

Dhananjay Huilgol, Ph.D.
Scientist IV (Associate Professor)

National Brain Research Centre, Manesar, Gurugram, India

Email: huilgol@gmail.com

Date of Birth: September 8, 1983; Nationality: Indian

Research Interest

Understanding the developmental basis of cell type diversification and circuit assembly with insights into forebrain evolution.

Education

- **2004-2012: Integrated Masters of Science and PhD**
Tata Institute of Fundamental Research (TIFR), Mumbai, India
- **2001-2004: Bachelor of Science (Honours) (Biomedical Science)**
University of Delhi, New Delhi, India

Relevant Research Experience

- **2025-present: Scientist IV (Associate Professor)**
Developmental basis of cell type diversification and forebrain circuit assembly
National Brain Research Centre, Manesar, Gurugram, India
- **2021-2024: Senior Research Associate**
Developmental specification of excitatory projection neuron types in mouse neocortex
Mentor: Prof. Z Josh Huang
Duke University Medical Center, Durham, North Carolina, USA
- **2013-2021: Postdoctoral fellow**
Understanding the role of cortical progenitors in the specification of projection neuron cell type diversity.
Mentor: Prof. Z Josh Huang
Cold Spring Harbor Laboratory, New York, USA
- **2004-2012: Integrated Masters (MSc) and PhD student**
Novel migrations in the developing rodent olfactory system
Mentor: Prof. Shubha Tole
Tata Institute of Fundamental Research, Mumbai, India

Fellowships and Research Support

- **2018 - 2020: NARSAD Young Investigator grant**
Brain and Behavior Research Foundation
- **2014 - 2017: HFSP Long term Postdoctoral fellowship**
Human Frontiers Science Programme Organization (HFSPPO)
- **2001 - 2004: Kishore Vaigyanik Protsahan Yojana (KVPY) fellowship**
Department of Science and Technology, Govt. of India

Research summary/accomplishments

I am interested in understanding the developmental basis of cell type diversification and circuit assembly in the mammalian brain. During my PhD and postdoc, I have been trained in identifying and understanding unique phenomena in building the brain, highlighting the developmental trajectory of projection neurons (PNs). These neurons constitute the largest neuronal population in the brain and form excitatory communication channels between different structures across large distances. Studying genetic and cellular mechanisms of PN development has provided evolutionary insights into the development of multiple forebrain structures. Building on this expertise, I will further explore the progenitor basis of the circuit assembly of the cerebral cortex, the largest, most complex and recently evolved structures in the mammalian brain.

In my PhD thesis with Prof. Shubha Tole, I examined novel PN migrations to two structures in the mouse olfactory system, pertaining to social behavior and feeding. My projects established an understanding of evolution and function in context of the development of an ancient sensory system, the olfactory system. I was awarded the Indian National Science Academy young scientist medal for my PhD work.

1. Dual origins of the mammalian accessory olfactory bulb revealed by an evolutionarily conserved novel migratory stream.

Huilgol D, Udin S, Shimogori T, Saha B, Roy A, Aizawa S, Hevner RF, Meyer G, Ohshima T, Pleasure SJ, Zhao Y, Tole S.

Nature Neuroscience (16): 157-165 (2013).

In this publication, we described a novel PN migration to the pheromone sensing accessory olfactory bulb (AOB). We identified the developmental basis for functional distinction between two halves of this olfactory substructure important for reproduction and aggression, respectively. In addition, we characterized a very unusual trajectory for PN migration to one half of the AOB, which is evolutionarily conserved in *Xenopus*.

2. A stream of cells from the caudal telencephalon reveals a link between the amygdala and neocortex.

Remedios R, **Huilgol D**, Saha B, Hari P, Bhatnagar L, Kowalczyk T, Hevner RF, Suda Y, Aizawa S, Ohshima T, Stoykova A, Tole S.

Nature Neuroscience (9): 1141-50 (2007).

In this study we identified a PN migration that populates a component of the olfactory amygdala, nucleus of the lateral olfactory tract (nLOT) implicated in feeding. We showed evidence for the conservation of early developmental mechanisms providing a link between the nLOT and the cerebral cortex, which is the seat of intelligence in mammals. We thereby provided a clue to the developmental transition between brain regions with older clustered organization (amygdala) and modern day laminated structures (cerebral cortex).

3. Cell migration in the developing rodent olfactory system.

Huilgol D, Tole S.

Cellular and Molecular Life Sciences (73): 2467-90 (2016).

Here we comprehensively summarized cell migrations in the olfactory system, their relationship to each other and compared them to the well-studied migrations in the cerebral cortex.

During my postdoc in Prof. Josh Huang's lab, I studied the developmental basis of PN generation in the cerebral cortex, which is responsible for higher order functions and intelligence in mammals. I was a leading member of the team that established and characterized a comprehensive toolbox of targeted knock-in mouse lines to provide genetic access to the major known PN and progenitor types. We then analyzed the role of progenitors in generating diverse PN types based on projection targets.

The diverse repertoire of cortical PNs is generated through two progenitor types in mice: (i) the principal progenitors, radial glia (RG) and (ii) intermediate progenitors (IP) that are RG-derived restricted progenitors. Cortical expansion during mammalian evolution is strongly correlated with the increase in IP number and types. Using the tools we generated, I addressed the role of evolutionarily recent IPs in the amplification and diversification of PN types. I further examined the role of IPs in the generation of cortical PNs based on their projection targets, over the period of neurogenesis.

4. Genetic dissection of the glutamatergic neuron system in cerebral cortex

Matho KS, **Huilgol D**, Galbavy W, He M, Kim G, An X, Lu J, Wu P, Di Bella DJ, Shetty

AS, Palaniswamy R, Hatfield J, Raudales R, Narasimhan A, Gamache E, Levine J, Tucciarone J, Harris JA, Mitra P, Osten P, Arlotta P, Huang ZJ

Nature 598:182–187 (2021)

In this study, we established comprehensive genetic strategies for fate-mapping and dissecting PN types on the basis of their developmental and molecular programs.

5. Direct and indirect neurogenesis generate a mosaic of distinct glutamatergic projection neuron types in cerebral cortex.

Huilgol D, Levine JM, Galbavy W, Wang BS, He M, Suryanarayana SM, Huang ZJ.

Neuron. 111(16):2557-2569.e4 (2023)

Here I found that IPs make distinct contributions that amplify and diversify PNs within each projection category. Remarkably, the two different progenitor types, RGs and IPs give rise to different PN classifications and assemble lineage-based distinct cortical projections.

6. Orderly specification and precise laminar deployment of cortical glutamatergic projection neuron types through intermediate progenitors

Huilgol D*, Levine JM*, Galbavy W, Wang BS, Huang ZJ.

Developmental Cell [Accepted] (2024)

See also *bioRxiv* doi: <https://doi.org/10.1101/2024.03.01.582863> (2024).

I examined the cellular logic behind the long-held dogma that cortical neurogenesis occurs in an inside-out manner. I discovered that IP-derived neurogenesis is based on sequential specification of projection target-defined PNs, in contrast to the dogma of a strict inside-out birth dating.

7. Progenitor basis for cortical projection neuron diversity

Huilgol D*, Russ JB*, Srivas S, Huang ZJ

Curr Op Neurobiol (81):102726 (2023).

In this review, we summarized the unanswered questions in the generation of cortical PN diversity and the multipronged approaches required to address them

8. Conservation and diversification of pallial cell types across vertebrates – an evo-devo perspective (Independent review)

Suryanarayana SM, **Huilgol D**

Brain Behav Evol. 98(4):210-228 (2023).

Here we discuss an evo-devo perspective to understand cell type changes in the course of cortical evolution in vertebrates. I wrote this review with a postdoctoral colleague.

Other publications

9. Chd5 regulates transcription factor Six3 to promote neuronal differentiation (Independent collaboration)

Shrestha P, Jaganathan A, **Huilgol D**, Ballon C, Chang Y, Mills AA

Stem Cells 41(3): 242–251 (2023) [Research article]

10. A multimodal cell census and atlas of the primary motor cortex

BRAIN Initiative Cell Census Network (BICCN) (**Huilgol D** is a contributing author)

Nature 598: 86-102 (2021) [Research article]

11. Transcription factors that govern development and disease: An Achilles Heel in cancer.

Huilgol D, Venkataramani P, Nandi S, Bhattacharjee S

Genes (Basel) 10(10): 794 (2019). [Review]

12. Lateral Thalamic Eminence: A Novel Origin for mGluR1/Lot Cells.

Ruiz-Reig N, Andrés B, **Huilgol D**, Grove EA, Tissir F, Tole S, Theil T, Herrera E, Fairén A.

Cerebral Cortex May 13. pii: bhw126 (2016) [Research article]

13. Seizure evoked regulation of LIM genes in the postnatal and adult hippocampus

Lakhina V, Subramanian L, **Huilgol D**, Shetty A, Vaidya VA and Tole S.
F1000Research (2): 205 (2013). [Research article]

14. F1000Prime Recommendation of [Nonaka-Kinoshita M et al., EMBO J 2013, 32(13):1817-28].
 F1000Prime, 04 Oct 2013; DOI: 10.3410/f.718122719.793484550.
 Tole S, **Huilgol D**. [Recommendation]

15. Building the Body, Building the Brain.
 Chatterjee M, **Huilgol D**, Tole S.
Journal of Indian Institute of Science (92:4): 369-375 (Oct-Dec 2012). [Review]

16. Dual role for LIM-HD gene Lhx2 in the formation of the lateral olfactory tract (LOT).
 Saha B, Hari P, **Huilgol D**, Tole S.
Journal of Neuroscience (27): 2290-2297 (2007). [Research article]

Please check Google scholar link for citations: <https://scholar.google.com/citations?user=kLajRJAAAAAJ&hl=en>

Manuscripts in preparation (Collaborative work with other labs)

1. Developmentally defined microcircuits in the hippocampus support spatial learning
 Huszár R*, Kirsakov A*, Henze G, **Huilgol D**, Huang ZJ, Buzsáki G
2. Chd5 regulates neural stem proliferation and differentiation in the developing neocortex
 Shrestha P, **Huilgol D**, Kaushalya S, Ballon C, Mills AA

Honors and Awards

- **2023: Outstanding Postdoc Award Nomination**
 Duke University, Durham, USA
- **2022: Discussion Leader: Molecular Mechanisms in Neural Development and Disease**
 Gordon Research Seminar (Gordon Research Conference Neural Development)
- **2018: National medal for Young Scientists**
 Indian National Science Academy
- **2016: Outstanding Post-doctoral Fellow Poster Prize**
 XVIII Annual Symposium Cold Spring Harbor Laboratory, USA
- **2012: Travel Awards: CSIR, DBT, Centre for International Co-operation in Science (CICS)**
 Gordon Research Conference (Cell Biology of a Neuron), USA
- **2012: Best oral presentation - DM Kar Award**
 Indian Academy of Neurosciences, Amritsar, India
- **2009: Asia-Pacific Microscopy Course**
 National Center for Biological Sciences-TIFR, Bangalore, India
- **2007: Asia Pacific Developmental Biology Network (APDBN) Travel Award**
 To learn slice cultures at Keio University (Prof. Kazunori Nakajima), Japan
- **2004: Silver medalist, University of Delhi**
 Bachelor of Science (honors) Biomedical Science, Delhi, India

Academic Service

- **2016 -2024: Invited reviewer for peer reviewed journals:**
 Frontiers in Cellular Neuroscience (2024); Nature Reviews Neuroscience (as a co-reviewer, 2024);
 Molecular and Cellular Neuroscience (2019); eNeuro (2017); Claustrium (2016)
- **2016-2019: Committee member: summer Undergraduate Research Program (URP)**
 Cold Spring Harbor Laboratory, USA

- **2018:** **Invited Panelist on Postdoctoral fellowships and grants**
Cold Spring Harbor Laboratory, USA
- **2013-2016:** **Associate faculty member of F1000prime**
with Prof. Shubha Tole
- **2015:** **Organizing member of “Demystifying Science at CSHL”**
Peer reviewed outreach seminar series, Cold Spring Harbor Laboratory, USA
- **2015-2018:** **Elected member of the Post-Doctoral Liaison Committee**
Goals: career development of postdocs; liaison with management/faculty
Cold Spring Harbor Laboratory, USA
- **2006-2009:** **Student in-charge of Departmental talks ‘Causerie’**
Informal trainee talks at Department of Biological Sciences, TIFR, India.

Invited/Selected Talks

- **2024:** **Developing Brain Workshop: Sudha Gopalakrishnan Brain Centre (SGBC), IIT Madras:**
Invited speaker and mentor
- **2024:** **Invited talks to present my research:** CCMB Hyderabad, CDFD Hyderabad, IISc Bangalore, IISER Pune
- **2024:** **Nerve-storming: from molecules to behaviour symposium**
Jawaharlal Nehru Center for Advanced Scientific Research (JNCASR), India
Invited talk
- **2024:** **Young Investigator Meeting**
Indiabioscience and IISER, Bhopal, India
Selected as a postdoc to attend and present
- **2023:** **NeuroNET, Department of Biochemistry & Cellular and Molecular Biology, University of Tennessee, Knoxville, USA**
Invited talk by Dr. Keerthi Krishnan
- **2023:** **Developing Brain Atlas, BRAIN Initiative Cell Atlas Network (BICAN)**
Selected for a consortium talk
- **2022:** **Gordon Research Conference - Neural Development, USA**
Selected to present a talk
- **2022:** **National Cooperative Reprogrammed Cell Research Groups (NCRCRG) & Convergent Neuroscience (CN) in Studies of mental Illness: Annual Consortium, NIH, USA**
Selected for a consortium talk
- **2021:** **Developing Brain Atlas, BRAIN Initiative Cell Census Network (BICCN)**
Selected for a consortium talk
- **2021:** **Brain Cell Data Center, BICCN Annual Symposium Teleconference**
Selected to present a trainee talk
- **2017:** **Invited talks to present my postdoctoral research:** IIT, Gandhinagar; TIFR, Mumbai; TIFR, Hyderabad; CCMB, Hyderabad; IISc, Bangalore; JNCASR, Bangalore; NBRC, Manesar; BITS Pilani, Goa; IIT Kanpur; IISER Bhopal; IISER Mohali; IISER, Pune.
- **2012:** **Indian Academy of Neurosciences, Amritsar, India**
Selected to present a trainee talk

Poster Presentations

- 2023: Structure, function and development of neural circuits, UC Irvine, USA
- 2022: Gordon Research Conference (GRC) - Neural Development, USA
- 2022: Gordon Research Seminar, GRC Neural Development, USA
- 2018: Molecular Mechanisms of Neuronal Connectivity, Cold Spring Harbor Laboratory, USA

- 2018: Brain & Behavior, Cold Spring Harbor Laboratory, USA
- 2017: Wiring the brain, Cold Spring Harbor Laboratory, USA
- 2016: Society for Neuroscience Annual Meeting, USA
- 2016: Cell Press Big Questions in Neuroscience, USA
- 2016: Neuronal Circuits, Cold Spring Harbor Laboratory, USA
- 2012: Gordon Research Conference - Cell Biology of the Neuron, USA
- 2012: International Society for Developmental Neuroscience (ISDN), Mumbai, India
- 2009: Model Organisms and Stem Cells in Development, Regeneration and Disease, Bangalore, India
- 2008: Society for Neuroscience Annual Meeting, USA
- 2007: Indian Academy of Neurosciences, Varanasi, India

Teaching

- **2018 - 2019: Scientific Reasoning and Logic (Module: Neuroscience) (Tutor and Instructor)** Graduate level course
Instructors: Prof. Bo Li, CSHL, USA and Dr. Jessica Tollkuhn. CSHL, USA
- **2012: Scientific Communication and Grant Writing (Co-Instructor)**
Indian Academy of Neurosciences, Amritsar, India
Instructors: Prof. Vidita Vaidya (TIFR, India) and Prof. Pankaj Seth (NBRC, India)
- **2009: Molecular and Cellular Neuroscience (TA and Instructor)**
Graduate level advance course
Instructor: Prof. Vidita Vaidya, TIFR, Mumbai, India
- **2009: Model Systems for Developmental Genetics (Invited Instructor)**
Graduate level lectures
Center for Excellence in Basic Sciences (CBS), University of Mumbai, India
- **2007 - 2008: Developmental Neuroscience (TA and Instructor)**
Graduate level course
Instructor: Prof. Shubha Tole, TIFR, Mumbai, India
- **2006: International Brain Research Organization (TA)**
Laboratory series, Asia-Pacific School at TIFR, Mumbai, India

Research Mentoring (Postdoctoral career)

1 Medical Scientist (Assistant Professor): Dr. Jeffrey B. Russ,
 2 Postdocs: Dr. Sweta Srivas, Dr. Yida Zhang
 1 MD-PhD student: Dr. Jesse M. Levine
 4 PhD students (in lab): Dr. William Galbavy, Mariana Holguin-Lopez, Jessica Zhang, Medy Mu
 2 PhD students (outside the lab): Dr. Padmina Shrestha (Mills lab, CSHL), Dr. Roman Huszar (Buszaki lab, NYU)
 6 rotation students, 3 summer interns, 3 technicians, 1 high-school student.

Science Outreach

- **2015 -2017: Volunteer scientist at the BioBase**
Teaching science to underprivileged school students, New York, USA
- **2011: Brain Development and Neurodevelopmental disorders**
Lectures for school students, rural Maharashtra, India
- **2011: Brain Development and Neurodevelopmental disorders**
Lecture for school students, Rotary Club of Dombivali, India
- **2010: Olfactory perception**
Speaker for public outreach program for X grade students, TIFR, Mumbai, India

- **2010:** **Olfactory perception**
Speaker for ‘Chai and Why?’, Mumbai, India [like ‘Café Scientifique’]