# 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.** (*equal contribution)

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).*

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.*

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.* In press at *Nature Machine Intelligence.*

Thorat S, Doerig A, Kroner A, Amme C, Kietzmann TC (2025). Predicting upcoming visual features during eye movements yields scene representations aligned with human visual cortex. *arXiv preprint arXiv:2511.12715.*

**RESEARCH GRANTS**   **MSCA Seal of Excellence** (92.6%) for a postdoctoral fellowship proposal: "Development of the Infant Visual System: assessing and improving the developmental alignment of empiricist models of infant vision" (2025).

**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.

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

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| **TEACHING EXPERIENCE** | – **Lecturer**: *Hands-on NeuroAI* (design, teaching, & evaluation; Masters) | *Osnabrück University, 2025* |
| | – **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* |

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| **WORKSHOPS ATTENDED** | **Analytical Connectionism (AC)** *Gatsby Computational Neuroscience Unit, United Kingdom* Project: Visual feature manifolds in a convolutional RNN. | *September, 2023* |
| | **IBRO-SIMONS Computational Neuroscience Imbizo (ISi-CNI)** *University of Cape Town, South Africa* Project: Assessing the role of feature attention in object detection with CNNs. | *January, 2017* |
| | **Computational Approaches to Memory and Plasticity (CAMP)** *National Centre for Biological Sciences, India* Project: The role of the billions of granule cells in the cerebellum. | *June, 2015* |

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| **INVITED TALKS (ACADEMIC)** | Glimpse prediction leads to natural scene representations aligned with human visual cortex. (Lab meeting talk) *Golan lab, BGU, Be'er Sheva, 2025* |
| | 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* |
| | Object processing in the human brain - exploring the primary organisation in high-level visual cortex. (Guest talk) *Department of Physics, IIT Bombay, Mumbai, 2020* |

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

OUTREACH – **Contributor**: "Connecting neural activity and perception", *The Transmitter* (2025).
ACTIVITIES – **Invited talk**: "Careers of the Future - Neuroscience", *Next Genius Webinars*, Mumbai (2022).

OTHER WORK **General Secretary**
EXPERIENCE *Undergraduate division - Department of Physics, IIT Bombay*     *2014-15*

**Content Developer**
*Avanti Fellows, Delhi*     *Summer 2013*

*Full list of Publications*
*(\* indicates equal contribution)*

## Preprints

Thorat, S., Doerig, A., Kroner, A., Amme, C., & Kietzmann, T. C. (2025). Predicting upcoming visual features during eye movements yields scene representations aligned with human visual cortex. arXiv preprint arXiv:2511.12715.

Bosch, V., Anthes, D., Doerig, A., Thorat, S., König, P., & Kietzmann, T. C. (2025). Brain-language fusion enables interactive neural readout and in-silico experimentation. arXiv preprint arXiv:2509.23941.

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

Koopmans, J. G., Thorat, S., Quek, G. L., & Peelen, M. V. (2026). Disentangling perceptual from non-perceptual expectation biases in short-term memory. Consciousness and Cognition, 137, 103964. https://doi.org/10.1016/j.concog.2025.103964

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., & <u>Thorat, S.</u> (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.*, <u>Thorat, S.</u>*, 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

<u>Thorat, S.</u>*, 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_

<u>Thorat, S.</u>, & 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

<u>Thorat, S.</u>, & 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., & <u>Thorat, S.</u> (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., <u>Thorat, S.</u>, 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

Anthes, D., <u>Thorat, S.</u>, 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

<u>Thorat, S.</u>, 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

<u>Thorat, S.</u>*, 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

<u>Thorat, S.</u>, 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 (*Koopmans et al. ConsCog 2026)*

**Bachelor's theses:** Linda Ventura, 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

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

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