ENS – IISER Network / BIOSANTEXC Project

Internship Proposal Form
France to India

(Discipline/Field name)

Neuroscience

Internship title: Investigating hypothalamic neural network in compulsive eating behavior

Keywords related with the subject (minimum 3): Neural circuits, compulsion, eating disorders.

Name of the IISER: Indian Institute of Science, Education and Research, Mohali

Name of the laboratory(ies): Systems Neuroscience lab

Name of the internship supervisor(s): Dr. Hasan Mohammad

Email(s): hasan@iisermohali.ac.in

Prerequisites for the internship: Basic understanding of neuroscience, statistics and comfortable working with mice models.
Requested level: Masters level

Foreseen internship dates: April 2025- September 2025

Internship type (refer to page 1):
☐ 3–6-month internship ☐ Research stays ☐ 6+6 months internship

For 3 to 6 months internships, please indicate the desired duration: 6 months

For 6+6 months internships, please also fill in:

- **Name of the internship co-supervisor:**
- **Name of the co-supervisor's laboratory/entity:**
- **Email of the co-supervisor:**

Internship proposal (description and expected training outcomes / half page min, 1 page max):

Food in itself is gratifying and rewarding, due to which it may share some features with other addictive substances (such as drugs, alcohol, tobacco, etc.). However, normal food and eating, unlike other addictive behaviors such as drug use, is necessary rather than compulsive. So, what diets and when is eating considered compulsive, and what causes compulsive eating. This is an intriguing and important direction to investigate considering rising obesity and eating disorders. It is the act of food consumption in the absence of energy demand (also termed hedonic feeding) and despite negative consequences. Studies suggest that the overeating of usually palatable and high energy diets is contributing to obesity and related health problems. The factors driving overeating in our society are altered food environments (food cues) associated with palatable food, which make hyperpalatable and energy-dense foods readily available. Previous research shows that eating palatable, high-energy foods on a regular basis can result in compulsive eating habits similar to drug addiction and also activate overlapping brain pathways. These compulsive or addictive eating habits may be driving overconsumption of food in our society, resulting in a rise in obesity and eating disorders. Not surprisingly, obese and overweight people report greater food cravings and consume excess food in response to food cues. Human neuroimaging studies and preclinical studies have revealed similarities in brain responses to addictive drugs and food. It has sparked an interesting debate about whether neural networks associated with drug abuse can also explain uncontrolled food intake, as in the case of compulsive eating. Based on our preliminary findings, we believe that hypothalamic circuits are key in mediating addictive food consumption. **In this project the major goal is identification of specific hypothalamic neural circuits for compulsive eating behavior.**

Our group has developed behavioral paradigms to model compulsive eating in mice. Using this paradigm, we are in a unique position to dissect the brain-wide networks of compulsive and non-compulsive eaters. The project involves use of mice models to perform stereotaxic surgeries, behavioral analysis, brain sectioning, imaging using confocal microscope and analysis of data. It will be complete training from designing scientific experiments to interpreting the results.

Expected training outcomes:

The student will learn behavioral modeling and perform machine-learning based behavioral analysis to quantify compulsive behaviors in mice. To decipher neural circuits, we are using transgenic lines such as TRAP2 which allows permanent labeling of active cells in response to a stimulus. This training will allow a student to perform brain-wide permanent labeling of active neurons and generate data for light sheet imaging. The imaging will be done in collaboration; however, student will be involved in computational analysis of the data to pinpoint the differences in hypothalamic response in compulsive and non-compulsive mice. The data will guide us to perform neuromodulation using optogenetics and chemogenetics to attenuate compulsive eating behaviors. The student will learn modern neuromodulation methods by performing in vivo surgeries and behaviors in mice.