friends of the mpibrain research

Friends of the
Max Planck Institute for Brain Research

newsletter 2/2018


Stephan Junek

Sepia officinalis, a common cuttlefish

contents

Elucidating cuttlefish camouflage

the ability of cuttlefish, squid and octopuses to hide by imitating the colors and texture of their environment has fascinated natural scientists since the time of Aristotle. Uniquely among all animals, these mollusks control their appearance by the direct action of neurons onto expandable pixels, numbered in millions, located in their skin. Scientists from the Laurent Department and the Frankfurt Institute for Advanced Studies as well as Goethe University used this neuron-pixel correspondence to peer into the brain of cuttlefish, inferring the putative structure of control networks through analysis of skin pattern dynamics.

The scientists filmed six animals in a tank over a period of weeks, and color-classified the chromatophores of the cuttlefish's dorsal mantle at single-cell resolution at sixty frames per second. In addition, they tracked pattern dynamics by moving a hand above the cuttlefish, causing it to transit from dark to light. This transition was examined over several trials allowing researchers to conclude that upon each stimulus, the animal generated the same target patterns. Laurent et al. suggest that these results enable an objective description of complex perceptual behavior and that this approach could provide insights into the organizational principles underlying neural systems.

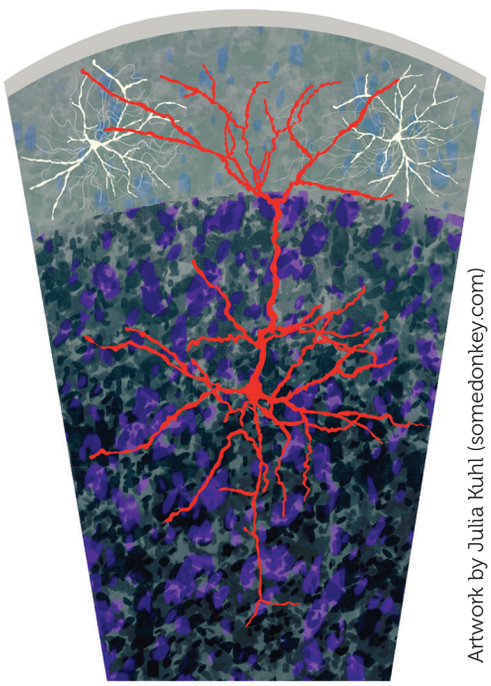
Master of the tree

a unique feature that sets neurons apart from all other cells are their beautiful, highly elaborate dendritic trees. These structures have evolved to receive the vast majority of information entering a neuron, which is integrated and processed by virtue of the dendrites' geometry and active properties. Higher brain functions such as memory, attention and association of information streams all critically rely on dendritic computations, which are in turn controlled by inhibitory synaptic input. An international team of scientists led by Max Planck Research Group Leader Johannes J. Letzkus has identified a novel form of inhibition that dominantly controls dendritic function and strongly depends on previous experiences.

continued

in order to understand the function of distal dendrites on pyramidal neurons, essential for higher brain functions, researchers in the Letzkus Lab went in search of a molecular marker for candidate inhibitory neurons. A collaboration with the group of Ivo Spiegel from the Weizmann Institute (Israel) has led to the discovery of the first selective marker for inhibitory interneurons in layer 1 of neocortex. Fueled by these findings, the Letzkus Lab discovered that these layer 1 interneurons contact many elements in the local circuit, and in particular provide strong inhibition to pyramidal neuron dendrites that are located right next to them. What is striking about this input compared to previous work on other interneurons is that it affects dendritic function at much longer timescales, due to the slower receptors that mediate the signal.

Which signals recruit these two forms of inhibition? Using an approach pioneered by the Conzelmann Lab at the LMU in Munich enabled the researchers to determine the sources of input to layer 1 interneurons throughout the entire brain. Strikingly, these cells receive information from a greater number of brain areas than deeper layer interneurons, and in particular from more areas that encode the particular relevance of a stimulus.



Artwork by Julia Kuhl (somedonkey.com)

The distal dendrites of pyramidal neurons (red) are controlled by a specialized set of interneurons (white) in layer 1 of neocortex.

'Our hope is that the present findings have put these underappreciated interneurons on the map also for other labs. A great feature of the transgenic tools we generated is that they can easily be shared with fellow scientists around the world, enabling concerted progress on these fascinating cells that crown over neocortex' concludes Johannes Letzkus.

Great winter party concludes an exciting year

Thomas Olstinski

the winter party of the Max Planck Institute for Brain Research on December 13 was a great event. It featured a science karaoke as well as other exciting entertainment, including games set up in our lecture hall. We thank all the MPI people, as well as the Minerva Bistro, for making this happen, in particular the members from the Laurent Lab for organizing this great party.

As in previous years, money was collected for charity. Institute's members and guest bought home-baked cookies and gloves (latter with the institute's logo) as well as kids clothing and toys. In total, we were able to raise 1500 Euro for Doctors without Borders Yemen.

Pretty decoration of the Institute exclusively for the winter party

Join us on Facebook and Twitter
www.facebook.com/mpibr
@mpibrain

Prizes and awards for Institute's members

in the second part of 2018 researchers at the Max Planck Institute for Brain Research received many prizes and awards:

Erin Schuman was awarded the Mika Salpeter Lifetime Achievement Award at the annual meeting of the Society for Neuroscience in San Diego. She received the prestigious award for her outstanding career achievements in neuroscience and for promoting the professional advancement of women in neuroscience.

Max Planck Research Group Leader Julijana Gjorgjieva received the 2018 Research Prize from Peter and Traudl Engelhorn Foundation for her work on computational models of neural circuit organization and development.

Maria Antonietta Tosches (postdoc at the Laurent lab) was selected as one of the six 2018 Next Generation Leader for the Allen Institute for Brain Science.

Postdocs Sara Haddad and Shahaf Weiss (Laurent Lab) were successful in the Humboldt Fellowship program as well as Raunak Basu (Ito Lab). Their grant will allow them to work on their two-year projects studying camouflage behavior in cuttlefish (Sara), memory systems in reptiles (Shahaf) and how animals plan their route to future goal locations (Raunak).

Postdoc Hiroaki Norimoto (Laurent Lab) has been awarded two prestigious prizes from Japan to study circuit mechanisms of memory consolidation in *ex vivo* reptilian whole brain tissue (Kanae Foundation) as well as the prestigious Inoue Research Award for Young Scientists.

Two postdocs received an EMBO long-term fellowships: Anna Schröder will join the Letzkus Lab in early 2019 to investigate the impact of long-range inhibition on neocortical circuit function and behavior, whereas Chao Sun has recently started his research to quantify the proteomic diversity of neuronal synapses using single-molecule localization microscopy in the Schuman Lab.

Selected recent publications

Reiter, S., Hülsdunk, P., Woo, T., Lauterbach, M.A., Eberle, J.S., Akay, L.A, Longo, A., Meier-Credo, J., Kretschmer, F., Langer, J.D., Kaschube, M. and Laurent, G. (2018). Elucidating the control and development of skin patterning in cuttlefish. *Nature* 562: 361-366 *(see also this newsletter)*

Abs, E., Poorthuis, R.B., Apelblat, D., Muhammad, K., Pardi, M.B., Enke, L., Kushinsky, D., Pu, D., Eizinger, M.F., Conzelmann, K.K., Spiegel, I., and Letzkus, J.J. (2018). Learning-Related Plasticity in Dendrite-Targeting Layer 1 Interneurons. *Neuron* 100: 1-16 *(see also this newsletter)*

Miska, N.J., Richter, L.M.A., Cary, B.A., Gjorgjieva, J. and Turrigiano, G.G. (2018). Sensory deprivation independently regulates neocortical feedforward and feedback excitation-inhibition ratio. *eLife* 7:e38846

Triesch, J., Vo, A.D., Hafner, A.-S. (2018). Competition for synaptic building blocks shapes synaptic plasticity. *eLife* 7:e37836.

Drawitsch, F., Karimi, A., Boergens, K.M., Helmstaedter, M. (2018). FluoEM, virtual labeling of axons in 3-dimensional electron microscopy data for long-range connectomics, *eLife 7*:e38976


Thomas Olstinski

friends of the mpibrain research

newsletter 2/2018

Matthias Kaschube (middle) with both awardees: Maria Antonietta Tosches (left) and Christopher Schanzenbächer (right)

2018 PhD and postdoc prizes awarded

using funds from the Friends of the Max Planck for Brain Research, the Institute awarded both a Scientific Discovery Award for the best doctoral student as well as the best postdoc of 2018. Both prizes were awarded at the Institute's winter party (December 13) by Matthias Kaschube (co-chair of the Friends Association) and went to postdoc Maria Antonietta Tosches (Laurent Lab) and to Christopher Schanzenbächer (both Schuman and Langer Labs) who recently received his doctoral degree.

Exhibition "The Art of the Brain"

on the Max Planck Day (September 14), the MPI opened the exhibition "The Art of the Brain". Spread through the public areas in our building, you can find amazing images originating from brain research performed at our institute. The exhibition was initiated and has been organized by Stephan Junek, head of our imaging facility.


Arjan Vink

2019 Upcoming lectures

(all lectures start at 11.00 hours at the Institute's lecture hall)

23.1.19 Attila Losonczy (Mortimer Zuckerman Mind Brain and Behavior Institute, Columbia University, New York, USA) *Neuroscience Lecture*
30.1.19 Elly Nedivi (MIT, Boston, USA) *Neuroscience Lecture*
13.3.19 Nicolas Renier (Laboratory of Plasticity, ICM Brain and Spine Institute, Paris) *Neuroscience Lecture*
20.3.19 Robert Froemke (New York University School of Medicine, USA) *Neuroscience Lecture*
27.3.19 Richard Morris (Centre of Cognitive and Neural Systems, University of Edinburgh) *Hertie Lecture*
5.6.19 Marta Zlatic (HHMI's Janelia Research Campus, Ashburn, USA) *Neuroscience Lecture*
W: www.brain.mpg.de/news-events/lectures-and-other-events.html

Join the friends of the mpibrain research

Contact
Friends of the MPI for Brain Research
Max-von-Laue-Str. 4
60438 Frankfurt am Main
www.brain.mpg.de/friends
friends@brain.mpg.de