

An Indian-Australian research partnership

**Project Title:**

Effect of sleep disruption on cognitive performance and its relevance with biological clock.

**Project Number**

HSS0501

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**IITB Department:**

Humanities and Social Sciences

## Research Academy Themes:

**Highlight which of the Academy's Theme(s) this project will address?**

*(Feel free to nominate more than one. For more information, see [www.iitbmonash.org](http://www.iitbmonash.org))*

1. Advanced computational engineering, simulation and manufacture
2. Infrastructure Engineering
3. Clean Energy
4. Water
5. Nanotechnology
6. Biotechnology and Stem Cell Research
7. **Humanities and Social Sciences**

## The research problem

*Define the problem* The performance pressure and expectations from the working population are increasing due to societal demands and lifestyle advancements. This constrains the availability of personal relaxation time and thus individuals often decide to, or in some cases are forced to, trade off their sleep with work. Consistent variability in sleep timing may lead to disturbed sleep-awake cycle, due to disruption of circadian rhythm regulatory mechanisms, which may cause circadian rhythm sleep disorders. Circadian disruption affects various neurocognitive and bodily functions. Although research has significantly advanced our understanding of the genetic and neurobiological bases of sleep (hypothalamo- thalomo-

brainstem- cortico interactions) and the relevant pathways within the biological clock, much less is known about how these interactions affect and alter the waking neurocognitive functions.

Disrupted sleep increases the risk of human-error in all modes of transportation, medical and other safety sensitive profession. Errors of omission and commission both are documented in micro-sleep intrusion hypothesis, resulting in impaired cognitive performance (Attention, decision making, working memory) and fatigue. Thus, the neuro-cognitive mechanisms within the prefrontal cortex and its associative cortical networks are affected. Although the effects of sleep deprivation and circadian rhythm disruption have been widely documented using measures of RT in attention, vigilance and declarative memory scales, these studies provide limited information on the 'how' part of this problem. Electroencephalography is a well-established tool to investigate sleep, but has limitations in its ability to investigate function and mechanisms. Recent neuroimaging advancements in EEG/ERP and MEG along with fMRI provide promising new approaches to study neurocognitive impairments associated with sleep disruption. This would help to answer the 'how' and 'where' part of this significant research problem.

## Project aims

*Define the aims of the project :*

1. To characterise neurocognitive phenotypes associated with sleep disruption in simulated shift work.
2. To examine the effects of sleep disruption associated with simulated shift work on circadian rhythms.
3. To examine the effects of sleep disruption on brain dynamics and neural markers for mental illness.

## Expected outcomes

*Highlight the expected outcomes of the project*

1. It would provide a new understanding about conspicuous occupational errors and accidents due to sleep deprivation.
2. It would provide new insights to see the effect of different working time zones (day/night) on sleep latency and performance measurements.
3. The study would establish the interaction effect model of sleep deprivation and circadian rhythms.
4. Moreover, study would give an experimental overview for altered brain states of subjective consciousness due to sleep deprivation and would provide temporary/ permanent deviations in default mode network and rest state EEG to address possible mental health issue.

## How will the project address the Goals of the above Themes?

*Describe how the project will address the goals of one or more of the 6 Themes listed above.*

## Capabilities and Degrees Required

*List the ideal set of capabilities that a student should have for this project. Feel free to be as specific or as general as you like. These capabilities will be input into the online application form and students who opt for this project will be required to show that they can demonstrate these capabilities.*

*First class Master's degree in psychology/ medicine/ cognitive neuroscience.*

*Applicants acquainted with the knowledge of EEG/ ERP and/or cognitive/ neuropsychology/ physiology would be encouraged.*

## Potential Collaborators

*Please visit the IITB website [www.iitb.ac.in](http://www.iitb.ac.in) OR Monash Website [www.monash.edu](http://www.monash.edu) to highlight some potential collaborators that would be best suited for the area of research you are intending to float.*

Please provide a few key words relating to this project to make it easier for the students to apply.

Sleep deprivation, circadian rhythm, human-errors, cognitive performance, EEG/ERP, default mode network, rest state brain network.