Katja Seeliger

seelikat.github.io

## Academic positions

Mar 2020 – present **Postdoctoral Research**, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig.
Convolutional neural networks and vision neuroscience. Synthesizing preferred stimuli for individual brain areas. Group leader: Martin Hebart

## Education

Oct 2015 – Dec 2019 **Ph.D. in Cognitive Computational Neuroscience**, Donders Institute for Brain, Cognition and Behaviour, Nijmegen.
Research on how representations learned by convolutional neural networks relate to human visual processing. Recording of the (up to then) largest audiovisual human functional MRI data set, with the aim of training modern neural network representations directly on brain activity. Further work on reconstructing visual perception from brain activity. Supervision: Marcel A. J. van Gerven, Umut Güçlü.

Oct 2012 – Sep 2015 **M.Sc. in Computational Neuroscience**, Technical & Humboldt University, Berlin.
Joint degree organized by *Bernstein Center for Computational Neuroscience*. My degree included three lab rotations and a seminar project (final grade: 1.4).
**Thesis** Neural encoding for video stimuli with unsupervised hierarchical representation learning. Supervised by Grégoire Montavon in the group of Klaus-Robert Müller, Machine Learning Group, Technical University of Berlin (grade: 1.0).

Apr 2008 – Apr 2012 **B.Sc. in Computer Science and Media**, Bauhaus University, Weimar.
Computer science degree with research focus through full-semester lab rotations. Courses in experimental and perception psychology (final grade: 1.3).
**Thesis** Usability of P300-spelling and asynchronous input for text input systems on the *Emotiv consumer EEG*. Supervision: Günther Schatter (grade: 1.3, written: 1.0).

Oct 2007 – Mar 2008 **Media Culture**, Bauhaus University, Weimar.
Transitioned to computer science in first semester.

June 2006 **Abitur**, Albert-Schweitzer-Gymnasium, Bad Düben.
Mathematics / Physics (final grade: 1.4; DPG membership award for best of the year)

### Post-graduate education

July 2017 **OCNC**, OIST, Okinawa, OIST Computational Neuroscience Course (fully-funded).

## Research visits

Apr 2014 – July 2014 **Research intern**, Center for Information and Neural Networks (CiNet), Osaka, Japan.
Hierarchical video feature learning for an fMRI encoding model for video stimuli (developed into my master thesis).
Supervision: Shinji Nishimoto (ex-gallantlab).

Feb 2014 – Mar 2014 **Research intern**, Max Planck Institute for Mathematics in the Sciences, Leipzig.
Extending a network editor for analysing robustness in random boolean networks.
Supervision: Johannes Rauh in the group of Nihat Ay.

Oct 2013 – Jan 2014 **Lab rotation**, Bernstein Center for Computational Neuroscience, Berlin.
fMRI pilot experiment for reconstructing spatiotemporal visual perception.
Supervision: Yi Chen and John-Dylan Haynes.

Apr 2013 – Aug 2013 **Seminar research project**, BBCI Group, Technical University, Berlin.
Detecting spatial auditory attention from EEG data in cocktail-party situations.
Supervision: Michael Tangermann in the group of Benjamin Blankertz.

Sep 2010 – Apr 2011 **Research intern**, *extracurricular*, Cybermedia Center, Osaka University, Osaka, Japan.
Implemented cellular automaton for Abelian sand dune dynamics on a large multi-tile display.
Supervision: Kei Tokita, Macoto Kikuchi and Kiyoshi Kiyokawa.

## Other positions

Mar 2017 – Sep 2018 **Software management & support**, *Donders Center for Cognition (DCC)*, Nijmegen.
DCC Cluster admin work and support.

Mar 2013 – Aug 2015 **Student assistant**, *DLR Institute of Planetary Research*, Berlin.
IT- and machine learning-related work for *Firewatch* (automated forest fire detection) and the *Rosetta mission*, supervised by Stubbe Hviid and Ekkehard Kührt at the section for *Asteroids and Comets*.

May 2012 – Aug 2012 **Research & development intern**, *Datameer*, San Mateo, California.
Implementation of a large-scale machine learning model in MapReduce, supervised by Ulrich Rückert and Hans-Henning Gabriel. Internship supported by GIZ.

June 2010 – Aug 2012 **Student assistant**, *Web Technology & Information Systems*, Bauhaus University, Weimar.
Large-scale information retrieval and feature engineering in the Wikipedia revision history with MapReduce; supervised by Maik Anderka.

Aug 2009 – Apr 2010 **Student assistant**, *Building Physics*, Bauhaus University, Weimar.
Literature research for Building Physics eLearning games; supervised by Thomas Bröker and Heinrich Söbke.

July 2007 – Sep 2007 **Intern location scouting**, *first site locations*, Hamburg.
Photographed and documented locations for advertisement and movie productions. Pre-university media internship.

July 2006 – June 2007 **Localisation tester**, *Rockstar Games*, Lincoln.
Proofread translations into European languages, quality assurance, game design evaluations.

## Teaching activities

2024 *Neural encoding and RSA* workshop at *IICCSSS* summer school (Osnabrück). Prepared and taught RSA and encoding model workshop.

2022 *Deep Learning and Vision* session at *IMPRS NeuroCom* summer school (Leipzig). Prepared and taught RSA practical.

2016 – 2018 Tutor Artificial Neural Networks (AI B.Sc.). Preparing, assisting and grading the assignments and the final exam. One of two tutors. My final tutoring year 2018 received an evaluation which was very high (8.1).

2017 – 2018 Tutor Python for Artificial Intelligence (AI B.Sc.). Assisting and grading assignments. One of four tutors.

2017 Tutor Academic and Professional Skills (AI B.Sc.). Grading final essays. One of four tutors.

2016 *Computational Modeling and Cognitive Development* at *Amsterdam Brain and Cognition Summer School*. Prepared and assisted one-week practical.

## Supervision

### Master theses (individual supervision)

Alexander Hergett — Image representation analysis using SPoSE in the higher ventral visual cortex, 2023, Leipzig University.

Roman Leipe — End-to-end learning in artificial neural networks for accurate prediction of visually evoked functional MRI Data, 2023, Leipzig University.

Johannes Roth — Generating most exciting images for neural populations via image synthesis from NIF Models, 2021, Leipzig University.

Leonieke van den Bulk — Reconstructing naturalistic movies from fMRI brain responses: Comparing motion-energy features with convolutional neural network representations, 2019, Radboud University.

Elizaveta Genke — Functional specialization in the ventral visual stream examined with convolutional neural network-derived visual representations, 2019, Erasmus Mundus MAIA.

Marjolein Troost — Generalization of an upper bound on the number of nodes needed to achieve linear separability, 2018, Radboud University.

Hugo Thabo Dictus — Encoding deep predictive network error responses as a representation of fMRI responses in visual areas, 2018, VU & University of Amsterdam.

### Secondary reader

Master theses — Sebastian Tiesmeyer (2019, Radboud University), Mart van Rijthoven (2018, Radboud University)

Bachelor theses — Lino Vliex (2016, Radboud University)

### Internships

Florian Mahner — Generative adversarial networks for video generation, 2018, Osnabrück & Radboud University.

## Reviewing

PRIMARY — CCN meeting, Human Brain Mapping, Nature Communications, Nature Machine Intelligence, Neurons, Behavior, Data analysis & Theory, NeurIPS SVRHM workshop, PLoS Computational Biology

CO-REVIEWS — Nature Human Behaviour, NeurIPS, Current Biology, Journal of Neuroscience

## Active collaborations

- Julie Boyle, Pierre Bellec & Marie St-Laurent, Courtois NeuroMod project, University of Montréal, Canada
- Rowan Sommers & Sander E. Bosch, Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands
- Antonio Lozano & Paolo Papale of Roelfsema Group, Netherlands Institute for Neuroscience, Amsterdam, Netherlands
- Affiliated with Neural Coding Lab of Umut Güçlü, Donders Institute, Nijmegen, Netherlands

## Organizational activities

CoCoNUT — Co-organizer of Cognitive Computational Neuroscience Unification Trial talk series at MPI-CBS.

## Publications

2025 Le, Lynn, Thirza Dado, **Seeliger, Katja**, Paolo Papale, Antonio Lozano, Pieter Roelfsema, Yağmur Güçlütürk, Marcel van Gerven, and Umut Güçlü (2025). "Inverse receptive field attention for naturalistic image reconstruction from the brain". In: *arXiv preprint arXiv:2501.03051*.

Le, Lynn, Nils Kimman, Thirza Dado, **Seeliger, Katja**, Paolo Papale, Antonio Lozano, Pieter Roelfsema, Marcel van Gerven, Yağmur Güçlütürk, and Umut Güçlü (2025). "Neural encoding with affine feature response transforms". In: *arXiv preprint arXiv:2501.03741*.

2024 Le, Lynn, Paolo Papale, **K. Seeliger**, Antonio Lozano, Thirza Dado, Feng Wang, Marcel van Gerven Pieter R. Roelfsema, Y. Güçlütürk, and U. Güçlü (2024). "MonkeySee: Space-time-resolved reconstructions of natural images from macaque multi-unit activity". In: *Advances in Neural Information Processing Systems (NeurIPS) 2024*.

**Seeliger, K**. and M. N. Hebart (2024). "What comparing deep neural networks can teach us about human vision". In: *Nature Machine Intelligence*.

2023 Doerig*, A., R. Sommers*, **Seeliger, K.**, B. Richards, J. Ismael, G. Lindsay, K. Kording, T. Konkle, M. A. J. van Gerven, N. Kriegeskorte, and T. C. Kietzmann (2023). "The neuroconnectionist research programme". In: *Nature Reviews Neuroscience*.

Golan, T., J. Taylor, H. Schütt, B. Peters, R. Sommers, **Seeliger, K.**, A. Doerig, M. A. J. van Gerven, K. P. Körding, B. Richards, T. C. Kietzmann, G. Lindsay, and N. Kriegeskorte (2023). "Deep neural networks are not a single hypothesis but a language for expressing computational hypotheses (commentary)". In: *Behavioral and Brain Sciences*.

2022 Le, L., L. Ambrogioni, K. **Seeliger**, Y. Güçlütürk, M. A. J. van Gerven, and U. Güçlü (2022). "Brain2Pix: Fully convolutional naturalistic video reconstruction from brain activity". In: *Frontiers in Neuroscience*.

Singer, J.D., K. **Seeliger**, T. C. Kietzmann, and M. N. Hebart (2022). "From photos to sketches-how humans and deep neural networks process objects across different levels of visual abstraction". In: *Journal of Vision* 22.2, pp. 4–4.

2021 **Seeliger**, K., L. Ambrogioni, Y. Güçlütürk, L. M. van den Bulk, U. Güçlü, and M. A. J. van Gerven (2021). "End-to-end neural system identification with neural information flow". In: *PLOS Computational Biology* 17.2.

2019 Gerven, M. A. J. van, K. **Seeliger**, U. Güçlü, and Y. Güclütürk (2019). "Current advances in neural decoding". In: *Explainable AI: Interpreting, Explaining and Visualizing Deep Learning*. Springer, pp. 379–394.

**Seeliger*, K.**, R. P. Sommers*, U. Güçlü, S. E. Bosch, and M. A. J. van Gerven (2019). "A large single-participant fMRI dataset for probing brain responses to naturalistic stimuli in space and time". In: *bioRxiv* PREPRINT.

2018 Rijthoven, M. van, Z. Swiderska-Chadaj, K. **Seeliger**, J. van der Laak, and F. Ciompi (2018). "You only look on lymphocytes once". In: *Medical Imaging with Deep Learning (MIDL) 2018*.

**Seeliger**, K., M. Fritsche, U. Güçlü, S. Schoenmakers, J.-M. Schoffelen, S. E. Bosch, and M. A. J. van Gerven (2018). "Convolutional neural network-based encoding and decoding of visual object recognition in space and time". In: *NeuroImage* 180, pp. 253–266.

**Seeliger**, K., U. Güçlü, L. Ambrogioni, Y. Güçlütürk, and M. A. J. van Gerven (2018). "Generative adversarial networks for reconstructing natural images from brain activity". In: *NeuroImage* 181, pp. 775–785.

Troost, M., K. **Seeliger**, and M. A. J. van Gerven (2018). "Generalization of an upper bound on the number of nodes needed to achieve linear separability". In: *Benelux Conference on Artificial Intelligence (BNAIC) 2018*.

2017 Güçlütürk, Y., U. Güçlü, K. **Seeliger**, S. Bosch, E. van Lier, and M. A. J. van Gerven (2017). "Reconstructing perceived faces from brain activations with deep adversarial neural decoding". In: *Advances in Neural Information Processing Systems (NeurIPS) 2017*, pp. 4249–4260.

2016 Bosch, S., K. **Seeliger**, and M. A. J. van Gerven (2016). "Modeling Cognitive Processes with Neural Reinforcement Learning". In: *bioRxiv* PREPRINT.

## Talks

2024 *Leveraging massive fMRI data sets and deep learning to synthesize images preferred by higher visual system areas.* The Brain Mosaic: Cellular heterogeneity in the CNS (3rd edition), VIB.AI, Leuven.

*Extracting neural information processing systems from large neuroimaging data* Workshop on Hybrid AI network, Lancaster University, Leipzig.

2022 *Leveraging large data sets and deep learning to synthesize images preferred by brain areas.* Symposium on Deep Learning and Vision Neuroscience, Iberian Conference on Perception (CIP), June 2022, Barcelona.

*Convolutional neural networks and human visual information processing.* 1st Leipzig Symposium on Intelligent Systems, Leipzig University, April 2022.

2021 *Convolutional neural networks and visual information processing.* Search Symposium Computational Neuroscience, Osnabrück University, virtual.

*A large single-participant fMRI dataset for probing brain responses to naturalistic stimuli in space and time.* Symposium on Naturalistic Stimuli in Cognitive Neuroscience, Tagung experimentell arbeitender Psychologen (TeaP), virtual.

2019 *End-to-end learning of neural information processing systems from brain data.* Deep learning in Computational Neuroscience Workshop, Bernstein Conference, Berlin.

*Neural network representations and visual processing in brains.* Symposium on Big Data in Vision Science, European Conference on Visual Perception (ECVP), Leuven.

2017 *Neural network representations and visual processing in brains.* Schloss Dagstuhl Seminar on Human-Like Neural-Symbolic Computing, Wadern.

### Invited (non-conference)

2023 Netherlands Institute for Neuroscience, Roelfsema Group
Host: ANTONIO LOZANO.

FU Berlin, Neural Dynamics of Visual Cognition lab, retreat.
Host: Johannes Singer.

2021 University of Montreal (virtual)
Courtois NeuroMod project. Host: Julie A. Boyle and Pierre Bellec.

2019 Max Planck Institute for Human Cognitive and Brain Sciences
Vision and Computational Cognition Group. Host: Martin Hebart.

## Conference posters

2023 K. Seeliger, R. Leipe, J. Roth, M. N. Hebart: Investigating High-Level Visual Cortex Preferences through Neural Network Training on Large Neuroimaging Data. Salzburg Mind Brain Meeting (SAMBA) 2023, Salzburg, Austria.

K. Seeliger, R. Leipe, J. Roth, M. N. Hebart: Uncovering high-level visual cortex preferences by training convolutional neural networks on large neuroimaging data. Vision Sciences Society (VSS) 2023, St. Pete Beach, Florida.

M. St-Laurent, B. Pinsard, O. Contier, K. Seeliger, V. Borghesani, J. Boyle, P. Bellec, M. N. Hebart: `cneuromod-things`: A large-scale fMRI dataset for task- and data-driven assessment of object representation and visual memory recognition in the human brain. Vision Sciences Society (VSS) 2023, St. Pete Beach, Florida.

O. Contier, S. Fujimori, K. Seeliger, A. R. Murty, M. N. Hebart: Uncovering high-level visual cortex preferences by training convolutional neural networks on large neuroimaging data. Vision Sciences Society (VSS) 2023, St. Pete Beach, Florida.

2022 W. Kłos, P. Coronica, K. Seeliger, M. N. Hebart: Training BigGAN on an ecologically motivated image dataset. Conference on Cognitive Computational Neuroscience (CCN), San Francisco, California.

F. P. Mahner, K. Seeliger, U. Güçlü, M. N. Hebart: Learning Cortical Magnification with Brain-Optimized Convolutional Neural Networks. Conference on Cognitive Computational Neuroscience (CCN), San Francisco, California.

M. St-Laurent, K. Seeliger, M. Hebart: The role of gaze position in training visual brain encoders on free-viewing data. Vision Sciences Society (VSS), 2022, St. Pete Beach, Florida.

2021 K. Seeliger, J. Roth, M. N. Hebart: Synthesizing preferred stimuli for individual voxels in the human visual system. Vision Sciences Society (VSS), 2022, St. Pete Beach, Florida.

J. Roth, K. Seeliger, T. Schmid, M. N. Hebart: Synthesizing Preferred Stimuli for Individual Voxels in the Human Visual System. Computational and Systems Neuroscience (COSYNE), 2021 (virtual).

2019 J. Singer, K. Seeliger, M. N. Hebart: The representation of object drawings and sketches in deep convolutional neural networks. NeurIPS workshop on Shared Visual Representations in Human & Machine Intelligence (SVRHM), 2020 (virtual).

K. Seeliger, L. Ambrogioni, U. Güçlü, M. A. J. van Gerven: Neural Information Flow: Learning neural information processing systems from brain activity. Conference on Cognitive Computational Neuroscience (CCN), Berlin.

2016 K. Seeliger, M. Fritsche, U. Güçlü, S. Schoenmakers, J.-M. Schoffelen, S. E. Bosch and M. A. J. van Gerven: A forward pass through the visual system: ConvNets encode MEG source activity. NeurIPS workshop MLINI, Barcelona.

K. Seeliger, G. Montavon, K.-R. Müller, M. A. J. van Gerven, S. Nishimoto: Hierarchical K-means encodes human visual cortex activity on video stimuli. NeurIPS workshop MLINI, Barcelona.

S. E. Bosch, K. Seeliger, M. A. J. van Gerven: Modeling human probabilistic categorization with neural reinforcement learning. NeurIPS workshop Brains+Bits, Barcelona.

K. Seeliger, M. Fritsche, U. Güçlü, S. Bosch, S. Schoenmakers and M. A. J. van Gerven: Convolutional neural networks code for spatiotemporal MEG source activity across the visual system. ICT.OPEN2016, Amersfoort.

2014 M. Tangermann, K. Seeliger, A. Nolte, J. Schumacher, P. Zhutovsky, B. Blankertz: Detecting spatial auditory attention in cocktail-party situations. 30th International Congress of Clinical Neurophysiology (ICCN) of the IFCN, Berlin.

## Languages

Programming Python (primary, scientific stack), C++, Matlab, Java.

Spoken English (fluent), German (native), Japanese (CEFR B1), Dutch/Flemish (CEFR A2), French (CEFR A1).

## References


**Prof. Dr. Klaus-Robert Müller**
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