. Within networks, energy and entropy were calculated and compared between groups to identify regional network pathophysiology in FESz. Results: Four of the 17 cortical alpha networks identified were pathological in FESz. The networks involved areas thought to be pathological in psychosis including left temporal lobe, right inferior frontal cortex, right

posterior parietal cortex, and bilateral cingulate cortex. The energy and entropy of network activations were compared between FESz and HC using the Wilcoxon rank sum test. Conclusion: Network analysis of resting alpha-band neural activity identified several aberrant networks in potentially pathologically-relevant areas in FESz, suggesting abnormal long-range system-level communication is evident at the first presentation for psychosis. Identification of pathophysiology in these networks may provide clues about mechanisms of disconnectivity and novel targets for non-invasive stimulation.

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6. Positive Psychology Course and Its effect on Well-Being, Social, and Emotional intelligence

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Objective. The present study examines whether the Positive Psychology course, which is given for 14 week and 3 hours per week to students at a university in Istanbul. Materials and Methods. 417 students participated. The study assessed pre- to post-test modifications in personal and mental well-being, happiness, satisfaction of life, emotional and social intelligence, emotional expressions and attachment styles factors. Results. The findings showed that significant differences between male and female gender in emotional and social intelligence. Interestingly, Results of paired sample t-test for females have significant difference on Positive Subscale of Emotional Expressivity Scale ($t=-2,047$: $p=0,042<0,05$), Negative Subscale of Emotional Expressivity Scale ($t=-2,052$: $p=0,041<0,05$), Personal Well- being Index ($t=4,65$: $p=0,00<0,05$), Social Information Processing Subscale of Tromso Social Intelligence Scale ($t=-1,997$: $p=0,047<0,05$), Social Skills Subscale of Tromso Social Intelligence Scale ($t=2,792$: $p=0,006<0,05$), Social Awareness Subscale of Tromso Social Intelligence Scale ($t=5,624$: $p=0,00<0,05$), Oxford Happiness Questionnaire ($t=2,112$: $p=0,036<0,05$), Total of Tromso Social Intelligence Scale ($t=-3,329$: $p=0,001<0,05$), Management Own Emotions Subscale of Bar-on Emotional Quotient Inventory ($t=-3,576$: $p=0,00<0,05$). Females reported significantly greater levels of positive emotional expressiveness, negative emotional expressiveness, social information processing and kendi duygularını yönetme on posttest compared to pretest. Discussion. It was necessary to discuss these results in a new perspective. The point reached at the end of the Positive Psychology course was not a happier life. Also, if the increase in awareness causes someone to find a deeper meaning, then happiness and well-being will be decreased at the beginning.

7. Correlation of EEG with Intracranial Pressure and Cerebral Hemodynamics during Burst-Suppression

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The physiological relationship between electroencephalography (EEG), intracranial pressure (ICP), and cerebral hemodynamics is poorly understood. Here we demonstrate work in correlating EEG with hemodynamic responses during burst-suppression states in non-human primates. Data were collected through acute experiments on non-human primates. All experiments and procedures were approved by the University of Pittsburgh and Carnegie Mellon University Institutional Animal Care and Use Committees. ICP and ABP was measured through invasive pressure probes in the parenchyma and external carotis, respectively. EEG was measured using 4 cup electrodes placed directly onto exposed skull using screws above the occipital and parietal cortices. Our preliminary results show that ICP and HbT change as a function of burst activity in the brain. Burst onset corresponded to a rise in ICP by 40%; a change of approximately 3mmHg. HbT simultaneously dropped by 0.2-0.3uM followed by a 0.5uM increase. ABP showed no significant change due to burst onset when compared to ICP changes. More work is needed to quantify the neurovascular relationship, specifically as a function of ICP baselines. Correlation of the hemodynamics with EEG may allow for quantifying intact neurovascular coupling in acute brain injury.

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8. Cerebral correlates of neurological soft signs in chronic schizophrenia

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Recent structural neuroimaging studies on the cerebral correlates of NSS focused on patients with first episode or recent onset schizophrenia. These findings may not apply to patients with chronic schizophrenia as longitudinal studies since NSS were found to increase with chronicity of the disease. 49 middle-aged patients with chronic schizophrenia (mean age: 42.3 ± 14a, duration of illness: 20.3 ± 14a) and 29 healthy subjects (mean age: 48.2 ± 14a) matched for age and sex were included. NSS were examined on the Heidelberg Scale and correlated to grey matter density by using whole brain high resolution magnetic resonance imaging (3 Tesla) with SPM12 analyses (FDR corrected). As expected, NSS were significantly ($p < 0.001$) higher in patients than controls. Patients showed significantly reduced gray matter volumes in the right inferior frontal gyrus and left parahippocampal gyrus, respectively. Within the patient group, NSS total scores were significantly correlated to reduced grey matter in the right occipital lobe, the left parahippocampal and superior temporal gyrus, the left thalamus (medial dorsal nucleus) and the left posterior lobe of the cerebellum (declive). These results were confirmed when chlorpromazine (CPZ)-equivalents were introduced as additional covariate; moreover, no significant correlates arose between NSS and CPZ-equivalents. In the healthy controls, solely NSS total scores were significantly ($p < 0.05$) correlated with the volume of right lentiform nucleus (medial globus pallidus). This pattern of cerebral changes in chronic schizophrenia differs from that typically found in patients with recent onset schizophrenia.

9. Parahippocampal Gyrus Thickness is Reduced and Associated with Hallucinatory Behavior and Verbal Fluency in the First Episode Schizophrenia Spectrum

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The early course of schizophrenia is associated with a progressive decrease in gray matter; however, it is unclear which structures decline first and how gray matter decline relates with cognition and symptoms. We examined these relationships in first episode schizophrenia-spectrum (FESz) individuals at their first contact with psychiatric services. T1-weighted MRI scans were acquired on 33 first-episode (FESz) and 32 matched healthy control (HC) individuals. Cortical thickness was estimated for 35 bilateral ROIs (Desikan-Killiany atlas) using Freesurfer. A cluster-based permutation test was used to determine significant group differences. Symptoms were rated with the Positive and Negative Syndrome Scale. Participants completed a category fluency task, naming as many animals as they could in one minute. FESz displayed a significant decrease in left fusiform gyrus, right insula, and right parahippocampal gyrus thickness ($p < .05$). Decreased parahippocampal gyrus thickness in left ($r = .37$, $p < .05$) and right ($r = .41$, $p < .05$) hemispheres were associated with worse verbal fluency. Increased right parahippocampal gyrus thickness was significantly associated with increased hallucinations ($r = .46$, $p < .05$). Right parahippocampal, right insula, and left fusiform gyrus thickness are reduced in FESz. Parahippocampal gyrus thickness is associated with verbal fluency and hallucinatory behavior in FESz. This may reflect the role of the parahippocampal gyrus in verbal memory, and abnormalities in verbal memory may impact hallucinations in schizophrenia. This likely occurs very early in disease course, as parahippocampal volume is also reduced in high-risk patients who convert to psychosis.

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10. Anterior Temporal Naming Area: a Patch Near the Anterior Tip of the Fusiform Causally Linked to Reading and Language

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The role of the ventral anterior temporal lobe in language processing remains unclear. In particular, electrical disruption of regions stretching along much of the ventral temporal cortex has

been shown to affect naming. Here, we present intracranial electrophysiology, direct cortical stimulation, and 7T fMRI results that describe a new Word sensitive region near the anterior tip of the fusiform gyrus, which we dub the anterior temporal naming area. In 5 neurosurgical epilepsy patients undergoing intracranial electroencephalography, electrodes near the left anterior fusiform exhibited word sensitivity over five other categories of visual stimuli (faces, bodies, houses, hammers, and phase-scrambled images). For 2 patients, those same electrodes also displayed sensitivity to non-words, such as letter strings and pseudo words. Direct cortical stimulation was administered to 2 patients (P1 and P2), disrupting word and picture naming when applied to the word sensitive electrodes in both individuals and resulting in item circumlocution for P1. Additionally, the word selectivity demonstrated in our intracranial and stimulation studies is consistent with 7T fMRI findings in healthy controls, which display preferential orthographic sensitivity versus line drawings of objects anterior to the visual word form area, near the anterior fusiform. Taken together, our results strongly suggest the presence of a word sensitive patch near the anterior tip of the fusiform gyrus that is critical for naming and language, but not conceptual knowledge per se.

11. Major Depressive and Bipolar Disorder Differentiation based on Hilbert Transform

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The purpose of the study is to recognize multivariate synchronization differences in the major depression and bipolar disorders based on empirical mode decomposition of multi-channel EEG signals. This approach will enable for better individualized treatment approach based on pre- and post-assessment of mental diseases. This paper focuses on an application to the multivariate empirical mode decomposition (MEMD). EMD will be based on time–frequency analysis of EEG records. In the proposed method, Multivariate EMD-Phase synchronization analysis associated with Hilbert Transform has demonstrated successfully understanding phase synchronization behavior of the brain function. The synchronization index is one of the most important tools for phase synchronization analysis. We then classified discriminative synchronization indices for two different mental disorders (i.e. Bipolar and Major Depression). The results obtained indicate that there is strong relation between Bipolar Disorders and Major Depressions. When compared to normal subjects, there is relevance to the loss of synchronization for beta-gamma bands. EEG signals are digitized by a sampling rate of 125 Hz and recorded between 0.1 and 70 Hz with 12-bit resolution on 10–20 international system by 14 channels. A notch filter of 50 Hz were utilized to remove the noise and power line interference. 18 depression patients and 17 bipolar patients have been implemented. We concluded that the local separation of fast and slow mean frequencies is unique when compared to normal subjects in smooth manner.

12. Deficits in Attentional Modulation of Auditory Stimuli in First Episode Schizophrenia

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The late perceptual N100 auditory evoked potential is reduced in long-term schizophrenia and in the first episode schizophrenia spectrum (FE). It is not known whether the deficits are purely sensory in nature or reflect the inability of executive control cognitive centers to modulate sensory processing by selective attention. The N100 is increased in healthy individuals when sounds are attended, providing an objective measure of selective attention effects. Eighteen FE individuals and 17 matched healthy controls (HC) were compared on two auditory attention tasks. In the single tone task, participants ignored the tones in one block and pressed a button to every 7th tone in another block. In the twotone “oddball” task, participants ignored tones in one block and pressed to the oddball tone (infrequent higher frequency tone) in another. Attentional modulation of the N100 was marginally impaired in FE (Group x Attention, $p = 0.06$). The increase in N100 was greater for the oddball task ($p = 0.04$) and follow up analyses revealed that FE did not modulate N100 during the oddball task with attention to the same extent as HC ($p = 0.05$). This deficit may reflect a long-range functional disconnection between cognitive control cortical areas and sensory cortex early in disease course. This difference in N100 modulation between groups may be useful in learning more about the neurophysiology of the disease and could be utilized as a potential biomarker for diagnosis among clinically high-risk individuals.

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13. QEEG-Power of Spectral Dencity of brain regions correlated with risk and resistance for bipolar disorder: Comparing with first degree relatives and unrelated healthy subjects

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Background: Temperament originates in the brain structure, and hereditary individual differences are attributable to neural and physiological function differences. Affective temperament is a suggested endophenotype for BD as well. qEEGPower of Spectral Dencity are considered as an index of the brain’s general affective and cognitive activity. The relationship between these two may help to identify brain functional endophenotypes associated with predisposition for bipolar disorder. Methods: TEMPS-A and resting state QEEG were acquired for 25 euthymic patients, their healthy first degree relatives ($n = 25$) and 25 unrelated healthy controls. All of patients were used lithium for maintenance treatment. Results: Cyclothymic and hyperthymic temperaments scores were found to be similar between patients and their relatives ($F = 18.43$, $p < 0.005$). F4 and T4 delta activity were similar between patients and their relatives, whereas Pz alpha activity in relatives and unrelated healthy subjects ($F = 20.08$, $p < 0.05$ and $F = 14.85$, $p < 0.05$). F7 beta and F7-O2 high beta power were correlated with hyperthymic and irritable temperament in bipolar patients, respectively ($r = 0.387$, 0.439 , 0.364). T3-F4-T4 delta power were correlated with cyclothymic temperament in patients and healthy relatives ($r = 0.420$, 0.443 , 0.505 and 0.334 , 0.258 , 0.372). There was found an inverse correlation between Pz alpha power and hyperthymic temperament in healty relatives and unrelated healthy subjects ($r = 0.256$ and 0.311). Conclusion: Medial temporal network seems to be associated with the heritability of bipolar disorders. However, left dorsolateral prefrontal beta and high beta activity may be a neural marker of a resistance factor for the disorder.

14. Dynamic Source Imaging of Ictal Activities in Focal Epilepsy Patients

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Scalp EEG is the only established non-invasive electrophysiological mapping tool that provides reliable seizure recording for pre-surgical evaluation of epilepsy. However, electrical source imaging (ESI) of ictal scalp EEG to localize the seizure onset zone (SOZ) remains challenging. Using a long-term dense-array EEG monitoring protocol along with a dynamic seizure imaging (DSI) algorithm, we were able to localize the ictal activity in concordance with surgically resected zones and ictal intracranial EEG recordings in the cohort of patients. 6 patients with focal epilepsy who had acquired T1 weighted MRI imaging with long-term 76-channel EEG recording were included in this study. All 6 patients had intracranial EEG recording and underwent resective surgery with at least 6-month follow-up. Seizures were visually inspected and the electrophysiological onset were identified by experienced clinicians. The recordings were also down-sampled to explore the effect of different montages. The localization results at the seizure onset were then compared with the SOZ electrodes, extracted from CT images and based on physician's reports. The mean localization error between the estimation and the SOZ electrodes is approximately 1.19 cm. In the subset of patients who became seizure-free, the localization error is smaller. Our results demonstrate the capability of imaging spatiotemporal seizure sources noninvasively, which nowadays can only be achieved by invasive procedures in clinical practice. It was also shown that the localization accuracy improves when electrode numbers are increased, which suggests the benefit of using high resolution EEG recording system.

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15. Prediction of Drug Resistance in Obsessive Compulsive Disorder Using EEG Complexity

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Obsessive Compulsive Disorder (OCD) is a common disorder with a life-time prevalence of 2.3 percent. The disorder is characterized by recurrent intrusive thoughts (obsessions) and repetitive behaviors (compulsions (DSM-5). The mainstay of the pharmacological treatment of OCD are selective serotonin reuptake inhibitor (SSRIs) and cognitive-behavioral therapy (CBT), producing a response in only 50% of patients. Accordingly, clinicians frequently encounter "treatment-resistant" cases of OCD, who do not respond adequately to conventional treatment modalities. Identifying treatment resistant patients early in the treatment course is an important goal in clinical practice. In this study, we have examined quantitative EEG recordings for predicting drug resistance in OCD patients. Thirty-seven patients responding to SSRIs and 28 resistant cases were identified retrospectively. Approximate Entropy (APEN), which is a well-

known complexity measure, was used as a potential biomarker for extracting EEG features. APEN features were extracted from raw EEG data (0-50 Hz) after data filtered according to four common frequency bands namely delta (0.5-4 Hz), theta (4-8 Hz), alpha (8-12 Hz) and beta (12-24 Hz) bands. The classification performance of feature vectors corresponding to five frequency bands were tested using a Random Forests classifier. The results indicated that it is possible to identify drug resistance with a classification accuracy of 75.28%, 68.99%, 89.95%, 63.91% and 64.78% with APEN features extracted from raw data, alpha, beta, delta and theta bands respectively. These results suggest that APEN could be a promising measure for identifying patients who would not respond to medications.

16. Electrophysiological Correlates of Learning and Emotion in Parkinson's Disease

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The dopaminergic reward system is the focus of intensive research because of its relevance to disorders such as addiction, obesity, Parkinson's disease (PD), schizophrenia, and depression. The current study was aimed to test whether learning effects on a measure of reward expectancy, the stimulus-preceding negativity (SPN), were dopamine mediated. A secondary goal was to test whether dopamine involved in processing of emotions triggered by positive and negative feedback displays. Parkinson's disease patients and healthy controls were tested via a probabilistic categorization task, in which they required to find out which of two doors was usually followed by a pleasant Picture and which by an unpleasant one. During the task procedure measurements for learning (i.e., changes in SPN) and emotion (i.e., late positive potential, startle blink reflex, and self-report) were recorded. Spontaneous eyeblink rate, an index of striatal dopamine level, of each participant was also recorded. Results showed that SPN learning effects seen in the control group were reduced in the patient group. Post-experimental questioning and SPN topography suggested that patients might have compensated for impairments in their dopamine-dependent reinforcement learning system by switching to declarative memory. Consistent with prior findings, participants with Parkinson's disease were less responsive to negative feedback as indicated by late positive potential. Patients with low spontaneous blink rate tended to exhibit reduced affective modulation of startle blink. Dopamine plays an important role in both anticipation and receipt of task feedback.

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17. Corticomuscular functional coupling assessment based on multifractal asymmetry cross-correlation analysis of EEG and EMG

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A large number of studies on animal cerebral cortex have demonstrated the presence of scale-affine dynamics in the patterns of neuronal avalanches. The scaling behavior between EEG and EMG signals can elucidate the dynamical mechanism of corticomuscular coupling function. To investigate the functional coupling between M1 and muscles, the multifractal asymmetric cross-correlation analysis (MF-ADCCA) method is adopted to analyze the time series of EEG and EMG in different coupling forces. The M1 and EMG signals during steady-state isometric contraction of right wrist flexor were recorded simultaneously from 12 right hand healthy subjects. In order to obtain homogenous EEG and EMG signals without motion artifacts and noise interference, a segmentation algorithm based on Jensen- Shannon entropic divergence and time irreversibility analysis is used to find common segments which have same boundaries. The processed EEG and EMG signals are analyzed by MF-ADCCA. The experimental results show that all the generalized fractal dimensions are greater than 0.5, which means that there is long-range persistent between EEG and EMG. Also, the cross-correlation between EEG and EMG are asymmetric and the asymmetric is obvious in the small fluctuation. With the increase of coupling force, the generalized hurst index of small fluctuation shows an increasing trend and the range of change from EEG to EMG is larger than EMG to EEG.

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18. Noninvasive Imaging Inter-Ictal Activity from Scalp EEG by Means of an Iterative Reweighted Edge Sparsity (IRES) Algorithm

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About one third of epilepsy patients do not respond to any medication, and surgical removal of the epileptogenic tissue is a viable option to stop seizures. The precise determination of the seizure onset zone (SOZ) is critical for presurgical guidance or intracranial grid placement. In this study, we aim to image the epileptic activity of the brain noninvasively from scalp EEG with an objective and computationally efficient technique. We have collected and analyzed pre-surgical MRI and high-density EEG recordings from 10 medically intractable epilepsy patients, from which an individual and realistic head model was made for each patient and inter-ictal spikes were extracted. More specifically, the EEG recordings were first pre-processed and then passed through a semi-automated detector to label out all potential candidates of the inter-ictal spikes, which were averaged to improve the signal-to-noise ratio. Solving the inverse problem using our recently proposed IRES method, we estimated the spatial location and extent of the interictal activity for each patient. The estimated results match well with the location and extent of the clinical findings defined by surgical resection and/or SOZ from intra-cranial studies. The results indicate a localization error of about 5 mm for resection and 10 mm for SOZ electrodes. The estimated source patch falls well inside the surgical resection volume and covers around 80% of the volume size. The capability of this algorithm to accurately localize and objectively determine the extent of the underlying epileptic brain sources is of crucial interest in studying epileptic brain and pre-surgical planning.

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