Alish Dipani

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Education

- **Ph.D. in Psychology**, Georgia Institute of Technology, USA 2024-Present
  CoCo Fellow, The Center of Excellence in Computational Cognition, Georgia Tech
  Advisors: Dr. Apurva Ratan Murty, Dr. Dobromir Rahnev, Dr. Audrey Sederberg
- **Ph.D. in Psychology**, Northeastern University, USA 2022-23
- **B.E. in Computer Science**, Birla Institute of Technology & Science (BITS) Pilani, India 2016-20
  Advisor: Dr. Charles-Henri Lecellier, Institute of Molecular Genetics of Montpellier, CNRS, France
  ○ Thesis: *Considering DNA topology to investigate Transcription Factor Combinatorics*

Publications

∗ **J** = Journal Publication, **C** = Conference Publication, **Pr** = In Preparation

J4 **Dipani, A.**, McNeal, N., Ratan Murty, N. A. (2024). *Linking faces to social cognition: The temporal pole as a potential social switch*. Proceedings of the National Academy of Sciences, 121(31), e2411735121.

J3 Rajan, R., Anandapadmanabhan, R., Vishnoi, A., Latorre, A., Thirugnanasambandam, N., **Dipani, A.**, Biswas, D., Radhakrishnan, D., Srivastava, A., Bhatia, K. (2023). *Essential tremor and essential tremor plus are essentially similar electrophysiologically*. Movement Disorders Clinical Practice. https://doi.org/10.1002/mdc3.13941

J2 Sarkar, A., **Dipani, A.**, Leodori, G., Popa, T., Kassavetis, P., Hallett, M., Thirugnanasambandam, N. (2022). *Inter-Individual Variability in Motor Output Is Driven by Recruitment Gain in the Corticospinal Tract Rather Than Motor Threshold*. Brain Sciences, 12(10), 1401

J1 t Hart, B., ..., **Dipani, A.**, ... et al. (2022). *Neuromatch Academy: a 3-week, online summer school in computational neuroscience*. Journal of Open Source Education, 5(49), 118

C1 Hu, S.X., Arefin, M.R., Nguyen, V.-N., **Dipani, A.**, Pitkow, X., Tolias, A.S. (2021). *AvaTr: One-Shot Speaker Extraction with Transformers*. Proc. Interspeech 2021, 3510-3514

Presentations

∗ **T** = Conference Talk, **P** = Conference Poster, **W** = Workshop

T2 Verma, D., **Dipani, A. (presenter)**, Lall, N., Gupta, P., Ralekar, C., Riskin, S., Phillips, F., Ganesh, S., Sinha, P. (2023). *A novel approach for analyzing the Heider and Simmel animation*, Talk at the Annual Conference of Cognitive Science (ACCS) 10, IIT Kanpur, India.

T1 **Dipani, A.**, Jaing, H., Kwon, M. (2023). *Local texture manipulation further illuminates the intrinsic difference between CNNs and human vision*, Talk at the Vision Sciences Society Annual Meeting (VSS) 2023, St. Pete Beach, FL, USA.

P7 Verma, D., Ben-Ami, S., **Dipani, A.**, Lall, N., Ganesh, S., Ralekar, C., Gilad-Gutnick, S., Sinha, P. (2024). *Visual experience and sensitivity to motion sequences, from human movement patterns to animated shapes*, Poster presentation at the Vision Sciences Society Annual Meeting (VSS) 2024, St. Pete Beach, FL, USA.

P6 Kwon, M., **Dipani, A.** (2023). *Mr. Chips Jr. : A transformer-based computational model to study eye movements during reading*, Poster presentation at the Vision Sciences Society Annual Meeting (VSS) 2023, St. Pete Beach, FL, USA.

P5 Rajan, R., Latorre, A., Anandapadmanabhan, R., Vishnoi, A., Biswas, D., **Dipani, A.**, Radhakrishnan, D., Thirugnanasambandam, N., Srivastava, A., Bhatia, K. (2023). *Essential tremor and essential tremor plus are essentially similar on electrophysiological tremor analysis*, Poster at International Dystonia Symposium, Dublin, Ireland.

P4 **Dipani, A.**, Lakshminarayanan, R., Leodori, G., Popa, T., Kassavetis, P., Hallett, M., Thirugnanasambandam, N. (2022). *An interpretable machine learning model to predict motor surround inhibition*, Poster presentation at the International Congress of Clinical Neurophysiology (ICCN) 2022, Geneva, Switzerland.

P3 Sarkar, A., **Dipani, A.**, Leodori, G., Popa, T., Kassavetis, P., Hallett, M., Thirugnanasambandam, N. (2022). *Inter-individual variability in motor output is driven by recruitment gain rather than motor threshold*, Poster presentation at the International Congress of Clinical Neurophysiology (ICCN) 2022, Geneva, Switzerland.

P2 Akshi, Kalra K., Choudhary Y., **Dipani, A.**, Bhattacharjee A., Urai A.E. (2020) *Classifying fMRI data for context-dependent and context-independent language tasks*, Poster presentation at the Bernstein Conference 2020, online.

P1 Avisha, Singh A., Bhatnagar H., **Dipani, A.**, Bhattacharjee A., Seethapathi N. (2020) *Shared neural activity patterns between facial expression and shape recognition*, Poster presentation at the Neuromatch Conference 3.0, online.

Presentations (continued)

W1 **Dipani, A.**, Iyer, G., Baths, V. (2020) *Recognizing Music Mood and Theme Using Convolutional Neural Networks and Attention*, MediaEval Workshop 2020, online.

Research Experience

- Research Affiliate, Department of Brain and Cognitive Sciences, MIT, USA & Research Associate, Project Prakash, Shroff Charity Eye Hospital, India 2023-2024
  Advisor(s): **Dr. Pawan Sinha** (The Sinha Lab for Developmental Research)

  ○ Conducting behavioral and neuroimaging experiments with children aged 4-18 years who have been treated for congenital cataracts to investigate visual learning and development after sight recovery.

  ○ **T2, P7**: Collecting longitudinal data before and after surgery to study visual functions (acuity, orientation discrimination, and contrast sensitivity), object recognition, visual cognition (working memory, and attention), higher-level cognition (drawing, biological motion, and social attribution), and neural correlates of face recognition via EEG.

- Graduate Research Assistant, Department of Psychology, Northeastern University, USA 2022-23
  Advisor(s): **Dr. MiYoung Kwon** (The Kwon Lab for Low Vision and Brain Research)

  ○ **T1**: Investigated how boundary detection is employed during object recognition in humans and CNNs. Created object-texture manipulated images to introduce a novel texture-defined boundary cue besides traditional texture and shape cues. Designed experiments to analyze human behavior through an online object recognition experiment and through eye movements collected during a visual search experiment. Trained and evaluated CNNs to estimate generalization. Concluded that both humans and CNNs can utilize texture-defined boundary cues, but CNNs are more biased towards it.

  ○ **Pr2**, **P6**: Developed an ideal-observer model to study eye movements during reading. The model integrates visual, lexical, and oculomotor information and uses a pre-trained Transformer (GPT2) for linguistic information. Compared the model to humans by recording eye movements during a reading experiment. Model saccade strategies closely resembled human saccade strategies.

- Project Assistant, National Brain Research Centre, India 2021-22
  Advisor(s): **Dr. Nivethida Thirugnanasambandam** (Human Motor Neurophysiology and Neuromodulation Lab)

  ○ **Pr1**, **P4**: Inspected most predictive neurophysiological features of motor surround inhibition (mSI) from TMS-EEG and EMG data. Used large-scale feature extraction followed by feature selection, and mSI prediction using Random Forests. Our approach required 60% fewer trials per subject as compared to traditional approaches using TMS-evoked potentials.

  ○ **J2, P3**: Investigated factors that drive inter-individual variability of motor-evoked potential (MEP) in response to a TMS pulse. Used General Linear Models to discover the important input-output curve parameters. The variability was primarily driven by the recruitment gain (peak slope) and maximum corticospinal excitability (maximum MEP amplitude).

  ○ **J3**, **P5**: Investigated electrophysiological (accelerometer and surface EMG) features to distinguish subjects with Dystonic Tremor, Essential Tremor, and Essential Tremor plus. Concluded that peak frequency, total power, peak power, full width half maximum, tremor stability index, and EMG-coherence were comparable among all groups.

- Machine Learning Engineer, Baylor College of Medicine & Upload AI LLC, USA 2020-21
  Advisor(s): **Dr. Andreas Tolias**, **Dr. Xaq Pitkow**

  ○ **C1**: Developed and trained Transformer models for targeted audio filtering (inspired by selective attention theory). The aim was to separate novel target speaker speech from a mixture of two speech or noise audios using only one target speaker sample. Used Wav2Vec model to provide unique target speaker embeddings.

- Research Intern, TCS Research, India 2020
  Advisor(s): **Dr. Arijit Mukherjee**

  ○ Developed biologically-plausible Spiking Neural Network models for hand gesture recognition. Used the IBM DVS128 Dataset. Models were simulated on the Neuromorphic platform SpiNNaker.

- Research Intern, The Institute of Molecular Genetics of Montpellier, CNRS, France 2019
  Advisor(s): **Dr. Charles-Henri Lecellier, Dr. Laurent Bréhélin, Dr. Sophie Lèbre**

  ○ Investigated interactions of a Transcription Factor (TF) bound to a promoter site with another TF bound to a promoter or an enhancer site while considering the DNA topology via DNA-DNA interaction. Used interpretable regression models that predicted the binding affinity of a TF to a promoter site.

Awards

- CoCo Fellowship, The Center of Excellence in Computational Cognition, Georgia Institute of Technology, USA 2024
- Rebec Family Fellowship, Program in Neuroscience, Indiana University, USA 2022
- IMPRS Neurosciences Fellowship, Georg-August-Universität Göttingen, Germany 2022
- IMPRS Mechanisms of Mental Function and Dysfunction (MMFD) Fellowship, MPI Biological Cybernetics, Germany 2022
- Ruby Association Grant, The Ruby Association, Japan 2019
- Linux Association Travel Grant, The Linux Foundation 2019
- Kishore Vaigyanik Protsahan Yojana (KVPY) Fellowship, Government of India 2016

Invited Talks

- The Sinha Lab for Developmental Research, Department of Brain and Cognitive Sciences, MIT, USA Aug 2024
- The Sinha Lab for Developmental Research, Department of Brain and Cognitive Sciences, MIT, USA Jun 2023
- Goffaux Lab, Université Catholique de Louvain, Belgium Dec 2022

Open Source Software Development

- Code for Earth, European Centre for Medium-Range Weather Forecasts (ECMWF) 2022

  ○ Integrated Matplotlib to Python interface of Magics, ECMWF's meteorological plotting software that supports plotting contours, wind fields, observations, and satellite images. This project made Magics more pythonic, user-friendly, customizable, and extensible to interactive plotting. Also improved documentation and created tutorials.

- Ruby Association Grant, The Ruby Association, Japan 2019-20

  ○ Grant Amount: 500,000¥ (≈4,700$). One of the five recipients from a competitive global applicant pool.

  ○ Further improved Rubyplot - Added image loading and manipulation functionality, support for Numo Array (inspired by NumPy). Improved documentation, tests, plot appearance, and made them compatible with multiple Ruby versions.

- Google Summer of Code (GSoC) 2019

  ○ Improved Rubyplot: An advanced plotting library for Ruby (inspired by Matplotlib). Improved front-end to make it compatible with multiple back-ends. Added ImageMagick backend and integrated the library with IRuby notebooks.

Teaching

- Neuromatch Academy (**P1, P2**)
  - ○ Lead TA, NeuroAI 2024
  - ○ TA, Computational Neuroscience 2020, 21 & 22
  - ○ TA, Deep Learning 2021

- Teaching Assistant; BITS Pilani
  - ○ BITS F382: Neurolinguistics & Artificial Intelligence 2020
  - ○ CS F407: Artificial Intelligence 2019
  - ○ CS F213: Object Oriented Programming 2018

Reviewing, Content Development & Diversity, Equity, and Inclusion

- Content Developer, Neuromatch Academy (**J1**)
  - ○ Normalization (NeuroAI)
  - ○ Learn how to work with Transformers (Deep Learning)
  - ○ Understanding Pre-training, Finetuning and Robustness of Transformers (Deep Learning)
  - ○ Introduction to processing time series (Deep Learning)
  - ○ Natural Language Processing and LLMs (Deep Learning)
  - ○ Multilingual Embeddings (Deep Learning)

- Ad-hoc Reviewing
  - ○ The European Conference on Computer Vision (ECCV) 2024
  - ○ The Annual Meeting of the Cognitive Science Society (CogSci) 2024
  - ○ Shared Visual Representations in Human & Machine Intelligence (SVRHM) @ NeurIPS 2022

Reviewing, Content Development & Diversity, Equity, and Inclusion (continued)

- Mentoring
  - Project SHORT (Students for Higher Education Opportunities and Representation in Training) 2022-Present
  - Application Statement Feedback Program (ASFP) 2022

Skills

Languages	Python, MATLAB, C/C++, Ruby, HTML, CSS, JavaScript, Java, LaTeX
Machine Learning	Generalized Linear Models, Clustering, SVMs, Random Forests, MLPs, CNNs, Transformers
Python Libraries	PyTorch, Huggingface, Scikit-learn, NumPy, Pandas, Matplotlib, Seaborn
Data Analysis	Images, Text, Audio, EMG, Accelerometer, EEG, TMS-EEG, Psychophysics, Eye-tracking
Data Collection	Eye-tracking, Psychophysics, EEG
Experimental Design	Eye-tracking, Psychophysics
Toolkits/Softwares	PsychToolBox, PsychoPy, Kubernetes, SLURM, IBM SPSS, Adobe Illustrator