

Brain Waves

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NTP student Maia Pujara at an outreach event at the Madison Children's Museum

Researchers Solve Membrane Protein Mystery

By Dian Land
University Communications

June 8, 2011 - A University of Wisconsin-Madison research team has solved a 25-year mystery that may lead to better treatments for people with learning deficits and mental retardation.

Synaptophysin is the first protein and most abundant ever found on the membranes surrounding the tiny sacs that carry chemical messengers to synapses, the gaps where communication between nerve cells occurs. But even though the loss of synaptophysin has recently been linked to learning deficits and mental retardation, scientists have been unable for more than a quarter-century to explain what it actually does.

Now UW-Madison researchers have shown that synaptophysin controls the replacement of the constantly needed sacs, also known as vesicles. The study, appearing in the current issue of the journal *Neuron*, may lead to future drugs that could restore normalcy when vesicles are not utilized efficiently.

"Vesicles are at the heart of fusion, the fundamental process by which information is exchanged between and inside all cells in the body," says Edwin Chapman, a Howard Hughes Medical Institute professor at the UW-Madison School of Medicine and Public Health.

In the nervous system Chapman's team studied, the process begins when an impulse triggers exocytosis - that is, when a vesicle releases neurotransmitter at the synapse. Then a receiving neuron on the other side of the synapse binds to the neurotransmitter and activates a signal. To wrap up the first phase, the spent vesicle is incorporated into the donor cell membrane. **Continued on pg. 2**

Membrane Protein Article (cont'd.)

In the recovery phase of the process, called endocytosis, a new vesicle is pinched off from the donor cell surface and reloaded with neurotransmitter.

"This is a tightly coupled recycling process involving trillions of vesicles throughout the brain," says Chapman, based in the Department of Neuroscience. "As vesicles are consumed, if they are not immediately replaced, then you have a synapse that is not active anymore, and this is a problem."

The synaptophysin mystery had stayed in the back of Chapman's mind since he had been a graduate student in the late 1980s. When his current graduate student Sung E. Kwon said he wanted to apply some of the newest techniques to analyzing the problem, Chapman encouraged him to do it, despite the fact that other scientists had failed for years to find what synaptophysin does.

Using a mouse that had been genetically engineered to have no synaptophysin, Kwon attached a fluorescent tag to a vesicle protein so he could study the exocytosis-endocytosis cycle optically. He also used electrophysiological methods to analyze signaling in normal versus synaptophysin-free vesicles.

The experiments showed that the lack of synaptophysin had no effect on exocytosis, but produced a clear-cut deficit in the recycling of vesicles during endocytosis. Kwon was able to confirm the effect when he inserted synaptophysin and regained normal endocytosis.

"We found that synaptophysin regulates two distinct phases of endocytosis in synaptic vesicles, both during and after sustained neuronal activity," Kwon says. "Lack of synaptophysin delayed the replenishment of usable vesicles."

The defect may help explain why people with synaptophysin mutations may have mental retardation, he says.

"It will take more studies to directly link how this cycling defect leads to mental retardation, but we now have a good starting point," Kwon says.

Scientists could also now begin to screen for molecules that could override the defect and restore normal rates of endocytosis, adds Chapman.

"You can't do anything like that until you know what the protein does," he says. "And now we do."

UW-Madison Law School Partners with Neuroscience Program to Offer Unique Dual-Degree

By Tom Solberg, Media Relations Coordinator, State Bar of Wisconsin

July 27, 2011 – Beginning next year, the University of Wisconsin-Madison will offer a unique post-graduate academic program designed to bridge the gap between the justice system and the rapid advances reshaping our understanding of neuroscience.



The integrated Dual Degree Program in Neuroscience and Law, the only such formally structured and university-approved initiative in the country, will offer students the opportunity to simultaneously earn a Ph.D. degree in neuroscience and a J.D. degree in law.

The goal, explains program director Professor Ronald Kalil, is to train a cadre of scientist/attorneys to be well versed in the realms of both scientific research and the law to inform conversations in both disciplines.

Neuroscience an interdisciplinary field

Neuroscience, the scientific study of the brain and nervous system, has traditionally been seen as a branch of biology, but it is now pursued as an interdisciplinary field that encourages collaboration among a wide range of academic disciplines.

At the UW-Madison campus, for example, more than 170 neuroscientists are advancing our understanding of the nervous system across levels ranging from molecular mechanisms to human behavior.

Neuroscience is an especially appropriate scientific field for students of law because recent research has called into question many widely-held assumptions about the brain that could impact the legal system, including research that is deepening our understanding of such issues as criminal responsibility, brain death, the capacity of adolescents and mental health patients to stand trial, impairment of decision-making capacity by drug or alcohol use and the relationships between mental impairment and dangerous behavior.

The dual degree program will produce neuroscientists who also are skilled in the law, thereby preparing them to address these and other emerging legal, scientific and public policy issues that bridge the two disciplines.

Neuroscience in the courtroom

In the years ahead, the courts are likely to confront challenging issues raised by the commercial application of new findings from neuroscience that will require careful assessment on both scientific and policy grounds.

For example, ongoing research is likely to shed light on claims that have already been made that brain scan imaging technologies offer the legal system a new and more reliable "lie detector." Other new neurotechnologies, such as brain implantations for therapeutic purposes, are

Continued on pg. 4

Ibis Agosto

Univ. of Puerto Rico - Rio Piedras
Major Prof. - Rotating

Trina Basu

Univ. of Illinois at Chicago
Major Prof. - Rotating

Lisa Sudmeier (M.D., Ph.D.)

Washington University
Major Prof. - Barry Ganetzky

Chadd Funk (M.D., Ph.D.)

Dartmouth College
Major Prof. - Guilio Tononi

David Ruhl

Univ. of New Mexico
Major Prof. - Rotating

Alexander Rodriguez

Mass. Institute of Technology
Major Prof. - Rotating

Kendra Taylor

Univ. of California - Santa Barbara
Major Prof. - Rotating

Christian La

Univ. of California - Berkeley
Major Prof. - Rotating

Amy Zellman

Simpson College
Major Prof. - Rotating

Robert Nichol

Univ. of California - Riverside
Major Prof. - Rotating

Robin French

Davidson College
Major Prof. - Rotating

Rikki Hullinger

Univ. of Michigan - Ann Arbor
Major Prof. - Rotating

Jingxin Wang

Harbin Medical Univ.
Major Prof. - Lingjun Li



New Associate Director of the Neuroscience Training Program

Prof. Mary Halloran of the Depts. of Zoology and Neuroscience has been appointed to a new position of Associate Director of the Program.

As Associate Director, Mary will share in the responsibilities and duties of the Director and assist in the day to day operation of the program. This will be of particular importance this coming semester with the renewal of the NTP training grant as well as the Graduate School review of the program. Congratulations and thanks to Mary!

Welcome New Faculty


Xinyu Zhao

Associate Professor
Ph.D. Univ. of Washington, Seattle
Molecular mechanisms that regulate neural stem cells and neurodevelopment


Ruth Litovsky

Professor
Ph.D., Univ. of Massachusetts - Amherst
Ability of humans to function in complex auditory environments


Bas Rokers

Assistant Professor
Ph.D., Univ. of California - Los Angeles
Neural mechanisms underlying motion and depth perception


Andy Alexander

Associate Professor
Ph.D., Univ. of Arizona, Tucson
Molecular imaging, radioisotope production & using PET methodologies to investigate neurochemical changes in the brain

Congratulations Recent Graduates

Lindsay Pascal graduated from Brian Baldo's lab and has joined the Western Institutional Review Board (WIRB) as a Scientific Specialist in the Institutional Biosafety Committee (IBC) Services department.

Valerie Grant graduated from Cynthia Czajkowski's lab and will be teaching at St. Ambrose Academy.

Michelle Edelmann graduated from Anthony Auger's lab and will be starting as a Post-Doc at St. Jude's Hospital.

Mike Dash graduated from Chiara Cirelli's lab and will be continuing as a Post-Doc in the Department of Psychiatry.

Ashutosh Dharap graduated from Raghu Vemuganti's lab and will be continuing as a Post-Doc in the Vemuganti's lab.

Jon Myers graduated from Tim Gomez's lab and will be returning to medical school.

Awards & Achievements

Prof. Erik Dent

has been awarded the Krieg Cortical Explorer award for 2011 from the Cajal Club. The award will be presented at the Cajal Club social at the Society for Neuroscience meeting in November.

Mira Kolodkin

received the Ruth Dickie Scholarship award for Graduate Women in Science and the Marie Kohler Fellowship through the Graduate School.

Jesus Mena

received a travel award to attend the annual SACNAS conference in San Jose this October and is a nominee for the Chapter SfN Travel Award.

Chelsey Smith

received the Vilas Conference Presentation Funds and the Ruth Dickie Scholarship award for Graduate Women in Science.

Congratulations to the students who have passed their preliminary examinations.

Ishmael Amarreh
Eugenia Friedman
Patric Hernandez
Bornali Kundu
Olga Ponomareva
Abha Rajbhandari
Aadhavi Sridharan

Neuroscience/Law Program Article (cont'd.)

likely to offer new treatment options, but could also raise a whole new set of legal and policy questions.

Despite the fact that science will almost certainly play an increasingly important role in our understanding of the neurologic factors that contribute to human behavior, including criminal behavior, there are few opportunities to rigorously apply the findings from one field to the other.

The UW-Madison's dual-degree initiative responds to this gap by providing a structured framework that will enable graduate students to examine how the two fields intersect.

Dual degree approach offers important advantages

While it would be possible for a student to earn a Ph.D. degree in neuroscience and a J.D. degree sequentially, the major advantage of studying both simultaneously in an integrated dual degree program is that it exposes students to points of contact between neuroscience and the law throughout their graduate careers.

This outcome will be promoted by the integrative context built into the dual-degree program and by explicit program requirements, such as mandatory enrollment in a neuroscience and public policy seminar during each year of study and completion of a required neuroscience and law comprehensive research paper.

"The student's legal studies may inform her/his choice of a thesis project," Kalil explains, "and conversely, as knowledge of neuroscience grows, it will inform the student's legal insights and help to shape the required Research Paper."

Kalil adds that a practical advantage of the dual degree program is that it will allow students to earn the Ph.D. and J.D. degrees, without sacrificing the quality of either, more efficiently than would be possible if the two degrees were pursued independently.

Approval of the dual degree approach offers students the opportunity to transfer 15 credits from the doctoral program toward the requirements for a law degree, effectively saving participating students 1.3 semesters of course work (and accompanying costs).

The Neuroscience and Law Program will be administered by the Neuroscience and Public Policy (N&PP) Program and will enroll its first class in the fall of 2012.

**If you would like to discuss supporting the
Neuroscience and Law Program, please contact:**

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Credits:

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State Bar of Wisconsin

Neuroscience Training Program

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Fall 2011 Events

September 24, 2011

Annual NTP Fall Picnic - Mary Behan's Farm, All Neuroscience students, faculty, staff, alumni, family and friends are invited

September 29, 2011

Maribel Rios
Tufts University
Minority Affairs Guest Speaker

Neuroscience and Public Policy Seminar Schedule

September 9, 2011

Walter Sinnott-Armstrong
Department of Philosophy and Keenan Institute for Ethics, Duke University.
Do you want to Die? Using Brain Scans to Detect Consciousness in Patients Diagnosed with Persistent Vegetative State

October 14, 2011

Owen Jones
Vanderbilt University Law School. and Director, MacArthur Law and Neuroscience Project
Law and the Brain

November 9, 2011

Laurence Steinberg
Department of Psychology, Temple University
Title to be announced

December 9, 2011

Walter Koroshetz
Deputy Director, National Institute of Neurological Disorders and Stroke
Title to be announced

**For more information on our events, contact
Jessica Karis at karis@wisc.edu.**

CONTRIBUTIONS TO THE PROGRAM

Funds given to the program are used to support recruiting activities, guest speakers, the undergraduate award in neurobiology research 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:

www.uwfoundation.wisc.edu

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



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