Katharina Duecker

@ katharina.duecker@gmail.com 📞 +44 759 681 7283 🐦 @katduecker in linkedIn ⚙ github 🅾 Orcid

I investigate how the temporal dynamics of the visual system support perception and attention. My hopthesis is that studying rhythmic and aperiodic dynamics can teach us how the brain allocates its computational resources efficiently. My main research tools are non-invasive brain recordings and computational modeling/machine learning.

EDUCATION

NEUROSCIENCE & PSYCHOLOGY

2019 – 2023

PhD in Neuroscience, Centre For Human Brain Health, School of Psychology, University of Birmingham, UK
Supervisor: Prof Ole Jensen, Prof Kimron Shapiro

2016 – 2019

MSc Neurocognitive Psychology, Department of Psychology, Carl-von-Ossietzky University of Oldenburg, Germany
Thesis: *Entrainment of Neuronal Gamma Oscillations using Rapid Frequency Tagging*
Supervisor: Prof Christoph Herrmann, Grade: 1.2, Thesis: 1.0

2013 – 2016

BSc Psychology, Faculty of Psychology, Bielefeld University, Germany
Thesis: *Attentional Capture by a Novel Stimulus in Visual Search*
Supervisor: Prof Gernot Horstmann, Grade: 1.9, Thesis: 1.0

RESEARCH EXPERIENCE

DOCTORAL RESEARCH

Synchronizing endogenous neuronal oscillations using photic stimulation [1]
Rhythmic responses to photic stimulation are often assumed to reflect a synchronization of ongoing neuronal oscillations to the non-invasive stimulus. My research challenges this view, showing that the intrinsic dynamics of the brain are not easily perturbed. This study motivates further work to understand how rhythmic sensory stimulation affects cellular activity.

Investigating the neuronal substrates of Visual Search (poster)
Visual search is a classic experiment used to operationalize selective attention to visual objects. This project aims to uncover the neural substrates of numerous behavioral findings and their corresponding models. I use Magnetoencephalography and rapid photic stimulation to investigate how the visual cortex modulates its neuronal excitability to solve the search task.

Biologically plausible neuronal dynamics in Computer Vision (see abstract 7)
This project is motivated by the idea that the dynamics of neuronal activity prevent sensory systems from getting overwhelmed by the abundance of stimuli competing for our attention. This modeling work shows that implementing biologically plausible temporal dynamics in a Machine Learning algorithm solves the competition between multiple stimuli, and allows the system to process them in rapid succession.

INTERNSHIPS & STUDENT PROJECTS

Nov 2017 – Apr 2018

Electric field modeling of transcranial brain stimulation [2], Prof Christoph Herrmann, Dr Florian Kasten

Carl-von-Ossietzky University of Oldenburg, Department of Psychology, Germany

Aug 2017 – Nov 2017

Decision-making in pathological gambing using fMRI [3], Dr Alexander Genauck, Prof Nina Romanczuk-Seiferth

Charité Berlin, Department of Psychiatry & Psychotherapy, Germany

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

SKILLS

PROGRAMMING

MATLAB	Psychtoolbox, fieldtrip
Python	NumPy, SciPy, MNE, PyTorch, Keras
	Matplotlib, jupyter notebook, spyder
R	ggplot, lme4, ez
other	shell (bash) & LaTeX

OTHER

Languages	German, English, Spanish, French
Other	Digital Signal Processing, Dynamic Systems
	Theory, Computational Neuroscience,
	Eyetracking

GRANTS & AWARDS

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

May 2022
Howard Hughs Medical Award, CSHL 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]   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`.

[3]   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`.

[4]   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`.

CONFERENCE ABSTRACTS/TALKS

[5]   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.

[6]   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 (Graphical Abstract), Nov. 2021.

[7]   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.

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

[9]   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.

[10]   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.

Summer Schools, Machine Learning & Mathematics

Jul 2022

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

Jun 2022

Kavli Summer Institue in Cognitive Neuroscience, Summer School at UC Santa Barbara, California, USA

Jul 2021

Neuromatch Academy: Deep Learning, (online summer school)

Jul 2020

Neuromatch Academy: Computational Neuroscience, (online summer school)

Aug 2019

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

2018/019

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

2017

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

Teaching/Mentoring

Mentoring

2022

Jiahui An, M.Sc. Cognitive Neuroscience and Robotics: Brain-Computer Interface based on photic stimulation

Teaching (M.Sc. level, selected)

Autumn 2022

MEG practical, School of Psychology, University of Birmingham
8 hours lecture + flexible tutoring, 3 students; developed and taught an introductory course on MEG with applications in MATLAB

Spring 2020, 2021, 2022

Application of Electrophysiological Approaches, School of Psychology, University of Birmingham
20 hours teaching/tutoring per term, grading of assignments, 40 students

Spring 2020, 2021

MATLAB programming, School of Psychology, University of Birmingham
10 hours teaching/tutoring per term, 40 students

Winter 2018/2019

Fundamental competencies in Psychology, Department of Computer Science, University of Oldenburg
20 hours teaching, weekly seminar on fundamental literature in cognitive psychology, prepared and taught teaching material, 10 students

Winter 2017/2018

Multivariate Statistics, Department of Psychology, University of Oldenburg
20 hours teaching, weekly tutorial on mutlivariate statistics, prepared repetition of weekly lectures and applications in R, 35 students

Ad Hoc Peer-Reviewing

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