A newsletter dedicated to keeping the TDLC community informed about the Center's progress in research and education
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The Temporal Dynamics of Learning Center's ONTIME

ANNOUNCEMENTS

TDLC is contributing to a new science of learning! TDLC's Terry Sejnowski and Javier Movellan (with Andrew Meltzoff and Patricia Kuhl, LIFE Center, Univ. of WA) recently co-authored an article in Science Magazine: Foundations for a New Science of Learning (July 2009). The article describes how new insights from psychology, neuroscience and machine learning are converging to create a new science of learning that may transform educational practices. For more information: www.sciencemag.org.

TDLC's Boot Camp 2009

Would you give up two weeks of your life to learn things that are totally outside your comfort zone? Did we forget to mention that you would be completely sleep-deprived in the process? Sound like fun? Well, 19 brave souls (mostly graduate students) did just that by signing up for TDLC's first "Trainee Boot Camp," which was held at UC San Diego from August 10-22.

In typical boot camp fashion, the days started early and usually didn't end until late into the evening. The first week consisted of intensive instruction and hands-on lab experience that

served to prepare the students for undertaking a demanding research project during the second week. The topics covered were based on the research areas from the four research "networks" of the Center: sensory-motor learning, interacting memory systems, perceptual expertise, and social interaction, combined with a day on computational modeling. Additionally, the students received training in how to use the Center's state of the art Motion Capture/Brain Dynamics facility, where techniques for simultaneous recording of motion, brain waves, and eye movements of a person immersed in virtual reality are being developed. This is the first facility of its type to provide these capabilities, and enables the fine-grained study of changes in motor behavior, information-seeking behavior (eye movements) and brain responses during learning.

Part of the boot camp's mission was to bring trainees from the Center's various partner institutions to San Diego so that they could train together in one place and get to know each other in the process. The institutions represented at this year's boot camp were UC San Diego, Brown University, Vanderbilt University, University of Colorado, and the University at Buffalo. The students came from a diverse array of disciplines, including psychology, electrical engineering, neuroscience, cognitive science, and computer science.

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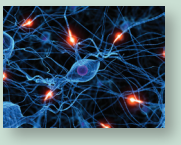
WHAT'S INSIDE

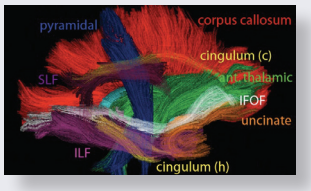


Science and Research

Terry Jernigan, Ph.D.: Vital Part of CHD / TDLC Collaborations

What are Brain Fiber Tracts?

Neural pathways, or neural tracts, connect one part of the nervous system with another and usually consist of bundles of long, myelin-insulated axons, known collectively as white matter. Neural pathways serve to connect and transmit signals between relatively distant areas of the brain or nervous system, compared to the local communication of grey matter.



TDLC's Social Interaction Network has a new member – Terry Jernigan, Ph.D.! Dr. Jernigan is Professor of Cognitive Science, Psychiatry, & Radiology at UC San Diego, where she teaches courses on cognitive neuroscience, brain development, and brain imaging and supervises graduate students, interns, residents, and postdoctoral fellows. Dr. Jernigan's primary interest today, as the recently appointed Director of the UCSD Center for Human Development (CHD) and a new member of TDLC, is brain development, the timing of brain development, and the implications of behavioral differences.

Exciting new projects are underway in a collaborative effort between CHD and TDLC. These projects explore the origins of individual differences in behavioral characteristics, and the effects of genetic factors and experience on the developing brain. Dr. Jernigan explains, "We don't know much about how biological development relates to cognitive/social/emotional development in people. We are beginning to see a correlation between developing mental and social functions, and biological development in brain tract fibers. What is driving the biological changes – activity in the fibers, genetics, environmental factors?"

Today, for the first time, we can examine these areas, using new neuroimaging methods– such as diffusion MR imaging for examining fiber tracts– and neurophysiological methods.

Researchers are finding that brain connectivity continues to develop throughout childhood, and that brain fiber tracts exhibit a protracted course of biological development throughout the school-age years. Little is known about differences in brain development among similar-aged children. These differences might affect children's responses to formal education. An understanding of these interactions may lead to better methods for improving learning.

In previous research, investigators used their data to construct a model of the development of the "average" child. But that approach is based on the assumption that development follows a relatively fixed course, and that schools should develop an "optimal," standardized curriculum geared to the "average" child.

But what if this standard model is wrong, and if children rarely follow this "average" course of development?

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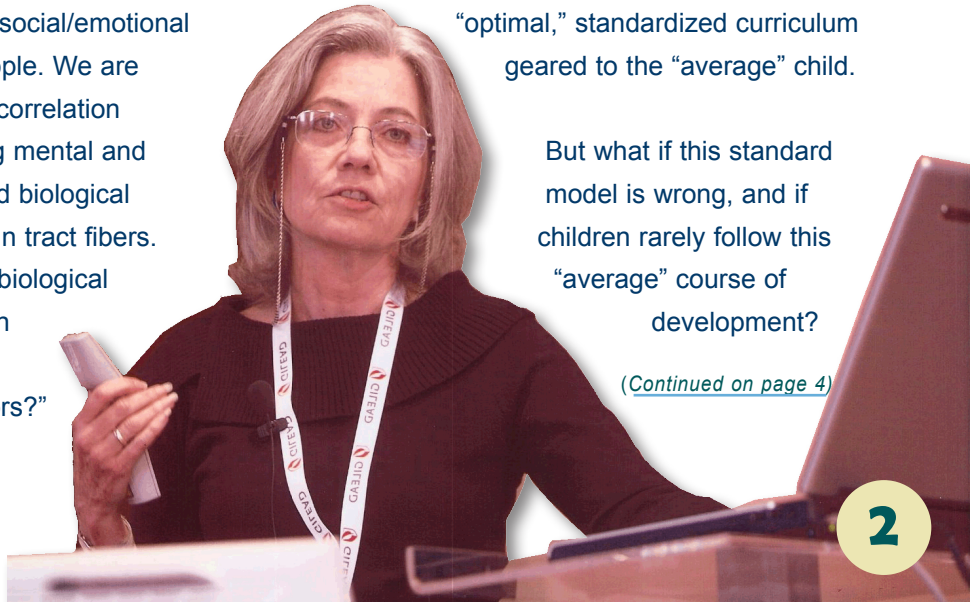

Education

Meet The Preuss School

The first thing to see when approaching the building or on the school's website is "The Preuss School UCSD." This important TDLC educational partner is a 6th through 12th grade school, chartered by the San Diego Unified School District, and located right on the UC San Diego campus. Founded by award-winning principal Doris Alvarez, and currently headed by Scott Barton, the school is dedicated to providing an intensive college preparation education for motivated diverse low-income students.

The Preuss School on Voigt Dr., UC San Diego North Campus

The first thing to learn about Preuss is how to say it – Proyce -- and that in itself is a great story. You see, the innovative school that variously ranks between 10th and 8th best public school in the country opened its doors just 10 years ago, thanks in large part to an affable computer graphics software entrepreneur. For the German-born Peter Preuss, childhood wartime experiences with helpful U.S. GI's formed indelible impressions of an "exciting and good America." And in 1965 he entered UC San Diego as a grad student, then went on to form Integrated Software Systems.

Peter Preuss (right) being shown the Viz Lab in SDSC by Larry Smarr, Director of CalIT2

Out of that wildly profitable high tech venture – started with a mere 10 dollars and ultimately worth many millions -- came the Preuss Family Foundation, initially funding brain cancer research. Later, as a

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Ask a Scientist

Featured Scientists: Matt Tong, PEN Network, email: mhtong@cs.ucsd.edu
Chris Kanan, PEN Network, email: chriskanan@gmail.com

What is visual saliency? How does it influence the way children learn?

Something is visually salient if it stands out from its surroundings and attracts your attention. The portion of our retina responsible for sharp vision is centrally located and surprisingly small, meaning that we tend to make eye movements to look at what we're focused on or thinking about. A waving hand or flashing light are examples of things that are intrinsically salient - regardless of what task you're performing, these sorts of stimuli will tend to capture your attention and attract your gaze. Salience also appears when you talk about "pop out" effects. A red target object is easy to find among green distractor objects and remains easy to find regardless of how many green distractor objects there

(See Scientist, Page 5)

Terry Jernigan, Ph.D. (continued from page 2)

All children may not respond to experiences in the same way, due to the interaction between genetic variability, experience and brain development. What if imposing the "ideal" conditions can actually be harmful to some children?

Dr. Jernigan, an orchid enthusiast, gives a powerful analogy: "A gardener might try to determine the optimal amount of water/fertilizer/sunlight for a garden. But this gardener fails to understand that there are differences between plants, and each has its own needs. Not all plants will do well with the 'optimal' level" (e.g. some thrive in shade, some love sun). "What makes a skillful, intelligent gardener is an understanding of the difference between plants – only then will he be able to maximize the beauty of a garden."

Ultimately, we want to determine: What works best, when, and for whom.

This approach has strong implications for the field of education: If children are not all the same, and each responds to experiences in a different way, then understanding the differences between children and how these differences affect their response to education, is a crucial area of study. Does tailoring educational interventions to each child change his emotional response to a topic, his motivation, or even his neurodevelopment?

Research has shown that the best motivation for learning occurs when a child is at the edge of what he does and does not know – he feels challenged, but not frustrated. Any more or less could negatively affect a child's motivation or expectation of success. That child is then in danger of never reaching his potential. Concurrently, if a curriculum is adapted to a child (using "intelligent technologies that track a child's status of learning), it raises the possibility that the student will become more motivated, will approach learning with a more positive emotion and will develop a better self-image and expectation of what he is capable of achieving in the classroom.

"We need intelligence based on empirical knowledge," Dr. Jernigan explains. "We need to measure brain development, patterns of timing and connectivity, cognitive development, genetic abilities, behavior/motivation/emotions, academic skills, different teaching methods as they affect learning, and how all of these factors interact." Ultimately, we want to determine: "What works best, when, and for whom" – to do the research and get the word out.

As her comments reveal, Dr. Jernigan brings sincere passion, as well as tremendous experience and talent to TDLC. One would never guess that this down-to-earth, dedicated researcher, who loves traveling, walking, blues guitar, and raising her 16-year-old son, has published over 125 articles and book chapters. Nor the fact that in addition to all of her roles above, she is the Imaging Section Editor for the journal *Neurobiology of Aging* and serves on the editorial boards of four other journals.

But Dr. Jernigan's main focus at TDLC is helping to develop a more complete model of brain development and its role in education. Ultimately, she hopes this model will lead to improved educational practices and technologies, which would give children a better chance of success in school, and ultimately in life.

by Rachel Weistrop

"The human brain, then, is the most complicated organization of matter that we know."

-- Isaac Asimov

Boot Camp (continued from page 1)

After the first week of intensive training, the participants chose a project for the second week in an area they had limited or no experience in prior to the boot camp. This guaranteed a rich training experience in a novel area, which was one of the main objectives of the boot camp. With the support of teaching assistants, the students defined their research objectives, collected and analyzed data, and finally presented their results in half-hour talks on the last day of the program (video of the talks is available on the website of TDLC's partner The Science Network: http://thesciencenetwork.org/programs/tdlc-boot-camp-2009).

TDLC Director Gary Cottrell sees the Center's boot camp as an effective way to immerse young researchers in a variety of TDLC-related research methodologies within a relatively short span of time. Upon completion of the boot camp, the participants returned to their labs with many newly-mastered research skills and a broader understanding of cross-disciplinary research that will likely contribute to new lines of inquiry they may not have otherwise considered pursuing.

by Andrew Kovacevic

Ask a Scientist (continued from page 3)

are - the red target pops out. Sometimes the task you're trying to perform will make things more or less salient. For example, if you're looking for a man with a beard, other bearded men will attract your attention. In regards to children, attention is drawn to salient objects - anyone who's spent any time around children knows that getting them to pay attention is an important way of getting them to learn. Infants find things like faces and jingling car keys quite salient and you can easily observe how focused they become on such things. Focused attention facilitates learning, so we tend to learn the most about objects we find most interesting.

How can the information you gather from your studies be translated into the classroom to help students learn?

Because humans are visual creatures, a better understanding of visual attention gives key insights into how we perceive and understand the world. Advances in this area are so important to understanding how we think and learn that it is sure to have a large impact in how we educate our students. More immediately, educational materials such as books and computer programs designed with saliency in mind may be more successful at keeping a child's attention by ensuring that important items have high salience while distracting items have low salience. The SUN model in particular emphasizes that visual novelty attracts attention. Proper use of salience could substantially improve children's rate of knowledge acquisition, especially in young and easily distracted children.

"We need teachers to help us develop the science and the engineering from the ground up. It's not really about us translating; it's about them giving us ideas."

Javier Movellan

Meet The Preuss School

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UC regent convinced of the value of a school that could introduce young students to science as a worthy and exciting endeavor, Preuss donated $5 million and the school was born. Today, with Scott Barton as Principal, Preuss has been evaluated as a California Distinguished School, has more than 700 students, 72% from underrepresented minorities, and at last count 95% of these highly diverse students go on to college.

The school annually recruits the most promising San Diego area youngsters ready to enter grades 6, 7, 8 or 9, employing unique admission criteria: Meeting federal Title One school guidelines for economic support, with parents or guardian not college graduates, and demonstrating high motivation and family support. Follow that up with a curriculum shaped around college entrance requirements that mandate at least three years of Spanish or Japanese, seven years of math, science participation, plus advanced placement courses and volunteer hours by both students and parents. Now the amazing rate of Preuss students' college acceptances becomes clear.

Significantly, the Preuss School's relationship with TDLC is a two-way street that includes research studies involving students at Preuss, as well as participation in the school's mentorship program and internships. In 2008-09, eight Preuss seniors interned in the Cottrell, Chiba, Deak, or Movellan labs over twelve-week sessions of participation in research and tutoring in research topics. Two even stayed on for additional lab work.

Preuss students immersed in an experiment in a research lab.

As in TDLC's annual report to NSF: Preuss School is one of our "living laboratories" for educational research, and translational research is by design first vetted in actual classrooms. One such project is an ongoing study by Hal Pashler, Michael Mozer and postdoc Shana Carpenter, looking at the differences in 8th graders' retention of study material depending on the spacing between study sessions before a history test.

TDLC is fortunate to have recruited Preuss Founding Principal Doris Alvarez as leader of The Educator Network, and she recently brought in Preuss math teacher David Weber (profiled in ONTime, Spring 2009). The goal is to continue to develop this essential partnership, involving teachers to help guide projects toward what is actually needed in the schools and to avoid ivory tower research with little impact on educational practice.

by Carolan Gladden

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