DR. SUSHRUT THORAT

CONTACT INFORMATION

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MISSION

Understanding and building resource-constrained agents that can learn & function in the wild.

INTERESTS

Lifelong learning, developmental science, decision making, explainable AI.

ACADEMIC TRAJECTORY

Postdoc in Machine Learning *2022 - 2026*
Institute of Cognitive Science, Osnabrück University, Germany
Advisor: Tim Kietzmann
Focus: Neuroconnectionist models of visual representations & learning.

Ph.D. in Cognitive Neuroscience *2017 - 2022*
Donders Centre for Cognition, Radboud University, The Netherlands
Advisors: Marius Peelen & Marcel van Gerven
Thesis: Smart Search - Investigations into human visual search in structured environments.

M.Sc. (cum laude) in Cognitive Neuroscience *2015 - 2017*
Center for Mind/Brain Sciences (CIMeC), University of Trento, Italy
Advisor: Marius Peelen
Thesis: Using Convolutional Neural Networks to measure the contribution of visual features to the representation of object animacy in the brain.

B.Tech. in Engineering Physics *2011 - 2015*
Department of Physics, Indian Institute of Technology - Bombay (IIT-B), India
Advisor: Bipin Rajendran
Thesis: Quadcopter Flight Control using Modular Spiking Neural Networks.

KEY PUBLICATIONS

A full list of publications can be accessed at the end of this CV, or on Google Scholar. Short descriptions of these projects can be found on my website.

Thorat S, Proklova D, Peelen MV (2019). The nature of the animacy organization in human ventral temporal cortex. *eLife* 8: e47142.

Anthes D*, Thorat S*, Konig P, Kietzmann TC (2024). Keep Moving: identifying task-relevant subspaces to maximise plasticity for newly learned tasks. *Conference on Lifelong Learning Agents (CoLLAs)*. *equal contribution.

Thorat S*, Aldegheri G*, Kietzmann TC (2021). Category-orthogonal object features guide information processing in recurrent neural networks trained for object categorization. *Shared Visual Representations in Human & Machine Intelligence Workshop @ NeurIPS*. *equal contribution.

Lu Z*, Thorat S*, Cichy RM, Kietzmann TC (2025). Adopting a human developmental visual diet yields robust, shape-based AI vision. *arXiv preprint arXiv:2507.03168*.

TECHNICAL EXPERIENCE

Programming languages: Python, MATLAB, Javascript

Machine learning frameworks: PyTorch, TensorFlow, MatConvNet

Experimentation frameworks: PsychToolbox, jsPsych, Pavlovia

Imaging techniques: fMRI, EEG, EyeLink

Conference Talks

Glimpse prediction networks: self-supervised natural scene representations aligned with human visual cortex
(Talk) *European Conference on Vision Perception (ECVP)*, Mainz, 2025

Category-orthogonal object features guide information processing in recurrent neural networks trained for object categorization.
(Talk) *European Conference on Vision Perception (ECVP)*, Nijmegen, 2022
(Flash talk) *Neuromatch conference 4.0*, Online, 2021

Body silhouettes as features in visual search: evidence from spatially-global attention modulation in visual cortex.
(Talk) *Neuromatch conference 3.0*, Online, 2020

The functional role of cue-driven feature-based feedback in object recognition.
(Talk) *Perception Day*, Nijmegen, 2018

Using convolutional neural networks to measure the contribution of visual features to the representation of object animacy in the brain.
(Talk) *Rovereto Workshop on Concepts, Actions and Objects (CAOs)*, Rovereto, 2017

Achievements/ Awards

- Voted **best poster/short-pitch**, among **15 posters**, in the 'Perception, Action, and Control' theme at the annual Donders Poster Session (2020).
- Recipient of the **Merit Award** (2017), awarded to students who achieve remarkable results at the end of their degree, by the University of Trento, Italy.
- Recipient of the **Abstract Award**, awarded to **5 of the 57** accepted abstracts at the Rovereto Workshop on Concepts, Actions and Objects (2017).
- Ranked **721 among 450,000** students in the Joint Entrance Examination **(JEE, 2011)** conducted towards admission to the Indian Institute of Technology (IIT).
- Recipient of the **KVPY scholarship** (2009), awarded to **215 students across India** with talent and aptitude for research, by the Dept. of Science & Technology, Govt. of India.
- Recipient of the **NTSE scholarship** (2007), awarded to **1000 students across India** with high intellect and academic talent, by the National Centre for Educational Research and Technology, Govt. of India.

Research Grants

MSCA Seal of Excellence for a postdoctoral fellowship proposal: "Development of the Infant Visual System: assessing and improving the developmental alignment of empiricist models of infant vision" (2025).

Reviewing work

Nature Human Behavior, Neural Networks, PLOS Computational Biology, Nature Communications, Science Advances, NeurIPS, ICLR, Memory & Cognition, eLife, iScience, CCN, Open Mind.

Supervision Experience

(Co-)supervised 14 undergraduate, 4 masters, and 3 PhD students. Notable theses are listed. A full list of students can be found at the end of this CV.

- (Bachelors) Jonas Jocham: *Processing over time and space: the use of gaze prediction to enhance spatial structure understanding of compositional scenes.* — *Osnabrück University, 2025*
- (Bachelors) Lotta Piefke: *Investigating the practicality and emergence of the Attention Schema Theory.* — *Osnabrück University, 2023*
- (Masters) Jochem Koopmans: *How our predictions do not deceive us: an investigation of the illusory perception of upside-down letters.* — *Radboud University, 2022*
- (Bachelors) Sjoerd Meijer & Ilze Thoonen: *Primed modulation of low-level object features using real-world objects and scenes.* — *Radboud University, 2018*

Teaching Experience

- **Lecturer**: *Reading group on natural and artificial reinforcement learning* (design, supervision, & evaluation; Masters) — *Osnabrück University, 2025*
- **Lecturer**: *Topics in cognitive neuroscience* (design, teaching, & evaluation; Masters) — *Osnabrück University, 23-25*
- **Lecturer**: *Reading group on cognitive abilities in artificial systems* (design, supervision, & evaluation; Masters) — *Osnabrück University, 2024*
- **Lecturer**: *Reading group on integrative systems approaches in computational cognitive neuroscience* (design, supervision, & evaluation; Masters) — *Osnabrück University, 2024*
- Co-lecturer: *Neuromatch Academy (NeuroAI course)* — *Online, 2024*
- **Lecturer**: *Machine learning for cognitive computational neuroscience* (teaching, & evaluation; Masters) — *Osnabrück University, 2023*
- **Lecturer**: *Reading group at the intersection of neuroscience & machine learning* (design, supervision, & evaluation; Masters) — *Osnabrück University, 2023*
- Mentor: *Neuromatch Academy (Deep Learning course)* — *Online, 2022*
- Teaching Assistant: *Advanced Academic & Professional Skills* (evaluation; Masters) — *Radboud University, 2020*
- Teaching Assistant: *Neural Networks* (supervision & evaluation; Bachelors) — *Radboud University, 2019*
- Guest Lecturer: *Academic Skills 2* (teaching & evaluation; Bachelors) — *Radboud University, 18-19*
- Teaching Assistant: *Brain for AI* (supervision & evaluation; Bachelors) — *Radboud University, 2018*

Workshops Attended

Analytical Connectionism (AC) — *September, 2023*
Gatsby Computational Neuroscience Unit, United Kingdom
Project: Visual feature manifolds in a convolutional RNN.

IBRO-SIMONS Computational Neuroscience Imbizo (ISi-CNI) — *January, 2017*
University of Cape Town, South Africa
Project: Assessing the role of feature attention in object detection with CNNs.

Computational Approaches to Memory and Plasticity (CAMP) — *June, 2015*
National Centre for Biological Sciences, India
Project: The role of the billions of granule cells in the cerebellum.

Invited Talks

Behaving RNNs: Bridging the gap between naturalistic evidence and decision-making.
(Lab retreat talk) *Cichy lab, FU, Berlin, 2024*

Useful scene representations.
(Lab meeting talk) *Kaiser lab, JLU, Giessen, 2023*

Category-orthogonal object features guide information processing in recurrent neural networks trained for object categorization.
(Guest talk) *MSc course on Advanced Neural and Cognitive Modelling, UvA, Amsterdam, 2022*

Representations: Useful, useless or harmful?
(Seminar talk) *Foundations of Cognition Series, Donders Institute, Nijmegen, 2019*

Other Work Experience

General Secretary — *2014-15*
Undergraduate division - Department of Physics, IIT Bombay

Content Developer — *Summer 2013*
Avanti Fellows, Delhi

Full list of Publications

(indicates equal contribution)*

Preprints

Lu, Z.*, Thorat, S.*, Cichy, R. M., & Kietzmann, T. C. (2025). Adopting a human developmental visual diet yields robust, shape-based AI vision. arXiv preprint arXiv:2507.03168.

Bowers, J. S., Puebla, G., Thorat, S., Tsetsos, K., & Ludwig, C. J. H. (2025). Centaur: A model without a theory. OSF. https://doi.org/10.31234/osf.io/v9w37_v3

Fakhoury, T.*, Turner, E.*, Thorat, S.*, & Akrami, A. (2025). Models of attractor dynamics in the brain. arXiv preprint arXiv:2505.01098.

Sommers, R.*, Thorat, S.*, Anthes, D., & Kietzmann, T. C. (2025). Sparks of cognitive flexibility: self-guided context inference for flexible stimulus-response mapping by attentional routing. arXiv preprint arXiv:2502.15634.

Peer-reviewed Journal Research Papers

Yeh, L. C., Thorat, S., & Peelen, M. V. (2024). Predicting cued and oddball visual search performance from fMRI, MEG, and DNN neural representational similarity. *Journal of Neuroscience*, 44(12). https://doi.org/10.1523/JNEUROSCI.1107-23.2024

Gayet, S., Battistoni, E., Thorat, S., & Peelen, M. V. (2024). Searching near and far: The attentional template incorporates viewing distance. *Journal of Experimental Psychology: Human Perception and Performance*, 50(2), 216. https://doi.org/10.1167/jov.23.9.4686

Thorat, S., Quek, G. L., & Peelen, M. V. (2022). Statistical learning of distractor co-occurrences facilitates visual search. *Journal of Vision*, 22(10), 2-2. https://doi.org/10.1167/jov.22.10.2

Thorat, S., & Peelen, M. V. (2022). Body shape as a visual feature: Evidence from spatially-global attentional modulation in human visual cortex. *NeuroImage*, 255, 119207. https://doi.org/10.1016/j.neuroimage.2022.119207

Thorat, S., Proklova, D., & Peelen, M. V. (2019). The nature of the animacy organization in human ventral temporal cortex. *Elife*, 8, e47142. https://doi.org/10.7554/eLife.47142

Peer-reviewed Journal Comment Papers

Luppi, A. I.*, Achterberg, J.*, Schmidgall, S., … , Thorat, S. et al. (2024) Trainees' perspectives and recommendations for catalyzing the next generation of NeuroAI researchers. *Nature Communications* 15, 9152. https://doi.org/10.1038/s41467-024-53375-2

Peer-reviewed Conference Research Papers

Long Papers (> 4 pages)

Piefke, L. M., Doerig, A., Kietzmann, T., & Thorat, S. (2024). Computational characterization of the role of an attention schema in controlling visuospatial attention. In *Proceedings of the Annual Meeting of the Cognitive Science Society* (Vol. 46). https://escholarship.org/uc/item/1516x0js

Anthes, D.*, Thorat, S.*, Kietzmann, T. C., & König, P. (2024). Keep Moving: identifying task-relevant subspaces to maximise plasticity for newly learned tasks. In *3rd Conference on Lifelong Learning Agents (CoLLAs)*. https://lifelong-ml.cc/Conferences/2024/acceptedpapersandvideos/conf-2024-44

Thorat, S.*, Aldegheri, G.*, & Kietzmann, T. C. (2021). Category-orthogonal object features guide information processing in recurrent neural networks trained for object categorization. In *SVRHM 2021 Workshop @ NeurIPS*. https://openreview.net/forum?id=BJpv46DGNl_

Thorat, S., & Choudhari, V. (2016). Implementing a Reverse Dictionary, based on word definitions, using a Node-Graph Architecture. In *Proceedings of COLING 2016, the 26th International Conference on Computational Linguistics: Technical Papers* (pp. 2797-2806). https://aclanthology.org/C16-1263

Thorat, S., & Rajendran, B. (2015). Arithmetic computing via rate coding in neural circuits with spike-triggered adaptive synapses. In 2015 *International Joint Conference on Neural Networks (IJCNN)* (pp. 1-8). IEEE. https://doi.org/10.1109/IJCNN.2015.7280822

Short Papers (≤ 4 pages)

Singer, J. J., Cichy, R. M., Kietzmann, T. C., & Thorat, S. (2024) Contrasting computational models of task-dependent readout from the ventral visual stream. In *2024 Conference on Cognitive Computational Neuroscience.* https://2024.ccneuro.org/pdf/98_Paper_authored_submission_non_anonymous.pdf

Anthes, D., Thorat, S., Konig, P., & Kietzmann, T. C. (2024) Continual learning in artificial neural networks as a computational framework for understanding representational drift in neuroscience. In *2024 Conference on Cognitive Computational Neuroscience.* https://2024.ccneuro.org/pdf/567_Paper_authored_CCN2024-authored.pdf

Bosch, V., Gutlin, D., Doerig, A., Anthes, D., Thorat, S., Konig, P., & Kietzmann, T. C. (2024) CorText: large language models for cross-modal transformations from visually evoked brain responses to text captions. In *2024 Conference on Cognitive Computational Neuroscience.* https://2024.ccneuro.org/pdf/526_Paper_authored_Cortext_Bosch_CCN2024.pdf

Anthes, D., Thorat, S., Kietzmann, T. C., & König, P. (2023). Diagnosing Catastrophe: Large parts of accuracy loss in continual learning can be accounted for by readout misalignment. In *2023 Conference on Cognitive Computational Neuroscience.* https://2023.ccneuro.org/view_paper0f17.html?PaperNum=1256

Thorat, S., Doerig, A., & Kietzmann, T. C. (2023). Characterising representation dynamics in recurrent neural networks for object recognition In *2023 Conference on Cognitive Computational Neuroscience.* https://2023.ccneuro.org/view_paperde47.html?PaperNum=1088

Thorat, S.*, Aldegheri, G.*, Van Gerven, M. A., & Peelen, M. V. (2019). Modulation of early visual processing alleviates capacity limits in solving multiple tasks. In *2019 Conference on Cognitive Computational Neuroscience.* https://2019.ccneuro.org/proceedings/0000226.pdf

Thorat, S., Van Gerven, M. A., & Peelen, M. V. (2018). The functional role of cue-driven feature-based feedback in object recognition. In *2018 Conference on Cognitive Computational Neuroscience.* https://2018.ccneuro.org/proceedings/1044.pdf

Full list of Students Supervised

(wherever applicable, published papers are *mentioned*)

PhD projects and internships: Zejin Lu (*Lu et al. arxiv 2025*), Johannes Singer (*Singer et al. CCN 2024*), Daniel Anthes (*Anthes et al., CoLLAs 2024; Anthes et al., CCN 2023*)

Master's theses: Jochem Koopmans

Bachelor's theses: Jonas Jocham, Jonas Bieber, Nicolle Rogalla, Lotta Piefke (*Piefke et al., CogSci 2024*), Lieke van der Velden, Joep Willems, Stefan Long, Sjoerd Meijer, Ilse Thoonen, Ingrid Mulder, Loes Tonnissen, Linda Ventura

Master's projects and internships: Lisa Golla, Thomas Nortmann, Andrei Klimenok

Bachelor's projects and internships: Jonathan Koenig, Ishita Darade