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Editorial

Neuronal Disorders and Deciphering Noise in the Brain

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Clinical neuroscience has becoming a very useful discipline mainly because of the spectacular technological developments like electroencephalogram(EEG), Functional Magnetic Resonance(FMRI), Positron Emission Tomography(PET), Transcranial Magnetic Stimulation(TMS), Diffusion Tensor Imaging(DTI), Magneto-encephalography(MEG) etc. With the help of these advanced techniques the clinical neuroscientists try to develop diagnostic methods so as to prevent and treat neurological disorders. Infact, this branch of neuroscience focuses on the fundamental mechanisms behind these neurological disease and disorders. Using brain imaging techniques like fMRI neuroscientists scans and track blood flow in the brain which reveal the hidden patterns under spontaneous neuronal activities which consumes large amount of energy of the brain. This spontaneous activity of brain occurs even when no consciously active task is performed. The challenging issue is why brain consumes so much energy just to maintain spontaneous activity or simply noise? Almost for a decade scientists are trying to understand the electrical activity using this imaging technique and suggested the concept of default mode network or resting mode network associated to the spontaneous activity. It is believed that the miswiring of this type of network plays important role in various neurological diseases or neurological disorders.

This kind of assessment of electrical activity based on fMRI has been criticized because of the relatively poor temporal resolution of fMRI and default mode network is considered to be artefact.

Recently, Parvizi and his collaborators in Stanford University used intracranial electrophysiology to understand the activity of distinct populations of neurons.

This technique provides resolution of the order of milliseconds and millimetres so as to address an individual's brain in a more meaningful way. They even observed similar pattern of activity during resting state as well as in sleep state. But it is not yet clear why brain consumes such huge energy to sustain the resting state network or default network or simply noisy state during sleep state. Further work in this direction may help us to understand the sleep disorder too. It is becoming a fascinating area of research to understand the role of noise in brain function. The noise in science and technology is considered to be unwanted and plays destructive role. The progress of non-linear dynamics clearly shows how noise can induce synchronization among the chaotic oscillators. Neuron at the individual level behaves like chaotic oscillator but at the ensemble level synchronization occurs. The study of coherence of synchronization may shed new light in understanding various neuronal disorders.

The recent developments of the research on various type of meditation using different imaging techniques raise new possibilities to treat neuronal disorders. During the process of meditation, the neuronal noise is being reduced and degree of coherence becomes higher.

The comparative study of deep meditation and deep sleep may shed new light to treat various neuronal disorders. It is observed that during seep sleep the extracellular space increases almost by 60%. It has been observed using two photon microscopy. This space is filled up with toxic materials and as soon as the toxic material goes away like washing machine one wakes up. Many neurological disorders from Alzheimer's to stroke and dementia may occur due to sleep disorders.

Some works have been done on the effect of evoked activity on resting state network and raise lot of controversies whether the evoked activity is linearly added to resting state activity.

It is very important to know what happens during deep meditative state as well as in deep sleep. In deep meditative state for particular type of meditation like watching breathing or witnessing thoughts what happens to the resting state network? During the process of mediation there will be less and less thoughts and degree of coherence increases for the synchronized oscillatory wave.

This indicates that the level of neuronal noise is reduced in deep meditation whether similar pattern of activity of resting state network in deep meditative state occurs during deep sleep? The findings on deep sleep as mentioned earlier indicate that the extracellular space becomes full of toxic material. In a sense, the noise level should not be reduced much. This needs further investigation. However, it may be easier to investigate the effect of meditation on the default mode network associated to spontaneous activity or noise (or resting state network) since invasive procedure is not needed to find such effect in contrast to the necessity of invasive procedure for deep sleep research. This type of work may open up

new vistas in deciphering noise in the brain and help to find useful methodologies to prevent and treat neuronal disorders in a more realistic manner.

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