NBRC LENS

a student run NEWSLETTER

NBRC LENS | EDITION #1

MARCH, 2025

Banismita Tripathi

FOREWORD BY DIRECTOR

It is not often that we see germination of ideas. The process of creating something *de novo* is beautiful, and many times even awe-inspiring. So, in a small but significant way, the process by which the students of NBRC have thought of starting the newsletter is also very significant. The name, NBRC Lens, itself is thought-provoking. However, if we take the most benign outlook, it means that the NBRC Lens will try to magnify the areas of NBRC life which are not very magnified and/or overlooked.

So why is such an effort important? While we all are in a scientific institute and our aim is to do science, we should not remain oblivious to the surrounding life and society. I am hopeful that this newsletter will be the place where taboos are broken and all the NBRCians find time to discuss their feelings, especially for those matters which do not strictly fall into their curriculum and lab work. This will also be the place to showcase their talent – without a fear of getting judged or overwhelmed.

Some labs are small and some labs are large. Similarly, all fingers of the hands are not equal. Hence I am asking everyone not to be shy and be withdrawn. Come out – express yourselves. After all this is your newsletter – by NBRC, for NBRC. Enjoy the feeling of creating something – while, I am sure, it will grow and stand the test of time.

Jai Hind.
Sagar Sengupta

OUR VISION

It is a thrilling moment when creative sparks illuminate both the scientific and the everyday facets of our lives. NBRC Lens is born from the same spirit of exploration that drives every experiment and every thought at NBRC. As Einstein wisely remarked, *"Imagination is more important than knowledge",* reminding us that our quest for discovery flourishes when we dare to see beyond the ordinary. With this newsletter, we intend to capture the unseen, celebrate diverse voices, and highlight those moments that often go unnoticed.

Why embark on such a journey? In the intricate network of our minds, every idea is a neuron waiting to fire—a tiny yet powerful burst of potential that contributes to a larger tapestry of innovation. We invite every NBRCian to share their insights, artistic expressions, and personal reflections—whether that means offering opinions on scientific articles, sharing fresh ideas on science, submitting evocative poems, a captivating photograph, or updating us on lab news. Much like every incremental discovery builds the vast mosaic of scientific understanding, your contributions are the essential pieces that illuminate and enrich our collective narrative.

Just as our brain relies on neurons connected and constantly communicating, every NBRCian's voice adds a unique and essential spark to our vibrant conversation. This newsletter is a space for bold expression, free from the confines of conventional lab work—a platform where science meets art, and intellect embraces emotion. So, let us step forward together, sharing our unique perspectives and celebrating the vibrant pulse of NBRC life.

Newsletter Committee

Newsletter Committee
NBRC

Pratika Siwach

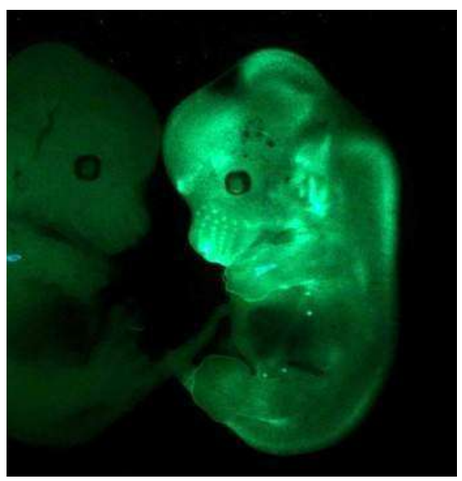
We are all Developmental Biologists!

Vidhya Munnamalai, Ph.D

Understanding the function of the human body and disease begins with developmental biology. Developmental biology is a field that dates to more than 100 years, but early observations on embryos and plants have been documented even further back. It delves into the most fundamental biological questions. 2025 marks 55 years of positional information, a quantitative measure of how much information a cell receives and takes on specific cell identities. Development has remained relevant through the ages and continues to reinvent itself by spurring new research directions. Developmental biologists often rise to the challenge of understanding detailed mechanisms of how things work in the cells, to tissues, to whole organs, and eventually to the whole organism and examine evolutionary conservation across species. Developmental biology has learned to evolve from simple observational studies to new disciplines contributing to genetics, epigenetics, experimental biology, reproductive biology, molecular biology, cell biology, evolutionary biology, and many more. Understanding the molecular mechanisms governed by genetics has been and still is instrumental for our understanding of diseases. The power of genetics has also led us to engineer transgenic animals, and in conjunction with microscopy, we can visualize and study development with incredible detail. Although now considered to be basic techniques, developmental biologists continue to amaze us with powerful images.

The most noteworthy subfield that has emerged from developmental biology is stem cell biology. Neuroscientists are now able to take human embryonic stem cells and grow them into organoids in a dish. This has become particularly important for the human nervous system as it can be ethically difficult to source early human brain or neurosensory tissues. The molecular mechanisms underpinning the development of embryonic stem cells have also led to scientists being able to dedifferentiate and reprogram cells into induced pluripotent stem cells (iPSCs). Organoids and iPSCs are now being used to understand complex, rare neurogenetic diseases. The ethical concerns have been somewhat negated with human organoid technology. Understanding stem cell biology has already and will continue to help us design cell replacement therapies, perform high-throughput drug discovery, and will soon enable us to design customized patient-specific treatments in the clinic, as well. In my area of research, although my colleagues in the field have developed early inner ear organoids with early vestibular fates, generating organoids with cochlear cell fates has proved to be much more challenging, which is why my laboratory focuses on understanding cochlear progenitor biology to engineer *cochleas in a dish.*

An emerging area of therapy for some types of cancer (e.g., acute promyelocytic leukemia and nasopharyngeal carcinoma) is differentiation therapy, which is based on mimicking molecular mechanisms driving the differentiation of immature cells to mature cells. The encouraging data in this arena is now propelling more research into other types of cancer. This research has the potential to impact aggressive cancers of the nervous system such as gliomas.



"Our real teacher has been and is the embryo, who is, incidentally the only teacher who is always right." –Viktor Hamburger.

Another hot research area in cell biology is the function of exosomes. Exosomes are nano-sized cellular vesicles that can transmit biological information over distances and are important for cell/tissue/organ formation and function. They can participate in cancer progression and metastasis by transferring molecules from cancerous cells to distant cellular microenvironments. Currently, this is an untapped area in neurodevelopment and neurological diseases. But now, research is being conducted on whether they can be used as biomarkers for disease or be co-opted as therapeutic biocarriers. These are but a few of the emerging scientific disciplines that can trace their roots back to developmental biology.

More recently, we have been moving into a 'multi-omics' data-driven era, which is powerful but only when investigators use these data to enhance their mechanistic understanding of biological processes, rather than just deriving mere correlations within these data. Bioinformatics with AI are definitely the areas of interest now and in the near future. However, we cannot take these results to be anything more than 'predictive' at this juncture. Of course, our goals are to identify gene targets/ druggable targets, etc., which can be acquired through computation, but they still must be mechanistically validated and tested through first, *in vitro* and then *in vivo* biological experimentation. During my time training in and leading labs, big pharma has been systematically shutting down their R&D programs and particularly their neuroscience divisions. When probed as to why, behind closed doors, the canned response is because of the billions of wasted dollars on research that does not work due to poor mechanistic understanding of targets. So, there are clear financial implications that drive these decisions. Thus, the crux of the problem remains that there is still a lack of understanding of the biological mechanisms leading to the expense of the resources on ineffective therapies/drugs. This is particularly true for the brain and the nervous system because too much is unknown about the fundamental molecular mechanisms. There is much to be learned before we can successfully take therapeutic strategies into the clinic. Those therapies that are in the clinic or have just passed through phase 1/2/3 clinical trials have already undergone decades of rigorous biological testing.

We are now seeing an interesting trend in the West where several biotech start-ups are returning to the fundamental biological questions as they recognize that co-opting developmental mechanisms is essential for regeneration therapies. Scientists are increasingly recognizing the importance of studying diseases at their earliest stages (origins of disease), rather than at the stages when symptoms become visible. There is so much to be excited about, what new directions developmental biology will move towards, especially in neurodevelopment, where there are a lot of unknowns. Right here at NBRC, researchers are actively investigating several aspects of developmental biology that I have highlighted, and I believe that in our own different ways, *we are all developmental biologists.*

the Visitors

The weather was slightly better on the afternoon of Vasant Panchami. There was a rhythmic shift between warmth and cold, mirroring the cyclical journey of life. It was a Sunday, a day the NBRC community associates with the popular dish "Chhole Bhature." My usual Sunday routine involves immersing myself in nature, seeking a connection with it and observing life from a broader perspective. The serene campus makes this experience effortless. However, this morning was different. Winter, in its final phase, felt overwhelming—much like the final stages of any process. A dense fog enveloped the entire campus, turning it into an isolated bubble. Normally, the hum of our technological advancements echoes across the campus from the bustling NH-8 Delhi-Jaipur highway, but this morning, the fog silenced everything. Instead, I could hear the pure, undisturbed songs of a *bulbul* perched on a neem tree just an arm's length from my balcony, though it remained hidden in the thick mist. The beautiful afternoon atmosphere tempted me to visit our winter guests—migratory birds who had made the campus their home for the past couple of months and were now preparing for their long journey back to their summer habitats, thousands of miles away.

I quickly grabbed my camera and binoculars, carefully avoiding the usual attention from campus dogs on my way from the lab to the hostel. The sun-kissed bushes cast a golden glow, as if the tall trees were adorned with gold ornaments. An occasional winter breeze tested the resilience of the old plumeria leaves. As I walked toward the crossroads, stepping over fallen leaves, I looked up, searching for birds of prey soaring high at this hour. In the distance, a few black kites glided gracefully.

The blooming flowers near IB1 showcased nature's unique color palette, a testament to the gardening staff's hard work. As I reached the crossroads, I caught the attention of some energetic, curious puppies, who quickly began to follow me. Soon, their mother joined them. The innocent curiosity of their developing minds was heartwarming and instantly lifted my mood. Somehow, I managed to divert their attention to the birds. However, one adult puppy soon rejoined me—his usual habit. He is known as "Cham-Cham," a reliable companion in my explorations over the past couple of years. He greeted and complained to me in his unique style before we continued on our walk together.

At this time of year, the berry trees on campus are heavy with fruit, attracting various birds and animals. I paused beneath the central light post to observe one of these trees. A group of *jungle babblers* and *red-vented bulbuls* caught my attention. These two species are the most common on campus, always vocalizing their presence. The bulbuls' calls seemed like a pleasant "thank you" for my visit, while the babblers, in contrast, protested loudly. Despite my active scanning, I spotted only a few other birds and some squirrels. Some were feasting on the fruits, while others basked in the sun. Suddenly, a splash of red emerged from the green canopy, like a red rose blooming amidst the leaves—a male *Rose-ringed Parakeet*, gripping a berry in its red beak. These vibrant green beauties are often seen hanging on trees near the MRI building. The parakeet savored a few fruits in its characteristic posture before flying off, revealing a hidden *coppersmith barbet* in the process. Sometimes, things are right in front of us, but we fail to notice them.
After taking a few snapshots of the squirrels, I continued toward the stage area, where I noticed a pair of *red-wattled lapwings*. These birds are often found on the campus lawns, relaxing until they sense a threat—at which point they alarm everyone with their high-pitched cries that sound like, "Did we do it… did we do it"

Sibaram Behera. PhD

Red wattled lapwing

Rose ringed parakeet

Red breasted flycatcher

Red vented bulbul

Plum headed parakeet

White wagtail

Nearby, a pair of *white wagtails*, winter migrants from Europe and Central Asia, were flitting about. They are typically seen on the football field during winter. Their tail-wagging behavior and high-pitched calls while flying make them easy to identify. A few *common mynas* and *brahminy starlings* were foraging on the football ground, while a group of yellow-footed green pigeons gathered in discussion on a tree near the stage. As I turned toward the MRI building, our presence disturbed the local dogs' territorial balance. The fresh green sprouting on the right side was beautifully illuminated by golden sunlight. The bright green carpet beneath the row of fig trees created a serene, inviting space for mindfulness and self-reflection, complemented by the symphony of birds in the background.

We exited through the security gate after Cham-Cham settled with the dogs near the main entrance. As I picked up a stick from the security post, I noticed a couple of lesser *whitethroats* and *common chiffchaffs* flitting about in a tree above the building. These tiny birds, active and energetic, moved between branches with short flights and jumps. As we walked along the barricaded road, I heard a series of "chip-chip-chr-rrr" calls. Recognizing the sound, I searched the small bushes nearby, their typical habitat. After a few attempts, I finally spotted a female *red-breasted flycatcher* perched on a dry branch—likely cut by local goatherders for their livestock. This tiny bird migrates from Europe, making an incredible journey for such a small bird each year.

Continuing down the road, I saw an *Indian robin* and an *Oriental magpie robin* calling near the old Monu shop. A male *black redstart* perched on a tree, but before I could take a photograph, it vanished into the branches. Above, the blue sky dotted with wispy white clouds framed the dark grey road, lined with lush green trees. The interplay of light and shadow enhanced the landscape's beauty. As we approached the second overpass, we encountered a couple of *peahens* and *grey francolins* along the road. A *spotted owlet* rested on a tree branch, basking in the gentle warmth of diffused sunlight. From deep within the forest, I heard the loud call of a *black-rumped flame back*. A *purple sunbird*, resembling a hummingbird with its curved beak adapted for nectar-drinking, flitted nearby. A single *green bee-eater* soared overhead, a sign that winter was nearing its end.
As the sunlight began to fade and the temperature dropped, we started our return to campus. Halfway back, I spotted a pair of *red-vented bulbuls* perched close together, grooming each other, reflecting their strong emotional bond. Their synchronized movements and melodic chorus expressed their affection. Watching their connection, a verse from Meer echoed in my mind as I walked back to the hostel:

"Ishq hi ishq hai jahan dekho
Saare aalam men bhar raha hai ishq

Ishq hai tarz o taur ishq ke taiin
Kahin banda kahin k̲huda hai ishq"

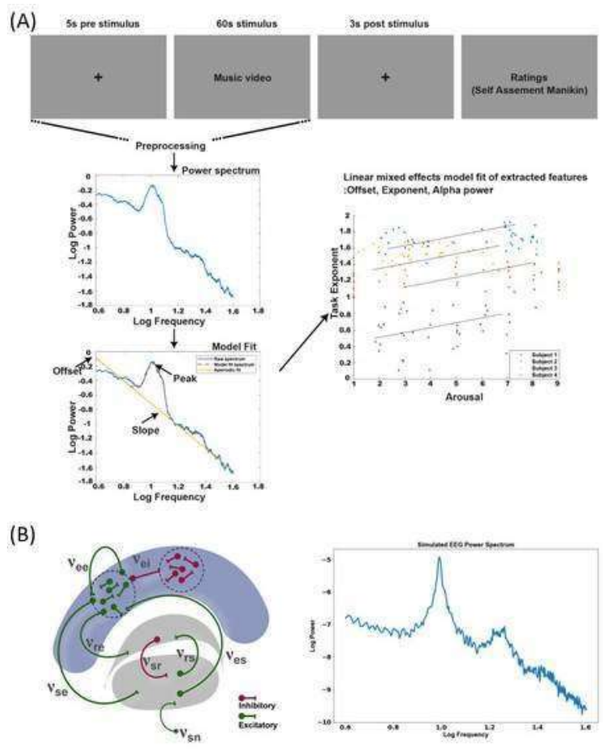
Resting by the volleyball court, I noticed some *plum-headed parakeets* enjoying berries on the tree near the hostel. I reflected on the different aspects of life that I encountered on the day. The way nature unfolds and reveals the different facets of existence never fails to surprise me.

New paper out !

Uncovering the Brain's Emotional Rhythms

Ritu M. Borah

In a recent study, we investigated how emotions, particularly arousal and valence, influence brain activity, as measured by EEG. While periodic brain activity has been the primary focus of most studies, the contribution of aperiodic signals—considered as background noise—has been largely overlooked. We therefore considered the role of aperiodic components in shaping emotional experiences, seeking to understand their specific contributions to emotional processing. To achieve this, we analyzed EEG recordings from the DEAP dataset, which includes data from 32 participants who watched emotionally evocative music videos while rating their arousal (level of excitement or tension) and valence (degree of positive or negative emotion). We then applied the Fitting Oscillations and One Over F method to decompose the EEG signals into periodic and aperiodic components. We found that higher arousal was associated with a previously unreported increase in both the exponent and offset of aperiodic background activity, alongside a decrease in alpha power, consistent with previous research on heightened emotional arousal states. Interestingly, valence did not show a significant effect on aperiodic features (requires further investigation). To understand these patterns mechanistically, we employed a corticothalamic neural field model, which simulates interactions between the cortex and thalamus, a key region for sensory processing, attention regulation and emotional regulation. Our simulations suggested that increased inhibition of the thalamic relay nuclei could account for the observed EEG changes, consistent with existing research on the role of the thalamic reticular nucleus in emotion-modulated selective attention. By integrating empirical EEG analysis with computational modeling, our study provides new insights into the neurophysiological underpinnings of emotional arousal. Our results highlight the significance of aperiodic brain activity and suggest that inhibitory mechanisms within the thalamus play a crucial role in shaping arousal-related brain dynamics. (Link to paper)



(A) Representation of the stimulus presentation and methodological workflow.
(B) Schematic representation of the corticothalamic model showcasing feedforward and feedback loop between thalamus and cortex.

Share your latest research /news from your lab for next edition!

PhD Defense !

Breaking Barriers: Investigating Zika Virus - induced blood brain barrier dysfunction

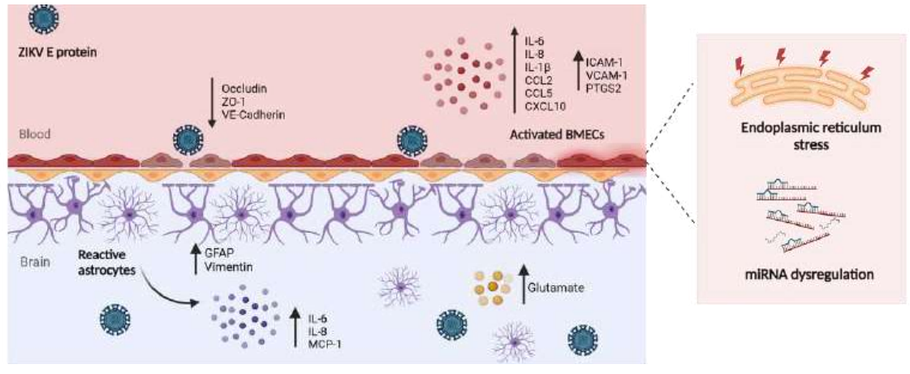
Guneet Kaur, PhD

Blood brain barrier (BBB) is a complex interface between the peripheral and central nervous system (CNS). It plays a crucial role in maintaining the microenvironment of CNS by restricting the entry of harmful pathogens, while regulating the exchange of essential nutrients. However, several neurotropic viruses like Zika Virus (ZIKV), have evolved mechanisms which breaches the BBB, providing access to the CNS leading to neurological complications.

Neurotropic viruses employ various mechanisms to disrupt the integrity of BBB- direct infection of BBB cells, disruption of tight junctions, Trojan Horse mechanism, or through induction of neuroinflammation. Specific viral proteins target key cellular pathways leading to BBB disruption.

The envelope (E) protein of ZIKV plays a critical role in viral entry. Understanding how E protein modulates BBB properties provides insights into ZIKV neuropathogenesis and paves the way for targeted interventions. During my doctoral journey, I aimed to address key questions: how ZIKV E protein affects the function of BBB cells- brain microvascular endothelial cells (BMECs), and astrocytes? What are the molecular mechanisms behind BBB dysregulation?

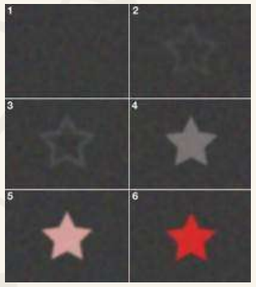
To answer this, we used a unique *in vitro* model of human BBB. The contact-based co-culture of BMECs and astrocytes was established using transwell apparatus. Upon overexpression of E protein in BMECs, we observed significant decrease in BBB integrity and increased endothelial permeability. We further observed decrease expression of endothelial tight junctions and adherens junctions (ZO-1, Occludin, and VE-Cadherin), which are critical for barrier formation. We also found increased expression of GFAP and Vimentin in astrocytes, which are hallmarks of 'astrogliosis'. Further investigations revealed E protein induces endoplasmic reticulum (ER) stress in BMECs, potentiating inflammation and cellular stress. Next generation small RNA sequencing revealed ZIKV E protein dysregulated the microRNA (miRNA) profile in BMECs. The miRNAs reported in our work are crucial for maintenance of BBB integrity in physiological and pathological conditions.



Our findings highlight how ZIKV E protein, which has a major role in virus entry into the host cell, further manipulates the host cellular pathways to create a favourable environment for viral replication and helps in progression of the infection. (Link to paper)

Imaginary Limits

-Vinitha Vinod Padippurackal



Rousseau once stated, "The world of reality has its limits; the world of imagination is boundless". But what if I told you that the world of imagination is, in fact, limited too? At the risk of offending some of our best philosophers, theorizing that our imagination is limited seems like a bold statement. However, it has been the topic of debate among the most prominent philosophers for centuries - "Do we really imagine?" Picture this: a warm summer evening, circa 400 BC Greece. Plato, as usual, is discussing a new dialogue. The question of imagination comes up, and Plato compares imagination to a clay tablet onto which one can carve pictures. Now the quality of the clay would decide how easy it is to carve on it. They called these pictures the "phantasies", and the part of the mind where it happens would later be called "the mind's eye". Not long after, a dualism emerged: one school of thought believes imagination is a distinct cognitive function, while the other dismisses this as merely a misunderstanding of memory and recall. Regardless of these differing perspectives, most agree that an imagined image is seen like they would see a real object, even if it is not present in front of them immediately. When I said "picture this" earlier, what was your immediate response? Did your mind prepare to visualise the next few words you were about to read, or did you instead focus on conceptualizing the meaning of the sentence? If you did the former, you probably have a more visualizing brain. If it was the latter, you may find it easier to conceptualise ideas rather than conjure up an image. This ability to conjure up an image is called Visual Mental Imagery (VMI), and like most cognitive abilities, it exists on a spectrum. Mental Imagery is the ability to simulate sensory experiences without the presence of a real stimulus. Simply put - if I tell you to imagine a red apple, do you see the image of a red apple? If the answer is yes, you are among an overwhelming 97% of humans with phantasia. If it is no, and you are only thinking about the concept of an apple, then you are among the rare few with aphantasia. Unlike several other conditions, aphantasia does not render one unable to do certain cognitive tasks. You may take a little longer to finish mental rotation tasks on your aptitude tests, but it has several other advantages. For instance, people with aphantasia and hypophantasia (a condition where you can imagine sparse images) have lower tendencies to overthink future scenarios because they can't picture them vividly. While visualisation may seem like a boon to many, over-visualizing traumatic events - real or imagined - can be debilitating. Fortunately, low imagery does not hinder individuals from leading normal lives. In fact, many spend most of their lives unaware of having this condition. One such individual is Glen Keane, the creator of Disney's Ariel. Keane is among the many aphant artists currently working at Disney and recently found out he is blind in his mind's eye. Mental imagery is fascinating in that it is deeply subjective and shaped by individual experiences and contexts. Certain disorders, such as schizophrenia, induce hallucinations that rely on visual and auditory imagery. Understanding the mechanism of imagination - and alternative neural correlates in aphantasia - may shed light on how to manage hallucinations, PTSD, and even anxiety. Yet, much remains unknown about aphantasia. Is it congenital? Is it acquired? Can intensity of imagery be controlled? Can the content of imagery be manipulated externally? What effect does language have on imagery? At Cognitive Brain Dynamics Lab, we try to explore the faculty of imagination and its underlying neural correlates and hope to answer some of these questions. We try to push the boundaries of our imagination. So was Rousseau right? Is imagination truly boundless?

Dreams have fascinated poets and scientists alike—blurring the lines between memory, imagination, and subconscious processing. This poem explores the strange logic of the dreaming mind.

DREAMS—so vivid...

As she closes her eyes in the night,
A mist gathers to take some shape in her sight.
Mist, drifting from deep corners of her own mind,
Blending—reshaping, a familiar stranger is designed.
The faint, gentle mist grows solid and dense.
DREAMS—so vivid, but do they ever make sense?

The architect works in reckless delight,
Revels in burying surprises in hindsight.
Snaring lost pieces in the memory net,
The dreams help remember, the dreams help forget.
An attempt to rewire, to cleanse.
DREAMS—so vivid, but do they ever make sense?

They take her out in the world again,
A fleeting escape, untouched by pain.
Trying all twists and turns, each miss and hit,
A safe practice arena for the real bit?
Yet what is an arena, if no rules commence?
DREAMS—so vivid, but do they ever make sense?

~ Medha Bhindwar.

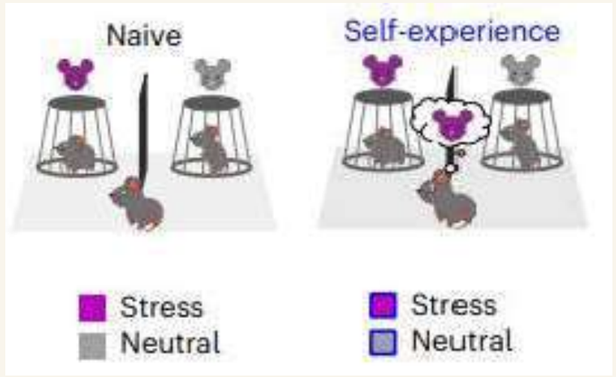
NBRC Journal Club Highlights

Glia detect and transiently protect against dendrite substructure disruption in C. elegans

Although discovered in 1856 by the pathologist R. Virchow in his search for a "connective tissue" in the brain, Glial Cells "Glue of the brain" were underrated throughout 20th century. However recent research has put the spotlight on Glia, the idea of this paper came from the Glia recently discovered role in promoting repair after Axonal injury. Question which this paper was addressing whether Glial have similar role for dendrites and for that they used C elegans' amphid neurons and glia. They found glial mediated by DGS-1 and FIG-1 do detect and respond to dendrite disruption and provide protection against damage.

DOI- https://doi.org/10.1038/s41467-024-55674-0

Presented by Dhyey Vyas



Self-experience of a negative event alters responses to others in similar states through prefrontal cortex CRF mechanisms.

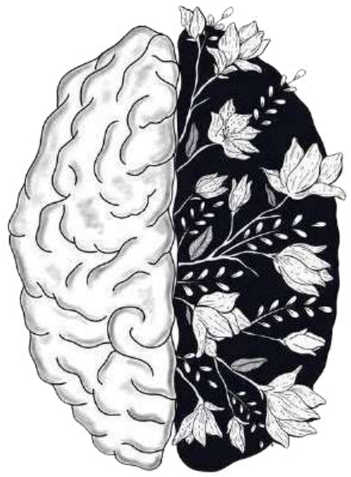
The way humans respond to others' emotions is strongly influenced by their own past emotional experiences. This study aims to elucidate the neurobiological mechanisms that underlie the complex interplay between self-experience and social cognition, focusing on the role of the corticotropin-releasing factor (CRF) within the medial prefrontal cortex (mPFC). The research examines how mice respond to conspecifics in stress after having similar emotional experiences. Techniques like in vivo microendoscopic calcium imaging, optogenetics, and knockdown were employed. The findings highlight the importance of the PFC in shaping social interactions. Moreover, the study reveals that sex affects these emotional responses: estrous dependent in females, while dominance dependent in males.

DOI - https://doi.org/10.1038/s41593-024-01816-y

Presented by Anjali Bind

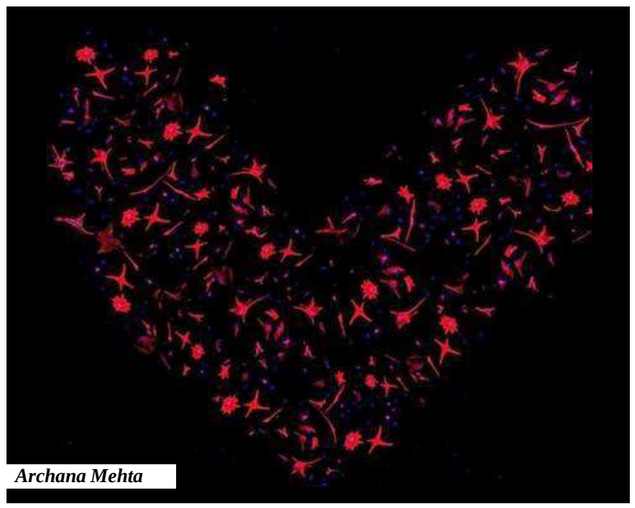
Meme of the edition!

Brain Art



Guneet Kaur

Microscopy Section



Archana Mehta

Valentine's Day special

Human Astrocytes immunostained with Glial Fibrillary Acidic Protein (red) and DAPI (blue)

Pratika Siwach

Sibaram Behera

Pratika Siwach

Pratika Siwach

Pratika Siwach

Pratika Siwach

Pratika Siwach

Pratika Siwach

Sibaram Behera

Your Photos, Our Pages!
Send your best clicks to newsletter.nbrc@gmail.com and get featured!

Tantrika Corner

You're Invited!