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Analyzing Effective Connectivityof MS patients and Health Controlsusing Dynamic Causal Modeling in Resting State fMRI data

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Abstract:

Introduction: Functional magnetic resonance (fMRI), also called Bold imaging, is a noninvasive technique for measuring brain activity.fMRI can be used to produce activation maps and measure the tiny metabolic changes that take place in an active part of the brain then improve our ability to quantify the pathological changes in brain diseases. Resting state functional MRI (Rs-fMRI) is a powerful method to evaluate regional activations that occur when a subject is not accomplishing a definitive task.Functional connectivity determines statistical dependencies. In contrast, effective connectivity tries to explain observed dependencies (functional connectivity), in fact corresponds to directed causal influences.

Efficiency of Diffusion Tensor Imaging in the Estimation of Brain Connectivity; A Simulation Study

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Background: Diffusion tensor imaging (DTI) and tractography are potent MRI tools forprovidingessential information about the structural networks associated with functional connectivityof the brain. This could be helpful for reliable pre-surgical planning of many brain pathologies**[1]**.However, selecting suitable imaging parameters for generating fibers and assessing the brain connectivity imposes constraints in their clinical implementations: (1)higher *b*-values could provide better contrast for high cellular structures whileit is achieved at the expense of losing signal-to-noise ratio (SNR); (2) SNR could be improved by increasing the number of excitations (NEX) in the acquisition and the number of diffusion gradient direction (NDGD), which both make the acquisition rather longer and not feasible for a routine clinical setting. The aim of this study is to assess the effects of using different amounts of NDGD, NEX and *b*-values on the fiber tracts and brain connectivity in a simulation scheme, to obtain guidelines for optimizing them for a reliable quantification.

Evaluating Interactions among Resting State Networks (RSNs) using Ancestral Graph

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Introduction: The human brain has been proofed to be spatially formed in a finite set of specific coherent patterns, namely Resting State Networks (RSNs). The interaction among RSNs, despite of being directed or undirected, lead us to have a better understanding of brain function in people with different condition and diseases. In order to evaluate the possible connectivity within those RSNs, we applied the origin of an ancestral graph to the RSNs defined according with neurobiological principles. In fact, ancestral graph is a robust, recently developed method, which shows three kinds of connectivity, undirected,directed, and bidirectedconnectivity, and this distinguishes it among other ways. In this investigation, we used it to study how the interactions among RSNs in MS patients, differs from normal controls.

Olfactory system in human: Cortical brain mapping using fMRI

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Abstract

Introduction: Functional magnetic resonance imaging (fMRI) is a non-invasive and convenient method to map brain activity associated with activations in human sensory systems. Among the sensory systems, there is lack of data in olfactory studies. This could be attributed to technical difficulties in odor delivery during the scanning. In the current study, for the first time in Iran, took the advantage of an olfactometer device was used to access brain activation during odor smelling process.

Objectives: The aim of this study was to investigate the neural network of olfactory system in human by using fMRI brain imaging.

Materials and Methods: This study examined functional map of olfactory system that used a block design of alternating between a 15-second odor presentation (Eucalyptus) and a rest period of 45-second (odorless air) in 15 healthy volunteers. This package of odor stimulation and rest periods was repeated for10 cycles (a total of 600 seconds).

Results: Our results showed that primary and secondary olfactory regions including piriform cortex, insula, amygdala, parahippocampal gyrus, caudate nucleus, inferior frontal gyrus, middle frontal gyrus, superior temporal gyrus, and cerebellum demonstrate significant activation in response to odor stimulation.

Conclusion: This study demonstrates the olfactory network is employed during smelling a hedonic and familiar odor (Eucalyptus). We found both primary and secondary olfactory network to be involved in our olfactory task. Pleasantness of the odor, timing of the task, familiarity of the presented odorant and the purity of the odorant (unimodal odorant) versus trigeminal olfactory evoked odor (bimodal odorant) determine the activation of certain parts of established olfactory regions. To achieve the appropriate task design, all abovementioned parameters have been considered in performing the task in our study. The methods indicated above can be used in addressing of brain regions in olfactory processing in healthy subjects. The abovementioned network and the pattern of activation are largely in accordance with previous published data in Western literature.

On the role of morphology and density of cortical column neurons on neural current MRI signal

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Introduction: Despite the blood oxygen level dependent functional magnetic resonance imaging(BOLD-fMRI) is a great facility for brain mapping; its hemodynamic based contrast confined the temporal resolution.The direct imaging of neural activity would overcome to the fMRI problems[1-4].The controversial results were reported about ability or inability of detection of such small signal changes [1,2,5-9]. The neural magnetic field (NMF) which is parallel to external field could affect the phase of MRI signal(ncMRI). The alteration of the phase and magnitude images between rest and active could be so small (~0.01^{o}/1ppm), so very delicate tuning of MRI must be used. The simulation of rat and human neuron activity were shown the NMF and MRI signal changes are dependent on the neuron morphology [10,11]. In this paper, a cortical column of rat neurons with different morphologies and densities for each layer was simulated to estimate expected MRI signal change.

Structural Hemispheric Asymmetries in the Human Precentral Gyrus on MRI imaging

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Key Words: Cortical Asymmetry, Motor Function, Hand Representation, Gender, Age.

Introduction: Knowledge and assessment of the dominance of cerebral

motor function is clinically important in developing novel neurorehabilitation strategies , as well as optimized planning of surgical procedures for brain diseases. Therefore, today a lot of studies has been done about direction and extent of motor asymmetry , and its relationship with various factors such as gender, age and genetic and environmental factors using autopsy studies and modern imaging techniques, in particular MRI.

Superparamagnetic iron oxide nanoparticles: their roles in diagnostic magnetic resonance imaging and potential therapeutic applications in brain tumors

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Keywords: Brain tumor, Nanoparticles, MRI contrast agent

Abstract

Despite advances in surgical techniques and chemotherapeutic agents, brain tumor still remains a fatal disorder and early detection and diagnosis of brain tumors is of great importance for improving treatment outcomes and hence increasing the survival of the patients. Magnetic resonance imaging (MRI) is a prominent, clinically-relevant imaging modality because of its excellent tissue contrast resolution and increased sensitivity to edema. MRI utility is further enhanced with the use of magnetic iron oxide nanoparticles.

The Evaluation of Simvastatin Administration on Brain Ischemic Damage Induced By Early and Delay Systemic Hyperthermia in a Thromboembolic Model of Stroke in Rat

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Abstract

Introduction: The destructive effects of hyperthermia on ischemic stroke outcomes are clearly shown in animal models and in clinical cases. However, the timing at which the cerebral lesion may be aggravated by high temperature has not been firmly established. In this study, we evaluated the effect of incidence time of hyperthermia on ischemic stroke outcomes and also examined the effects of simvastatin administration on brain ischemic damage induced by early and delay systemic hyperthermia in a thromboembolic model of stroke in rat.

The limbic system role in high-level processing and the mental states based on intelligent learning agent modeling perspective

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Abstract:

In this paper we demonstrate, how intelligent learning agent modeling explains the limbic system involving in high-level processing and the mental states. This paper presents, a new approach to investigate the role of basal ganglia and limbic system that accumulate in the nervous system have using a model-based approach to intelligent learning agent in artificial intelligence. With regard to the exchange of signals between the basal ganglia and the brain cortex, the purpose of this paper provides a system model to demonstrate the feed-back/feed-forward roles of these cells in high processing capabilities of the brain to create a mental, emotional, and ensures comprehensive diagnosis process. In order to achieve this goal, the main focus will be of the thalamus and the amygdala nucleus in the control, direction and strengthen the connections between the cortex and the limbic system.

Treadmill exercise improves long term potentiation impairment in sleep deprived female rats

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Abstract

Introduction: Previous studies have indicated that physical exercise has preventive role on synaptic plasticity deficits in the hippocampus in sleep deprived male rats. The objective of the present study was to evaluate the effects of treadmill running on synaptic plasticity at Cornu Ammonis (CA1) area of the hippocampus in sleep deprived female rats.

ADHD/Control Adults' Discrimination based on Group-Independent Components

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Introduction: Attention deficit hyperactivity disorder (ADHD) is one of the most prevalent childhood disorders, affecting approximately 4-6% of school-aged children [1-2]. In 35 to 80 percent of cases symptoms will persist into adulthood [1, 3]. With increasing age, the profile of the ADHD symptoms changes slightly, as symptoms of hyperactivity is decreased in adults with ADHD; symptoms related to inattention become more prominent [4-7]. Due to an apparent decline of symptoms over time [8-9], diagnosis of patients with ADHD is more complicated in adulthood. Event-related potentials (ERPs) provide direct measurement of attention and are increasingly used to determine the neural correlates of ADHD [for reviews see 8-9]. Until now, ERP studies on adults with ADHD are scarce and their results are largely inconsistent [10-13]. Therefore to achieve the higher sensitivity in discriminating between adults with ADHD and healthy controls, this study aimed to investigate the EEG source differences using group independent component analysis.

Lyapunov exponent as a feature to distinguish patients with Alzheimer's disease and healthy controls using resting-state fMRI BOLD signals

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Abstract

Nonlinear complex nature of resting-state fMRI BOLD (Blood Oxygen Level Dependent) fluctuations can be studied based through nonlinear dynamic characteristics like Lyapunov exponent. In this paper, resting-state fMRI signals of 13 patients with Alzheimer's disease (AD) and 13 normal subjects are analyzed by evaluating Lyapunov exponents of regional fMRI time series. The results show that Lyapunov exponent in some regions of the brain like left hippocampus and Cuneus indicates more regularity in AD patients in comparison to normal subjects. Due to inherent nonlinear nature of BOLD signals, these findings indicate that Lyapunov Exponent may be considered as a suitable indicator for quantifying changes in resting-state function of human brain.

Wavelet transform aided support vector machine classifier for classification of the left and right hand motor imagery EEG signals

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Abstract— In this paper, the EEG signal data related to the left and right hand motor imagery has been used for Brain Computer Interface. First, the signal is decomposed by wavelet transform to the frequency sub-bands. Then the power spectral density (PSD) average and energy sub-bands are extracted as the features. Support Vector Machine (SVM) classifier uses this feature as inputs. It has been trained with 30 training set and tested with 10 testing sets. Finally classification accuracy of 63.63% has been obtained.

Compromised Motor Imagery Ability in Individuals with Multiple Sclerosis and Mild Physical Disability: An ERP Study

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Abstract:

Introduction: Motor imagery (MI) impairment has been reported in individuals with multiple sclerosis (MS). The present study was designed to investigate the neural evidence for MI
impairment and its' relationship to working memory in patients with MS

ADVANCED NEONATAL ATLAS TEMPLATES FOR WHOLE-BRAIN SPATIAL NORMALIZATION

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ABSTRACT

1. INTRODUCTION

The risk of inappropriate development necessitates attaining information about neonatal brain growth. Due to the complications of the study, the existent investigations in the field of neonatal brains are exiguous. Normalization, which reforms an individual brain shape to conform to a reference template image, is a necessary step of group-level statistical analyses. To the best of our knowledge, in spite of the essential clinical applications, any atlas template has not yet been constructed for normalization of neonatal CT images. In this paper, at first, we explain our steps towards creation of MR and CT atlases by employing 6 and 10 high resolution neonatal MR and CT scans, respectively. We then represent the results of applying various qualitative and quantitative methodologies to appraise our achieved atlases. We conclude the paper with discussion on the results of our assessments.

ReducedGray Matter Volume of Cerebellum and Fusiform Gyros in Autism

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Abstract

Introduction: Autism Spectrum Disorders (ASD) are lifelong neurodevelopmental syndromes, affecting social interactions and communication,with restricted, repetitivepatterns of interests or behaviors (American Psychiatric Association, 2013). Previous neuroimaging studies have shown abnormalities in a wide range of brain areas. However, presumably due to heterogeneities within ASD, controversiesamong different studiesstill exist.Therefore, more studies can further elucidate the abnormalities of different brain areas among this population.

The effect of cholinergic antagonist and glutamatergic receptor system of CA1 on memory acquisition

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Abstract

Background &aim: Cholinergic mechanisms modulate learning and memory formation. The glutamate as an excitatory neurotransmitter is particularly abundant in the mammalian brain. In the present study, the effect of pre-training intra-CA1 administration of scopolamine, NMDA and D-AP7 on acquisition of memory have been investigated.

Methods: The step- through inhibitory avoidance task was used to measure of memory in male wistar rats. Male wistar rats from Pasteur Institute, weighing 220-250g at the time of surgery, were used. All experiments were performed between 09:00 and 13:00h. Eight animals were used in each group of experiments. The drug used in the present study was scopolamine, NMDA and D-AP7. Drug was dissolved in sterile 0.9% saline and was injected into the intra-CA1 in a volume of 0.5 μl/ rat.