دومین کنگره بین المللی

2nd نقشه برداری مغز ایران

Iranian Congress on HUMAN BRAIN MAPPING

Message from the President of National Institute for Medical Research Development (NIMAD)

Dear Participants,

It is a pleasure to welcome you to the 2nd Iranian Congress on Human Brain Mapping. The 1st Congress last year coincided with the inauguration of National Brain Mapping Centre. This center works under auspices of National Institute for Medical Research Development (NIMAD). NIMAD is the only governmental grant awarding body dedicated to medical research in Iran.

Supporting brain sciences and promoting translational research in the field is one of NIMAD's top priorities. Brain mapping technologies are at the forefront of translational research in neuroscience. It has helped unlocking many mysteries in the brain in the last few decades, from identification of vulnerable brain regions in different neurological disorders to discovery of possible mechanisms of cognitive processes such as decision-making. I have no doubt that this trend will continue and even more important discoveries in brain sciences are yet to come.

I encourage all basic and clinical neuroscientists to actively participate in this congress which I am sure will be yet another success for the community.

Reza Malekzadeh MD AGAF
Distinguished Professor of Medicine
Minister's Deputy For Research and Technology &
Ministry of Health and Medical Education & President,
National Institute for Medical Research Development (NIMAD)

Message from the Congress Chairman

Dear Participants,

It is my pleasure to welcome you to the 2nd International Human Brain Mapping Congress in Tehran, Iran. This congress is aimed to create a venue for sharing the cutting-edge advances in the brain mapping domain. Some of the pioneers of brain mapping have accepted our invitation to give talks in this year congress. As before, we thrive to reflect our moto; “Brain mapping, from molecule to medicine”. This year we will have more contribution from clinically oriented scientists. I am sure your presence will enrich the academic atmosphere of the Congress.

Mojtaba Zarei MD PhD MRCP (UK)
Professor of Neurology and Neuroscience
Director, National Centre for Brain Mapping

Message from the Scientific Secretary

Dear Colleagues,

It is my pleasure to invite you to attend the 2nd Iranian Human Brain Mapping congress. The second annual meeting of brain mapping gives us a unique opportunity to gather and network with our colleagues from around the world in a professional environment.
In these three days, we will have an opportunity to discover best of practices in the research of the structure and function of the brain. Scientists from pioneering labs around the world will present their findings to provide a unique opportunity to learn and discuss new methods on how the brain works.
Science has improved by sharing information. Your attendance in this event will make it even more spectacular. We thank you for your presence in the first meeting and hope to have an opportunity to meet you again. More importantly, we hope the meeting addresses our greater mission of understanding how the brain works.

Ali Yoonessi MD PhD
Assistant Professor of Neuroscience
Tehran University of Medical Science

Iran Human Brain Mapping Committees 2015

Program Chair: Mojtaba Zarei, Professor of neurology and neuroscience, National Institute for Medical Research Development
Scientific Secretary: Ali Yoonessi, Assistant professor of neuroscience, Tehran University of Medical Science
Executive Secretary: Reza Khosrowabadi, Assistant professor of biomedical engineering , Shahid Beheshti University

Scientific committee members

Abbas Alavi, Professor of nuclear imaging , University of Pennsylvania, USA
Mojtaba Zarei, Neurologist and professor of neuroscience, National Brain Mapping Center, Iran
Ali Yoonessi, Assistant professor of neuroscience, Tehran University of Medical Science, Iran
Hamidreza Pouretemad, Professor of neuropsychology, Shahid Behehsti University, Iran
Reza Khosrowabadi, Assistant professor of biomedical engineering, Shahid Behehsti University, Iran
Masoud Tahmassian, Neuroscientist, University of Cologne, Germany
Manouchehr Seyedi Vafaee, Associate Professor of neuroscience, University of Copenhagen, Denmark
Mohammad Ali Arami, Neurologist, Milad General Hospital, Iran
Mohammad Karimi, Neurologist, Milad General Hospital, Iran

Executive committee members

Reza Khosrowabadi, Assistant professor of biomedical engineering, Shahid Behehsti University, Iran
Ali Yoonessi, Assistant professor of neuroscience, Tehran University of Medical Science, Iran
Nazila Sepehrkia, Research Coordinator, National Brain Mapping Center, Iran
Mr Shafiei, Finance Coordinator, National Brain Mapping Center, Iran

Abbas Alavi, professor of Nuclear Medicine, University of Pennsylvania, is a physician_scientist specializing in the field of molecular imaging. He is the pioneer in PET imaging. He was the first to perform human PET studies in human using [18F]FDG in 1974.

Albert Gjedde is professor of Neurobiology and Pharmacology at the Faculty of Health Sciences and Head of Department of Neuroscience and Pharmacology at theUniversity of Copenhagen. He was trained in Denmark and Canada. He has vast experience in Brain PET imaging and cerebral metabolism.

Jyrki Mäkelä is a clinician_scientist in BioMag Laboratory, Helsinki University Medical Imaging Center, Helsinki University Central Hospital, Finland. He has expertise in MEG assessment of epilepsy patients.

Sven Braeutigam is the head of the Department of Physics at Oxford Centre for Human Brain Activity, University of Oxford. He specializes in Magneto-encephalography technology.

Mojtaba Zarei, professor of Neurology and Neuroscience, National Brain Mapping Centre, Tehran, Iran. He was trained in Shiraz, London, Oxford, Cambridge and Chicago. He has expertise in neuroimaging and neurodegenerative disorders.

Thilo van Eimeren, is professor at the Department of Nuclear Medicine and a Consultant Neurologist, University Hospital of Cologne, Germany. He has expertise in PET imaging in movement disorders.

Mir Shahram Safari, is a research scientist, Riken Brain Science Institute, Japan. He was trained in Tehran and Japan. He has expertise in in-vivo electrophysiological recording in primates.

Abbas Nasiraee Moghadam, is an assistant professor of biomedical engineering. He was trained in Tehran, Canada and USA. He currently also works at IPM, Tehran. He has expertise in MRI physics.

Behrooz Hooshyar Yousefi is an associate professor in the Department of Nuclear Medicine Department, Technical University of München, Germany. He has experties in PET neuroimaging.

Masoud Tahsamian is a research scientist, Neuroimaging Research Group, Max Planck Institute of Psychiatry, Munich, Germany. He was trained in Kermanshah and Munich. He has expertise in fMRI in neurodegenerative disorders.

Ali Khatibi, Trained in Tehran, Belgium and Canada. He is now an assistant professor at the Psychology Department, Bilkent University, Ankara, Turkey. He has interest in pain psychophysiology.

Hamidreza Saghaei is an assistant professor of biomedical engineering, Tehran University of Medical Sciences. He was trained in Tehran, Kingston, Canada and University of Pennsylvania, USA. He has expertise in MRI physics.

Ali Yoonessi, is an assistant professor of Neuroscience, Tehran University of Medical Sciences, He was trained in Tehran, Montreal and New York. He specializes in visual cognitive neuroscience.

Reza Khosrowabadi is an assistant professor of Biomedical Engineering, Shahid Beheshti University, Tehran. He was trained in Tabriz and Singapore. He specializes in Neural signal and image data processing.

Ehsan Shamsi is an assistant professor of Medical Ethics, Tehran University of Medical Sciences. He was trained in Shiraz and Austria. He is the secretary of National Committee for Medical Ethics, at the MoH.

Atsanch Taher, a consultant neuropsychiatrist, National Brain Injury Unit, Northampton, UK. She was trained in Shiraz, London and Oxford. She has expertise in neuropsychiatry, epilepsy, and learning disability.

Ali Arami, a consultant neurologist at Milad Hospital, was trained in Tabriz and Germany. He has experties in intraoperative corticography.

Manouchehr Vafaee is an associate professor of Neuroscience, University of Copenhagen, Denmark. He was trained in Tehran, and Montreal. He has expertise in PET imaging.

Saeed Saneii is a professor of Neuroengineering, Surrey University, UK. He was trained in Tehran and London. He has expertise in biosignal processing.

Gabriel Castrillon is a researcher at Neuroimaging Center, University of Munich, Germany. He has expertise in transcranial Magnetic stimulation.

Frank Schwartz, is a researcher at the Department of Neurology, University Hospital of Cologne, Germany. He was trained in Germany and has interest in PET imaging.

Amin Jahanbakhshi, is a clinician - scientist in neurosurgery, National Brain Mapping Centre, Tehran. He was trained in Tehran.

2nd Iranian Congress on Human Brain Mapping Program			
	Saturday 14 Nov	**Sunday 15 Nov**	**Monday 16 Nov**
8:00-8:30	**Registration**		
8:30-9:00	Welcome talks TBC	**Mir Shahram Safari** Optogenetic and two-photon laser scanning microscopy approaches for functional mouse brain mapping.	**Sven Braeutigam** MEG - foundations and analytical methods
9:00-9:30	**Behrooz Yousefi** Novel radiotracers for imaging proteopathies in neurodegenerative disorders	**Manouchehr Vafaee** Imaging dopaminergic system in Attention Deficit Hyperactive Disorders	**Mojtaba Zarei** Presurgical evaluation using fMRI, DTI and sMRI
9:30-10:30	**Abass Alavi** Molecular imaging with PET;unavoidable future of science and day to day practice of medicine	**Albert Gjedde** The roles of aerobic glycolysis and lactate transmission in brain at different ages	**Jyrki Makela** Accepted and emerging clinical MEG applications in medical and surgical neurology
10:30-11:00	Break		
11:00-11:30	**Thilo van Eimeren** What tau imaging tells us about neurodegeneratio?	**Thilo van Eimeren** How dopaminergic drugs cause behavioral addictions	**Saeed Sanei** Advances on joint EEG-fMRI analysis
11:30-12:00	**Masoud Tahmasian** Multimodal neuroimaging in neurodegenerative disorders using PET/fMRI	**Frank Schwartz** Parkinson disease subtypes show a specific link between dopaminergic and glucose metabolism in striatum.	**Gabriel Castrillon**Disturbing and testing communication in functional brain networks using transcranial magnetic stimulation
12:00-12:30	**Abass Nasiraee-Moghadam** Averaged-BOSS, a novel fMRI technique to enhance functional contrast	**Reza Khosrowabadi** Using graph theory in analysis of task free fMRI data to screen autism	**Ali Khatibi** Cerebrospinal correlates of vicarious pain modulation

12:30-13:00	**Hamidreza Saligherad** What can a physicist add in clinical MR neuroimaging ISMRM mission	**Ali Yoonessi** Measuring attention and cue-reactivity in methamphetamine users	**Mohammadali Arami** Intraoperative corticography in Iran
13:00-14:00	Lunch		
14:00-14:30	**Gabriel Castrillón** Preprocessing fMRI	**Abass Alavi** Challenges of life and how to charge ahead with determination in spite of obstacles placed along your path	**Saeed Sanei** Practical issues in EEG data analysis1
14:30-15:00	**Masoud Tahmasian**BOLD signal and resting-state fMRI	**Ehsan Shamsi** Medical Ethics and Neuroscience	**Reza Khosrowabadi** Practical issues in EEG data analysis2
15:00-15:30	Break		
15:30-16:00	**Masoud Tahmasian** Seed-based functional connectivity	**Afsaneh Tajer** Women in neuroscience, opportunities and challenges	**Sven Braeutigam** MEG data acquisition
16:00-16:30	**Gabriel Castrillón** Graph based analysis	**Amin Jahanbakhshi** Bottom-up view of a clinician-scientist in Iran	**Sven Braeutigam** MEG preprocessing
16:30-17:00	**Thilo van Eimeren**Independent Component Analysis	**Mojtaba Zarei** Iran Ministry of Health Clinician-Scientist Program	**Sven Braeutigam** MEG Analysis

Poster Display
All posters will be displayed in poster hall during three days of the conference.

Set Up Time
Please set up your poster from 8:30 – 9:00 am on the first day of the conference.

Daily Poster Stand By Session Times: 10:30 - 11:00 am, 15:00-15:30.
Presenting authors should stand by their poster during the assigned time. Attendees expect authors to be available and willing to engage in dialogue about the work displayed. Any author on the abstract is eligible to present at the meeting.

Cognitive Functional Patterns in the Early Stages of MS Patients Using fMRI

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[2.]School of Cognitive Sciences (SCS), Institute for Research in Fundamental Science (IPM), Niavaran, Tehran, Iran.
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[4] Control and Intelligent Processing Center of Excellence, School of Electrical and Computer Engineering, University College of Engineering, University of Tehran, Tehran, Iran.

Abstract - The structural damages exist in the brain of multiple sclerosis (MS) patients can cause dysfunction of physical or cognitive abilities in MS patients [1-3]. Cognitive deficits are frequently found in early phases of MS patients [4, 5]. These impairments include many different cognitive domains such as attention, memory, executive functions and information processing speed [2, 6-8] that seems they can lead to alternations in connectivity [1, 6]. Brain's functional connectivity changes related to specific cognitive tasks can be investigated with blood oxygenation level dependent (BOLD) functional magnetic resonance imaging (fMRI) [2, 9].

In this study, we applied fMRI data to study the activation patterns relevant neural hemodynamic responses during attention and working memory task using 3.0 Tesla scanner. Patients with clinically isolated syndrome (CIS) and clinically definite relapsing-remitting MS (RRMS) in the early stages and healthy subjects matched for age, years of education and handedness were scanned during Paced Auditory Serial Addition Task (PASAT) [2, 3, 6] in Persian version. During PASAT task, a random series of single numbers was presented in an auditory way, and the subjects were required to add each digit to the one immediately preceding it and reported the result by pressing the response box keys in comparing

with target number. FMRI data were preprocessed using FSL software. The analysis of preprocessed data hence was based on the analytical method of general linear model (GLM) which is the most widely used approach to analyze and inference of fMRI data.
According to this method, the time series of each voxel is statistically related to task paradigm corresponding to the repetition, in a temporal succession, consequently to which phases of activation and baseline phases are alternated. The results indicate that BOLD signal intensity changes could follow the specific model of temporal sequence of cognitive task as well and accordingly show the altered patterns of activity related to cognitive functions between two groups. These finding also suggest the feasibility of fMRI to monitor early cognitive impairments during disease progression.

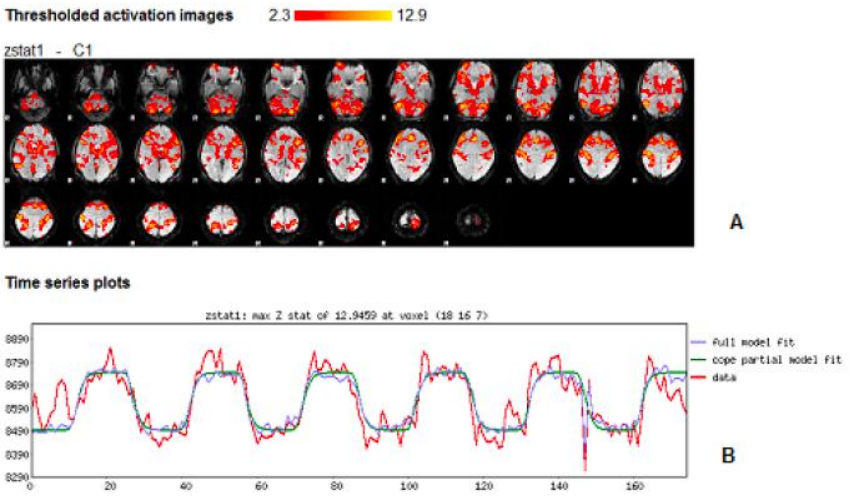

Fig. 1. (B) Correlation between the BOLD signal intensity changes (red line) and a specific model (blue line) of temporal sequence of stimuli presented (PASAT) to the MS subject, and **(A)** corresponding PASAT activation pattern.

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Subtype Specific Pattern of Gray Matter Changes in ADHD

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Abstract - Attention deficit/hyperactivity disorder (ADHD) is one of the most common neurodevelopmental disorder which influences structure and function of central nervous system [1-3]. ADHD subtypes including hyperactivity-impulsivity, attention deficit and combined subtype are currently known to differ according to age at onset, evolution of symptomatology, prevalence by gender, and comorbidity. The most marked differences among them involve behavior, attention, and social relations, suggesting the existence of differences in the underlying neurobiology. Recent neuroimaging studies have demonstrated different effects of subtypes on not only whole brain structure but also on focal brain areas. However, specific changes in individual subtypes have not been fully understood. In this study, brain anatomy of 55 ADHD subjects and 30 healthy controls (15 male) are recorded by MRI technique [4]. Brain is segmented to gray, white matter and CSF segments. Then, the gray matter part is parcellated to 116 regions of interest (ROI) using automatic anatomical labeling (AAL) method. Two groups of ADHD subtypes including combined (ADHD-C: N=25, 13 male) and inattentive (ADHD-I: N=30, 15 male) subgroups are compared to each other and to control group. Compared to control group, ADHD-C had significantly greater gray matter in right insula and cerebellum at part 9 ($p < 0.05$, FDR corrected). In contrast, ADHD-I group showed significantly greater gray matter in right hippocampus, insula, cerebellum at parts 4,5,6 and left cerebellum at part 6 ($p < 0.05$, FDR corrected). Moreover, ADHD-I group showed smaller gray matter at right cerebellum-part 9 and greater gray matter volume at right cerebellum-part 6, hippocampus and fusiform areas ($p <0.05$,

uncorrected). The results indicate that individual ADHD subtypes influence the brain anatomy in a subtype specific way; more dominantly on cerebellum and hippocampus areas.

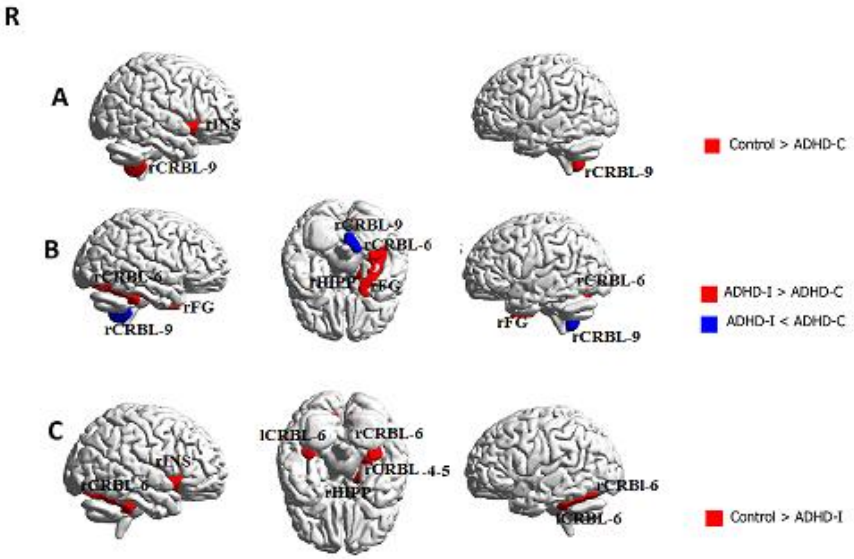

Figure 1. Alteration of gray matter intensity in subtypes of ADHD. A: ADHD-Combined subtype compared to healthy control group; B: ADHD-Inattentive subtype compared to ADHD-Combined subtype; C: ADHD-Inattentive subtype compared to healthy control.
Abbreviations: INS – Insula; FG – Fusiform Gyrus; HIPP – Hippocampus; CRBL-4,5,6,9 – Cerebellum- part 4,5,6,9; ADHD-C – ADHD-Combined subtype; ADHD-I – ADHD-Inattentive subtype Inattentive subtype; r – right; l – left.

Keywords: MRI, ADHD Subtype, Gray Matter Alteration

Reference

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Seeking Brain-based Activities Related to Sustained Attention in Electroencephalography Data Using Time and Frequency Domain ICA

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Abstract - Recently, Independent Component Analysis (ICA) has been widely used for studying EEG signals. In this approach, multi-channel EEG recordings are decomposed into a number of maximally temporally independent components (ICs) equal to the number of electrodes. Generally, ICA algorithms are inherently biased towards finding artifacts such as eye blink, muscle movement (EMG) and other technical noises against finding components whose related to brain activity. The main reason is artifact's amplitudes have more non-Gaussian distribution while oscillatory activities of brain sources are often near Gaussian.

Therefore, in numerous studies ICA is usually applied for separation and rejection artifacts from spontaneous EEG whereas only few studies have examined its potential application in finding brain-based activities. They proposed after suitable sparsifying transformation of the data, ICA is likely to reveal oscillatory EEG sources since they will have non-Gaussian distribution in the new domain. To this end, we employed Wavelet-ICA technique and developed procedure to evaluate and compare its performance in identifying brain-based components with traditional time-domain ICA.

In this research, we investigated the electroencephalographic data recorded from a healthy normal subject during a continuous performance task (CPT). CPT is among the most popular tests for evaluating sustained attention which is defined as the ability of maintenance vigilance and consistent behavioral responses during continuous and repetitive processing of stimuli.

The procedure of preprocessing, including baseline correction, band pass filtering, notch filtering, eye blink removing and rejection of abnormal values of amplitudes,

spectra and also trend was performed. Then, two mentioned algorithms decomposed the data into separate sets of 21 components using the Multi-Combi algorithm from ICALAB toolbox. The type of Wavelet function was Daubechies with 4 levels. Single equivalent dipole source localization for each independent component was computed by a four-shell spherical template of the brain using DIPFIT toolbox. Each extracted components were interpreted in logical process of investigating different aspects containing functional (time courses, power spectra, and time-trial activity) as well as spatial (scalp map and dipole location) IC characteristics.
Figure 1 shows these features related to one of the components obtained from wavelet-ICA method. As shown below, scalp topography appears to have brain origin and estimated dipole is located inside the skull in the occipital lobe. Apart from that activity power spectrum has a peak in about 10 Hz, which can be related to neural oscillation of alpha rhythms. Alpha-band waves are closely linked to the process of attention and play a key role in monitoring and measuring the attention level in biofeedback. In addition, time-trial plot shows synchronous activity around 200-400 ms in all trials which mean some cognitive processes are formed after stimulus onset. All of these confirm the assumption of being brain based on this component.

Results show Wavelet-ICA algorithm is more successful in finding brain related components than traditional algorithms of ICA in time domain. This method is especially increased the percentage of presence brain based activities related to sustained attention in our study.

Table 1- Presence of brain based activity components

Algorithm	*Presence of brain based activity components (%)*
ICA	*28%*
Wavelet-ICA	*38%*

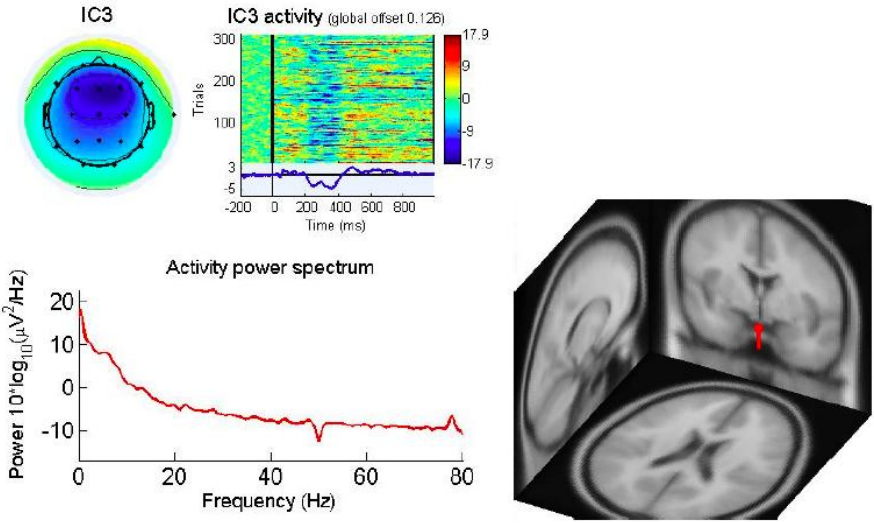

Figure 1-the properties of a brain activity related component

Is it beneficial to mapping brain at endoplasmic reticulum chloride channels level by electrophysiological studies?

Farzaneh Aslanpour[1,2*], Reza Saghiri[3], Afsaneh Eliassi[1,2]

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[2]Department of physiology, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
[3]Department of biochemistry, Pasteur Institute of Iran, Tehran, Iran.

Introduction - Earlier studies indicate ion channels importance in neurons normal function. Normal pH of neuron environment is essential for its function. Chloride channels of rough endoplasmic reticulum (RER), an organelle with an extreme intracellular function such as neurotransmitter synthesis and loading, are involved in pH regulation. Our study characterized acidic pH effect on single-channel gating behavior of a new chloride channel in rough endoplasmic reticulum (RER).

Methods - L-a-lecithin was extracted from fresh egg yolk and then utilized to form artificial bilayer lipid membrane in a 150 μ m diameter hole. Rough microsomes derived from RER of rat tissue and Fusion of the vesicles was initiated by gently touching the bilayer. After recording in normal pH, recording was repeated in acidic pH throe adding HCl, in recording environment. Data were analyzed by PClamp9. Statistical analysis was performed based on Markov noise free single channel analysis.

Results - Our results demonstrated that the channel conductance was approximately 251 pS in 200 mM KCl cis/50 mM KCl trans. The channel open probability (Po) appeared voltage-dependent at -50 to +50 mV and has lower amounts with increase in positive voltages. I-V curve of this channel was nonlinear. Channel conductance and Po were decreased in acidic pH.

Conclusion - Our results suggest that this chloride channel may be involved in many physiological functions of ER also pH regulation

and could be one of important drug targets in treatment of many nervous system disorders such as epilepsy, autism, etc.

Keywords: Electrophysiology, pH, neuron, Rough Endoplasmic Reticulum, Chloride channel.

References

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Alteration of brain oscillatory pattern during development in infancy period

Farshid Javadi[1,2], Reza Khosrowabadi[1]*, Changiz Eslahchi[1,2], Hamidreza Pouretemad[1,3]

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[3] Faculty of Psychology and Educational Sciences, Shahid Beheshti University, Iran.

Introduction - Study of infants' cognitive development involves investigation of early changes in the brain as the center of cognitive system. It is believed that brain develops in a way to learn how to extract meaningful features from stimuli and bind these information together to form a representation of an event. It has been shown that neural activities at delta, theta, alpha, beta and specially at gamma band (>30 Hz) are closely linked to the process of cognitive development. However, the findings are controversy and early changes are still largely unknown. In this study, we examine how the neural oscillations change while typically developing infants grow from 6 to 18 months of life.

Method - In a cross-sectional study, a group of 39 infants (18 female, full-term), with no family history of neurodevelopmental disorders were selected. Electroencephalography (EEG) of awake infants were recorded at 6 and 18 months of age while exposed to auditory stimuli of "Ma/Na" syllables played in a counter-balanced and random order in the background. The EEG data were recorded by an EGI system (www.egi.com) using 128 scalp locations (10-20 international system coordinates) with a sampling frequency of 1000 Hz. The collected EEG data were then cleaned from biological and environmental noises. After controlling quality of the cleaned EEG data, power spectrum of the cleaned EEG data was calculated using fast Fourier transform. The extracted power spectrum was then normalized in a channel-wise manner. Subsequently, a paired-wise t-

test analysis was performed to calculate the significant changes related to the development. Since, our statistical analysis was separately performed for each individual EEG channel at each frequency. Therefore, the Bonferroni correction technique was also applied to counteract the problem of multiple comparisons in the test of significance of the results.

Results - The average **power spectrum** of neural oscillations based on one sample t-test across the 39 participants for all electrodes were calculated at 6- and 18-month of age (Figure 1B and 1C). Subsequently, the contrast pattern of 18-month versus 6-month was computed to better present the developmental pattern of changes (Figure 1A).

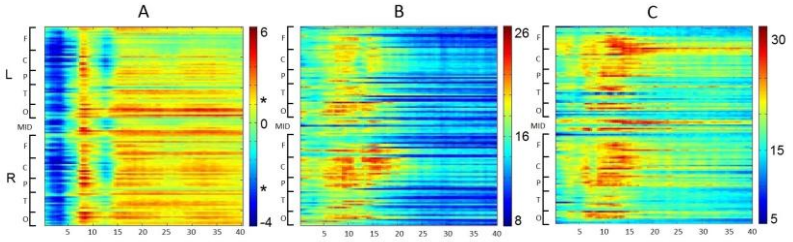

Figure 1. Developmental changes of oscillatory power (colorbar denotes the t values of a paired t-test) t-test between data of 18 and 6 months of age (A). Average power spectrum of 39 subjects (one sample t-test) at 6-month of age (B) and 18-month of age (C).
Abbreviations: F: frontal, C: central, P: parietal, T: temporal, O: occipital, MID: midline area, L: left and R: right.

The results showed significant enhancement in alpha, beta and gamma band and significant reduction in delta oscillations once infants typically grow from 6 to 18 months. As expected, pattern of changes were not the same in all the brain regions. Interestingly, the significant enhancements were observed bilaterally at the occipital, the temporal and the parietal regions but unilateral at the frontal and the central regions in beta and gamma band. In addition, significant enhancements were also observed in all parts of alpha band while

significant reduction were observed in all parts of delta band ($P<0.05$, FWE corrected).

Conclusion - Study of EEG oscillations in infants has spanned a variety of areas within the domains of early social, emotional, and cognitive development. However, the specific nature and function of EEG frequency bands in infants and their relations to cognitive development has remained largely unknown. In this study, pattern of EEG changes in infants during normal development were examined. The results showed a special pattern of changes in neural oscillations including enhancement of lower alpha and beta, as well as occurrence of gamma band. Considering the cognitive functions of brain activities, these findings could potentially reflect a cognitive development process that occurs automatically due to maturation in infancy period. However, considering the brain's complexity level, a broader investigation using different approaches such as functional connectivity would help us to better justify the fact.

Keywords: Electroencephalography (EEG), Power spectrum analysis, Neurodevelopment, Infancy period

Anticonvulsant effect of neural regeneration peptide 2945 on pentylenetetrazol-induced seizures in rats

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Introduction - Neuron regeneration peptides (NRPs) are small synthetic peptides that stimulate neural proliferation, migration, and differentiation with no apparent toxicity and high target specificity in CNS. The aim of this study was to investigate the effect of NRP2945 on seizure activity induced by pentylenetetrazol (PTZ) in rats.

Methods - Using behavioral assessment and electro-corticographical recordings, the effects of different doses of NRP2945 (5–20 µg/kg) were tested on seizure attacks induced by PTZ injection. In addition, the effect of NRP2945 was evaluated on the production of dark neurons and expression of GABAA receptor α and β subunits and GAD-65 in the hippocampus and somatosensory cortex of the rat brain.

Results - Intra-peritoneal injection of NRP2945 at 20 µg/kg prevented seizure attacks after PTZ injection. NRP2945 at doses of 5 and 10 µg/kg significantly decreased the total duration of seizure attacks and reduced the amplitude, duration and latency of epileptic-form burst discharges induced by PTZ. In addition, the peptide significantly inhibited the production of dark neurons in the hippocampus and somatosensory cortex of epileptic rats. NRP2945 also significantly increased the expression of GABAA receptor α and β subunits and GAD65 in the hippocampus and somatosensory cortex compared with PTZ treated rats. Conclusion: This study indicates that NRP2945 is able to prevent the seizure attacks and neuronal injuries induced by PTZ, likely by stimulating GABAA and GAD-65 protein expression and/or protecting these components of GABAergic signaling from PTZ-induced alteration. Further studies are needed to elucidate the potential role of NRP2945 as an antiepileptic drug.

Keywords: Neuro-inflammation, Epilepsy, Neuropharmacology, Brain

Brain Lateralization and Paranormal beliefs: Performance in Cognitive Task and Brain Frequency Rhythms

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Introduction - According to mind-body supervinience, all cognitive processes somehow relate to brain states. Among them, phenomena such as consciousness, attention, and even the present topic, paranormal beliefs, are assumed to have some relevant neural correlates. Paranormal beliefs are mentalities incompatible or unexplainable with current scientific norms. Thereby, the main purpose of the study was to reveal neurocognitive correlates of this phenomenon and its relation to brain lateralization using a perceptual cognitive task and brain frequency bands.

Method - A convenient sample of 32 university students (10 females) were recruited for the experiment. A Procomp2 instrument (Thought Technology Inc.) was employed for EEG recordings at F7 and F8 (10-20 International Placement System). Three measures were used, a computerized face/house recognition task, a brain lateralization scale (Wells and Wagner, 1985), and paranormal belief questionnaire (Blackmore and Moore, 1994).

Result - The result of ANOVA showed a significant difference between groups with high and low paranormal belief in their brain wave frequency rhythms, especially in Beta band. Moreover, analysis using Pearson's correlation showed a significant correlation between paranormal belief and right brained lateralization scores as well as noisy face/house recognition speed and accuracy.

Conclusion - The current study revealed a difference in individuals with high and low paranormal belief in terms of brain wave frequency and a relationship between paranormal belief with right brained lateralization scores and perception in degraded stimuli.

Keywords: Lateralization, paranormal belief, brain frequency bands.

Response properties of neurons in rat barrel cortex are modified by excitotoxic lesion of the nucleus basalis of Meynert

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Abstract - As nocturnal animals, rats efficiently use their facial vibrissae to explore their environment. The integration of neuronal responses across multiple whiskers can be crucial for an effective sensory processing. Converging lines of evidence indicate an important role for the basal forebrain cholinergic system in memory processes. The principal origin of the cholinergic projection to the neocortex appears to be the magnocellular neurons in the region of the nucleus basalis of Meynert (nbM). In this study, in order to identify the prominent mechanisms underlying the modulation of the sensory and tactile information processing, the effects of chemical lesions to the nbM on the temporal characteristics of response integration evoked by multiple whisker stimulations were investigated in the barrel cortex of rats. Animals were randomly distributed into two groups; control group and rats that received bilateral excitotoxic lesion. Lesions were produced by intra-nbM administration of a solution of 5µg ibotenic acid(IBO, a glutamate analogue) in 5µl phosphate-buffered saline (PBS). Extracellular single-unit recordings were performed across layer V of the barrel cortex of normal (19 neurons) and nbM lesioned (21 neurons) rats using single-pipette glass microelectrodes with tip diameters of 2 to5µm. Two neighboring principal and adjacent whiskers (PW and AW, respectively) in the same row were deflected alone or in paired combination rostrally or caudally at varying inter stimulus intervals (ISIs) in a condition test paradigm, to assess excitatory and inhibitory receptive fields(RFs) characteristics. Spikes were discriminated using an amplitude window discriminator. On and off responses were calculated using spike counts and spike activities (SA). Single whisker experience changes the response properties of spared barrel neurons to deflections of principal and adjacent whiskers. A facilitation index was used to quantitatively assess the effect of

combined whisker stimulation. Student's t-test and one-way ANOVA followed by Tukey's test were used for analysis of data. Results show that nbM lesion significantly decreased response magnitude but did not affect response latencies. Response onset latency to both PW and AW in IBO-injected animals were not significant compared with the control group; but unlike the AW, the magnitude of ON response to PW deflection in IBO-injected animal was significantly lower (nearly 20%) than control group. However, the magnitudes of responses were significantly reduced at each inter-deflection interval in nbM lesioned group. Unit's discharges to subsequent deflection of AW were reduced in a time-dependent fashion in both groups. In combined deflection of two whiskers, the magnitude of response varied depending on the time interval between the whisker deflections. The excitatory RFs of units were extended in nbM lesioned animals and nbM lesion increased surround inhibition. Therefore, it has been suggested that interactions of nearby whiskers and the resulting facilitation and inhibition in the barrel cortical neurons have an important role in translating discrete information from individual whiskers to a continuous space. Thus, the nbM has an important role in regulating the balance of excitation and inhibition in the barrel cortex and can influence the temporal integration of tactile inputs in the barrel cortex, modulating the sensory information processing.

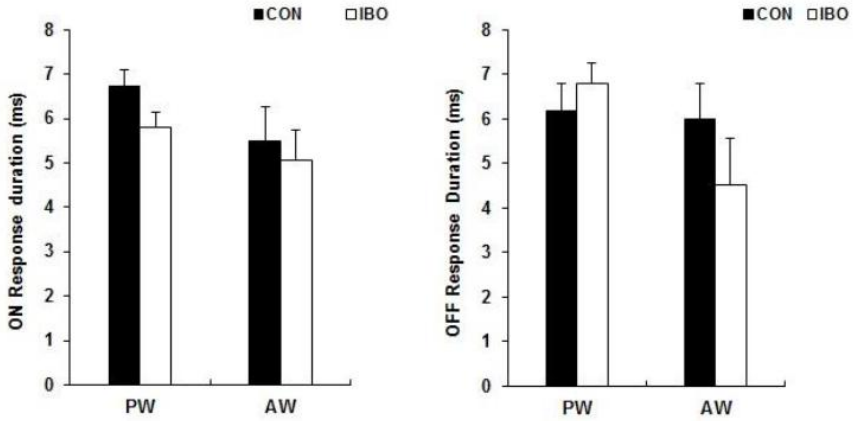

Figure 1. On and off responses in IBO and control groups

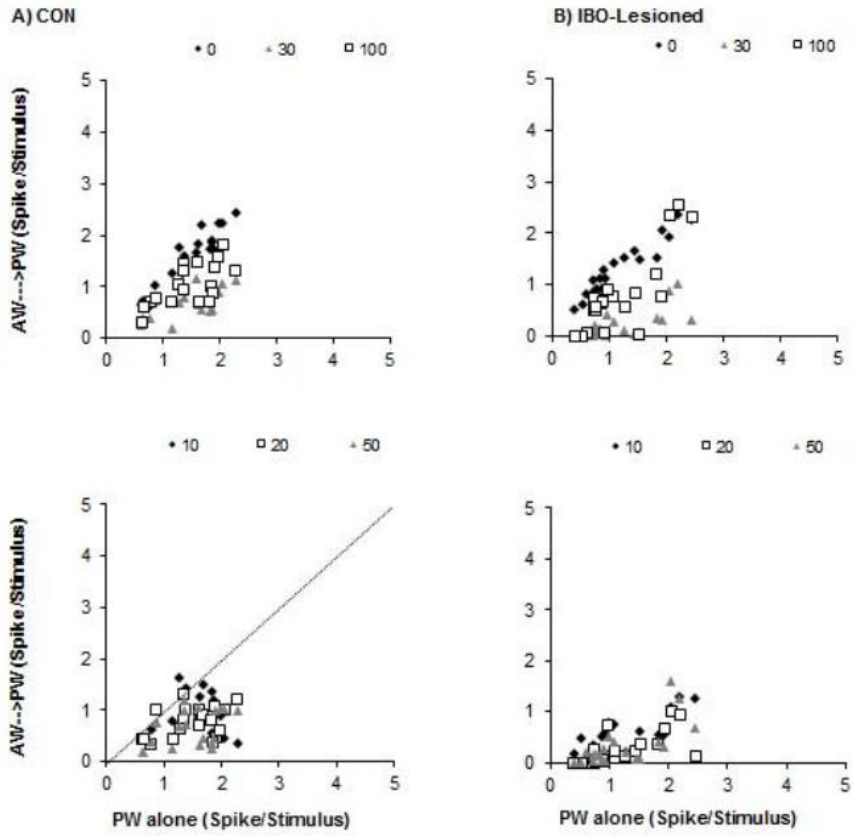

Figure 2. Spike/Stimulus ratio of single and combined whisker stimulation in IBO and control groups

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Validity Assessment of Group Independent Component Analysis by Comparing EEG Dynamics of ADHD and Normal Individuals

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Introduction - Although considerable benefits of using independent component analysis (ICA) for electroencephalography studies, combining results across different ICA decompositions(multi-subject and/or multi-session) to draw group inference is a serious limitation. Group-ICA is one the methods that have been proposed to solve this problem. This approach at first applied for fMRI data analysis and then successfully utilized in a number of exciting fMRI applications with various strategies. These strategies differ from each other in terms of how the data are organized prior to the ICA, what types of output are available (e.g. single subject contributions, group averages, etc.), and how the statistical inference is made [1]. In recent years, g-ICA methods are used for EEG/MEG data analysis, however, such methods are based on additional assumption. For example, they assume the mixing process is the same for all subjects and find the strongest components that are common across subjects/sessions [2]. Thus, it is necessary to assess how well the model fits the data. The present study aimed to evaluate g-ICA approach in the context of comparing EEG characteristics between ADHD and normal participants.

Method - The continuous electroencephalogram activity was recorded from 21 adults (7 male)aged 29.8 □ 6.4 years while they carried out a continuous performance task (CPT). Participants were divided in two groups of ADHD inattention type (10 persons) and age-matched comparison controls based on psychiatrist's interview. This experiment has been performed in accordance with the Declaration of Helsinki and Institute for Cognitive Science Studies (ICSS) has been approved its protocol [3]. The procedure of preprocessing was including band-pass filtering of 0.1 -80 Hz, line noise correction, removing of EOG artifact using ICA, segmentation

beginning 200 ms before stimulus onset to 1000 ms after that and automatically rejection of artifactual part of epochs by EEGLAB toolbox [4]. Refined epochs with a target stimulus (X, no-go condition) and non-target stimulus (non-X, Go condition) for ADHD and normal participants were separated and concatenated into four data sets. The resulting data matrices were n-by-m in size, where n is the number of electrodes and m is equal to the number of subjects times the number of epochs in each conditions times the number of time points per epoch. Thus, unmixing matrices were obtained using extended infomax algorithm [5] for Go and No-Go condition separately in each group. The accuracy of estimation of these metrices was assessed by reliability analysis. To this end, first, the index of similarity between two topographies (r_{ij}) based on [6] was defined and then the relative proportion of total power of components ($P_{0.95}$) was used as a rough indicator of the accuracy of estimates. Several reliability analysis based on bootstrap resampling were carried out and above indices were computed. In addition, second and forth quantities of mutual dependencies (*p* and *p*') were calculated as natural measures of how well the model fits the data. Finally, two methods of clustering based on topographies [7] and equivalent dipole source for each gIC were performed to find corresponding gICs in ADHD and normal subjects.

Results: After the procedure of preprocessing, the number of valid trials did not differ significantly between groups (P = 0.27). Reliability tests 1 to 5 indicate gICA model is apparently high reliable in terms of accuracy($\bar{\hat{r}} > 0.93$ and $\bar{P}_{0.95} > 0.95$). Comparing *p* and *p*' values before and after transformation to gIC domain using paired t-test revealed mutual dependence is significantly decreased and so gICA model corresponds to each individual EEG recording closely (the exact values of statistics and p-values for each condition are expressed in Table). CORRMAP clustering and k-means clustering based on dipole locations confirmed the result of each other and indicated one to one correspondence between ADHD and normal gICs which can be used for further analysis of discriminating between two groups.

- Second Order Mutual Dependence: $\rho = \frac{1}{n(n-1)} \sum_{i \neq j} \left| \rho_{ij} \right|$

where $\rho_{ij} = \frac{\left\langle \hat{S}_i(t) \hat{S}_j(j) \right\rangle_T - \mu_i \mu_j}{\sigma_i \sigma_j}$, $\mu_i = \left\langle \hat{S}_i(t) \right\rangle_T$ and $\sigma_i = \sqrt{\left\langle \left(\hat{S}_i(t) - \mu_i \right)^2 \right\rangle_T}$.

- Forth Order Mutual Dependence: $\rho' = \frac{1}{n(n-1)} \sum_{i \neq j} \left| \rho'_{ij} \right|$

where $\rho_{ij} = \frac{\left\langle \hat{S}_i^2(t) \hat{S}_j^2(j) \right\rangle_T - \mu'_i \mu'_j}{\sigma'_i \sigma'_j}$, $\mu'_i = \left\langle \hat{S}_i^2(t) \right\rangle_T$ and $\sigma'_i = \sqrt{\left\langle \left(\hat{S}_i^2(t) - \mu'_i \right)^2 \right\rangle_T}$.

Table 1. Comparing second and forth quantities (ρ and ρ') before and after transformation to group component domain using paired t-test.

Experimental Unit	2nd Ordder (ρ)		4th Ordder (ρ')	
	Statistic	P-value	Statistic	P-value
EEG-gIC (Target)	19.21	2.32×10^{-14}	13.53	1.59×10^{-11}
EEG-gIC (nonTarget)	23.69	4.15×10^{-16}	17.51	1.33×10^{-13}

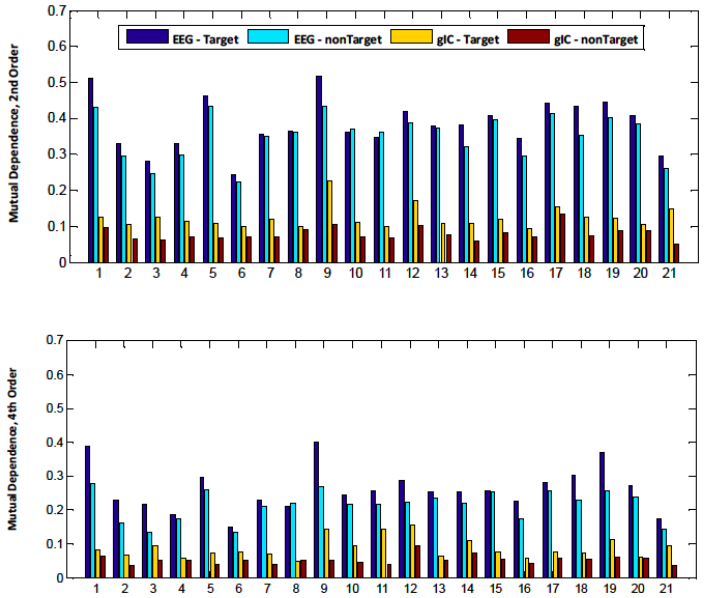

Fig. 1. Mutual dependences of EEG and gICs using second and forth quantities (ρ and ρ')

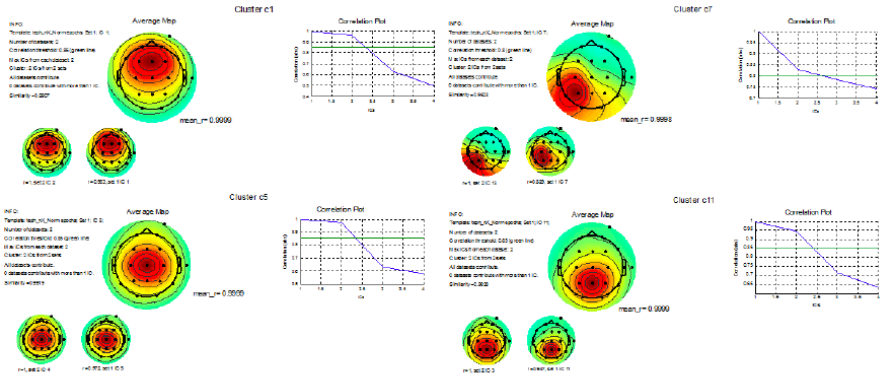

Fig. 2. CORRMAP clustering of scalp topographies related to mixing matrix of ADHD and Normal participants.

Investigation of brain functional connectivity network in autistim using onlnear based methods

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Abstract - Extracting the brain's functional connectivity pattern and its deviations due to several types of diseases is one of the most challenging areas in modern science. One of the most important approaches to investigate the brain functional connectivity is modeling it as a complex network and graph theoretical method is a reproducible and reliable technique in analyzing fMRI data for this purpose. According to the graph theory, brain connectivity networks can be depicted as graphs composed of nodes representing regions or voxels with the edges representing functional connectivity between them. Considerable studies on the functional network in individuals with autism spectrum disorder (ASD) based on task-free fMRI reveal mechanisms of abnormality and graph theoretical analyses have been applied to investigate the network. The usual considered method in the literatures for estimating the functional association in the network, is computing the temporal correlation between the spontaneous BOLD signals. Nevertheless, new methodological advancement needs to be developed to better understand the brain networks and mechanism of their interactions. According to the likely nonlinear nature of sources of signal fluctuations, nonlinear methods give additional insight into the fMRI data.

In this research, we propose a different strategy and a nonlinear method to construct network. This technique uses mutual information of the nodes to construct the functional connectivity between them. The graph theory is used to extract parameters of functional network. Subsequently, a graph presenting the functional network is calculated and various parameters of graph have been investigated. For two anatomical and functional brain parcellation scheme, the mean time series for each region from the preprocessed four-dimensional time

series data have been extracted, and the connectivity matrix calculated by path consistency algorithm based on conditional mutual information. In this algorithm, the conditional dependency between pairs of nodes (regions) is represented by the conditional mutual information between them. This method is able to distinguish direct (or causal) region interactions from indirect associations.

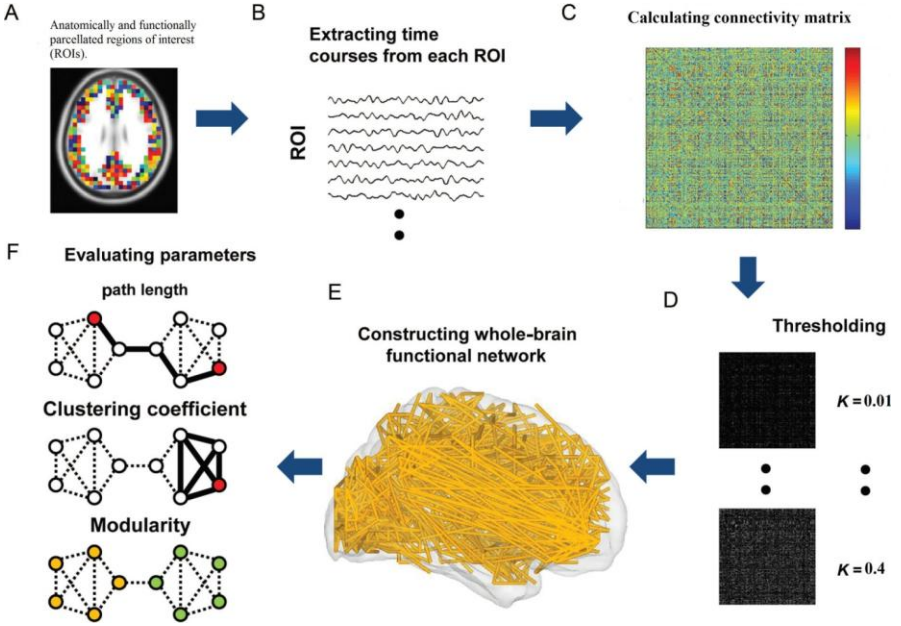

Figure 1. Schematic of data analysis

Keywords: Autism spectrum disorder, Resting-state functional magnetic resonance imaging, Graph theory, Functional connectivity, Conditional mutual information

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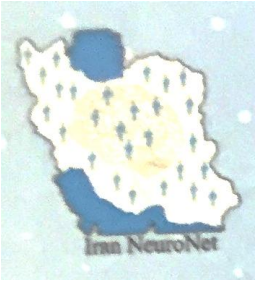

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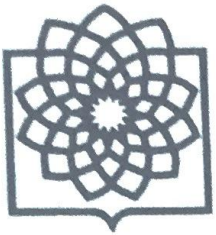

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