THE COGNITIVE NEUROSCIENCE LABORATORY (CNL): PAST, PRESENT, AND FUTURE

Jaime A. Pineda, Ph.D. has been the Director of CNL at the University of California, San Diego since 1989 when he joined the Cognitive Science Department as a faculty member. Since the beginning of his academic career, Dr. Pineda has been interested in the functional mapping between neuroanatomical and neurotransmitter systems and the control, adaptation, and regulation of behavior. His specific research interests are wide-ranging and encompass the understanding of functional and dysfunctional cognitive systems, attention, motivation, decision-making, working memory, face processing, action comprehension, and context-dependent actions. Furthermore, he has been interested in the interactions among brain processes that underlie attention, reward, and action systems. While the specific focus of this research continues to evolve and expand, the underlying motivation remains essentially unchanged, which is to understand the relationship between neural systems and cognition.

Research

Four major themes have blended in Dr. Pineda's work at CNL: 1) mind-brain interactions; 2) interactions among neural systems; 3) levels of processing; and 4) translational research. Understanding complex mind-brain interactions demands a description and understanding of how various neural systems interact and integrate information, as well as the mechanisms that make this possible at different levels of analysis. The importance of this approach is that descriptions at one level inform and constrain the interpretation of results at other levels. In retrospect, this perspective has produced a significant amount of work because of Dr. Pineda's attempt to understand those relationships at the single cell, neurotransmitter system, behavioral and finally at the social level. Beginning with his non-human primate work and ranging to the latest work on children on the autism spectrum the progression has been to examine more and more complex information processing. Equally important has been the need to explore the links among neural systems involved in perception and action, such as those that regulate orienting, alerting, attending, and reward. This line of research is necessary for a more complete description of mind-brain interactions and is really the only way to truly understand context-dependent actions. Another approach that Dr. Pineda has found useful is to test and disrupt the system using external probes, such as drugs. Throughout his career, Dr. Pineda has been motivated by the idea of bridging different domains of knowledge, from animal to human, including clinical perspectives. This translational aspect has involved examining special populations, such as nicotine addicts, children with autism, adults suffering from schizophrenia and from phantom sounds such as tinnitus. Successful, and has been dependent on collaborations with other researchers and clinicians. Part of Dr. Pineda's motivation has been the conviction that diseases and disorders provide unique perspectives on how a normal brain works. Hence, taking basic research findings and applying them to the understanding of diseases and brain disorders, and making research meaningful in a practical way, has been an important self-motivating force.

Studying these relationships requires a direct approach, and to do this Dr. Pineda has found it necessary to apply a variety of techniques, from single unit recording, radiofrequency lesions, immunohistology, electrical stimulation, pharmacological interventions (intracranial and systemic), event-related potentials, electroencephalography, transcranial magnetic stimulation, neuroimaging, behavioral analysis and cognitive assessments. This is a considerable range of skills brought to bear on these complex issues. To find this combination of approaches in a single lab is exceptional and allows for creative approaches that address questions that cannot be addressed otherwise. It is this

variety of interests, perspectives, motivations, and tools, coupled with an understanding of behavior and the physiological and neurochemical correlates, which makes his work unique. Furthermore, this multi- and inter-disciplinary approach, coupled with the multi-level analyses and array of tools brought to bear on understanding mind-brain relationships, is an excellent example of the cognitive science enterprise, and an important model for undergraduate and graduate students in this field.

The importance of Dr. Pineda's work has been to 1) bring to bear a multi- and inter-disciplinary perspective to an understanding of mind-brain relationships; 2) map the relationship between specific cognitive processes and their neural correlates at different levels of information processing; 3) bridge animal-patient findings to understand more clearly the relationship between neural systems and high-level cognition; and 4) develop practical applications from the basic research that can be helpful to patients. This work has led to observations and results that could not have been achieved in a more circumscribed research enterprise. Three examples of these insights (which are more fully described below) include the relationship between the noradrenergic system and cognition, the identification of an objective index of tinnitus, and the relationship between mu rhythm oscillations and mirror neuron activity. Some of this work has been recognized as pioneering and is playing a role in guiding and shaping the cognitive neuroscience field, as acknowledged by colleagues in recent reviews.

Teaching

Several themes are part of Dr. Pineda's teaching philosophy. He takes seriously the idea that it is important to educate and train future research scientists, both in the classroom and in the laboratory. To that end, he views both undergraduate and graduate training as equally important and has devoted a significant amount of time to insure that his undergraduate students receive opportunities to excel in experimental design and in conducting research. This interest in undergraduate student education is reflected in the large number of students who have worked in his lab. During the past few years, for example, approximately 50-60 students have completed independent research, Honor's, Faculty Mentor, MARC, AMGEN, and Howard Hughes projects with Dr. Pineda. Many of them have been encouraged to present at the annual UCSD Research Conference, Faculty Mentor's Conference, departmental Honor's presentations, and other forums. The truly excellent students have been encouraged to present at professional conferences, such as the Society for Neuroscience and Cognitive Neuroscience Society conferences.

Dr. Pineda teaches several courses on a regular basis: Cogs107A [Neuroanatomy and Physiology], Cogs174 [Drugs: Brain, Mind, and Culture], Cogs175 [Neurophysiology of Alternate States of Consciousness], and Cogs17 [Neurobiology of Cognition]. He has also taught COGS160 Special Topics courses on Drugs and the Brain and Research Practicum; COGS172 Brain Disorders and Cognition; COGS91 SCANS Presents, and been a regular presenter in the COGS1 Introduction to Cognitive Science class. More recently, he has developed a number of new courses, including combined graduate/undergraduate classes in Neuropsychopharmacology and Mirror Neurons and Social Cognition, as well as undergraduate electives on Zen and the Brain and Mirroring and Social Cognition. He is especially proud of the fact that many students have chosen to major in Cognitive Science and to specialize in Neuroscience because they have taken his classes and have been fascinated by the subject. He believes it's important to convey the enthusiasm for cognitive neuroscience to those who are just starting out and trying to decide what their major should be. The same mentoring philosophy guides his work with graduate and postgraduate students, i.e., being available to them as much as possible to help with both academic and personal needs.

Dr. Pineda has participated in and made contributions to promoting a diverse undergraduate student population by serving as the Program Director of the Minorities Access to Research Careers (MARC) program, as well as being involved both as a faculty mentor and participant in the following programs: *Summer Training Academy for Research in the Sciences (STARS), AMGEN Scholars Summer Research Program in Science and Biotechnology, Regents Scholar Research Initiative (RSRI) program, UCSD Summer Research Program (Science/Engineering Colloquium), Faculty-Mentor*

Program, Marshall Mentor Program, and APA Summer Science Institute. Additionally, I have hosted students to my lab from the American Psychological Association, Hughes Scholars Program, and the Cognitive Science Student Association. Finally, he has participated multiple times as faculty presider at a variety of undergraduate conferences including the UCSD Undergraduate Research Conference (both during the school year and summer) and the MARC First Annual Boot Camp.

During the past several years Dr. Pineda has acted as research and/or thesis adviser to twelve graduate students from UCSD [Matthew Schalles, Mike Datko, Sandra Weber, Adrienne Moore, Emma Marxer-Tobler, Lindsay Oberman], and other universities [Kristen La Marca, Sally Miller, Luciano Giromini, Jia-Min Bai, Roy Cox, Max Keuken and Ron Le Bel], as well as mentor and adviser to three postdoctoral students [Fiza Singh, M.D. and William Horan, Ph.D., Inna Fishman, Ph.D.]. He serves on numerous dissertation and Minor Proposition committees (for Group in Neurosciences).

Professional Service

Dr. Pineda is involved as a reviewer with a number of journals and organizations, including Brain Research, Neuropsychopharmacology, European Journal of Neuroscience, IEEE Transactions on Biomedical Research, Austrian Science Fund, among many others. For approximately 3 years (1997-2000), he served on several NIH review committees, including the Integrative Functional Cognitive Neuroscience group, National Institute on Drug Abuse "D" group, NIH Special Emphasis panel, and on an NIH IGERT Panel. He has been a consultant and Chairman of the Scientific Advisory Board for Otosonics, Inc and Zybernetix, Inc. These are two startup companies that he co-founded. He is also a member of professional organizations, such as the Society for Neuroscience, American Psychological Association, and Cognitive Neuroscience Society.

University Service. Dr. Pineda has served and chaired a number of departmental committees, including the Space, Graduate Admissions, and Subject Pool committees. He has been Undergraduate advisor multiple times, Academic Senate representative, and on the Computer committee. He has served on a number of university committees, including a Provost Review committee, the Undergraduate Scholarship and Registration Fee Advisory committee, the Undergraduate Program Review Committee, and as Undergraduate Advisor (both primary and secondary). He is also currently a member of the Eleanor Roosevelt College Executive Committee.

Collaborations. The past couple of years have seen a fruitful development in ongoing as well as new collaborative projects for Dr. Pineda. He has established collaborative relationships with other UCSD faculty in a variety of departments [Kristin Cadenhead, Martin Paulus, Fiza Singh and David Feifel - Psychiatry, Vilayanur Ramachandran – Psychology; Sheldon Brown – Visual Arts, Erik Viirre - Neuroscience, Dick Moore - Music]; San Diego State University [Ralph-Axel Mueller, Bob McGivern, Dieter Hillert, and David Hubbard - Psychology]; Alliance University [Alan Lincoln and Donald Viglione - Psychology]; University of California, Los Angeles [William Horan - Psychiatry]; University of Milan, Italy [Piero Porcelli, Laura Parolin]; and University of Colorado, Boulder [Anu Sharma - Speech, Language and Hearing Science]. All these are active collaborations that involve postdoctoral, graduate and undergraduate students.

Funding.

Current

1T34GM087193-01 UCSD Marc Program	NIGMS	$2,335,793	2009-2014	PI
AR09335 Improving Synchronization and Functional Connectivity in Autism Spectrum Disorders through Plasticity-	DOD-CDMRP	$490,233	2009-2011	PI

Induced Rehabilitation Training				
Past				
Noradrenergic Involvement in Reallocation of Attention	NIMH	$400,000	1996-2000	PI
Neurocognitive Etiology of Addiction	NIDA	$400,000	1998-2001	PI
Treatment of Tinnitus with SSRI		$300,000	1999-2002	Co-Inv
Is Neurofeedback Training Helpful for Children Diagnosed with ASD	Autism Society of America	$2040	2007-2008	PI
Effectiveness of Neurofeedback Training on Autism Spectrum Disorders	Autism Speaks	$27,500	2006-2008	PI
UCSD Senate Grants				
1. Monoaminergic Modulation of Cortical Information Processing	UCSD	$3,500	1989-1990	PI
2. Face Perception in Humans and Nonhuman Primates	UCSD	$6,000	1992-1993	PI
3. Human and Monkey N400-like Responses to Digitized Faces in a Priming Paradigm	UCSD	$12,000	1993-1995	PI
4. Electrophysiological Indices of Attention in Humans and Monkeys	UCSD	$6,000	1995-1996	PI
5. The Electrophysiology of Tinnitus	UCSD	$25,000	2001-2002	PI
6. Connectivity-guided Plasticity-induced Rehabilition Training (PIRT) for Autism Spectrum Disorders	UCSD	$10,000	2010-2011	PI
Pending				
An Integrated qEEG-guided in-home intervention for Autism Spectrum Disorder	NIMH	$1,109,133.00	7/01/12-6/30/17	PI
Social skills in ASD: Enhancing Neurofeedback by intranasal Oxytocin inhalation	NIH	$330,502	7/1/11-6/30/13	PI

Future Research Directions

The success in identifying a putative electrophysiological index of mirror neuron activity (i.e., mu rhythm suppression) has generated a substantial amount of interest in the field in using such an index to address a variety of issues in a non-invasive way and to study a variety of conditions, including the ontogeny of mirroring in children and the efficacy of neurofeedback in conjunction with pharmacological interventions. These are clearly some of the directions of future work at CNL that may in fact temporarily supersede other areas.

To that extent Dr. Pineda has completed a grant in collaboration with Dr. David Feifel, Department of Psychiatry at UCSD to test the hypothesis that the neuropeptide oxytocin (OXT) contributes to MNS activity and that if administered intranasally in conjunction with QEEG-guided neurofeedback can improve the speed and efficacy of such intervention. He has started and is continuing a collaborative study with Drs. Kristin Cadenhead and Fiza Singh also in the Psychiatry Department examining mu rhythm characteristics in prodromal and schizophrenic populations. A pilot study that measured EEG activity in response to movement was successfully completed and published so we are now considering using a neurofeedback intervention to see whether it can significantly affect cognitive outcomes. Similarly, he has an ongoing collaboration with Dr. Bob McGivern, of SDSU to examine gender differences in spatial navigation using this index of mirroring activity. The question is whether simulation-based mechanisms, such as the mirror neuron system affect or induce gender differences in cognition. An initial study indicated that such differences reflect how males and females embody information or simulate movement in space differently. A third line of work has been started with Dr. Anu Sharma of the University of Colorado, Boulder examining auditory mirror neuron activity, its characteristics, and its integration with visual signals. Work with long-time collaborators, e.g., Drs Erik Viirre and Dick Moore on the neurophysiology of tinnitus, has been successful and will be a continuing direction of research. More recently Dr. Pineda has begun a collaborative effort with Dr. Dieter Hillert, Psychology Department at SDSU, to examine the role of mirroring in language and specifically whether simulation and embodiment plays a role in recognizing concrete versus abstract ironic statements.

Academic Genealogy

Dr. Pineda's Ph.D. thesis advisors were Dr. Helen J. Neville and Dr. Stephen L. Foote.
http://www.neuro.uoregon.edu/ionmain/htdocs/faculty/neville.html
http://bdl.uoregon.edu/


Dr. Helen J. Neville


Dr. Stephen L. Foote