Katharina Duecker

@_ ☎ _ 🐦 @katduecker in linkedIn ⌗ github ⓘ Orcid

I am a vision scientist working at the intersection of Neuroscience and Machine Learning. My passion is to uncover how the temporal dynamics of the visual system improve computational efficiency in perception. I aspire to use my neuroscientific insights in real-world applications, such as the development of intelligent systems that will advance scientific progress.

EDUCATION

PhD Neuroscience   Jun 2019 – present
Centre For Human Brain Health, School of Psychology, University of Birmingham, UK

MSc Neurocognitive Psychology   Oct 2016 – May 2019
Carl-von-Ossietzky University of Oldenburg, Germany. Grade: 1.2; thesis: 1.0[1]

BSc Psychology   Oct 2013 – Sep 2016
Bielefeld University, Germany. Grade: 1.9; thesis: 1.0

RESEARCH EXPERIENCE

Doctoral Researcher   Jun 2019 - present
Centre for Human Brain Health, UK

All my projects involve collaborators from the fields of Machine Learning, Cognitive Neuroscience, Psychophysics, & Physics.

Project 3: Biologically plausible neuronal dynamics in Computer Vision (see abstract 7)
  - implemented biologically plausible dynamics in different neural network architectures (see github)
  - outcome & relevance: algorithm shows a computationally efficient way of implementing multiplexing in neural networks, inspired by the temporal dynamics of the visual system. I received the "Leading women in NeuroAI abstract award" at the Montreal AI & Neuroscience meeting 2021 for this work.

Project 2: Investigating the neuronal substrates of Visual Search [poster]
  - responsibilities: developed experimental design & implemented Magnetoencephalography (MEG) experiment in MATLAB; collected 48 data sets (brain recordings, eye tracking, behavior, demographic data and MRI scans); data analysis (digital signal processing, statistical analysis) in MATLAB, Python, R, & shell scripting [link]
  - outcome & relevance: my results demonstrate the neural correlates of highly influential models of visual attention

Project 1: Synchronizing endogenous neuronal oscillations using photic stimulation [1]
  - responsibilities: developed & implemented MEG experiment; collected 30 data sets, including MEG recordings and MRI scans; analyzed all data in MATLAB, R, & shell script programming [link]; wrote & edited manuscript.
  - my results challenge long-held beliefs that ongoing brain rhythms can be modulated through sensory stimulation, explaining numerous null-findings & non-replicability across different studies.

Student researcher   Nov 2017 – Apr 2018
Carl-von-Ossietzky University of Oldenburg, Germany

Electric field modeling of transcranial brain stimulation [4]; Developed experimental paradigm, conducted MEG experiment with transcranial brain stimulation (N=20), data curation & pre-processing, frequency & source analyses in MATLAB

Research internship   Aug 2017 – Nov 2017
Charité Berlin, Germany

Decision-making in pathological gambing using fMRI [2]: Pre-processing of fMRI scans, development of linear models predicting brain activation from behavior in R, clinical screenings

SKILLS

Python	NumPy, SciPy, MNE, PyTorch, Keras	**Languages**	German, English, Spanish, French
MATLAB	Psychtoolbox, fieldtrip	**Other**	digital signal processing, eyetracking
R	ggplot, lme4, ez		dynamic systems theory
other	shell (bash) & LaTeX		spatial filtering, dimensionality reduction

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[1]Grading: 1.0 - 1.7: very good, 1.7 - 2.7: good, 2.7 - 3.7: pass, >4: fail

Summer Schools, Machine Learning & Mathematics

Computational Neuroscience: Vision   Jul 2022
Summer School at Cold Spring Harbor Laboratory, Long Island, NY, USA

Kavli Summer Institute in Cognitive Neuroscience   Jun 2022
Summer School at UC Santa Barbara, California, USA

Neuromatch Academy: Deep Learning   Jul 2021
online summer school

Neuromatch Academy: Computational Neuroscience   Jul 2020
online summer school

Linear Algebra for Neuroscientists   Aug 2019
Summer School at Radboud University, Nijmegen, The Netherlands

Machine Learning I: Unsupervised Learning   2018/2019
M.Sc. Physics course at the University of Oldenburg, Germany

Tools for Teaching Quantitative Thinking   Mar 2017
Erasmus+ Seminar at the University of Graz, Austria

Grants & Awards

Jun 2022
Travel Grant, Boehringer Ingelheim Fonds   3,150 EUR/ 3,307.5 USD

May 2022
Howard Hughes Medical Award, Cold Spring Harbor Laboratory course waiver   1,500 USD

Mar 2022
PhD paper of the year 2022 (2nd place), Centre for Human Brain Health

Oct 2021
Leading Women in Neuro-AI abstract award, Montreal AI & Neuroscience meeting   400 CAD/ 324 USD

Publications

[1] K. Duecker, T. P. Gutteling, C. S. Herrmann, and O. Jensen, "No evidence for entrainment: Endogenous gamma oscillations and rhythmic flicker responses coexist in visual cortex," *Journal of Neuroscience*, 2021. DOI: `10.1523/JNEUROSCI.3134-20.2021`.

[2] A. Genauck, C. Matthis, M. Andrejevic, *et al.*, "Neural correlates of cue-induced changes in decision-making distinguish subjects with gambling disorder from healthy controls," *Addiction Biology*, 2021. DOI: `10.1111/adb.12951`.

[3] A. Zhigalov, K. Duecker, and O. Jensen, "The visual cortex produces gamma band echo in response to broadband visual flicker," *PLoS Computational Biology*, 2021. DOI: `10.1371/journal.pcbi.1009046`.

[4] F. H. Kasten, K. Duecker, M. C. Maack, A. Meiser, and C. S. Herrmann, "Integrating electric field modeling and neuroimaging to explain inter-individual variability of tacs effects," *Nature Communications*, 2019. DOI: `10.1038/s41467-019-13417-6`.

Conference abstracts/talks

[5] K. Duecker, K. L. Shapiro, S. Hanslmayr, J. Wolfe, Y. Pan, and O. Jensen, "Alpha oscillations support modulation of neuronal excitability to target and distractor features in guided search," The 22nd International Conference on Biomagnetism (poster), Aug. 2022.

[6] K. Duecker, K. L. Shapiro, S. Hanslmayr, J. Wolfe, Y. Pan, and O. Jensen, "Guided search is associated with modulated neuronal excitability to target and distractor features in early visual regions," International Conference of Cognitive Neuroscience (poster), May 2022.

[7] K. Duecker, "Early career researcher talk: How does the visual system implement selective attention?" Psyched@UoB (invited talk), Jun. 2021.

[8] K. Duecker, "Oscillatory responses to sinusoidal and broadband frequency tagging: No entrainment, but a perceptual echo in the gamma-band," Neuoxillations: Early career researcher talk series by the Experimental Psychology group, University of Oxford (invited talk), Sep. 2021.

[9] K. Duecker, M. Idiart, and O. Jensen, "Space-to-time-conversion: Oscillations in an artificial neural network generate a temporal code representing simultaneous visual inputs," Montreal AI & Neuroscience (conference abstract), Nov. 2021.

[10] K. Duecker, T. P. Gutteling, C. S. Herrmann, and O. Jensen, "No evidence for entrainment: Endogenous gamma oscillations and rhythmic flicker responses coexist in visual cortex," Neuromatch Conference 3 (virtual poster), Nov. 2020.

[11] K. Duecker, T. P. Gutteling, C. S. Herrmann, and O. Jensen, "Does rapid frequency tagging entrain neuronal gamma oscillations?" British Association for Cognitive Neuroscience (poster), Sep. 2019.

TEACHING/MENTORING

MENTORING

Jiahui An, M.Sc. Cognitive Neuroscience and Robotics   2022
Brain-Computer Interface based on feature-based attention, photic stimulation & Machine Learning

TEACHING (M.SC. LEVEL, SELECTED)

Current Research & Practice: Magnetoencephalography practical   Autumn 2021, 2022
School of Psychology, University of Birmingham

8 hours lecture + flexible tutoring, 3 students; developed and taught an introductory course on MEG

Application of Electrophysiological Approaches   Spring 2020, 2021, 2022
School of Psychology, University of Birmingham

20 hours teaching per term, 40 students, grading of assignments, course on digital signal processing of MEG data

MATLAB programming   Autumn 2020, 2021
School of Psychology, University of Birmingham

10 hours teaching/tutoring per term, 40 students

Fundamental competencies in Psychology   Autumn 2018
Department of Computer Science, University of Oldenburg

20 hours teaching, 10 students, weekly seminar on fundamental literature in cognitive psychology

Multivariate Statistics   Autumn 2017
Department of Psychology, University of Oldenburg

20 hours teaching per term, 35 students, weekly tutorial on mutlivariate statistics with applications in R

AD HOC PEER-REVIEWING

Journal of Neuroscience; Psychophysiology; European Journal of Neuroscience; Cerebral Cortex; PLOS One; Brain & Behavior; Attention, Perception, & Psychophysics