

## **CURRICULUM VITAE - SABINE KASTNER**

Princeton Neuroscience Institute & Department of Psychology, Princeton University, Princeton, NJ 08544

**CITIZENSHIP** U.S., German

### **DEGREES**

1985 B.A., History & Philosophy, Georg-August University, Göttingen, Germany  
1993 M.D., Heinrich-Heine University, Düsseldorf, Germany  
1994 Ph.D., Neurophysiology, Georg-August University, Göttingen, Germany

### **POSITIONS AND EMPLOYMENT**

2012-present Visiting Scientist, Helen Wills Neuroscience Institute, UC Berkeley  
2009-present Professor of Psychology & Neuroscience, Princeton University  
2005-present Scientific Director, Scully Center for the Neuroscience of Mind & Behavior, Princeton University  
2005-2009 Associate Professor of Psychology & Neuroscience, Princeton University  
2000-2005 Assistant Professor of Psychology, Princeton University  
1996-2000 Visiting Research Associate, National Institute of Mental Health  
1996 Lecturer, Dept. of Psychiatry, Medical School, University of Göttingen, Germany  
1994-1996 Postdoctoral Research Fellow, MPI for Biophysical Chemistry, Göttingen, Germany  
1988-1992 PhD student, Max-Planck-Institute for Biophysical Chemistry, Göttingen, Germany

### **HONORS**

- George A. Miller Prize in Cognitive Neuroscience, 2023
- Member (elected), German Society for Clinical Electrophysiology and Functional Imaging, 2022
- Member (elected), American Academy of Arts & Sciences, 2022
- Member (elected), National Academy of Sciences Leopoldina, Germany, 2021
- Fellow (elected), Society for Experimental Psychology, 2020
- Society for Neuroscience Award in Education and Training, 2019
- Member (elected), International Neuropsychology Symposium, 2016
- Distinguished Fellow, Sage Center for the Study of the Mind, Santa Barbara, 2014
- Fellow, American Psychological Society, 2010
- Young Investigator Award, Cognitive Neuroscience Society, 2005
- John McLean Jr., Presidential University Preceptorship, Princeton University, 2003 – 2006
- Fellows Award for Research Excellence, National Institutes of Health, 1999 & 2000
- Fellow of the German National Scholarship Foundation, 1985 – 1993

### **SPECIAL LECTURES**

- George A. Miller Lecture, Cognitive Neuroscience Society, 2023
- Distinguished Lecturer, Ian P. Howard Memorial Lecture Series, York University, 2022
- Special Lecture, Society for Neuroscience Annual Meeting, San Diego, 2018
- Attneave Lecture, University of Oregon, 2018
- Inaugural Marianne Fillenz Lecture, Department of Anatomy & Physiology, Oxford University, 2018
- Keynote Lecture, Vision Sciences Society meeting, St. Petersburg, FL, 2016
- Creutzfeldt Lecture, 11<sup>th</sup> Meeting of the German Neuroscience Society, Göttingen, Germany, 2015
- Key Note Lecture, Human Brain Mapping, Honolulu, HI, 2015
- SAGE Lecture, Sage Center for the Study of the Mind, Santa Barbara, 2014
- Donders Lecture, Donders Institute, Nijmegen, Netherlands, 2014
- 2<sup>nd</sup> Homewood Brain and Cognition Lecture, Johns Hopkins University, Baltimore, MD, 2012
- 4<sup>th</sup> Annual CCSN Invited Lecture, Washington University, St. Louis, 2012

## **EDITORIAL SERVICES**

- Editor-in-Chief, *The Journal of Neuroscience*, 2023 –
- Specialty Chief Editor, Understanding the Brain, *Frontiers for Young Minds*, 2015 – present
- Editor-in-Chief, *Progress in Neurobiology*, 2018 – 2022
- Board of Reviewing Editors, *Science*, 2021 - 2022
- Advisory Board, *eNeuro*, 2019 – 2022
- Advisory Board, *BrainFacts.org*, Society for Neuroscience, 2019 – 2022
- Senior Editor (2016 – 2018) & Board Reviewing Editor (2015), *eLife*
- Senior Editor (2009 – 2015) & Reviewing Editor (2006 – 2009), *Journal of Neuroscience*
- Section Editor (Perception), *Neuropsychologia*, 2007 – 2013
- Handling Editor, *NeuroImage*, 2005 – 2008
- Section Editor (Attention), *The Cognitive Neurosciences V* (MIT Press, 2014)
- Section Editor (Attention & Working memory), *The Cognitive Neurosciences VI* (MIT Press, 2019)
- Editor, *The Handbook of Attention* (with AC Nobre) (Oxford University Press, 2014)
- Served on editorial boards (e.g. *Science*, *Neuron*, *Cognitive Neuroscience*, *Brain Topography*, *Frontiers in Neuroscience*, *Neuropsychologia*, *NeuroForum*)

## **OTHER PROFESSIONAL ACTIVITIES**

- Co-Chair, Gordon Research Conference ‘Neurobiology of Cognition’, 2022
- Director, Kavli Summer Institute (Attention), UC Santa Barbara, 2022
- Chair, Scientific Advisory Board, Center for Biomedical Imaging, Lausanne, Switzerland, 2021 – present
- Expertengremium (‘Committee of Experts’), Council of Science & Humanities (‘Wissenschaftsrat’, German Science Ministry & German Research Society, DFG), Germany, 2020 – present
- Scientific Advisory Board, Paris Brain Institute (Institut du Cerveau), Pitie-Salpetriere Hospital, Paris, France, 2020 – present
- Scientific Advisory Board, McGovern Institute, MIT, 2022 – present
- Finance Committee, Society for Neuroscience, 2019 – 2022
- Publications Committee, Society for Neuroscience, 2015 – 2018
- Advisory Board, *BrainFacts.org*, Society for Neuroscience, 2019 – 2022
- Board of Advisors, Howard Hughes Medical Institute, 2021 - 2022
- SIF Review Committee, IndiaAlliance, Wellcome Trust, 2019 – present
- ELSC International Steering Committee, Hebrew University, Jerusalem, 2019 - present
- External Advisory Board, U19 project (PI: E. Buffalo), University of Washington, Seattle, 2019 – present
- PRIME-DRE Executive Committee, 2019 – present
- Scientific Advisory Board, Wellcome Strategic Award (PI: J. Duncan), Oxford & Cambridge University, UK
- External Review Committee, Department of Neuroscience, University of Philadelphia, 2019
- External Review Committee, Department of Psychology, Cornell University, 2014
- Served on >30 study sections, special emphasis panels for NIH and NSF
- >200 conference talks, seminars and invited lectures (recent ones are listed below)

## **SERVICE TO PRINCETON UNIVERSITY**

- Chair, Animal User Committee (PNI), 2022 -
- Scientific Director, Regina and John Scully ‘66 Center for the Neuroscience of Mind and Behavior, 2005 – present
- Executive Committee for the PNI Neuroimaging Facility, 2005 – present
- Interdepartmental Committee for the Program in Neuroscience, 2000 – present
- Graduate admission committee (PNI), 2018 – present
- Committee on Faculty Awards (PSY), 2019 - present
- Chair and member of various promotion and tenure committees
- Chair and member of various departmental search committees
- Presidential search committee for the Dean of Graduate School, 2015

- Committee of Committees, 2011 – 2013
- Council of the Princeton University Community, 2013 – 2016, 2019
- Member, IACUC, 2016 – 2019

## **TEACHING**

- NEU/PSY 202/259: Introduction to Cognitive Neuroscience
- NEU/PSY 331: Introduction to Clinical Neuropsychology
- NEU/PSY 402: Case Studies in Cognitive Neuroscience
- NEU/PSY 406: Primate posterior parietal cortex: Organization, Functions and Pathology
- NEU/PSY 421: The Cognitive Neuroscience of Selective Attention
- NEU/PSY 428: Neurodevelopment Disorders – Neural Basis, Clinic and Interventions
- FRS 119: The Human Toolmaker (Freshman seminar)
- Various graduate courses

## **OUTREACH, DIVERSITY & INCLUSION ACTIVITIES**

- Specialty Chief Editor for open access kids' science journal: Frontiers for Young Minds/Section: Understanding the Brain, 2015 – present
- Advisory Board, BrainFacts.org, Society for Neuroscience, 2019 – 2022
- Mentor to first generation and URM college and graduate students
- Participation in annual Young Women's Science Conference to foster the careers of young women interested in life sciences
- Organizing ~20 outreach events/year including Teacher prep seminars on ADHD, dyslexia and dyspraxia, talks at ADHD support groups, visits to science classrooms in elementary and middle schools, and school visits to the Princeton Neuroscience Institute

## **MENTORSHIP**

- Trained 39 graduate students and postdocs, promoting diversity, equity, and inclusion: 21 of the trainees were female, several of them URMs and/or first-generation students
- >30 trainees moved on to careers in academia and research
- Advised >70 undergraduate junior and senior students on their junior and senior thesis research, many of whom got inspired to join graduate programs in psychology or neuroscience

## **PROFESSIONAL SOCIETY MEMBERSHIPS**

American Academy of Arts & Sciences (elected)  
 National Academy of Sciences Leopoldina, Germany (elected)  
 Society for Experimental Psychology (elected)  
 German Society for Clinical Electrophysiology and Functional Imaging (elected)  
 Society for Neuroscience  
 Cognitive Neuroscience Society  
 German Society for Neuroscience  
 Organization for Human Brain Mapping  
 Vision Sciences Society  
 American Physiological Society  
 American Psychological Society  
 American Association for the Advancement of Science

## **CURRENT RESEARCH SUPPORT**

- PI, NIH grant 2RO1 EY017699, "Functions of the thalamus in perception and cognition", 2018-2023
- PI, NIH grant 2RO1 MH64043-10, "Neural basis of visual attention", 2016-2023

- Co-PI, NIH 21560-685-Project, Silvio O. Conte Center, Project 2: Dynamic thalamocortical gating of corticocortical communication in visual active sensing, 2017-2023
- Center Director & PI, P50 MH132642, 'Cognitive Thalamus', 2023-2028, *pending*

## INVITED TALKS (last 6 years)

### 2022

Distinguished Lecturer, Ian P. Howard Memorial Lecture Series, York University, Toronto, CA  
 Leslie G. Ungerleider Symposium, NIMH/NIH, Bethesda, MD  
 Keynote, BIOMAG, Birmingham, UK  
 Kavli Summer Institute (Director), Santa Barbara, CA  
 Society of Experimental Psychologists, Annual meeting, Chicago, IL  
 Invited symposium, Cognitive Neuroscience Annual Conference, San Francisco, CA  
 Department of Ophthalmology, University of Pittsburgh Medical School, PA  
 Paris Brain Institute, Sorbonne University, Paris, France  
 (virtual) MIT, Cambridge, MA  
 (virtual) Annual Interdisciplinary Conference, Jacksonhole, WY  
 (virtual) National Eye Institute, National Institutes of Health, Bethesda, MD  
 (virtual) fMRI Speaker Series, University of Michigan, Ann Arbor, MI

### 2021

Virtual special symposium, Society for Neuroscience Annual meeting  
 Virtual Keynote, 10th Anniversary International Symposium on Brain Science, IDG/McGovern Institute for Brain Research at PKU, Beijing, China  
 Virtual seminar, VisionBrunch, Stanford University, Palo Alto, CA  
 Virtual Attention Symposium, 20th World Congress on Psychophysiology, China

### 2020

Virtual seminar, Department of Psychology, University of Washington, Seattle  
 Virtual seminar, CERNEC, Department of Psychology, University of Montreal  
 Virtual Keynote, Neurizons Conference  
 Department of Neuroscience, Mount Sinai, NY  
 Speaker, Gordon Research Conference Thalamocortical interactions, Ventura Beach, CA

### 2019

Descartes University, Paris, France  
 Tata Institute for Fundamental Research, Mumbai, India  
*Chair*, Panel on Animal Welfare, PRIME Workshop, Wellcome Trust, London, UK  
 Department of Neuroscience, Boston University, Boston, MA  
 Inaugural speaker, Psychology seminar series, University of Toronto, Toronto, CN  
 Department of Psychology, Vanderbilt University, Nashville, TN

### 2018

Department of Neuroscience, UT Austin, Austin, TX  
 Department of Psychology, University of Birmingham, UK  
 Special Lecture, Society for Neuroscience meeting, San Diego, CA  
 Center for Brain & Mind, UC Davis, Davis, CA  
 GRC Neurobiology of Cognition, Newry, Maine, ME  
 Cognitive Neuroscience Summer Institute, Lake Tahoe, CA  
 Attneave Lecture, University of Oregon, Eugene, OR  
 Marianne Fillenz Lecture, Oxford University, Oxford, UK  
 Department of Psychology, University of Nevada, Reno, NV  
 Graduate neuroscience program, University of California, San Diego, CA  
 Neuroscience program, Columbia University, New York City, NY

GRC, Neurobiology of Cognition, Sunday River, MN

## 2017

Cell symposium 'Big Questions in Neuroscience', Washington D.C.  
Pavlovian Society, Philadelphia, PA  
Brainy Days of Jerusalem, Jerusalem, Israel  
Interdisciplinary neuroscience program, Georgia Tech/Emory University, Atlanta, GA  
Cognitive Science program, University of Maryland, College Park, MD  
Keynote speaker, Cofees spring school, Jena, Germany  
Department of Psychology, Michigan State University, East Lansing, MI  
Department of Psychology, George Washington University, Washington, D.C.  
Neuroscience program, Case Western University, Cleveland, OH  
CCNP, Rutgers University, New Brunswick, NJ  
Interdisciplinary Neuroscience Symposium, Lehigh University, Bethlehem, PA

## 2016

Brain Day Symposium, University of Waterloo, Waterloo, CA  
Swartz Symposium, Caltech, Pasadena, CA  
Computational Neuroscience Retreat Keynote Speaker, Boston University, Boston, MA  
CNBC Retreat Keynote Speaker, Pittsburgh, PA  
CNS Symposium, New York, NY  
Perception Symposium, Keynote Speaker, Beijing, China  
Neuroscience program, University of Lubeck, Germany  
Neuroscience & psychology programs, University of Maastricht, Netherlands  
Future of attention symposium, University of Rochester, Rochester, NY  
Gordon Conference, Los Angeles, CA  
Cognitive control processes, SfN satellite symposium, San Diego, CA  
*Keynote Lecture*, 15<sup>th</sup> VSS meeting, St. Petersburg, FL  
Francis Crick Symposium, Rockefeller University, New York, NY

## CONTRIBUTIONS TO SCIENCE

I am a vision and cognitive neuroscientist and was trained by Otto Creutzfeldt, Bob Desimone and Leslie Ungerleider. I study the neural basis of visual perception and cognitive behavior in the human and monkey brain in a comparative approach using intracranial electrophysiology and functional brain imaging methods. The goal of this research is currently three-fold: (i) understand the neural substrates of cognitive behavior at the level of large-scale networks (1-3 below), (ii) identify differences and commonalities in the functional organization of primate brains (4-5), and (iii) apply cognitive models to gain a mechanistic understanding of development (3). A full list of >150 original articles, book chapters, commentaries and books is available upon request. In the following, I highlight some areas to which I contributed most with a few key references for each.

1. *A rhythmic theory of cognition*: Cognition unfolds over time. For example, when sustained attention is tracked over time, rhythmic properties are revealed that set up alternating states of better or worse sampling from the environment. These attentional rhythms are evolutionarily preserved and are present in both humans and monkeys. Based on our empirical research, our novel theory proposes that intrinsic theta rhythms temporally resolve functional conflicts between sensory (visual) and motor (oculomotor) networks, by periodically changing the weighting of functional connections between higher-order brain regions and either sensory or motor regions. This rhythmic re-weighting alternately promotes either sampling at a behaviorally relevant location (i.e., sensory functions) or shifting to another location (i.e., motor functions). This theory reconciles a large body of empirical and theoretical work in the attention field into a novel framework and provides a foundation for understanding neural substrates of cognitive flexibility.

Helfrich RF, Fiebelkorn IC, Szczepanski S, Parvizi J, Lin JJ, Knight RT, Kastner S (2018). Neural mechanisms of sustained attention are rhythmic. *Neuron* 99, 854-865.

Fiebelkorn IC, Pinsk MA, Kastner S (2018). A dynamic interplay of frontoparietal cortex as a neural basis for rhythmic spatial attention. Neuron 99, 842-853.

Fiebelkorn IC, Kastner S (2019). A rhythmic theory of attention: sampling versus shifting. Trends in Cog. Neurosci. 23, 87-101.

Fiebelkorn IC, Kastner S (2021). Spike timing in the attention network predicts behavioral outcome prior to target selection. Neuron 109, 177-188.

Aussel A, Fiebelkorn IC, Kastner S, Kopell N, Polletta B (2021). Interacting rhythms enhance sensitivity of target detection in a fronto-parietal computational model of visual attention. eLife, in revision.

**2. Functions of the thalamus in perception and cognition:** The visual thalamus (i.e. the lateral geniculate nucleus, LGN, and the pulvinar) has been traditionally viewed as passive relays that transmit information from the sensory periphery to the cortex (or between cortical areas), whereas cognition has been viewed as the product of cortical networks. Our neuroimaging studies in humans and electrophysiology studies in monkeys of the last 15 years have shown that these notions deserve thorough revision: (i) The LGN is part of a large-scale attention network, and its neural responses are modulated during selective attention. (ii) Neural correlates of visual awareness can be found in the visual thalamus and are not necessarily a function of cortical processing. (iii) The pulvinar has an important control function in selective attention by providing a temporal reference frame to which the cortical network nodes align. These studies have contributed to a paradigm shift away from the cortico-centric view of cognition towards a perspective that embraces the thalamus as an integral part of cognitive networks.

O'Connor DH, Fukui MM, Pinsk MA, Kastner S (2002). Attention modulates responses in the human lateral geniculate nucleus. Nature Neurosci. 5: 1203-1209.

Saalmann Y, Kastner S (2011). Cognitive and perceptual functions of the thalamus. Neuron 71: 209-223.

Saalmann YB, Pinsk MA, Wang L, Li X, Kastner S (2012). Pulvinar regulates information transmission between cortical areas according to attentional demands. Science 337: 753-756.

Halassa MM, Kastner S (2017). Thalamic functions in distributed cognitive control. Nature Neurosci. 20: 1669-1679.

Fiebelkorn IC, Pinsk MA, Kastner S (2019). Thalamo-cortical interactions define functional dissociations across the macaque attention. Nature communications 10: 215.

**3. Neural basis of selective attention in the adult and developing human brain:** Natural visual scenes are cluttered and contain many objects that cannot all be processed simultaneously due to limited processing capacity. Therefore, multiple stimuli present at the same time compete for neural representation. This competition can be biased through top-down factors such as the allocation of attention, or through bottom-up factors such as stimulus salience or perceptual grouping. The notion of biased competition was formulated by Desimone & Duncan based on behavioral observations and experimental evidence from monkey physiology studies. We established this concept in the human brain using neuroimaging methods and demonstrated (i) the principles of neural competition, (ii) mechanisms of bottom-up biases, and (iii) mechanisms of top-down biases. Together, these studies resulted in a thorough characterization of the large-scale cognitive network that subserves attentional selection in humans and were among the first to provide mechanistic insight into human brain function during selective processing. We are currently using this framework to study the development of selective processing in school aged children populations and atypical developmental trajectories such as in ADHD.

Kastner S, DeWeerd P, Desimone R, Ungerleider LG (1998). Mechanisms of directed attention in ventral extrastriate cortex as revealed by functional MRI. Science 282: 108-111.

Kastner S, Pinsk MA, De Weerd P, Desimone R, Ungerleider LG (1999). Increased activity in human visual cortex during directed attention in the absence of visual stimulation. Neuron 22: 751-761.

Beck DM, Kastner S (2005): Stimulus context modulates competition in human extrastriate cortex. Nature Neurosci. 8: 1110-1116.

Peelen MV, Fei-fei Li, Kastner S (2009): Neural mechanisms of rapid natural scene categorization in human visual cortex. Nature 460: 94-97.

Szczepanski SM, Konen CS, Kastner S (2010): Mechanisms of spatial attention control in frontal and parietal cortex. J. Neurosci. 30: 148-160.

Peelen MV, Kastner S (2011): A neural basis for naturalistic search in human extrastriate cortex. Proc. Natl. Acad. Sci. USA 108: 12125-12130.

Peelen MV, Kastner S (2014): Attention in the real world: Towards understanding its neural basis. TICS 18: 242-250.

Handbook of Attention (2014), edited by A.C. Nobre and S. Kastner, Oxford University Press.

Buschman TJ, Kastner S (2015). From behavior to neural dynamics: An integrated theory of attention. Neuron 88, 127-144.

Kim N, Hoyos P, Chang D, Finkelston A, Kastner S (2021). Development of spatial biases in school-aged children. Developmental Sci. 24, e13053.

4. Topographic organization of the human visual system: Much of the knowledge of the anatomical and functional organization of the visual system has been based on studies in non-human primates using invasive techniques. The advent of functional brain imaging together with sophisticated experimental design and analytical routines has permitted to study the topographic organization of the human visual system non-invasively and in comparison to that observed in the monkey brain. We developed specialized high-resolution imaging for the human and the monkey brain to specifically characterize the topography of areas that presented challenges due to their small sizes or deep locations. Our studies in the human brain have identified about 30 areas in the mid-brain, thalamus, occipital, temporal, parietal and frontal cortex that contain a representation of visual space and are organized as maps. We have compiled many of these data as a service to our field in the form of a probabilistic atlas of the human visual system (freely accessible at our website and widely used). These studies provide a foundation in comparing the functional organization of monkey and human brains.

Schneider KA, Richter M, Kastner S (2004). Retinotopic organization and functional subdivisions of the human lateral geniculate nucleus: A high-resolution fMRI study. J. Neurosci. 24: 8975-8985.

Silver M, Kastner S (2009): Topographic maps in human frontal and parietal cortex. TICS 13: 488-495.

Arcaro M, McMains SA, Kastner S (2009): Retinotopic organization of human ventral visual cortex. J. Neurosci. 29: 10638-10652.

Wang L, Mruczek REB, Arcaro MJ, Kastner S (2015): Probabilistic maps of visual topography in human cortex. Cerebral Cortex 25: 3911-3931.

Arcaro MJ, Pinsk MA, Kastner S (2018). Organizing principles of pulvino-cortical connectivity in humans. Nature communications 9: 5382.

5. Functional organization of the primate parietal cortex: The primate parietal cortex undergoes significant expansion during evolution. Particularly, in humans, human-specific networks evolve with crucial representations in parietal cortex such as the tool network. We have studied parietal cortex function in humans and non-human primates using fMRI for many years. Our major contributions elucidating parietal cortex function are as follows: (i) Our studies were the first to directly compare the topographic organization of primate posterior

parietal cortex (PPC) and to characterize PPC's perceptual and cognitive response properties. (ii) In the human, we have established an evolutionarily novel object vision system in the dorsal pathway that shares many characteristics with the ventral object pathway. The dorsal vision system is unique to humans and exists only in rudimentary form in monkeys. (iii) We have extended our object vision studies in the dorsal pathway to investigate the representation of tool information in the parietal cortex, a human-specific representation. Together, these studies have established primate parietal cortex as a model system to contextualize differences in functional organization across primate species as a function of behavioral repertoire and the evolution of advanced cognitive abilities.

Konen CS, Kastner S (2008): Two hierarchically organized neural systems for object information in human visual cortex. Nature Neurosci. 11: 224-231.

Arcaro MJ, Pinsk MA, Li X, Kastner S (2011): Visuotopic organization of macaque posterior parietal cortex: An fMRI study. J. Neurosci. 31: 2064-2078.

Mruczek REB, Von Loga IS, Kastner S (2013): The representation of tool and non-tool object information in the human intraparietal sulcus. J. Neurophysiol. 109: 2883-2896.

Kastner S, Chen Q, Jeong SK, Mruczek REB (2017). A brief comparative review on primate posterior parietal cortex: A novel hypothesis on the human toolmaker. Neuropsychologia 105: 123-134.

*My research has been supported by the National Institute of Mental Health, the National Eye Institute, the National Science Foundation, the James S. McDonnell Foundation, the Simons Foundation, the Overdeck Family Foundation, the Whitehall Foundation and Princeton University.*