Dr Ratna Sharma

Stress and Cognitive Electroimaging Lab

Research interests:

The Stress and Cognitive Electroimaging Lab aims at assessing the Physiological, psychological, biochemical and electrophysiological correlates of stress and cognitive functions in normal individuals and neurodegenerative & psychiatric disorders.

The key areas of research include:

1. Neurophysiology of Stress and Cognitive Behaviour
2. Quantitative EEG Changes as a tool to assess specific conditions: awake, sleep, cognitive functions, psychological stress, neurodegenerative and psychiatric disorders etc
3. Explore the neurophysiological correlates of qEEG
4. Effect of psychological stress on cognitive functions in health and disease

The laboratory has the Dense Array (128 electrodes) EEG and Polygraph recording system through which quantitative analysis of EEG, ECG, EMG and various bio-signals are done. Some of the key quantitative analysis carried out in the laboratory includes:

- Quantitative EEG analysis:
    - Source Localization
        - LAURA, LORETA based source localization of the neural correlates of cognitive behavior with milliseconds temporal resolution in the health and diseased states.
        - Source data computed from the Dense Array EEG is reconstructed over the Montreal Neurological Institute (MNI) MRI pane to view as 2D and 3D whole brain mapping.
        - Source montages are created for analysis by selecting particular group of source electric dipoles depending on the brain regions of interest for the cognitive task.
    - Wavelet transformation based Joint Time-Frequency Analysis (JTFA) – Temporal and frequency bands are analyzed simultaneously in the EEG signals.
        - Wavelet co-efficient – computes phase and magnitude of correspondence of frequency bands in relation with time, which facilitates analysis of the frequency band changes in the EEG signals with milliseconds temporal resolution.

        - Circular variance – computes phase stability of the frequencies across trials and between various brain states. High phase stability means higher correlation between brain regions.
    - Fast-Fourier Transformation (FFT) based frequency spectral analysis
        - Power spectral analysis – Frequency band changes in resting state and while performing cognitive task are analyzed in health and diseased state.
        - Coherence analysis – Frequency band coherence between brain regions are analyzed which signifies communication between brain regions.
- Quantitative ECG, EMG and GSR are recorded simultaneously with EEG recording to assess the effect of psychological stress on cognitive functions in health and disease.
- Along with quantitative bio-signal analysis, behavioral parameters are also assessed. The laboratory has the E-PRIME platform based stimulus presentation system in which cognitive function test are created and administered to the subjects, from which various behavioral cognitive parameters like reaction time and decision making are assessed.

Further projects have been designed to investigate if a combination signature of baseline quantitative EEG changes along with altered EEG changes during cognitive load in health, neurodegenerative or psychiatric disorders improves the chances of early diagnosis and progression of disease.

The projects currently in progress are:

1. A study of quantitative EEG changes, cognitive function and stress in mild cognitive impairment and Alzheimer's disease, funded by Cognitive Science Initiative program of DST
2. Quantitative EEG correlates of Cognitive deficits in Parkinson Disease, funded by DBT
3. The effects of positive, negative and neutral affect on cognitive functions and associated psychological stress response

Projects completed:

1. A study on stress reactivity of students as a function of their general and emotional intelligence and effect of meditation on the stress response
2. A study to assess acute mental stress induced changes in EEG, cognitive behavior and neurosteroids across the menstrual cycle and effect of meditation on stress induced changes.
3. A study to assess the effect of meditation on general and emotional intelligence, their EEG correlates and stress response.

4. The effect of stress induced changes in theta and alpha bands during memory retrieval.
5. Effect of meditation on Stress induced changes in cognitive functions
6. A randomized controlled trial on the efficacy of yogic intervention in premenstrual syndrome.
7. Cognition induced changes in brain oscillations

Research Students working in the lab:

PhD Students: 5
MD students: 2
Senior Demonstrator: 1
Research students from other Departments: 1

Publications in last 5 years:

1. Gupta N, Khera, S, Vempati, RP, **Sharma R**, Bijlani RL Effect of yoga based lifestyle intervention on state and trait anxiety. Ind J Physiol Pharmacol, 50(1): 41-47, 2006.
2. Meena NB, Jain S, Sharma R, Mathur R, and Nayar U Amygdalar neuronal responses to peripheral noxious stimuli in rats. Ind J Physiol Pharmacol, 50(1): 17-27, 2006.
3. **Sharma R**, Meditation and mental well being. Ind J Physiol Pharmacol, 50(3): 205-214, 2006.
4. **Sharma R**, Khera, S, Mohan A, Gupta, N, Basu Ray, Assessment of computer game as a psychological stressor. Ind J Physiol Pharmacol, 50(4): 367-374, 2006.
5. **Sharma R**, Gupta N, Bijlani RL Effect of yoga based lifestyle intervention on subjective well being. Ind J Physiol Pharmacol, 52(2): 123-131, 2008.
6. Mohan A, **Sharma R**, Bijlani RL, Effect of Meditation on Stress-Induced Changes in Cognitive Functions. J Compl Alt Med, 17(3): 207-212, 2011.
7. Singh Y, **Sharma R**, Talwar A. Immediate and long term effects of Meditation on acute stress reactivity, cognitive functions and intelligence, Alternative Therapies in Health and Medicine**,** 18 (6): 46-52, 2012
8. Yadav RK, Magan D, Mehta N, Sharma R, Mahapatra SC. Efficacy of a Short-term Yoga-based Lifestyle Intervention in Reducing Stress and Inflammation: Preliminary Results" J Altern Complement Med. 2012 Jul;18(7):662-7.
9. Singh Y, **Sharma R**, Relationship between General Intelligence, Emotional Intelligence, Stress Levels and Stress Reactivity. Annals of Neuroscience, 19(3):107-111, 2012.