

DR. SUSHRUT THORAT

CONTACT INFORMATION

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MISSION

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

RESEARCH AREAS

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

ACADEMIC TRAJECTORY

Postdoc in Machine Learning 2022 - now

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*, 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.

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, Quek GL, Peelen MV (2022). Statistical learning of distractor co-occurrences facilitates visual search. *Journal of Vision* 22(10), 2-2.

Piefke L, Doerig A, Kietzmann T, Thorat S (2024). Computational characterization of the role of an attention schema in controlling visuospatial attention. *Annual Meeting of the Cognitive Science Society* (Vol. 46).

TECHNICAL EXPERIENCE

Programming languages: Python, MATLAB, Javascript

Machine learning frameworks: TensorFlow, PyTorch, MatConvNet

Experimentation frameworks: PsychToolbox, jsPsych, Pavlovio

Imaging techniques: fMRI, EEG, EyeLink

CONFERENCE TALKS

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 Bieber: *Leveraging reinforcement learning to generate natural reaction times from image-classifying RNNs.* Osnabrück University, 2024
- (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* Osnabrück University, 2025
(design, supervision, & evaluation; Masters)
- **Lecturer:** *Topics in cognitive neuroscience* Osnabrück University, 23-25
(design, teaching, & evaluation; Masters)

- **Lecturer:** *Reading group on cognitive abilities in artificial systems* Osnabrück University, 2024
(design, supervision, & evaluation; Masters)
- **Lecturer:** *Reading group on integrative systems approaches in computational cognitive neuroscience* Osnabrück University, 2024
(design, supervision, & evaluation; Masters)
- **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* Radboud University, 2020
(evaluation; Masters)
- **Teaching Assistant:** *Neural Networks* Radboud University, 2019
(supervision & evaluation; Bachelors)
- **Guest Lecturer:** *Academic Skills 2* Radboud University, 18-19
(teaching & evaluation; Bachelors)
- **Teaching Assistant:** *Brain for AI* Radboud University, 2018
(supervision & evaluation; Bachelors)

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
Undergraduate division - Department of Physics, IIT Bombay 2014-15

Content Developer
Avanti Fellows, Delhi Summer 2013

Full list of Publications

Preprints (* indicates equal contribution)

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., König, 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., König, 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, 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: Asmit Ganguly, Jonathan Koenig