BIOGRAPHICAL SKETCH

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NAME	POSITION TITLE
Dieter Jaeger	Professor of Biology
eRA COMMONS USER NAME (credential, e.g., agency login) DIETERJAEGER	

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

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	MM/YY	FIELD OF STUDY
Tübingen University, Germany	BSc equiv.	1980-1984	Biochemistry
University of Michigan, Ann Arbor	PhD	1984-1990	Neuroscience / Electrophysiology
California Institute of Technology		1991-1996	Computational Neuroscience

A. Personal Statement

I have been an electrophysiologist since 1985, when I started my PhD thesis involving recordings from the basal ganglia of awake trained monkeys. From the start, I was interested in correlated neuronal discharge, and for my thesis I devised a multiwire electrode to record from 2-5 basal ganglia neurons simultaneously. I extended the multisite approach of basal ganglia recordings to in vivo intracellular recordings in a collaboration with Charles Wilson, then at UT Memphis (a.). In my own lab at Emory we have used intracellular, extracellular, local field potential, and EEG recordings in rodents to address questions of neural correlations and oscillations. Notably, we found that during ketamine/xylazine anesthesia both basal ganglia and cerebellar circuits participate in slow-wave oscillations. We probed cortical coherence during a study of antidromically mediated cortical effects of deep brain stimulation in the subthalamic nucleus (c.). We have applied coherence and Granger causality analysis to study functional connectivity of cerebellar-cortical circuits in ketamine/xylazine anesthetized rats (d.). In addition to *in vivo* recordings I have considerable expertise with brain slice recordings (e.g., b.) and computer modeling of synaptic integration with detailed compartmental models. Throughout my career I have been active in mentoring graduate and undergraduate students, including underrepresented minorities. Nathan Rowland (d) was an African-American PhD student in my lab, who is now a successful neurosurgeon resident at UCSF. I am also the P.I. on an NIH funded Blueprint joint undergraduate and graduate T90/R90 training grant in Computational Neuroscience (http://compneurosci.college.emory.edu/).

a. E. Stern, D. Jaeger, C.J. Wilson (1998) Membrane potential fluctuations of simultaneously recorded striatal spiny neurons in vivo. Nature. 394: 475-478
b. Gauck, V, Jaeger, D. (2003) The contribution of NMDA and AMPA conductances to the control of spiking in neurons of the deep cerebellar nuclei. J. Neurosci. 23: 8109-8118.
c. Li S, Arbuthnott GW, Jutras M, Goldberg JA, Jaeger D. (2007) Resonant antidromic cortical circuit activation as a consequence of high-frequency subthalamic deep-brain stimulation. J Neurophysiol 98: 3525-3537 PMID: 17928554
d. Rowland NC, Goldberg JA, Jaeger D (2010) Cortico-cerebellar coherence and causal connectivity during slow-wave activity. Neuroscience 166:698-711. PMCID: PMC2823967

B. Positions and Honors

Positions and Employment

1984 Research Assistant w/ Dr. V. Braitenberg, MPI für biologische Kybernetik, Tübingen
1984-1990 Graduate Student w/ Dr. J.W. Aldridge, University of Michigan
1991-1996 Postdoctoral fellow w/ Dr. J.M. Bower, California Institute of Technology
1994-1995 Research Collaboration with Dr. C. Wilson, University of Tennessee at Memphis
1996 Research Collaboration with Dr. Y. Yarom, Hebrew University, Jerusalem
1997-2003 Assistant Professor (tenure track), Dept. of Biology, Emory University, Atlanta
2003-2011 Associate Professor with tenure, Dept. of Biology, Emory University, Atlanta

2011-present Professor with tenure, Dept. of Biology, Emory University, Atlanta

Other Experience and Professional Memberships

1985-present Member, Society for Neuroscience
2002 Invited Lecturer in Edinburgh Summer School in Neuroinformatics Simulation Tools
2003-present Member, American Physiological Society
2006-2009 Vice President, Organization for Computational Neuroscience (www.cnsorg.org)
2006 Invited Lecturer, First Latin American School on Computational Neuroscience LASCON
2007 Invited Lecturer, Okinawa International Computational Neuroscience Course
2007-2012 Associate Editor, Journal of Neuroscience
2008-present Editorial Board, The Cerebellum
2009-2010 Invited Lecturer, Advanced European Course in Computational Neuroscience
2009-present Reviewing Editor, Frontiers in Neuroscience
2011-2014 Co-Director, Advanced European Course in Computational Neuroscience

Participation on Review Panels

National Institute of Health Panel Reviews

2001 Parkinson's Disease RFA
2002 Postdoctoral NRSA review
2003,2004 Udall Center Review Panel
2004-2008 Regular Member: SMI study section
2012 ZRG1-IFCN-B-04M, ad hoc member
2012 ZRG1-IFCN-B-03M, ad hoc member
2013 ZNS1 SRB-J(04) - NINDS T32
2015 NIH, ZRG1, NIH Directors New Innnovator
2015 NIH, RFA-EY-15-001, Brain Initiative Review Meeting
2016 NIH, ZRG1, ETTN-B 90 S, Theories, Models and Methods

National Science Foundation Panel Reviews

2004 Collaborative Research in Computational Neuroscience
2014 Collaborative Research in Computational Neuroscience

International Grant Reviews

1997,1999 United States-Israel Binational Science Foundation
2000/2003/2009 Health Research Council of New Zealand
2001/2006/2007 Wellcome Trust Senior Research Fellowship Review
2016 European Human Brain Project

Honors

1980-1986 Fellowship for University Studies, Studienstifung des Deutschen Volkes
1989-1990 Predoctoral Fellowship, Rackham Graduate School, U. of Michigan
1995-1996 Postdoctoral Fellowship, Sloan Center for Theoretical Neurobiology, Caltech
2006 Winship Distinguished Associate Professor, Emory College

C. Contribution to Science

1. I have a longstanding interest in the mechanisms by which GABAergic inhibition can transmit information to code complex temporal spike patterns. Traditionally, neuroscientists consider excitation as the major carrier of information but this is obviously not the case in pathways that exclusively communicate through GABAergic synapses such as the Purkinje-cell-to-cerebellar-nuclei communication, or the pallido-thalamic pathways. I have made multiple significant contributions to the literature showing that inhibition can result in fine-tuned temporal spiking patterns. In an early computer simulation study during my postdoctoral fellowship I showed that even in Purkinje cells, which are typically thought to be controlled by mossy fiber excitation, the input of molecular GABAergic interneurons has more impact on spike timing than excitation does (a). This result was verified in one of the first uses of real-time dynamic clamp methods that apply *in vivo*-like inhibitory and excitatory conductance

patterns to whole cell slice recordings (b). We later showed that inhibition could similarly control spiking in cerebellar nuclei neurons (c). I designed all of these studies, and carried out the first two, while supervising the later work as P.I.

a. D. Jaeger, E. De Schutter, J.M. Bower. (1997) The role of synaptic and voltage-gated currents in the control of Purkinje cell spiking: a modeling study. J. Neurosci. 17: 91-106. PMID: 8987739

b. D. Jaeger and J.M. Bower (1999) Synaptic control of spiking in cerebellar Purkinje cells: Dynamic current clamp based on model conductances. J. Neurosci. 19: 6090-6101. PMID: 10407045

c. Gauck, V., Jaeger, D. (2000) The control of rate and timing of spikes in the deep cerebellar nuclei by inhibition. J. Neurosci. 20: 3006-3016 PMID: 10751453

2. In the study of synaptic control of spiking it became clear that intrinsic voltage-gated conductance play a major role in determining neural activity patterns. With respect to our Globus Pallidus (GP) studies we discovered in anatomical and slice studies that GP dendrites strongly express voltage-gated sodium channels, which can result in dendritic action potential initiation (a). We examined the possible functional consequence of dendritic sodium spiking in a detailed GP neuron model that we had constructed (b) and found that the synaptic coding properties fundamentally changed in the presence of dendritic sodium spiking (c). Considering changes in synaptic input to GP in the parkinsonian state, we found that dendritic sodium channels lead to a decorrelation of oscillatory inputs and may have anti-parkinsonian effects (d). Our GP neuron model is openly shared and has been used by other groups already. It presents one of the cornerstones of detailed understanding of active GP neuron properties in the field. The original study was co-advised by myself (physiology) and Dr. Yoland Smith (EM microscopy). The modeling studies were advised by myself as PI.

a. Hanson, J.E., Smith, Y., Jaeger, D. (2004) Sodium channels and dendritic spike initiation at excitatory synapses in globus pallidus neurons. J. Neurosci. 24:329-340. PMID: 14724231

b. Gunay C, Edgerton JR, Jaeger D (2008) Channel Density Distributions Explain Spiking Variability in the Globus Pallidus: A Combined Physiology and Computer Simulation Database Approach. J Neurosci. 28:7476-7491. PMID: 18650326

c. Edgerton, J. R., J. E. Hanson, Gunay, C., and Jaeger, D. (2010). "Dendritic Sodium Channels Regulate Network Integration in Globus Pallidus Neurons: A Modeling Study." J. Neurosci. 30: 15146-15159. PMID: 21795543; PMCID: PMC3178657

d. Edgerton, JR, Jaeger D. (2011) Dendritic sodium channels promote active decorrelation and reduce phase locking to parkinsonian input oscillations in model globus pallidus neurons. J. Neurosci. 31:10919-36; PMID: 21795543; PMCID: PMC3178657

3. Post-inhibitory rebound spike responses represent combined effect of inhibitory inputs and intrinsic neuronal properties. Such responses are generated through the de-inactivation of an inward current during hyperpolarization. This mechanism has generated considerable interest in both the fields of cerebellar and basal ganglia signal integration, and we have provided important insights to rebound processing in both structures. In studies of the cerebellar nuclei, we found that rebound responses have multiple phases, consisting of a short T-type calcium current-dependent spike burst and a longer and pronounced spike rate increase that depends on activation of the persistent sodium current (a). In this study we programmed an expanded set of real-time dynamic clamp algorithms in our Labview RT interface that allowed us to model intracellular calcium pool dynamics and calcium dependent potassium current in real time. We then constructed a detailed compartmental computer model of cerebellar nuclear neurons that faithfully reproduces these properties (b) and is now used by several other groups. With respect to processing in the basal ganglia, we recently found that rebound responses in motor thalamic neurons may present a feature of synchronized inhibitory inputs which would be expected to occur under parkinsonian, but not normal, conditions (c).

a. Sangrey T, Jaeger D. (2010) Analysis of distinct short and prolonged components in rebound spiking of deep cerebellar nucleus neurons. Eur. J. Neurosci., 32: 1646-1657, PMID: 21039958; PubMed Central PMCID: PMC3058674

b. Steuber, V., Schultheiss, N.W., Silver, R.A. De Schutter, E., Jaeger, D. (2011). "Determinants of synaptic integration and heterogeneity in rebound firing explored with data driven models of deep cerebellar nucleus cells." J. Comput. Neurosci. 30:633-58. PMID: 21052805; PMCID: PMC3108018

c. Edgerton JR, Jaeger D. (2014) Optogenetic activation of nigral inhibitory inputs to motor thalamus in the mouse reveals classic inhibition with little potential for rebound activation. Front. Cell Neurosci. 8:36. PMID: 24574972; PMCID: PMC3920182

Complete List of Published Work in MyBibliography:
http://www.ncbi.nlm.nih.gov/sites/myncbi/1jcrmtqZsb6A8/bibliography/41407949/public/?sort=date&direction=ascending

D. Research Support

Ongoing Research

1 P50 NS098685-01 National Institute of Neurological Disorder and Stroke (NINDS) 08/01/2016 to 07/31/2021
Udall Parkinson's Disease Center at Emory University: Circuitry to Therapy. Jaeger (PI Project 1) Synaptic Integration of Cortical and Nigral Input in Parkinsonian Mouse Motor Thalamus
This project examines the activity of mouse motor thalamus in normal animals and animals rendered Parkinsonian with slice recordings, in vivo recordings, and computer modeling

U01 NS094302-01 (Jaeger, contact-PI, Stanley, P.I. 08/30/2015-07/31/2018)
NIH-NINDS, "Multiscale Analysis of Sensory-Motor Cortical Gating in Behaving Mice."
The goal of this project is to determine interactions between thalamus and cortex in sensory and motor circuits with a multiscale recording paradigm including voltage-sensitive protein imaging, whole cell recordings, and LFP recordings in behaving mice.

R01NS078095 (Keilholz, PI; Jaeger, co-I) 09/20/2012 - 08/31/2017
NIH/NINDS, "Contribution of ultra low frequency LFPs to functional MRI"
The goal of the project is to relate functional networks and temporal fluctuations determined from fMRI imaging to multi-site LFP recordings in rodents.

Recently Completed Research

R01NS067201 (Jaeger, PI) 09/01/2009 - 08/31/2015 (NCE)
NIH/NINDS, "CRCNS: Cerebellar cortico-nuclear interactions"
This project examines cerebellar processing and synaptic integration at the level of the deep cerebellar nuclei. Computer simulations in the Jaeger lab are combined in this collaborative project with multiwire recordings from awake mice in Dr. Detlef Heck's lab at UT Memphis.

P50NS071669 (Wichmann, Center PI; Jaeger, project PI) 08/01/2010 - 07/31/2015
NIH/NINDS (Udall Center), "Project 1: Influence of basal ganglia output on the thalamus"
This project examines the neuronal activity in the motor thalamus in mice, in the normal parkinsonian states. A focus lies in the determination of oscillatory and bursting activity patterns in motor thalamus.

R21NS074296 (Jaeger, PI) 03/01/2011 - 02/28/2013
NIH/NINDS, "Optogenetic investigation of olivary inputs to the deep cerebellar nuclei"
In this project neurons in the inferior olive are made to express Channelrhodopsin-2. Optical stimulation of the inferior olivary axons in the cerebellar nuclei will be used to determine the excitatory effects of olivary input on the cerebellar nuclei.