Pranjal Garg

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Rishikesh, Dehradun
India

EDUCATION

MBBS	Bachelor of Medicine, Bachelor of Surgery (equivalent to US MD) All India Institute of Medical Sciences (AIIMS), Rishikesh	Rishikesh 2017-present

RESEARCH EXPERIENCE

Project- Modulatory effects of Sharp Wave Ripples on extrahippocampal structures — Nov 2023- Present
Research Intern**,** University of New Mexico — (Remote)
Advisor: Dr. Sam McKenzie, PhD

- Retrieved lab data on sharp wave ripples
- Accessed CARC high performance cluster to perform statistical modelling

Project: Mechanistic interpretability of transformer, RWKV and Mamba models during counting tasks — Nov 2023-present
Research Assistant — (Remote)
Advisor: Mitchell Ostrow (PhD student at MIT)

- Accessed large and small language models (such as Phi, RWKV, Mamba) from Hugging face and ran inference.
- Designed novel counting task and assessed the accuracy and limits of the models.
- Performed activation patching to determine the causally important architectural components.
- Trained continuous time recurrent neural network to uncover the underlying dynamics of the system.

Project: Signatures of criticality in hippocampus during awake and sleep epochs in rodent brain during sharp wave ripples — June 2023-Dec 2023
Principal Investigator, *independently*

- Conceptualized the novel hypothesis and identified and retrieved the suitable publicly available dataset.
- Identified sharp wave ripples and neuronal avalanches with rigorous computational techniques in the local field potential dataset.
- Performed several novel analyses to rigorously evaluate criticality.
- Delegated computationally expensive analysis to Microsoft's Azure high performance computing clusters with Python SDK.
- Documented the results, wrote the manuscript, and listed as a first author on a pre-print.

Project- Developing novel linear dimensionality reduction algorithm, generalized contrastive principal component analysis (gcPCA) — Aug 2022-Present

Research Intern**,** Albert Einstein College of Medicine (Remote)
Advisor: Dr. Luke Sjulson, MD, PhD

- Accessed electrophysiological open dataset from Allen Institute Brain Observatory (AIBO) and trained classifier to determine the accuracy of gcPCA as compared to PCA
- Performed several other analyses on AIBO such as cosine similarity
- Explored MNIST and other electrophysiological datasets for the utility of the method.
- Accessed scRNA dataset from Allen Institute and performed analysis such as differential gene expression
- Designed artificial behavioral tasks and trained continuous time recurrent neural network (CTRNN). Performed ablation experiments and representational analysis.
- Listed as a co-author on the Society for Neuroscience presentation and manuscript currently being prepared.

Project: Exploring the relationship between popular culture and perceptions of social standing in STEMM careers: A pilot study using Structural Equation Modeling June 2022 - Jan 2023
Principal Investigator**,** *independently* (Remote)

- Organized a team of peers and jointly conceptualized a questionnaire-based study
- Designed a novel questionnaire and collected samples from a multinational population
- Statistically analyzed the data with R. To determine the relationship between variables performed structural equation modeling.
- Documented the results, wrote the manuscript, and published it as a pre-print.
- Presented the poster as a first author at the Cognitive Science Society Meeting.

Project: Modelling cortical up-down state switching by astrocytes
Principal Investigator, i*ndependently* June 2022-August 2023 (Remote)

- Organized a team of peers and jointly conceptualized a computational modeling project.
- Mathematically designed an astrocyte-neuron network rate model.
- Performed linear stability analysis and sensitivity analysis to determine the suitability of the model.
- Documented the results, wrote the manuscript, and published it as a pre-print. The manuscript is currently under peer review at the Journal of Computational Neuroscience.
- Listed as the corresponding author during the International Symposium on the Mathematics of Neuroscience presentation.

Project: Awareness and acceptability of Malaria vaccine in India. March 2022-
Research Intern, University of Minnesota June 2022
Advisor: Dr. Olihe Okoro, PhD (Remote)

- Collected subject data with pre-designed questionnaires in different states of India.
- Designed and enforced strategies to maximize sampling for the analysis
- Correlated the acquired evidence with the existing literature and wrote the discussion section
- Listed as the co-author in the peer-reviewed publication.

Project: Evaluating the effect of ubiquitination of UNC-104/KIF1A on cargo crowding March 2022-Jan 2023
Research Intern, Tata Institute of Fundamental Research, Mumbai (Hybrid)
Advisor: Dr. Sandhya Koushika, PhD

- Performed basic genetic cross in *C. elegans* to create mutants
- Annotated and statistically analyzed kymographs (images) of vesicular movement in the neurons of mutated animals

Project: Dye filling in the head neurons of *Steinernema hermaphroditum* and the neuroanatomy characterization — Aug-Oct 2021 (In person)
Research Fellow, California Institute of Technology (Caltech)
Advisor: Dr Paul Sternberg, PhD

- Designed the novel protocol to image the head neurons in *S. hermaphroditum* under fluorescence microscopy.
- Performed statistical analysis to determine and thereafter establish the suitability of the designed protocol as compared to the existing protocol.
- Discovered the head neuroanatomy and established homology with *C. elegans*
- Documented the evidence and wrote the manuscript.
- Listed as a first author in a peer-reviewed publication and presented at an international symposium.

Project: Sleep hygiene index, excessive daytime sleepiness & sleep quality in different socioeconomic strata — 2018 (In person)
Research Assistant, All India Institute of Medical Sciences (AIIMS)
Advisor: Dr Rajesh Kathrotia, MD

- Conceptualized the study and designed a questionnaire across four different indices.
- With stratified sampling, collected resident data from Rishikesh (city).
- Performed statistical analysis, correlated with previous evidence, and wrote the first draft of the manuscript.
- Listed as a first author in a peer-reviewed publication and presentation at an international conference.

ADDITIONAL RESEARCH EXPERIENCE

Principal Investigator, All India Institute of Medical Sciences, Rishikesh — 2022-2024
Advisor: Dr. Manisha Naithani, MD
Is curd psychobiotic?- A pilot open labelled Randomized Clinical Trial on the effects of curd on cognition. [Clinical Trial Registry of India No.: CTRI/2022/06/043142]

Research Fellow, WormBase — May - Nov 2021
Advisor: Dr Raymond Lee, PhD, Dr Paul Sternberg, PhD
Project: Nematode anatomy ontology curation for neuronal regulation of dauer in C. elegans & contributing to GO CAM

Summer Student, Neuromatch Academy — 2020
Advisor: Dr Mehrdad Jazayeri, MIT, USA
Project: Construction of a ring attractor system as a memory model
Available at- https://youtu.be/jl940P-TvLI

Research Observer, Indian Institute of Technology (IIT), Roorkee — 2019-2020
Advisor: Dr. Gopinath Packirisamy
Contributed to Project: Development of contrast agent using nanotechnology for Alzheimer's disease imaging

Research Observer, CSIR- Centre for Cellular and Molecular Biology 2018
Advisor: Dr. Rajan Sankaranarayanan
Skills: X-ray Crystallography, Drosophila lab, Rodent handling.

HONORS AND AWARDS

Openscope Program (Allen Institute) 2023
Independent proposal on Successor Representation selected for the second stage of the Openscope program (proposal was subsequently withdrawn due to lack of resources and mentorship)

NIH's SPARC (Stimulating Peripheral Activity to Relieve Conditions) FAIR Codeathon – 3rd prize ($ 7,000 (*in team*)) 2023
https://doi.org/10.5281/zenodo.8223110

Conference Travel/Registration Grants

- **COSYNE Undergraduate Travel Award** 2024
  Selected to receive the travel award to attend Computational and Systems Neuroscience (COSYNE) conference (availed and planned to travel)

- **COSYNE Undergraduate Travel Award**
  Selected to receive the travel award to attend Computational and Systems Neuroscience (COSYNE) conference (not availed due to delay in visa processing) 2023

- **India International Science Festival (IISF) Travel Grant** 2018
  By Department of Science and Technology, Government of India to present the poster

Grants Project Encephalon received under my leadership- 2020-2022
a) IBRO APRC Grant 2020- €1,250
b) IndiaBioscience Outreach Grant 2022- $1,300.
c) Finalist at Falling Walls Engage 2022
Full list available at neurogarg.github.io/leadership

Summer Undergraduate Research Fellowship ($6,620) 2021
California Institute of Technology (Caltech)

Developing Indian Physician Scientist 2021
Shortlisted for the prestigious DIPS workshop

Graphical abstract competition
BioRender 2020
◦ *Finalist*- 'Epigenetics and Hebbian plasticity: Need for integrated model of memory. Available from: https://www.researchgate.net/publication/352329689_Epigenetics_and_Hebbian_plasticity_Need_for_integrated_model_of_memory
◦ *Semi-Finalist*- 'Use of opsins to study the role of calcium in astrocyte-neuron communication'. Available from:

https://www.researchgate.net/publication/352366725_Use_of_opsins_to_study_the_role_of_calcium_in_astrocyte-neuron_communication

Young Scientist Incentive Plan, Kishore Vaigyanik Protsahan Yojana (KVPY) 2017
Department of Science and Technology, Government of India

PUBLICATIONS

Original articles (preprint)

- **Garg P***. Mixed signatures for subcritical dynamics in rodent hippocampus during sleep and awake epochs. bioRxiv. 2023. DOI: 10.1101/2023.10.30.564597
- Verma J, **Garg P***. Computational Modeling of Hyperpolarizing Astrocytic Influence on Cortical Up-Down State Transitions. bioRxiv. 2023. DOI: 10.1101/2023.10.16.562461.
- **Garg P***, Chunduri R, Balusu C. Exploring the relationship between popular culture and perceptions of social standing in Science, Technology, Engineering, Mathematics, and Medicine (STEMM) careers: a pilot study using path analysis. PsyArXiv. 2023. DOI: 10.31234/osf.io/c4p3y

Original articles (peer reviewed)

- Singhal C, Aremu T O, **Garg P**, et al. Awareness of the Malaria Vaccine in India. Cureus. 2022 14(9): e29210. DOI:10.7759/cureus.29210
- **Garg P,** Tan CH, Sternberg PW*. DiI staining of sensory neurons in the entomopathogenic nematode Steinernema hermaphroditum. microPublication Biology. 2022. DOI: 10.17912/micropub.biology.000516.
- **Garg P**, Kathrotia R, Mahadule A*, Kumari A, Goel A. Is maintaining sleep hygiene enough for good sleep? A socioeconomic correlation study in north India. *European Journal of Molecular & Clinical Medicine*. 2021;7(9):3621-3629. Available from: https://ejmcm.com/article_10405.html.

Opinion articles and letter to editor

- **Garg P***, Muthiah S, Sengupta S. Introducing stimulogenetics, unraveling pertinent semantic ambiguity, and determining clinical relevance among novel neuromodulation. Biology Methods and Protocols. 2022. DOI: 10.1093/biomethods/bpac019
- **Garg P***. and Sengupta, S. Chasing engrams in zebrafish (Danio rerio). J Neurosci Res. 2022. DOI: 10.1002/jnr.25097
- **Garg P***, Muthiah S, Singla C. Issue of poor student-faculty relationship in Indian medical education. Can. Med. Ed. J. 2022. DOI: 10.36834/cmej.74776
- Muthiah, S., Shekhar, S. & **Garg, P***. Basic and clinical neuroscience: a tale of dreadful trade in India. Neurol Sci. 2022. DOI: 10.1007/s10072-022-06028-5

- **Garg P***, Muthiah S, Singla C. Telerehabilitation for COVID-19 patients in India: Problem to Solution. *Harvard Public Health Review*. 2021; 29. DOI:10.54111/0001/cc9

- **Garg, P***. My ideal medical college. J Med Evid 2020;1:61-4. 2020. DOI: 10.4103/JME.JME_91_20.

Book chapters

- **Garg, P**. and Gupta, S. (2022) "IoT-Based Disease Prediction," in Smart and Secure Internet of Healthcare Things. 1st edn. Florida: CRC Press. DOI:10.1201/9781003239895-2

*Corresponding author

Presentations and invited talks

Panel discussions

- Youth Led Neuroscience Initiatives. NeuroNovember Convention 2020, Project Encephalon x Stimulus; 2020 Nov

Scientific presentation

- Oliveira E. F. de[#], **Garg P**, Sjulson, L*. Generalized Contrastive PCA (gcPCA): a generalized framework for finding low-dimensional subspaces that differ between experimental conditions. SFN (Society for Neuroscience) Meeting; 2023 November; USA.

- Verma J[#], **Garg P*.** Computational Modeling of Hyperpolarising Astrocytic Influence on Cortical Up-Down State Transitions. 4th International Symposium on the Mathematics of Neuroscience; 2023 August; Greece. [online mode]

- **Garg P***[#], Chunduri R, Balusu C. Exploring the relationship between popular culture and perceptions of social standing in STEMM careers: A pilot study using Structural Equation Modeling. Cognitive Science Society Meeting; 2023 July; Australia [online mode]

- **Garg P**[#], Tan CH, Sternberg PW*. Dye filling in the sensory head neurons in Steinernema hermaphroditum. SteXen Mini-symposium; 2023 Feb; USA [online mode]

- **Garg P***[#], Muthiah S, Sengupta S. Stimulogenetics: Redefining Neuromodulation in Neuropsychiatry. Translation in Action: From Neuropsychiatry Research to Health Solutions. (University of British Columbia); 2022 Dec; Canada. [online mode]

- **Garg P***, Muthiah S[#], Singla C. Panacea: A telehealth portal for COVID-19 rehabilitation. Ideation, Armed Forces Medical College; 2020 Oct; Pune, India. [online mode]

- **Garg P***[#]. Nanotechnology in Healthcare. Poster presented at: 1st Annual National Science Festival, AIIMS Rishikesh; 2020 Feb; Rishikesh, India.

- **Garg P**[#], Kathrotia, R*. Assessment of socioeconomic standards and sleeping patterns in the locality of Rishikesh. Poster presented at: Young Scientists Conference, 4th India International Science Festival; 2018 Oct; Lucknow, India.

[#]Presenting author

LEADERSHIP EXPERIENCE

Project Encephalon 06/2020-present
Founder and Managing Trustee of *Project Encephalon Foundation*
It is an international, trainee-led non-profit, organization for neuroscience enthusiasts that organizes various seminars, symposia, conferences, mentorship sessions, etc. Website- www.projectencephalon.org

Student editor 08/2022-02/2023
International Journal of Medical Students

VOLUNTEER WORK

Medical Student Association of India
Local Officer on Research Exchange 2018-2019
Entrusted with organizing research exchanges from regional level to international schools

Ganga Prem Hospice 2018
Provided palliative care to terminal cancer patients at several cities (Dehradun, Haridwar, Rishikesh, Raiwala)

All India Institute of Medical Sciences 2017
Volunteer for the first edition of the convocation program, providing services to the stage committee for the Honourable President of India