Spring 2017

Brain Waves

Neuroscience Training Program Semiannual Newsletter

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NTP Student Outreach Program Snapshots

Liz Kiernan working with children to observe brains.

Charlene Rivera-Bonet at WID.

Margaux Kenwood at the Madison Children's Museum.

NTP Career Chats with Alumni:
A Conversation with Tim Meier

By NTP student Katie Yang (Ciucci Lab)

Tim Meier's forward-thinking manner not only allowed him to see novel and exciting research questions; it also helped him to hit the ground running with his post-NTP career. Tim completed his NTP PhD in the lab of Vivek Prabhakaran from 2007 to 2012. After spending a year as a postdoc in his thesis lab, Tim moved on from the UW to the Laureate Institute for Brain Research in Oklahoma, a private research facility. Tim then moved on again to the Mind Research Network, working under Andy Mayer. Tim is now a tenure-track assistant professor at the Medical College of Wisconsin in the Department of Neurosurgery

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CONGRATS RECENT GRADUATES!

TaeHee Kim
graduated from the Vemuganti lab and is now a Research Associate in the Department of Neurological Surgery at UW-Madison.

Tristan Lee
graduated from the Halloran lab.

Bob Nichol
graduated from the Gomez lab and is now a Postdoctoral Fellow in the Department of Neuroscience at UW-Madison

Alex Rodriguez
graduated from the Cirelli lab and is now a Postdoctoral Fellow in the Department of Electrical and Computer Engineering at Rice University.

Ryan Selleck
graduated from the Baldo lab and is now a Postdoctoral Research Associate at Rosalind Franklin University of Medicine and Science.

Ewa Bomba-Warczak
graduated from the Chapman lab and is now a Postdoctoral Researcher at Northwestern University, Department of Neurology.

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studying sports-related concussions and injuries. His lab is primarily supported by Department of Defense and NCAA funds with no need to apply for smaller grants.

"I'm now focusing on applying to R mechanisms – we have a lot of preliminary data to make it happen," Meier notes. His lab is small – two other people – but the atmosphere within the Medical College is intensely collaborative. Tim works closely with others from a variety of fields, including neuropsychologists and physicists, to make his work as impactful as possible. Though Tim does not work with any undergraduate research assistants, a staple of many laboratories, his productivity remains high. He credits his productivity, a staggering 29 publications from 2007 to 2017, to not having to build an infrastructure in his previous positions nor his current lab.

"Get a postdoc that you can be productive in immediately, and be aware of groups doing research that you're interested in while you're still in graduate school," Tim shared when asked how he became so quickly successful following graduate school. "Develop relationships with labs early so that you have options when the time comes." Tim noted that his first postdoc in Oklahoma was established through connections of NTP professor, Rasmus Birn. He stressed that networking and getting your name out there to the right people was key.

Tim ultimately hopes to sustain a brain injury research program throughout his career and looks forward to the opportunity to train postdocs and graduate students. His work is building the road away from subjective patient reports to examine when and how the brain recovers from stroke. With the trajectory he is on right now, Tim Meier is one researcher to look out for.

Dr. Tim Meier
Assistant Professor at the Medical College of Wisconsin in the Department of Neurosurgery

CONGRATS TO THE STUDENTS THAT HAVE RECENTLY PASSED THEIR PRELIMS!

Sara Heyn **Cole Korponay** **Andy Madrid**

Welcome New Faculty!

Josh Cisler
Assistant Professor, Department of Psychiatry. Focus: Refining and expanding neurocircuitry models of PTSD and trauma exposure.

Subhojit Roy
Professor, Department of Pathology & Laboratory Medicine. Focus: Cell Biology of neuronal trafficking in physiology and neurodegenerative diseases.

Rob Sanders
Assistant Professor, Department of Anesthesiology. Focus: mechanisms of delirium-inflammation and anesthesia-impairments of consciousness.

Eric Shusta
Professor, Department of Neuroscience. Focus: Discovery of novel transport systems and cognate antibody targeting molecules.

Michael Taylor
Assistant Professor, Department of Pharmacy. Focus: Blood-brain barrier formation and function; Neuroimmunology, Zebrafish genetics.

Awards & Recognitions

Congratulations to the following students and faculty for their recent achievements:

Anjon Audhya received a Romnes Faculty Fellowship.
Edward Hubbard was awarded for Mentoring Undergraduates in Research, Scholarly & Creative Activities.
Taylor Keding received NSF GRFP Predoctoral Fellowship.
Jon S. Kuo was promoted to Professor of Neurological Surgery and Human Oncology.
Corinne Jones received the Sumiko Okada Scholarship and NRSA fellowship.
Darcie Moore received a Sloan Research Fellowship.
Subhojit Roy received a UW2020 award.
Edwin Suarez-Zayas received NSF GRFP Predoctoral Fellowship.
Marc Wolman received 2016 Neurofibromatosis Research Program New Investigator Award and 2017 Chi-bin Chien Young Investigator Award.

UW sleep research high-resolution images show how the brain resets during sleep

UW-Madison News, February 2, 2017

Striking electron microscope pictures from inside the brains of mice suggest what happens in our own brain every day: Our synapses – the junctions between nerve cells – grow strong and large during the stimulation of daytime, then shrink by nearly 20 percent while we sleep, creating room for more growth and learning the next day.

The four-year research project published today in Science offers a direct visual proof of the "synaptic homeostasis hypothesis" (SHY) proposed by Drs. Chiara Cirelli and Giulio Tononi of the Wisconsin Center for Sleep and Consciousness.

This hypothesis holds that sleep is the price we pay for brains that are plastic and able to keep learning new things.

When a synapse is repeatedly activated during waking, it grows in strength, and this growth is believed to be important for learning and memory. According to SHY, however, this growth needs to be balanced to avoid the

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saturation of synapses and the obliteration of neural signaling and memories. Sleep is believed to be the best time for this process of renormalization, since when asleep we pay much less attention to the external world and are free from the "here and now."

When synapses get stronger and more effective they also become bigger, and conversely they shrink when they weaken. Thus, Cirelli and Tononi reasoned that a direct test of SHY was to determine whether the size of synapses changes between sleep and wake. To do so, they used a method with extremely high spatial resolution called serial scanning 3-D electron microscopy.

The research itself was a massive undertaking, with many research specialists working for four years to photograph, reconstruct, and analyze two areas of cerebral cortex in the mouse brain. They were able to reconstruct 6,920 synapses and measure their size.

The team deliberately did not know whether they were analyzing the brain cells of a well-rested mouse or one that had been awake. When they finally "broke the code" and correlated the measurements with the amount of sleep the mice had during the six to eight hours before the image was taken, they found that a few hours of sleep led on average to an 18 percent decrease in the size of the synapses. These changes occurred in both areas of the cerebral cortex and were proportional to the size of the synapses.

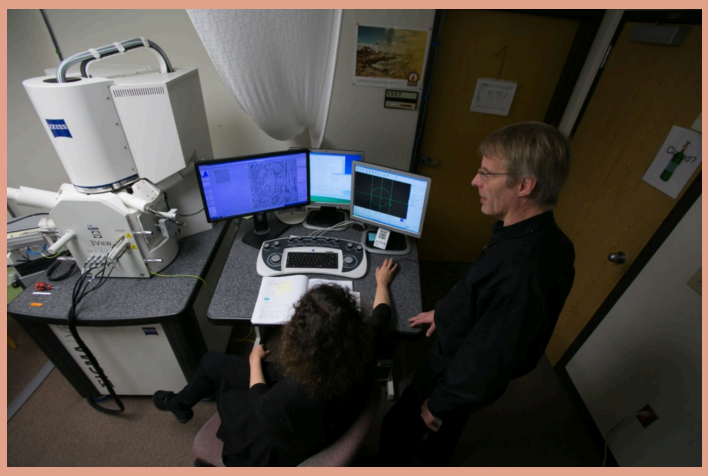
This picture shows 3D reconstructions of electron microscope images of tree branch-like dendrites. At the end of the branches are cup-like structures called the spines, and in the tips of the spines are synapses. By studying thousands of images like these, the Wisconsin researchers showed that the synapses shrink after the mouse sleeps and grow again during the next wakeful period.

The scaling occurred in about 80 percent of the synapses but spared the largest ones, which may be associated with the most stable memory traces.

"This shows, in unequivocal ultrastructural terms, that the balance of synaptic size and strength is upset by wake and restored by sleep," Cirelli says. "It is remarkable that the vast majority of synapses in the cortex undergo such a large change in size over just a few hours of wake and sleep.
Tononi adds, "Extrapolating from mice to humans, our findings mean that every night trillions of synapses in our cortex could get slimmer by nearly 20 percent."

The study was published today in Science along with research from Dr. Richard Huganir's laboratory at Johns Hopkins University in Baltimore. This study, using biochemical and molecular methods, confirms SHY's prediction that synapses undergo a process of scaling down during sleep, and identifies genes important for this process.

Tononi and Cirelli are professors of psychiatry in the University of Wisconsin–Madison School of Medicine and Public Health. The co-authors on the project include Drs. Luisa de Vivo, Michele Bellesi and William Marshall, all of the UW Department of Psychiatry, and Drs. Eric Bushong and Mark Ellisman from the University of California-San Diego. Their work is supported by the National Institutes of Health.



Drs. Cirelli, foreground, and Tononi, right, study an image of a mouse brain taken by a scanning electron microscope, left. Thousands of these images were analyzed for the study published this week in the journal Science. John Maniaci/ UW Health

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Contributions to the Program

Funds given to the program are used to support recruiting activities, guest speakers, the graduate travel award for professional conferences and the annual program picnic. For additional information, please contact the program office at (608) 262-4932. To contribute, please contact the UW Foundation at:
https://www.myuwconnect.org/give?id=9E933A87-82C0-449E-B62E-6476CF0A0A93

Thank you to all those who have contributed and continue to support the Neuroscience Training Program and its students.

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