BIOGRAPHICAL SKETCH

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NAME: Ebbesen, Christian Laut

eRA COMMONS USER NAME (credential, e.g., agency login): N/A

POSITION TITLE: Postdoctoral fellow, Skirball Institute for Biomolecular Medicine, New York University School of Medicine, New York, NY 10016, USA.

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
University of Copenhagen, Copenhagen, Denmark	B.Sc.	09/2010	Biophysics
University of Copenhagen, Copenhagen, Denmark	M.Sc.	09/2013	Physics
Humboldt Universität zu Berlin, Berlin, Germany	PhD	07/2017	Neurobiology
New York University, New York, NY, USA	Posdoctoral	current	Neuroscience

A. Personal Statement

I am very interested in the neural basis of healthy social behavior. Specifically, I am interested in how the mammalian brain represents the 'social valence' of sensory stimuli. For example: why is social touch so much more salient than other haptic stimuli? In my postdoctoral research (supported by a highly competitive fellowship), I aim to investigate how the hormone oxytocin modulates neural activity during social touch between mouse mothers and pups – a highly significant social stimulus during parenting. This study builds naturally from my own PhD research on social facial touch in Michael Brecht's lab. We investigated how vibrissa motor cortex (the largest frontal area in the rat brain) contributes to the control of social facial touch. Recordings from socially interacting rats revealed that while modulation by movement is weak, motor cortex activity is strongly suppressed by social touch. Sometimes, motor cortex cells respond differentially to males and females, even though the movement patterns with the two sexes were similar, a signature of social computations (Ebbesen et al., in prep.). I also recorded from head-fixed rats during staged social interactions to examine the genetic identity of the suppressed cells by in-vivo labeling and post-hoc immunohistochemistry. In addition to my work on social touch, I did several projects investigating spatial computation and temporal patterns in parahippocampal cortex, which we also published in high-impact journals. These projects related to spatial coding have given me extensive experience with powerful, state-of-the-art computational and statistical approaches to elucidate the relationship between neural signals and behavior.

1. **Ebbesen, CL**, Doron, G, Lenschow, C, Brecht, M. Vibrissa motor cortex activity suppresses contralateral whisking behavior. **Nature Neuroscience** 2017; 20:82-89. PMID: 27798633
2. **Ebbesen, CL**, Reifenstein, ET, Tang, Q, Burgalossi, A, Ray, S, Schreiber, S, Kempter, R & Brecht, M. Cell type-specific differences in spike timing and spike shape in rat parasubiculum and superficial medial entorhinal cortex. **Cell Reports** 2016; 16(4):1005-15. PMID: 27425616 PMC: 4967475
3. (*)Tang, Q, (*)Burgalossi, A, **(*)Ebbesen, CL**, Ray, S, Naumann, R, Schmidt, H, Spicher, D & Brecht, M. Pyramidal and Stellate Cell Specificity of Grid and Border Representations in Layer 2 of Medial Entorhinal Cortex. **Neuron** 2014; 84(6):1191-7. PMID: 25482025 PMC: 4276741.
4. (*)Tang, Q, (*)Burgalossi A, **(*)Ebbesen, CL**, (*)Sanguinetti-Scheck, JI, Schmidt, H, Tukker, JJ, Naumann, R, Ray, S, Preston-Ferrer, P, Schmitz, D, Brecht, M. Functional Architecture of the Rat Parasubiculum. **Journal of Neuroscience** 2016; 36(7):2289-301. PMID: 26888938.

B. Positions and Honors

Positions and Employment

2013-2017	PhD student ("Wissenschaftlicher Mitarbeiter", lit. "Scientific Employee"), Humboldt Universität zu Berlin, Berlin, Germany
2017-	Postdoctoral Fellow, New York University School of Medicine, NY, NY, USA

Other Experience and Professional Memberships

2009-2013	Teaching/correcting, International Physics Olympiad in Mexico, Thailand, Estonia & Denmark
2012	FELASA B certification, Federation of European Laboratory Animal Science Associations
2013	BCF/NWG course Analysis and Models in Neurophysiology, Bernstein Center Freiburg
2013-	Member, Society for Neuroscience
2013-2017	Berlin School of Mind & Brian, Interdisciplinary Graduate Neuroscience Research Program
2015	Okinawa Computational Neuroscience Course, Okinawa, Japan
2017-	Member, Danish Society for Neuroscience
2018	Chair, organizer and speaker, mini-symposium, SfN Neuroscience 2018, San Diego

Honors

2010	Travel grant, Danish Acoustics Society
2014	Best Poster Award, FENS Brain Prize Conference: Controlling Neurons, Circuits and Behavior
2015	Travel grant, CSN II (Biomimetics and Neurotechnology)
2017	Humboldt Postdoctoral Scholarship (6 months, transitional funding bridging PhD and PostDoc)
2017	Novo Nordisk Postdoctoral Fellowship (4 years full postdoctoral funding)
2017	Lundbeck Foundation Talent Prize (100.000 DKK research prize for scientists under 30 yrs)

C. Contribution to Science

1. The vibrissa motor cortex is one of the largest regions in the rodent brain. Ever since the discovery of motor cortex about a 150 years ago, the prime function attributed to this cortical region has been generation of movement, hence the name „motor' cortex. Surprisingly, our data indicate that the role of vibrissa motor cortex in motor control is different from this commonly held notion. We investigated the activity of neurons in vibrissa motor cortex during complex, self-initated motor behaviors, which play a vital role in rat ecology: self-initiated bouts of exploratory whisking in air, whisking to touch conspecifics during social interactions and whisking to palpate objects. Briefly, we find that whisking is associated with decreased spike rates in motor cortex. We used juxtacellular and intracellular recordings from awake, socially interacting animals – extremely challenging techniques – to show that social whisking is associated with reduced excitability and increased motor cortical inhibition. Further, we showed that microstimulation leads to whisker retraction and that pharmacological blockade increases whisker movement. Our observations collectively suggest that the primary role of vibrissa motor cortex activity is to suppress whisking behaviors (i.e. this cortical area serves a "brake" rather than "motor" function). It is very rare that findings reshape the thinking about the function of large brain regions such as the vibrissa motor cortex.
    a. **Ebbesen, CL**, Doron, G, Lenschow, C, Brecht, M. Vibrissa motor cortex activity suppresses contralateral whisking behavior. **Nature Neuroscience** 2017; 20:82-89. PMID: 27798633

2. The role of hippocampal spike timing in (spatial) memory is the most studied example of temporal coding in all of neuroscience. Despite the enormous scientific interest, we still know surprisingly little about how temporal coding features like spike bursts, theta-modulation (rhythmicity, locking, skipping) and phase precession map onto hippocampal and parahippocampal microcircuits. We combined juxtacellular recording and labeling of neurons recorded in freely moving rats with tetrode recordings, anatomical studies to show that anatomical identity and microcircuit embedding is a major determinant of both spatial discharge patterns (such as the discharge patterns of grid cells, border cells and head-direction cells) and temporal coding features (such as spike bursts, theta-modulation and phase precession) in parahippocampal cortex. We were first to characterize the functional architecture of the parasubiculum, a thin brain structure, which wraps around the medial enthorhinal cortex and seems to provide strong head-directional input to the entorhinal grid cell system. We used machine learning methods to show that temporal patterns of identified neurons in medial enthorhinal cortex suggest that grid cells in the medial entorhinal cortex are not chiefly stellate neurons, but pyramidal neurons. Our observation that features of spatial and temporal coding map

onto distinct cell types with distinct input and projection patterns has broad ramifications for our understanding of how temporal coding flows in the parahippocampal cortex and the hippocampus.

a. (*)Tang, Q, (*)Burgalossi, A, **(*)Ebbesen, CL**, Ray, S, Naumann, R, Schmidt, H, Spicher, D & Brecht, M. Pyramidal and Stellate Cell Specificity of Grid and Border Representations in Layer 2 of Medial Entorhinal Cortex. **Neuron** 2014; 84(6):1191-7. PMID: 25482025 PMC: 4276741.
b. **Ebbesen, CL**, Reifenstein, ET, Tang, Q, Burgalossi, A, Ray, S, Schreiber, S, Kempter, R & Brecht, M. Cell type-specific differences in spike timing and spike shape in rat parasubiculum and superficial medial entorhinal cortex. **Cell Reports** 2016; 16(4):1005-15. PMID: 27425616 PMC: 4967475
c. (*)Tang, Q, (*)Burgalossi A, **(*)Ebbesen, CL**, (*)Sanguinetti-Scheck, JI, Schmidt, H, Tukker, JJ, Naumann, R, Ray, S, Preston-Ferrer, P, Schmitz, D, Brecht, M. Functional Architecture of the Rat Parasubiculum. **Journal of Neuroscience** 2016; 36(7):2289-301. PMID: 26888938.
d. Tang, Q, **Ebbesen, CL**, Sanguinetti, JI, Preston-Ferrer, P, Gundlfinger, A, Winterer, J, Beed, P, Ray, S, Naumann, R, Schmitz, D, Brecht, M, & Burgalossi, A. Anatomical organization and spatiotemporal firing properties of layer 3 neurons in the rat medial entorhinal cortex. **Journal of Neuroscience** 2015; 35(36):12346-54. PMID: 26354904.

3. During my undergraduate studies in biophysics, I utilized advanced mathematical approaches from continuum physics and fluid dynamics to analyze and develop new microfluidic methods for cell biology. We combined theory and microfabrication methods to develop and build a microfluidic chip, which used gentle mechanical forces arising from ultrasonic pressure waves ('acoustophoresis') to separate red blood cells from plasma. This microfluidic acoustophoretic separator was capable of unprecedented high throughput (about 1 L/h for a whole blood sample), approximately 100x higher than previously reported. In another study, we investigated 'optical neuronal guidance', the observation that it is possible to control the growth direction of neuronal growth cones by stimulation with weak laser light. Previous studies had assumed that localized laser heating effects were negligible and that neuronal outgrowth was driven by electric-field-gradient forces ('optical tweezing'). Based on thermodynamic modeling and simulation using published experimental parameters as input, we predicted biologically significant temperature gradients and argued that optical neuronal guidance is not optical, but rather linked to heating. This was subsequently confirmed by several experimental studies.
    a. **Ebbesen, CL** & Bruus, H. Analysis of laser-induced heating in optical neuronal guidance. **Journal of Neuroscience Methods** 2012; 209:168-177 PMID: 22387314
    b. (*)Adams, JD, **(*)Ebbesen CL**, Barnkob, R, Yang, AHJ , Soh, HT, & Bruus, H. High-throughput, temperature-controlled micro-channel acoustophoresis device made with rapid prototyping. **Journal of Micromechanics and Microengineering** 2012; 22(7):075017.1-8.

Complete List of Published Work in MyBibliography:
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