INCUBATOR

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Spring 2013

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UCSD Creates Center for Brain Activity Mapping

Responding to President Barack Obama's "grand challenge" to chart the function of the human brain in unprecedented detail, the University of California, San Diego has established the Center for Brain Activity Mapping (CBAM).

The new center, under the aegis of the interdisciplinary Kavli Institute for Brain and Mind, will tackle the technological and biological challenge of developing a new generation of tools to enable recording of neuronal activity throughout the brain. It will also conduct brain-mapping experiments and analyze the collected data.

Ralph Greenspan–one of the original architects of a visionary proposal that eventually led to the national BRAIN Initiative launched by President Obama in April–has been named CBAM's founding director.

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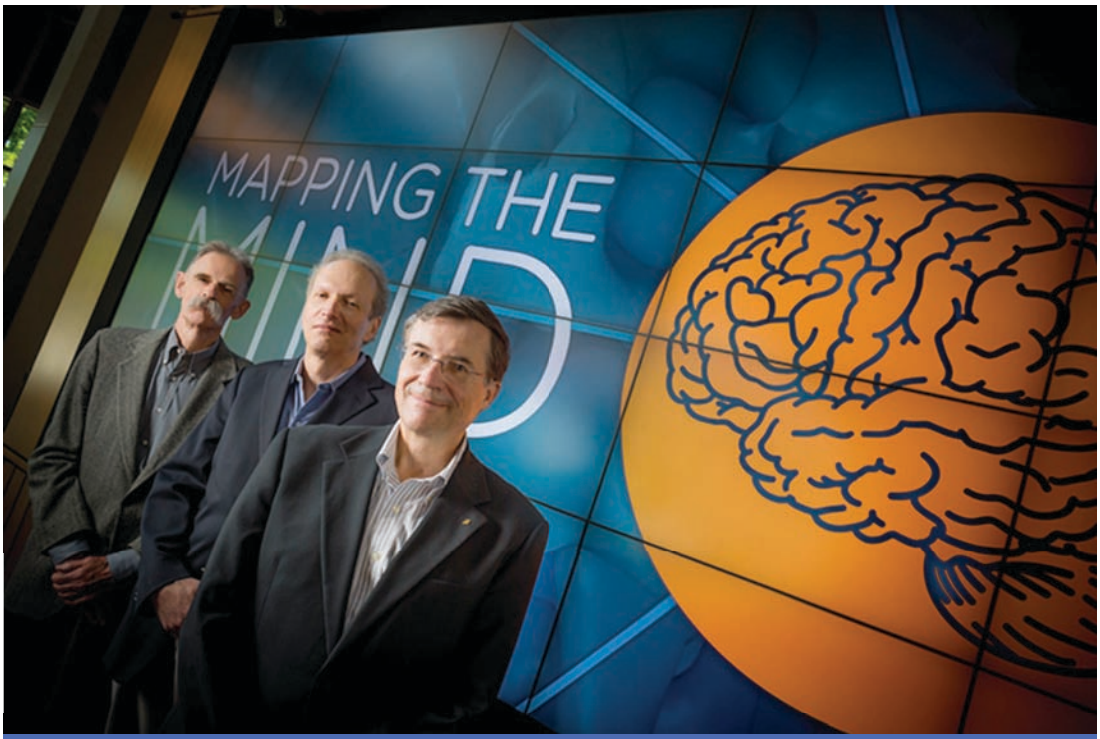

From left, Nick Spitzer, Ralph Greenspan, and Terry Sejnowski. (Photos by Erik Jepsen/UC San Diego Publications)

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UC San Diego Chancellor Pradeep K. Khosla, who attended Obama's unveiling of the BRAIN Initiative, said: "I am pleased to announce the launch of the Center for Brain Activity Mapping. This new center will require the type of in-depth and impactful research that we are so good at producing at UC San Diego. We have strengths here on our campus and the Torrey Pines Mesa, both in breadth of talent and in the scientific openness to collaborate across disciplines, that few others can offer the project."

Greenspan, who also serves as associate director of the Kavli Institute for Brain and Mind at UC San Diego, said CBAM will focus on developing new technologies necessary for global brain-mapping at the resolution level of single cells and the timescale of a millisecond, participate in brain mapping experiments, and develop the necessary support mechanisms for handling and analyzing the enormous datasets that such efforts will produce.

Brain-mapping discoveries made by CBAM may shed light on such brain disorders as autism, traumatic brain injury and Alzheimer's–and could potentially point the way to new treatments, Greenspan said. The technologies developed and advances in understanding brain networks will also likely have industrial applications outside of medicine, he said.

The new center will bring together researchers from neuroscience (including cognitive science, psychology, neurology and psychiatry), engineering, nanoscience, radiology, chemistry, physics, computer science and mathematics.

"An essential component of the center will be its close relationships with other San Diego research institutions and with industrial partners in the region's hi-tech and biotech clusters," said Nick Spitzer, distinguished professor of neurobiology and director of the Kavli Institute for Brain and Mind at UC San Diego.

Ralph Greenspan

Beyond bringing researchers together, the center will seek the resources to support specific projects. Some of these projects will likely build on existing research at UC San Diego while others will be brand new, growing out of the novel collaborations that CBAM will encourage and nurture.

The center aims to compete for national grant funds but will also seek to pursue projects with the help of philanthropists and industry partners.

Administratively, CBAM will be part of the interdisciplinary Kavli Institute for Brain and Mind. Calit2's Qualcomm Institute at UC San Diego will support CBAM with some initial space for collaborative projects.

Greenspan will soon assemble a director's council, to help guide the center's scientific program, and an advisory board, to assist on general strategy and fundraising.

Greenspan authored the proposal for CBAM with Spitzer and Terry Sejnowski, director of UC San Diego's Institute for Neural Computation, who holds joint appointments with UC San Diego and The Salk Institute.

The trio identified the center's immediate goal as preparing CBAM to compete effectively for federal BRAIN initiative funding. Activities will include, for

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"We are among the best-positioned places anywhere to make a significant contribution to the president's challenge."

— Ralph Greenspan

Brain Activity Mapping, cont from page 2

example, topic-oriented meetings and workshops to identify potential project areas.

In the long term, CBAM hopes to create an endowment for stable support of the most promising projects and to facilitate the formation of new start-up companies.

"We have the capability and the atmosphere here to make some major advances on the BRAIN Initiative," Greenspan said. "We are among the best-positioned places anywhere to make a significant contribution to the president's challenge.

"We invite members of the scientific and philanthropic communities – here in San Diego and further afield," he said, "to join with us on this vital quest."

Read Kavli Foundation Q&A with Ralph Greenspan on the BRAIN Initiative and UC San Diego's CBAM.

The above story is reprinted from materials provided by UCSD News Center.

The original article was written by Inga Kiderra.

Sejnowski Elected to American Academy of Arts and Sciences

INC director Terrence J. Sejnowski, professor and head of the Computational Neurobiology Laboratory, has been elected a Fellow of the American Academy of Arts and Sciences, a distinction awarded annually to global leaders in business, government, public affairs, the arts and popular culture as well as biomedical research.

Sejnowski is world renowned as a pioneer in the field of computational neuroscience and his work on neural networks helped spark the neural networks revolution in computing in the 1980s. His research has made important contributions to artificial and real neural network algorithms and applying signal processing models to neuroscience.

Sejnowski is the 12th scientist from Salk to be inducted into the Academy and will share the honor with 198 new members of the 2013 class that include Nobel Prize winner Bruce A. Beutler, philanthropist David M. Rubenstein, astronaut John Glenn, actor Robert De Niro and singer-songwriter Bruce Springsteen.

Terrence J. Sejnowski

The Academy selected Sejnowski and the other new Fellows as a result of their preeminent contributions to their disciplines and society at large. The honorees will be formally inducted into the Academy on October 12 at its headquarters in Cambridge, Massachusetts.

"Election to the Academy honors individual accomplishment and calls upon members to serve the public good," said Academy President Leslie C. Berlowitz. "We look forward to drawing on the knowledge and expertise of these distinguished men and women to advance solutions to the pressing policy challenges of the day."

Since its founding in 1780, the Academy has elected leading "thinkers and doers" from each generation, including George Washington and Benjamin Franklin in the eighteenth century, Daniel Webster and Ralph Waldo Emerson in the nineteenth, and Albert Einstein and Winston Churchill in the twentieth. The current membership includes more than 250 Nobel laureates and more than 60 Pulitzer Prize winners.

(Source: http://goo.gl/im2Hb)

Faculty Spotlight - Garrison W. Cottrell

Twenty-five years of neural network research

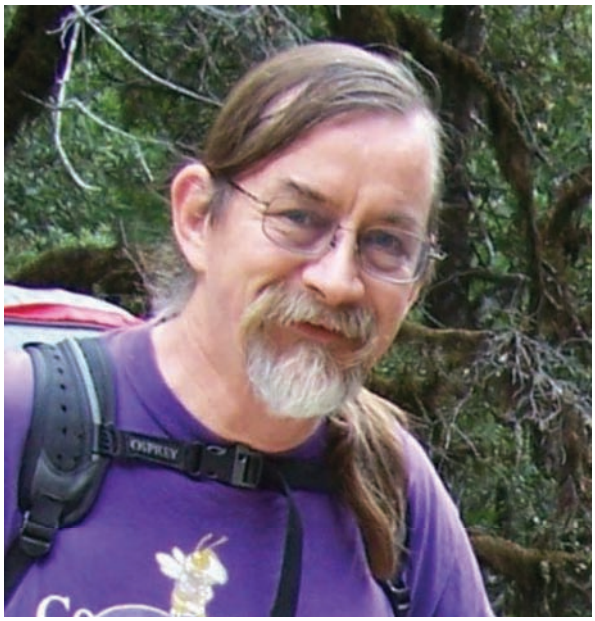
Newsletter editor Tomoki Tsuchida sat down with Dr. Garrison W. Cottrell, director of the Temporal Dynamics of Learning Center (TDLC) and professor in the computer science and engineering department at UCSD. We asked him about the path leading him to UCSD and his current research interests.

How did you become interested in Artificial Intelligence?

I became interested in Artificial Intelligence when I read "I, Robot" by Isaac Asimov in my freshman year in high school. It was the first time I discovered you could read a book for fun! Later I read other books by Asimov — including the Foundation Trilogy — and I decided I wanted to be Hari Seldon, who was the psycho-historian in the story. He predicts ten thousand years of chaos of the empire, which he was able to reduce to one thousand years by starting a foundation to preserve all human knowledge. He appears holographically over the thousand years to Foundation leaders to predict things and tell people what to do.

In college, I majored in math and sociology in Cornell, because those were the closest things to psycho-history at that time. I spent most of the time protesting the war, though, and it wasn't until my senior year when I realized you could be serious about math as a subject. When I graduated, the revolution didn't happen, so I went back to school for teaching math; I received a permanent teaching certificate for grades 7-12 mathematics in New York state. I couldn't find a job teaching in Ithaca, though, and no one could really leave Ithaca those days, because it was ten square miles surrounded by reality. So instead, I did school bus driving, rough carpentry, auto-body work, and ice-cream scooping at Carvel.

When it was time to do something different, I decided that being a lawyer was boring. I didn't have the background for medicine, but I really enjoyed the one course I had taken in computer science for my teaching masters, because it was like puzzle solving. In those times, you would have to submit your job on a stack of punched cards and get the results next morning, so it was really important to debug properly. It was always interested trying to figure out exactly what the error was. So, I went to graduate school at Syracuse for a couple of years, where I learned that "all AI has done in twenty years is LISP" from Alan Robinson, the inventor of resolution theorem proving. In the second year of the program, I applied to other schools and got into University of Rochester where Jerry Feldman and Dana Ballard had just written the paper "Connectionist Models and Their Properties." I eagerly read that paper to find out how to build a connectionist model, but I got to the end and still didn't know how to do it. Then I read "An interactive activation model of context effects in letter perception" by McClelland and Rumelhart, and said to myself, "oh, that's how you build a connectionist model!" My thesis work used ideas from this model.



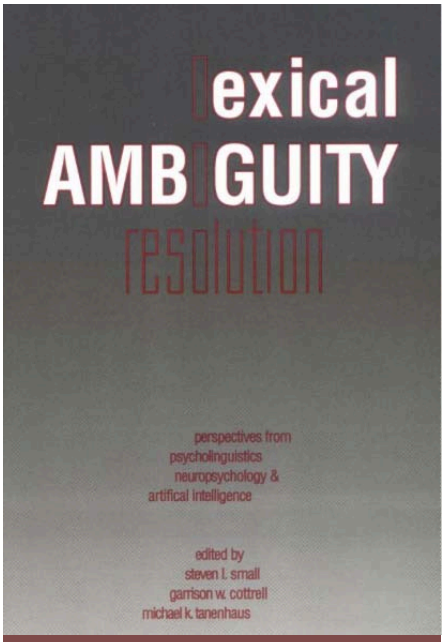
For my thesis, I worked on word sense disambiguation. Jerry Feldman was on my committee, but James Allen was my advisor, who did natural language processing. Part of my thesis was disambiguating the word "threw", which can mean to propel, intentionally lose, host a formal dance, and (with "up"), vomit. I interviewed a few places, one of which was the University of Pennsylvania. I didn't get the job there, but I was told afterwards that I would have, if I hadn't brought up vomiting — because all people could think of after I interviewed was throwing up! I did get offers from McGill University, University of Toronto and UCSD. I decided to come to UCSD, because Rumelhart had done all this wonderful work here.

What are some of the projects you have worked on at UCSD?

When I came here in 1987 and finished up with Rumelhart, I was a connectionist on the job market, and connectionism was hot. I got nineteen interviews and four offers, and I decided to stay here at UCSD. A lot of people didn't know what to do with me, because interdisciplinary studies weren't popular these days. In many places, I interviewed at both psychology and computer science departments. In psychology departments, I would give talk on my thesis on word sense disambiguation; and in computer science departments, I would give talk on my first paper about using backpropagation in an auto-encoder for image compression with Dave Zipser and Paul Munro.

I had a lot of students when I started out here, and I had an infinite number of thesis topics: A connectionist approach to X, for all X. One of the projects we did was on information retrieval. My first PhD student, Brian Bartell, did work on using gradient descent to learn relevance scores and similarity matrix for documents. I also got a grant from NIH to work on the lobster stomatogastric ganglion with Al Selverston; I was really appreciative of him, because it was my first big grant. My second Ph.D. student to finish, Fu-Sheng Tsung, worked on that project. However, he became more and more Buddhist as time went on, and did not want to work on lobsters. He is now the Venerable Jian Hu, and started the Chung Tai Zen Center of Sunnyvale, where he is the abbot of the monastery, with four monks under him. I think of him as being the head of his department!

During this time, there was some resistance to connectionist models from a particular panel of NIH, which made it difficult to get grants for the computational psycholinguistics work. You could always tell when a particularly vicious reviewer had read your grant, as she always called the models "connectionistic." In the end, I received a grant for work that followed up on my image compression work, where we applied it to face processing. I had an undergraduate student, Michael Fleming, who was a senior in psychology working on his honors thesis. We wanted to apply the image compression to face recognition. We bought a digital camera for that purpose (it was a big deal those days, and very expensive), and it was delivered two weeks before the quarter was over. But in that time, he had taken pictures of faces of people, compressed the images using an auto-encoder network, and trained a perceptron to recognize face/non-face, male/female, and identity. The network generalized well: on faces it had never seen, it knew it was a face; and if it was a face, it knew whether the face was male or a female. It also worked when part of the image was blanked out, and it would complete the image. For some pictures, it thought my dog JellyBean was a face! The project culminated in papers in the International Joint Conference on Neural Networks in San Diego and International Neural Network Conference in Paris.



Dr. Cottrell's earlier works focused on word sense disambiguation.

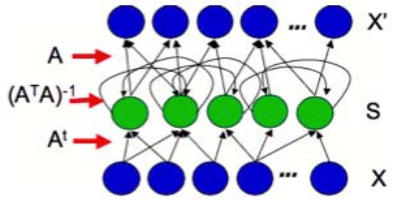
Then Janet Metcalfe visited me, and we took pictures of UCSD Psychology undergrads making emotional faces. We told people to look many different faces — happy, sad, angry, and so on. Unfortunately, we got the Irish Setter effect, where most people would make one or two faces for all emotions. There was just no good signal there to model. We still got a NIPS paper out of it, though.

Eventually, these face-processing projects morphed into objects processing and expertise in visual processing. Now, we're trying to understand how brain processes visual stimuli in general, and how early visual cortex become organized.

What are some of the models that you are working on now?

"TDLC is strategically placed to work on issues related to the BRAIN initiative."

— Garrison W. Cottrell



The sparse PCA network minimizes the variance of hidden units, while still retaining the correlated connections.

One of the models of early visual processing we have is called sparse principal component analysis (PCA). I always think of PCA as an auto-encoder network, as we showed in that early work that the network hidden units were spanning the space of the principal components. It is a kind of direct method of performing PCA. Sparse PCA is a version of PCA that, besides minimizing reconstruction error, also minimizes the number of connections (energy efficient), and is constrained to equalize the work among the hidden units. The idea is that, while an auto-encoder network using backpropagation incompletely normalizes the variance among the hidden units, this model explicitly limits the amount of variance that the hidden units can have. The number of connections on hidden units is minimized, while still retaining the most correlated connections. As a result, you get local receptive fields with center-surround structure: neighboring units have to correct for each other's activity in the reproduction, so that there's a mild inhibition around where the hidden unit is receiving its input from. Because the activity of units is normalized, they tend to be about the same size. It is an exciting work, because it explains how early visual processing is structured to encode information from natural scenes efficiently, and it also works when applied to sound, giving gammatone filters (like those seen in the auditory nerve of cats), so it appears to be domain-general.

You're leaving for France (from July 9th, 2013) on a sabbatical for a year. What are some of your plans there?

I'm visiting my ironically-named friend, Bob French, at the Université de Bourgogne in Dijon. He has a new technique for learning sequences in neural networks that I plan on investigating. Bob is also interested in developmental issues, so I'm planning to look into whether there's some collaboration we can do. He has done some interesting work on the development of infant visual categorization using auto-encoder networks.

What do you think of the new brain activity mapping initiative and its effect on TDLC and INC?

TDLC plays a vital role within INC, because the center deals with issues related to learning — especially in brains, in contrast to machine learning. I believe it is strategically placed to work on issues related to the initiative. Right now, the initiative is mostly about technology for recording, because they want to first record from neurons and synapses. But, eventually, the question is what we should do with the data. We will need to understand what the data means, and we won't understand it without a theory or a model. I certainly see many future possibilities between the initiative, TDLC and INC: many INC labs are already incorporated into TDLC, so the organizations are intimately connected.

Thank you for the interview, and bon voyage!

Cottrell Lab

http://cseweb.ucsd.edu/groups/guru/index.html

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Cottrell, G.W., Metcalfe, J. (1991) **EMPATH: face, gender and emotion recognition using holons.** D. Touretzky (Ed.) Advances in Neural Information Processing Systems 3, San Mateo: Morgan Kaufmann,.

Staff Spotlight - Patricia Gorospe

INC's Business Office Manager Helps Researchers Manage Finances

Patricia "Patty" Gorospe replaced Carol Hudson's position as INC business office manager as Carol Hudson is now the new Management Services Officer (MSO) of INC in October 2012. Patty has over two decades of administration experience in the public and university environment. Most recently, she was the Sponsored Project Analyst at the Alzheimer's Disease Research Center in the Department of Neurosciences.

Patty, we're very excited to have you as a member of our administration team. What is it about the new position that lured you to INC?

I thought it would be a great challenge. I liked that it had more independence, as I would be taking on a more supervisory role. I also wanted to know that I could bring up other administrative staff, so that they would be ready to move on in their career paths. I like that aspect of the supervisory position, because I know how important it was for me.

What are your current responsibilities?

I am responsible for overseeing and providing administrative support for very complex programs and projects within INC. This was passed along to me from Carol's position. What is somewhat new is the function related to the Temporal Dynamics of Learning Center (TDLC), which was primarily a project that Shelly Marquez spearheaded and really made what it was. The administration for that has expanded, because now we're also responsible for administering the TDLC grants. To me that's important, because we want to ensure the continuity and communication in business processes and keep it up to speed. That's exciting, since I have worked with large projects before and am very familiar with it.

What are some of the organizational challenges that you see in the INC?

I think that challenge for most departments now is the sustainability. Because we're looking at very large center grants, we want to ensure we're doing our best to help the PIs make use of their funds and support them if they need to apply for additional funding sources. Our job is to make sure that the compliance and administration is done at a high level, so that they're happy.

They would also see us as a valuable resource for anything that has to do with contracts; not just financial, but also programatic. We want to know a little bit about their programs, so that we can best benefit them from the financial means. What is really important is

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Patricia "Patty" Gorospe

Patricia Gorospe, cont from page 5

communicating with the researchers not just what's going on at the technical level, but also at the program level. I would like to see our staff get more involved in the program end, by going on to the meeting with them when appropriate. I think it just makes for a better coordinated team, and we can provide better services.

The challenge is to change the way of thinking within the unit so that they understand we are here to support them, and to be involved in their day-to-day administration of their grants. We have to be accessible and be able to communicate with staff members, researchers, postdocs and graduate students.

"We have to be accessible and be able to communicate with staff members, researchers, postdocs and graduate students."

Are there specific changes that has taken place, or that you want to take place?

I think there have been changes that started to occur even before I came on board with the retirement of Shelly. The biggest change was that we are moving some of the administrative structures around, which is exciting. My goal now is to concentrate on research administration.

We're also going to start doing workshops for the staff. Carol and I have developed workshops for research administration and in-house training, called pre- and post-award administration. The training is provided on campus too, but we want to make sure our staff members go through it again based on what we do here at INC. It improves our cross-training ability with other staff members within the administrative structure and gives us the ability to progress in their careers.

What do you do in your spare time?

In my spare time, I enjoy spending time with family and reading. I have four daughters - all adults now - and I have become grandmother in February. I lead a women's bible study group, and I am also a leader the hula troop that I dane with and do administrative work for a ukulele group. Those are some of my hobbies outside of work, so it's a very exciting time.

Thank you for the interview!

INCEVENTS

NEUROENGINEERING SEMINAR SERIES

05/20/13	**Akinori Ueno**	Non-contact Biopotential Sensing

CHALK TALKS

04/11/13	**Eric Halgren**	Cortical dynamics of word understanding
04/25/13	**David Kleinfeld**	Coupled brainstem sensorimotor oscillators
05/09/13	**Miroslav Kristic**	Extremum seeking and learning in adversarial networks
05/23/13	**Henry Abarbanel**	Nervous systems from the bottom up
06/06/13	**Shaya Fainman**	Nanophotonics technology and applications

SPECIAL EVENTS

02/08/13 - 02/09/13

TDLC NSF Site Visit

05/11/13 - 06/01/13

Mozart & the Mind: Music & the Brain Exposition

For more information, please see the following article about the event on the TDLC website and TDLC newsletter:

http://tdlc.ucsd.edu/about/about-matm.html

06/01/13

Annual Joint Symposium on Neural Computation

California Institute of Technology

http://www.jsnc.caltech.edu

More information: *http://inc.uscd.edu/events.html*

For more information on current events,
please contact **Kristen Michener** kmichener@ucsd.edu

INC at a glance

INC Research Groups and staff

Institute for Neural Computation (INC)
http://www.inc.ucsd.edu
Terrence Sejnowski and Gert Cauwenberghs, Co-Directors
Carol Hudson, Management Service Officer

Swartz Center for Computational Neuroscience at INC
http://www.sccn.ucsd.edu
Scott Makeig and Tzyy-Ping Jung, Co-Directors

Machine Perception Laboratory at INC
http://mplab.ucsd.edu/
Javier Movellan, Marian Stewart Bartlett, and Glen Littlewort, Principal Investigators

Temporal Dynamics of Learning Center (TDLC) Motion Capture/Brain Dynamics Facility at INC
http://inc.ucsd.edu/~poizner/motioncapture.html
Howard Poizner and Scott Makeig, Co-Directors

Office of Naval Research (ONR) Multidisciplinary University Initiative (MURI) Center
http://inc.ucsd.edu/~poizner/onr_muri/
Howard Poizner, UCSD (PI); Gary Lynch, UCI (Co-PI); Terrence Sejnowski, Salk Institute/UCSD (Co-PI)

Mobile Brain Imaging Laboratory (MoBI) at INC
Scott Makeig, Principal Investigator

Poizner Laboratry at INC
http://inc2.ucsd.edu/poizner/
Howard Poizner, Principal Investigator

Dynamics of Motor Behavior Laboratory at INC
http://pelican.ucsd.edu/~peter/
Peter Rowat, Principal Investigator

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