Florida Atlantic University

Academic Program Review

Self-Study Report

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A. MISSION AND PURPOSE OF THE PROGRAM 3

B. PREVIOUS EXTERNAL REVIEW (SPRING AND FALL 2005) 4

C. INSTRUCTION 5

Establishment of Student Learning Outcomes (SLOs) 6
Assessment of SLOs and Program Improvement 6
Baccalaureate Programs 7
Graduate Programs 7
Faculty 15

D. RESEARCH 19

Review of part II of the department dashboard indicators 19
Interdisciplinary efforts and community engagement efforts: 21
Establishment of goals for research: 22
Assessment of how well goals are being met 24

E. SERVICE/COMMUNITY ENGAGEMENT FOR DEPARTMENT/SCHOOL 24

Community engagement: 24
Review of part III of the departmental dashboard indicators for Department/School 26
Establishment of goals for service 26
Assessment of how well goals are being met 27

F. OTHER PROGRAM GOALS FOR SCHOOL OR COLLEGE 27

Describe and assess how well goals are being met 27

G. STRENGTHS AND OPPORTUNITIES THAT SUPPORT ACHIEVEMENT OF PROGRAM GOALS FOR SCHOOL OR COLLEGE 28

H. WEAKNESSES AND THREATS THAT IMPEDE PROGRAM PROGRESS FOR CENTER 28

I. RESOURCE ANALYSIS FOR CENTER 29

Infrastructure (including Support Staff) 29
Research and Education Personnel 30
Budget for Research Efforts 31

J. FUTURE DIRECTIONS FOR CENTER 31

K. STUDENT FEEDBACK 32

Graduate Student Questionnaire 32
Undergraduate Research Experiences 35

APPENDIX A, BROAD INTERDISCIPLINARY AND GEOGRAPHICAL OUTCOME OF CENTER ALUMNI 36

APPENDIX B: LIST OF PUBLICATIONS FOR THE LAST 5 YEARS 40

APPENDIX C: ANALYSIS OF CENTER LEADERSHIP IN FAU'S NEUROSCIENCE 48

APPENDIX D: PROPOSED CURRICULUM FOR INTERDISCIPLINARY UNDERGRADUATE PROGRAM IN COMPLEX SYSTEMS 49

APPENDIX E: CENTER FACULTY BIOSKETCHES 50

A. Mission and Purpose of the Program

The Center for Complex Systems and Brain Sciences at FAU seeks to serve the University, professional communities, and local surrounding community with instructional, research, and extracurricular activities that enhance the understanding and appreciation of all issues related to the complexity of the human brain, mind, and behavior. The Center is unique at FAU in maintaining a research-oriented Ph.D. program that enhances the academic atmosphere of the university, and promotes the awarding of much-needed research funding. The Center is also unique internationally as one of the only programs in the world that is solely dedicated to promoting the study and exposition of the brain as a complex, spatiotemporal dynamical system.

We propose to attain the goals of the Center by hiring junior tenure-track faculty in the areas of expertise that comprise Complex Systems and Brain Sciences. It is expected that the new faculty members will enhance the quality of research and teaching in the Center, in various Departments within the College of Science and at FAU. They are also expected to provide significant liaisons to the new Marcus Neuroscience Institute at Boca Raton Regional Hospital (BRRH), and contribute to ongoing efforts to elevate the status of FAU as a research institution. Finally, they will support a new interdisciplinary undergraduate program in Complex Systems, a new educational opportunity that we aim to develop in the next 5 years.

		Core tenure Faculty	Core research Faculty	Associate Faculty	Graduate student employment	Technical support
Janet Blanks Director	J. A. Scott Kelso Eminent Scholar	Steven Bressler Psychology	E. Tognoli	Elan Barenholtz Psychology	~14 Teaching & Research Assistants	William Mc Lean Engineer
Keyla Thamsten Administrative Coordinator		Armin Fuchs Physics		Brenda Claiborne Biology		X Computer/Media/IT
Rhona Frankel Program Assistant		Robert Vertes Psychology		Howard Hock Psychology		
				Sammy Hong Psychology		
				Robert Levy MNI - BRRH		
Gary Perry (administrative leave)				Howard Prentice Biomed		
				Wen Shen Biomed		
				Fred Steinberg UMRI		
				Robert Stackman Psychology		
				Jian Yen Wu Biomed		
				Abhijit Pandya (medical leave)		

Table 1: Members of Center for Complex Systems and Brain Sciences (CCSBS)

Members of CCSBS include Administrators: Dr. Blanks, Director, assisted by Ms. Thamsten the Administrative Coordinator and Ms. Frankel, Program Assistant (reduced to 50% effort in 2009); Dr. Scott Kelso, Eminent Scholar and Founding Director of CCSBS (1985-2004). Core members of the CCSBS faculty have been reduced to Drs. Bressler and Vertes (Professors in Dept. of Psychology) and Dr. Fuchs (Associate Professor, Dept. of Physics), and on the research track, Dr. Tognoli (Associate Research Professor). A search is underway for an Assistant/Associate Professor in the field of Cognitive Neuroscience to replace Dr. Ed Large who recently left to join the Dept. of Psychology at University of Connecticut. During the 90's and 00's, CCSBS received solid support by the University, with 12 tenure-track faculty (and frequent visiting professors), approximately 20 research fellows and post-docs and over 25 graduate students, complemented with a cutting-edge technical staff (computer/network support and electronic engineer support) that led innovation in computational and experimental infrastructure (e.g. first VAX computer in the entire State of Florida; early engagement -1995- in supercomputing facility at FAU with NSF support), and greatly facilitated breakthrough research and research training. Unfortunately, policy changes and the dire state of the economy lead to decreased funding at the Federal and State level such that when faculty left for other positions, they were not replaced. At the recommendation of the last External Review Committee (2007), CCSBS has attracted neuroscientists from other parts of the campus to join CCSBS as "Associate" faculty: (Drs. Barenholtz, Hong, and Stackman from Dept. of Psychology, Drs. Prentice, Shen and Wu from the Dept. of Biomedicine in College of Medicine (COM) and Dr. Pandya from the College of Engineering (COE), currently on medical leave. Dr. Claiborne, former Provost, now Professor of Biology located on the Jupiter campus is also an Associate member of the Center. In summary, the Center provides an administrative structure that brings the faculty from different departments together to establish interactions that lead to collaborative proposals and, hopefully in the future, program project grants. Collaborative interaction in the Center provides a scientific strength that transcends the typical committee structures used to administer Ph.D. programs.

Additionally, two community physicians are Affiliate Full Professors in CCSBS: Dr. Robert Levy, a neurosurgeon and Director of the newly formed Marcus Neuroscience Center at Boca Raton Regional Hospital (BRRH) located across the street from FAU) and Dr. Fred Steinberg, neuroradiologist and Director of University MRI (located on the FAU campus in University Park (where private companies, including some start-ups, are located). Currently, 14 graduate students from CCSBS are employed as Teaching Assistants. Unfortunately, CCSBS has only one post-doc remaining (during the 90's-00's there were approximately 12 post-docs at any given time). Engineering (William McLean) and computer support was reduced in 2009 and now neither of these positions are filled due to lack of funds.

B. Previous External Review (Spring and Fall 2005)

Dr. Péter Érdi, Henry R. Luce Professor, Center for Complex Studies, Kalamazoo College, MI

Dr. Thomas Haines, Professor of Chemistry and Biochemistry, City University of New York, New York, NY

Dr. Stephen H. Koslow, Allen Institute for Brain Science, Seattle WA, formerly at NIMH, NIH

Dr. Nicholas Tsinoremas, Head & Director, Bioinformatics, Scripps Research Inst. Florida, Jupiter FL

Dr. John R. Wiesenfeld, Schmidt Senior Faculty Fellow and former Dean, Charles E. Schmidt College of Science, Florida Atlantic University

Note: CCSBS had an External Review in Spring 2005 with positive response of the panel to the implementation of their suggestions as noted during the second visit in Fall 2005. CCSBS also participated in the campus-wide program review in 2009.

Summary of findings - 2005 review:

Research Program: *"The Center should reinvent itself as the organizing structure of an interdisciplinary neuroscience program consisting of molecular, genetics, cellular, behavioral, computational and other scientists with fields of relevance to neuroscience from the Departments of Biology, Biomedical Science, Chemistry, Mathematics, Physics, Psychology, other Centers, Departments from the College of Engineering and other Departments that become relevant. Relevant current faculty from these departments might be granted full participation in the Center. It will be of great value to FAU since it will provide a scientific strength that would transcend the typical committee structures used to administer Ph.D. programs.*

Academic Programs: That the State has authorized a Ph.D. program entitled "Complex Systems and Brain Sciences" is of great value to FAU as well as to the Center. It has provided the Center with a reputation and an authority in the field that has placed it on the radar screen of persons working in fields related to the work within the Center. It is also an opportunity for growth within the Center."

"A. All parties agreed that the Center and its focus on computational neuroscience must be continued and expanded. The most appropriate way to integrate the Center with FAU would be to make it the base for an FAU Program in Neuroscience. We recognize that there are important, strong and critical contributions that can be made to this program from faculty in other FAU Departments. The Center for Complex Systems and Brain Sciences is the most appropriate structure for this program since the success of neuroscience will depend in the future on the integration of knowledge using computational approaches.

B. The committee recognized that the university has many goals and severe budgetary constraints and may have to postpone a national search for a new Director. If this turns out to be the case we recommend that a Director be appointed at this time as soon as possible.

C. We also recommend that a creative plan be drawn up by the Center and the Dean and presented to the Provost for implementation of the development of a new, interdisciplinary FAU Program in Neuroscience."

C. Instruction

Summary: The Center for Complex Systems and Brain Sciences is home to a small PhD program, whose alumni have evidenced spectacular upward academic mobility, landing Faculty positions in the best US Universities (Harvard Medical School, Brown, University of Michigan, University of Pennsylvania, Drexel University, UCSF etc., and in major universities in France, Germany, Poland, Sweden New Zealand, India, and Japan), leadership positions worldwide in academia, industry and government (Appendix A).

Highlights:

- Attracts highly qualified students
- Student attendance at conference, workshops, summer schools
- Student leadership: journal club, Neuroscience outreach, Brain Awareness Week, Access Project
- Student success in the (highly competitive) job market, science competitions, awards

Establishment of Student Learning Outcomes (SLOs)

The Center for Complex Systems and Brain Sciences offers a Ph.D. degree that encompasses diverse areas of study. The areas of study are organized around a unifying framework that is both timely and exciting, namely that the concepts, methods and tools of complex, dynamical systems will provide major breakthroughs and powerful insights into the workings of the human brain, the most complex organ in the known universe. that the mathematical and computational tools of nonlinear dynamics will provide major breakthroughs in the understanding of mind, brain and behavior. Students acquire research skills in specific experimental systems in the brain and behavioral sciences while developing theoretical concepts, computational methods and tools within a specially tailored graduate program.

Assessment of SLOs and Program Improvement

Assessment of SLOs in the Ph.D. Program in Complex Systems & Brain Sciences is performed using four outcomes:

1. Those students who successfully obtain the doctorate can apply the scientific method, including use of an appropriate experimental design, relevant data analysis and statistical techniques, as well and modeling and computational tools, to a novel problem in their field, and communicate their finding in writing. A mixture of relevant electives and research builds up a knowledge base, finally leading to the write-up and successful defense of a Ph.D. thesis. Faculty members encourage students to attend conferences and support participation through university and grant funds. The ability of students to complete scientific work is evaluated by a point system that monitors the students' oral and written communication skills when presenting their research. Each publication of an article in a journal counts as two units and each meeting presentation as one unit. We expect that 75% of CCSBS students will have achieved at least 1 unit by their 3rd year in the program and 3 units at the time of their defense. Student progress is documented in the annual student evaluation form.

2. Graduates will be well prepared and hence competitive for research and/or teaching positions in their field. Students have access to state of the art technical equipment (EEG, computational facilities and formerly, fMRI) and are encouraged and supported by faculty to interact with leading scientists in their fields. Job statistics are evaluated by the percentage of graduates obtaining positions in the field and in other professional areas and the quality of those positions.

3. Doctoral graduates will have the ability to communicate orally scientific methods, findings and their importance. Students present their work at conferences like the annual meeting of the Society for Neuroscience, the Annual Charles E. Schmidt College of Science Research Day and in seminars at the Center (e.g. Journal Club, a lecture series run by the students under the supervision of a faculty member). Students are encouraged to participate in appropriate academic and social activities. Where possible, presentations are supervised and evaluated by the faculty advisor who also reviews a draft of the poster and provides feedback on the poster presentation. Success of the presentation is evaluated and documented in a standardized evaluation sheet as "Outstanding", "Good", "Acceptable", "Poor" and "Unacceptable" for the criteria: Content - Organization - Delivery - Visual Aids.

4. Those students who successfully obtain the doctorate have a profound knowledge in the disciplines relevant for advanced research in Complex Systems and Brain Sciences. During their first year in the program, students should complete the core courses, identify a faculty advisor and start a guided research project. Declarative knowledge in the Center's Ph.D. program is assessed in the two core courses Neuroscience I and II, and Introduction to Nonlinear Dynamics and Chaos. As these are very different topics areas, in which most of our incoming students have a background in one of them but not both, they form a ideal basis for monitoring student progress during their first year in the program.

Baccalaureate Programs

Not Applicable

Graduate Programs

i. Limited access:

Not Applicable

ii. Admissions criteria

In addition to meeting all of the University and College requirements for admission to graduate study, applicants for the Doctor of Philosophy (Ph.D.) degree must meet each of the following criteria:

1. The student must have a baccalaureate degree from an accredited college or university or foreign equivalent;
2. The student must have a quantitative score of 155 or higher on the Graduate Record Examination or foreign equivalent;
3. The student must have a minimum 3.0 average in the last 60 credits of undergraduate work or foreign equivalent; and
4. The student must be approved for admission to the program by the faculty of the Center for Complex Systems and Brain Sciences.

iii. Enrollment information

During the past seven years the number of students in the Ph.D. program decreased from 20 during the academic year 2007-08 to 14 in 2013-14 (see Table 2 below). The main reason for the decline was limited number of TA slots. Last year our enrollment suffered a setback when Professor Ed Large left the Center for a position in the Psychology Department at the University of Connecticut (U Conn). His three graduate students followed him and joined the doctoral program at U Conn.

Gender	Semester				
	Fall, 2010	Fall, 2011	Fall, 2012	Fall, 2013	Fall, 2014
Female	6	5	6	6	6
Male	8	8	9	8	7
Total	14	13	15	14	13

Table 2. Number and Gender of students matriculating in CCSBS graduate program 2010 through Fall 2014

iv. Average class size and faculty/student ratio:

During the academic years from 2007-08 to 2013-14, the Center offered an average of 12 graduate lecture/seminar courses with an average enrollment of about 7 students, and roughly 40 other course-type sessions such as directed independent study (DIS). DIS typically enrolls one student per project, and delivers a highly personalized, mentorship-intensive research experience that has proven critical to prepare the future worldwide leaders of academics and industry that our program has delivered (Appendix A). Each member of the Center's core faculty mentors about two Ph.D. students, with about two-three per year graduating with a Ph.D. in Complex Systems and Brain Sciences. The average time to graduation is about 5.5 years. The quality of the instruction evaluated by students using the SPOT form is similar to the average in the College of Science, and in the University in general, for small graduate courses with average ratings around 1.7 and 2.0 (on a 5–point scale, with 1.0 being the highest) on the quality of instruction (item 20) and instructor (item 21), respectively.

				Complex Systems			College Total	University Total
				2010-2011	2011-2012	2012-2013	2012-2013	2012-2013
Course Level	Type					2	692	5,154
Graduate	Lecture/Seminar	Sections Offered	#	11	14	14	167	1,575
			# Enrolled	74	86	96	1,386	22,406
			Avg Section Enrollment	6.7	6.1	6.9	8.3	14.2
		Sections Faculty-Taught	#	11	14	14	158	1,318
			%	100.0	100.0	100.0	94.6	83.7
	Other Course Types	Sections Offered	#	37	21	42	756	1,951
			# Enrolled	38	30	62	1,080	4,840
			Avg Section Enrollment	1.0	1.4	1.5	1.4	2.5
		Sections Faculty-Taught	#	35	20	40	703	1,831
			%	94.6	95.2	95.2	93.0	93.8

Table 3: Average Class Size and Faculty/Student Ratio

v. Curriculum

The aim of this program is to create a new kind of brain scientist who will be both biologically and mathematically literate who will introduce new ways of thinking to neuroscience. The courses are research oriented and consist of a core curriculum in neuroscience (including computational and cognitive neuroscience), the mathematical concepts and tools of nonlinear dynamical systems, and computational science. In contrast to many similar programs developed in the wake of

our own PhD program in Complex Systems and Brain Sciences, emphasis is not placed on either experimental or computational skills, but on a careful balance between the two.

Core Courses: Neuroscience I and II, Introduction to Dynamical Systems, Cognitive Neuroscience, Methods in Complex Systems (or Psychology "PSY" statistics course)

-Electives (minimum 5), Directed Independent Study, Dissertation (minimum 12)

-Total of 80 credits, grade "B" or better

Additionally, in the second year, a research paper is required for admission to candidacy, and in the third year, the student submits a Plan of Study (Form 5) and forms a Ph.D. committee.

vi. Internships, practicum, study abroad, field experiences

Dr. Silke Dodel was the organizer and program leader of the six-weeks Study Abroad Program "Methods in Brain Computer Interfaces" in Tubingen, Germany, in collaboration with Dr. Niels Birbaumer (Head of the Institute for Medical Psychology and Behavioural Neurobiology, University of Tubingen) and his group. This program was offered as a Summer class in 2011, 2012 and 2013. Students from the Center graduate program attended as well as graduate and undergraduate students from FIU, FAU, CFU and CSU.

Many internship opportunities to high school, undergraduate and graduate students (from other departments at FAU and beyond) participate in paid and unpaid research lab experiences. Students were also involved in 3 locally organized conferences: 2007, Coordination Dynamics; 2010: Neurocognitive Networks; 2010: Brain Coordination Dynamics, a Conference at Sea, and other various lecture series, and mini-symposia.

vii. Pedagogy/pedagogical innovations

The Center's PhD program was innovative from its inception. It is based on the notion that the field of neuroscience needs to extend its traditional borders to embrace new technical, conceptual, and empirical developments, thereby creating opportunities for a new breed of brain scientist to evolve.

The Center designed a Certificate program in Neuroscience administered by the Director, Dr. Janet Blanks. Approximately 50 graduate students have taken advantage of this program in the 6 years it has been in place. As part of the requirements for the Neuroscience certificate, the Center started the only Neuroscience seminar series on campus six years ago and now it is one of the recognized seminar series attracting an audience of 30-40 students and faculty from the Center, Psychology, Biology, Chemistry plus the Colleges of Medicine, Nursing and Engineering. The seminar was jointly organized with the Max Planck Florida Institute for several semesters. Last year with the move of a group of cellular and molecular neurobiologists to the Jupiter campus, we have joined with them to offer some of the lectures in Jupiter, as well as on the Boca campus with videolinks between the two campuses plus the FAU campus in Davie.

Dr. Blanks started a new graduate course on Traumatic Brain Injury (TBI) now in its 5th year. Traumatic Brain Injury, and associated efforts to repair brain function are important and strategic issues for the state of Florida and Nationwide, both because of Veterans from Iraq and Afghanistan, sports injuries, e.g. in college football. and because of

the aging population. The majority of Center students have taken the course as well as other students from College of Nursing, College of Medicine (from their new Masters program), plus the following departments: Anthropology, Biology, and Psychology. Also, two foreign exchange students – one a medical doctor from Poland and the other a 2nd year medical student from Brazil, took the class. The class is unique since the first four class periods involve human neuroanatomy laboratories. The students meet in the Gross Anatomy Laboratory, next door in the COM. These four, 3-hour lab sessions allow the students to study surface anatomy as well as sagittal and coronal sections of human brains. Dr. Rainald Schmidt-Kastner, Associate Professor in the Clinical Department at COM, co-teaches the Neuroanatomy section with Dr. Blanks. In addition, local professionals present lectures on Diagnosis and Treatment of TBI, Use of Neuroimaging to Diagnose and Treat TBI, Psychological Issues Following TBI, Mechanism of Cell Death in the Brain, New Discoveries in Pathophysiology and Treatment of TBI, and Neurogenesis for Repair of Brain Injury. A high-light of the course is a guest speaker from the Center for Injury Biomechanics at Virginia Tech-Wake Forest University discussing the "Cumulative Effects of Head Impacts from Football at the High School Level". The final session is a "field trip" to Pinecrest Rehabilitation Center in neighboring Delray Beach to see how TBI patients are treated with physical therapy and occupational therapy, as well as psychological counseling.

Dr. Robert Vertes designed a new course entitled "Structure, Function and Disorders of the Central Nervous System" which provides a foundation in understanding the structure and function of the nervous system with an emphasis on disorders of the nervous system. The course provides a brief overview of neuronal function including membrane and action potential, neuromuscular junction, and synaptic signaling as it relates to various diseases resulting from defects in ion channels (or channelopathies). The remainder of the course is devoted to a consideration of CNS disorders from a clinical neuroanatomical perspective. CNS disorders discussed include: affective disorders (anxiety, depression, schizophrenia), autism, Parkinson's disease, Alzheimer's disease, epilepsy, sleep disorders, altered states of consciousness (e.g., coma, vegetative states), sensory/motor dysfunctions, and pain syndromes.

viii. Comparison to SUS and Peer Programs

CCSBS is unique among our peer institutions in the SUS (Florida A & M, Florida Gulf Coast College and Florida International University) since we are the only university with a long history of publications in brain imaging and with a long-standing doctoral program in Neuroscience. Florida A&M only offers a Ph.D. in Biomedical Engineering. Florida Gulf Coast does not award doctoral degrees. FIU awards a Ph.D. in the School of Integrative Science, and Humanity, their home for biomedical, behavioral, and cognitive neuroscience. Numbers of degrees awarded were unavailable on their website. FIU has just initiated a Cognitive Neuroscience & Imaging Center where researchers are analyzing brain development, brain function and the neurological basis of behavior.

Among aspirational peers, George Mason University (Washington, DC) offers a Ph.D. program in Neuroscience (behavioral, anatomical, and molecular neuroscience; and theoretical, computational, and physiological neuroscience) and another doctorate in Cognitive and Behavioral Neuroscience. The latter program focuses on translational neuroscience-complementary study of neural systems in humans and animals, including application of animal research to human behavior. This program is quite different from ours since CCSBS does not concentrate on animal research nor molecular biology of the nervous system.

Among aspirational peers, the University of Michigan (Ann Arbor) has the Center for the Study of Complex Systems which is a broadly interdisciplinary program in the College of Literature, Science and the Arts. While the mission of this Center encompasses research and education in the general area of nonlinear, dynamical and adaptive systems, they offer a Certificate but not a Ph.D. in this discipline. Students receive their Ph.D. from other departments within the University.

Brandeis University (Waltham, MA) is another aspirational peer with the Volen national Center for Complex Systems which opened in 1994. The Center, composed of 24 Neuroscience faculty located in four departments (Biology, Biochemistry, Psychology, and Chemistry) "houses" the Neuroscience Program at Brandeis. Doctoral students have opportunities to work in a range of fields, including cognitive neuroscience in humans, neurophysiology in behaving animals, the physiology and theory of synapses and networks, the structure and function of ion channels, and the neurogenetics of behavior. There are approximately 45 graduate students in this excellent program.

In summary, CCSBS at FAU was the first NIMH supported National Training Program and the first to offer a Doctoral Degree in Complex Systems and Brain Sciences. We believe that three things are needed to build on our success: 1) to invest in new junior faculty hires, especially in quantitative areas; b) to create much needed infrastructure to support the program, especially for human brain imaging research; and c) to initiate a new undergraduate program in complex systems which can serve as a 'feeder' for our PhD doctoral program.

ix. Scope of institutional contributions

The Neuroscience seminar has re-invigorated neuroscience at FAU since it is the only weekly seminar series attended by graduate students and faculty from the COS, COM and COE and College of Nursing plus College of Arts and Letters. The mixture of students and faculty from so many different disciplines results in a unique synergy. The interdisciplinary nature of the Neuroscience seminars is evidenced by the topics presented: learning and memory, addiction, deep brain stimulation, perception, brain-machine interface, to name a few. The seminar speakers are both local (FIU, University of Miami, Scripps Research Institute in Florida, Max Planck Florida Institute plus University of Florida, UCF and FAU) and from the East Coast (MIT, NYU, Columbia, Rockefeller, UNC, Duke, U Penn, Wayne State and Emory). An added feature is that the majority of the speakers meet for 30 minutes with CSSBS students in an informal setting allowing students to ask questions about research or obtain career advice. This unique experience allows our students to begin "networking" early in their career. Several CCSBS students have identified members of their thesis committee from the invited speakers.

The seminar series also attracts members from the public since once they attend a seminar they usually ask to be included on our mailing list to attend future seminars

Neuroscience I and II are Center courses taught by our faculty that attract a large number of graduate students from other programs such as Anthropology, Biology, Experimental Psychology, Integrative Biology, IBAN, Masters in Biomedicine (COM). And Biomedical Engineering (COE)

x. Student profile

CCSBS students come from universities such as University of Pennsylvania, University of Wisconsin, Notre Dame, MIT, the University of California system, Yale and many others. Many international students have matriculated in our Ph.D. program with students from Germany, Poland, Turkey, Columbia, India, Japan and Korea. The ethnicity and sex of current graduate students follows, and the chart below indicates year 2011-2013.

2 Caucasian Females

5 Caucasian Males

1 Latino Female

1 Afro-American Female

2 Asian Females

1 Asian Male

Majors Enrolled (Annual Headcount) By Gender and Ethnicity Complex Systems (Program CIP: 421101)			Complex Systems		College Total	University Total
			2011-2012	2012-2013	2012-2013	2012-2013
Graduate	American Indian/Alaskan Native	Female			2	11
		Male				8
		Total			2	19
	Asian or Pacific Islander	Female		1	14	155
		Male			13	119
		Total		1	27	274
	Black (Not of Hispanic Origin)	Female	2	2	10	624
		Male	1	1	20	265
		Total	3	3	30	889
	Hispanic	Female			27	495
		Male	1	1	25	318
		Total	1	1	52	813
	White (Not of Hispanic Origin)	Female	2	2	158	1,926
		Male	6	6	143	1,233
		Total	8	8	301	3,159
	Non-Resident Alien	Female	1		38	177

Majors Enrolled (Annual Headcount) By Gender and Ethnicity Complex Systems (Program CIP: 421101)			Complex Systems		College Total	University Total
			2011-2012	2012-2013	2012-2013	2012-2013
		Male	1	1	53	200
		Total	2	1	91	377
	Not Reported	Female	1	1	4	41
		Male				30
		Total	1	1	4	71
	Total	Female	6	6	253	3,429
		Male	9	9	254	2,173
		Total	15	15	507	5,602

Table 4: student profile

xi. Advising procedures

As part of the application to the Center's doctoral program, the student must identify and communicate in advance with a member of the Center faculty. If the student is admitted, the Mentor advises the student on the courses to be taken plus possible Committee members for their Thesis Committee. At the end of the academic year, each Mentor is required to summarize the progress of each of their students. This evaluation is shared with the student and reviewed by the entire faculty at a special meeting devoted to review of all graduate students.

xii. Licensure rates (if applicable)

Not applicable

xiii. Placement rates/employment profile

An inventory of the placement of Center graduates in Appendix A demonstrates the unique niche the Center occupies both nationally and internationally. (Note: two of the former Center graduates help run the Core Imaging Facility at the National Institute of Mental Health (NIMH) in Bethesda, MD). Despite the past success of the Center, the Faculty is concerned that the Center must be allowed to replace recent faculty who have left to take administrative/research positions at NSF, CNRS, U Conn., etc. It is essential that these faculty are replaced with tenure-track appointments in Computational or Theoretical Neuroscience, Cognitive Neuroscience and/or Social Neuroscience in order to provide a "state-of-the-art" education for CCSBS doctoral students.

xiv. Retention rates

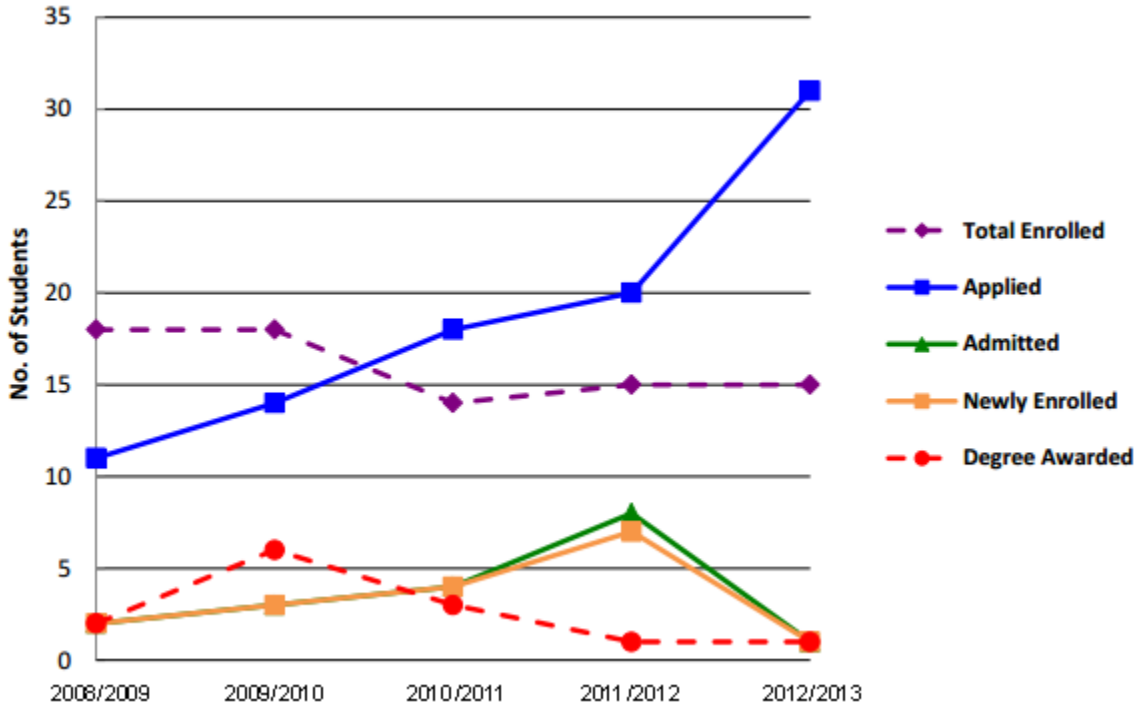

Figure 1: statistics on students' application, enrollment, admission and degree completion for 2008-2009 (yr1) to 2012-2013 (yr5).

Good retention rates can be assessed from the closeness of graduation rate (red dash) and admission (solid green) in Figure 1.

xv. Graduation rates

	2007/08	2008/09	2009/10	20010/11	2011/12	2012/13	2013/14
Students in program	20	19	18	17	15	15	15
Students graduating	3	2	5	4	2	1	2

Table 5: Graduation rate (time period refers to the date of PhD defense, may slightly differ from the date of University Graduation).

We are concerned that our graduation rate is declining partly because we have had a couple of years of no admittance of students because of the lack of funding for TAs. There is a need for us to become more competitive in order to attract more highly qualified students. We need more federal funding for RAs as well as University funds for TAs.

xvi. Student recruitment:

The Center has received between $600 to $2000/year over the past 7 years from the Graduate College to aid in our recruitment process. When possible, the Center used the funds to bring students in for interviews with all faculty members. The past 2 years, due tobudgetary issues, we have had Skype interviews with students out of state as well from abroad. This has worked surprising well and we feel that it is a good "2nd choice" for the interview process.

Our recruitment efforts face the challenge of uncompetitive student stipends, which are several thousand dollars below the national average, although the international reputation of our Faculty somewhat mitigates this drawback. We have also received a Provost scholarship (from $1,000 to $2,000) to use as a "one time" enticement for recruiting students for the past 4 out of the 5 years that the awards were given from the Graduate College.

In the future, the Center will recruit students for the PhD program through announcements to online mailing lists such as *Connectionists* and *Comp-neuro,* as well as through social media such as twitter, an increasingly popular and effective method to communicate information to the target population. Students will also be attracted through international exchange programs that FAU has established, or will establish, with other universities. In the past, the Center has attracted students from many countries around the world. Some of these students were supported by funding from their countries of origin. The Center will also develop distant-learning hybrid courses that students can enroll in without ever leaving their home universities. Distant-learning hybrid courses will attract students from the South Florida area, from the entire state, from the nation, and from around the world.

Faculty

i. Administrative structure

Only Drs. Bressler, Fuchs and Vertes report directly to the Director of the Center. The other faculty listed in the Organizational Chart below have their primary appointments in other departments or colleges. This means that the Center only derives indirect cost recovery from a handful of faculty.

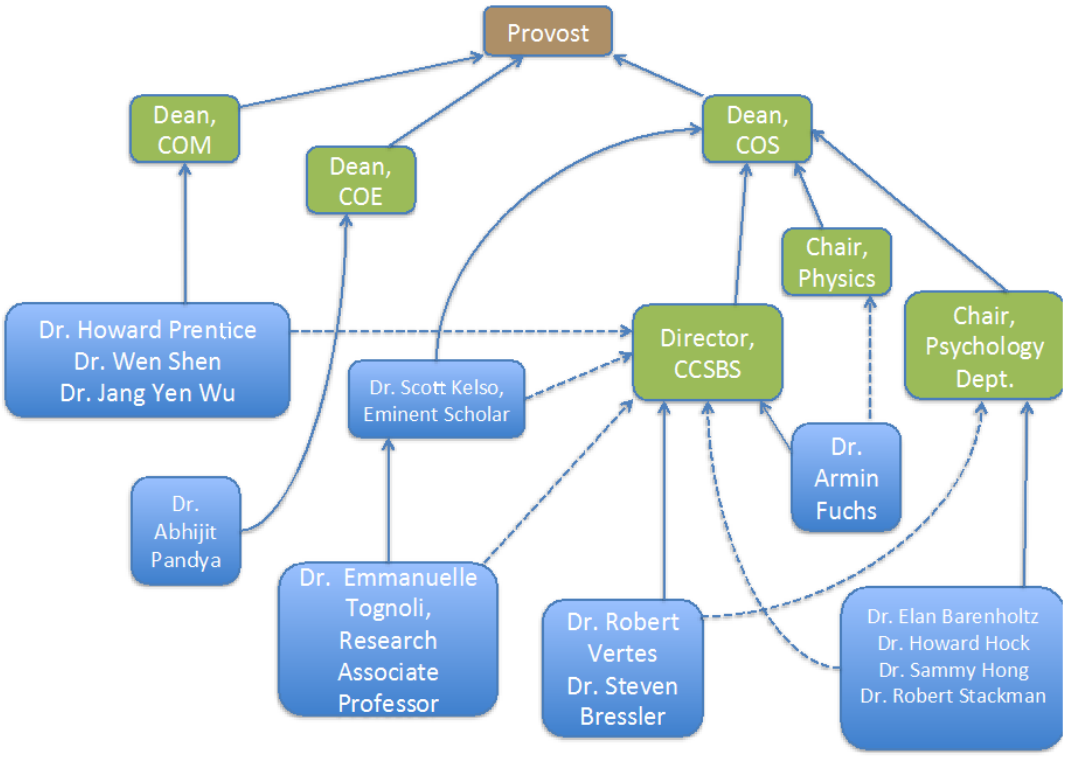

Figure 2: Administrative structure. (note: solid lines indicate "primary reporting", dashed lines indicate "secondary reporting")

ii. Faculty profile

As of November 2014, counting all Center faculty including 1 Research Associate Professor and 9 faculty whose primary appointment is in either the Psychology Department or the College of Medicine plus 5 faculty (including Drs. Kelso and Blanks) with primary appointments within the Center and affiliate from UMRI and the Marcus Neuroscience Institute, we have 9 Caucasian males, 2 Caucasian females, 3 Asian males and 1 Asian female.

iii. Faculty teaching load:

Faculty with primary appointments within the Center (Bressler, Fuchs, Large (left FAU last Summer) and Vertes) typically teach a "2 X 2" teaching load: they teach one course for the their Department of Tenure (sometimes this is an Undergraduate Course such as the "Biobasis of Behavior") and one Center course each semester. Faculty are able to "buy out" of one class per year but only if they have sufficient Federal grant money to pay for the "buy out." The two "special faculty" (Dr. Blanks, Director and Dr. Kelso, Eminent Scholar) teach a reduced load. Dr. Blanks directs the Neuroscience seminar series, as well as teaches her TBI course and co-directs Neuroscience 2, a graduate course with approximately 35 students. Dr Kelso teaches a graduate course on the concepts, methods and tools of Coordination Dynamics, a theoretical and empirical foundation for understanding complex biological systems at all levels. Coordination Dynamics is the overarching framework behind much of the research at CCSBS (see Figure 3).

iv. Summary of faculty research

Grant Funding: Our Faculty represents 1.5% of the total Faculty count at FAU, but according to the table below, it carries 12.6% of all sponsored research at FAU.

FUNDING COVERING PERIOD (2010-14)				
PI NAME	**AGENCY**	**TERM (years)**	**AMOUNT**	
BARENHOLTZ	NSF	3	$196,647	
*BLANKS	Shanghai Univ.	1.5	$15,500	
*	DoR	3	$500,000	
*BRESSLER	NIH-MSU	5	$525,000	
*	NIH-WaSL	5	$288,000	
*DEGUZMAN/KELSO/TOGNOLI	NSF	4	$748,776	
*KELSO	NIH	5	$1,631,796	
*KELSO/TOGNOLI	ONR	3	$660,000	
*KELSO/TOGNOLI	NIH	5	$1,966,784	
*LARGE	NSF	3	$410,128	
*	Seed Grant-Science	1	$8,000	
LEWKOWICZ	NSF	3	$386,999	
	NIH	5	$1,518,802	
SHEN	NSF	5	$416,467	
STACKMAN	NIH	5	$1,463,866	
	DoR-Researcher Year	1	$5,000	
*VERTES	NSF	3	$449,135	
*	NIH	3	$423,421	
WU/PRENTICE/SHEN	State FL-Challenge Grant	2	$748,046	
TOTAL			**$12,362,367**	**$3,155,470/yr**

** processed through the Center*

Table 6: grant covering the period 2010-2014

Publications:

PUBLICATIONS					
	2010	2011	2012	2013	2014
Articles/Chapters	33	33	37	30	33
Books		1	2	1	

Table 7: summary of publications

Please see Appendix B for details: The Faculty of FAU has published 166 articles, chapters and proceedings and 4 books (3 edited and 1 authored) over the past 5 years, with publications in prestigious journals such as Science, Nature Neuroscience, Proceedings of the National Academy of Sciences, Trends in Cognitive Sciences, Neuron and Progress in Neurobiology.

v. Strategic planning for hires

The Center currently is recruiting for a position of cognitive neuroscientist to replace Professor Ed Large who left over a year ago to assume a position at the University of Connecticut. Last year we were unsuccessful in filling this position but we are more optimistic this year since we are starting the Search process much earlier in the academic year.

Since the current Director is retiring, a request to hire a new director is being sent to the Provost for approval. Hopefully, we will be able to start recruiting for this position soon.

The Center needs to add more Faculty to meet the training needs of our current doctoral program and to design and execute a new undergraduate major in Complex Systems (see section G for a proposed Interdisciplinary Undergraduate degree in Complex Systems). Therefore, our strategic plan calls for the hiring of 6 new faculty in computational and cognitive neuroscience, biophysics, mathematics and complex systems within the next 5 years. The investment would be beneficial for both the University and the State, by initiating opportunities that would cut across a variety of programs from brain sciences, a current grand challenge nationally, to environment science, economy, health and/or social sciences; and by strengthening the local economy with the training of a highly qualified workforce in Complex Systems – the foundation of the 21st Century Knowledge Economy.

If the pedagogical mission of FAU is to prepare students for the future, it would seem that junior hires in Computational/Theoretical Neuroscience, Cognitive Neuroscience and Social Neuroscience are a necessity. Moreover, numerous opportunities exist for collaborative hires with other disciplines, (e.g. bioengineering and biotechnology, nursing, rehabilitation, brain-computer interfaces).

Were permission granted to pursue the above strategy, and were the appropriate publicity regarding FAU's level of commitment to Complex Systems & Brain Sciences generated, FAU (in conjunction with its partners) would be well positioned to seek the next generation of NIH or NSF or Human Frontiers or McDonnell Foundation Training Grants.

It is important that the Center work with the Dean of the College of Science to define a revenue stream for the Center. Even if the above hires are made in the near future, the Center is suffering from severely reduced University funding over the past 5 years. In the past, the Center was awarded a reasonable amount of indirect cost recovery, but more recently, the Division of Research is giving more to individual investigators and less to Centers and Departments, and this has limited the scope of educational experiences offered to some of our students (participation in conferences and summer schools outside funded research efforts).

The Center is eager to collaborate with scientists in departments within the COS and with other Colleges to form a Neuroscience Steering Committee to promote human neuroscience research on the Boca campus. This Committee would assist the Dean of COS and the Provost to facilitate campus-wide integration of human neuroscience research and education, with the end goal of alleviating diseases of the brain. Initially, the committee would craft an agreement with the newly formed Marcus Neuroscience Institute to enhance research partnerships. The agreement would also include provisions for educational opportunities so that FAU students could enhance their research training through research collaborations with the Institute.

Center faculty appear to be the largest contributor to Neuroscience at FAU (Appendix C) and we are poised to participate in important research themes for the future of the state of Florida: Healthy Aging since new course offerings in the Center emphasize Traumatic Brain Injury (Professor Blanks) and neurodegenerative diseases (Professor Vertes), health issues prevalent in the US, especially in the local aging population. Collaboration with the Marcus Neuroscience Institute will foster more research by Center faculty in important diseases of the brain, such as epilepsy, autism and Alzheimers' and Parkinson's disease, Traumatic Brain Injuries and Stroke, mood and personality disorders to cite a few.

vi. Abbreviated faculty CVs :

Please see NIH Biosketches in Appendix E

D. Research

Highlights:

- Intensive grant submission and awards.
- Intensive publication record, including half of FAU's Science and Nature publications, many in PNAS and other high impact journals (despite the small size of our Faculty!).
- Interdisciplinary research
- Maintains computational and research facility, mostly grant-supported
- Most of FAU's postdoctoral population, historically large research staff
- All PhD students are intensively immersed in research as core of their training experience, several participate in externally funded research, additional research experience for high school students, undergraduate, and postgraduate fellows.

Review of part II of the department dashboard indicators

The Center has an unusual circumstance since only two faculty members (Dr. Janet Blanks and the Eminent Scholar in Science, Dr. Scott Kelso) are listed under the Center for Complex Systems and Brain Sciences. Since the lines that original existed in the Center from about 10 years ago, were moved to the respective department, thus productivity of Research and Service within the Center is not reported separately. Our faculty are reported under the Department of Psychology (Drs. Bressler, Kelso, Vertes) or Physics (Dr. Fuchs). Consequently, in the Assessment Database, the Center only inputs data on the Ph.D. program and the Neuroscience Certificate program, but NOT research and service. Therefore, while part I of the DDIS regarding the students in the doctoral program, courses taught etc., are meaningful, there is no data uploaded for Part II or Part III of the DDIS.

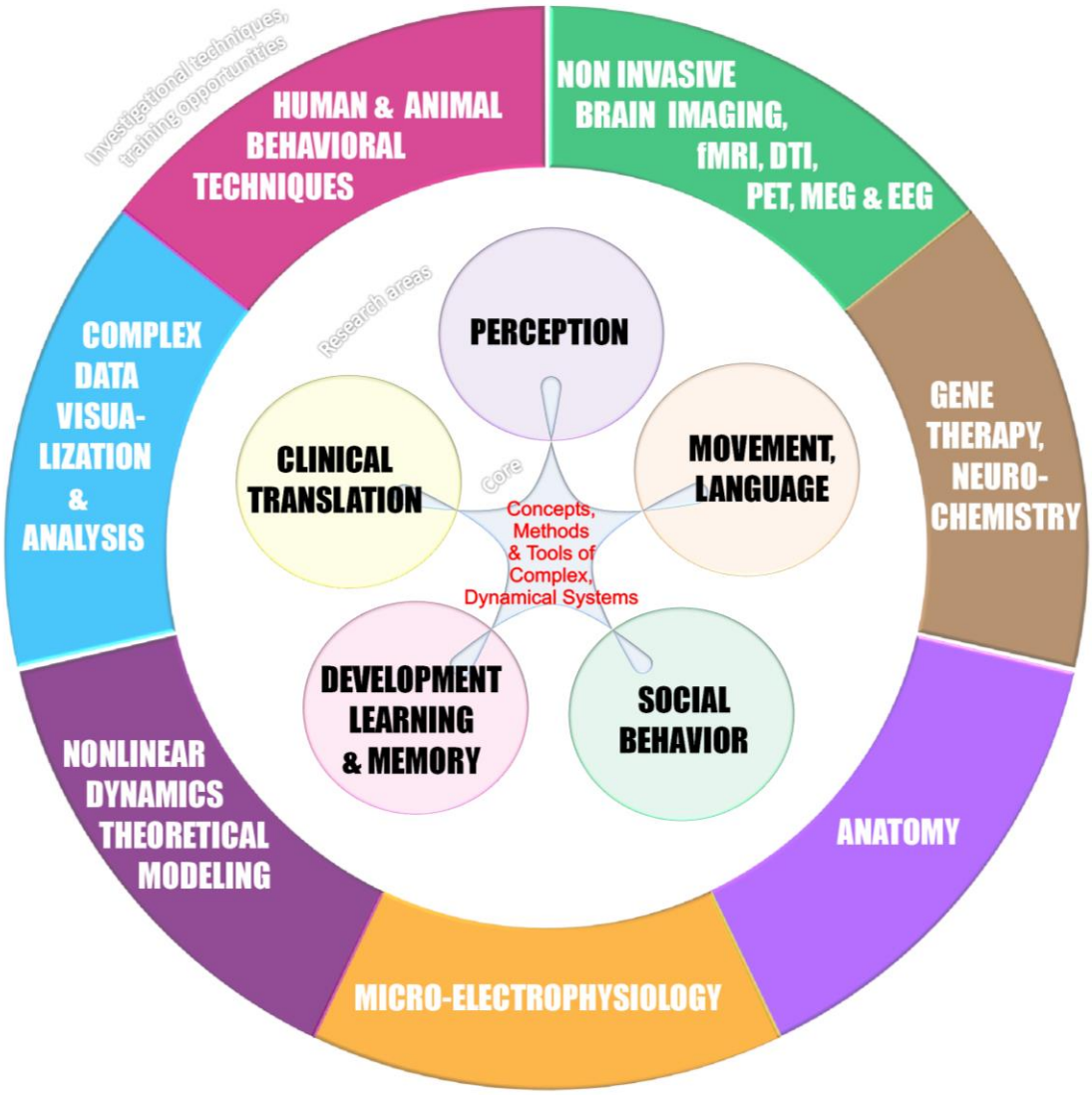

Figure 3: outline of CCSBS research

Introduction: CCSBS is a research-intensive center with a pedagogical mission, established in 1985 at FAU, dedicated to understanding the brain and creating a new kind of brain scientist. A belief shared by its members is that the brain, -- one of the most complex forms of organization in Nature--, can best be understood within a complexity framework. The framework developed at FAU combines the concepts, methods and tools of complex dynamical systems, with computation and real experiments using the latest imaging technologies. The Center is strong because of the diverse fields represented and because of its authentic interdisciplinary nature: theories, experiments, models and methodological developments are combined to understand perception, movement, language, social interactions, development, learning and memory both in health and disease. Neurological and neuropsychiatric diseases strike from early childhood to old age and add a significant burden to society, in the State of Florida and beyond. CCSBS's key motivation and a key to its future success is to help in understanding and treating these diseases which constitute a major challenge for contemporary society.

Current CCSBS Faculty members are from Biomedical Science, Psychology, Cognitive and Behavioral Neuroscience and Physics, and its research trainees (graduate students, postdoctoral associates and others) come from (and ultimately go

to) an equally broad array of disciplines. A sign of the program's success is the noticeably upward academic and professional mobility of graduates of the program (see appendix A). Center research is published in top journals including *Science, Nature Neuroscience, Proceedings of the National Academy of Sciences, Trends in Cognitive Sciences, Neuron and Progress in Neurobiology*; its members have published several books with MIT press and Springer, and the Center is the home of a very successful International Book Series called "Understanding Complex Systems" currently with 84 volumes. The Center has many research partnerships within the University (Science, Biomedical Science, Engineering), and further (e.g. Princeton; Washington University School of Medicine, St Louis; Drexel University, Stanford University; Harvard University, Massachusetts General Hospital and Rutgers University in the US; Universities of Barcelona, Ulster, Toronto, McGill; Trinity College Dublin; CNRS; Riken; China Medical University). It has public- private partnerships with health-delivering and research-involved entities (e.g. longstanding collaborations with University MRI, a diagnosis and bioimaging company in Boca Raton; and under development with the Marcus Neuroscience Institute at the Boca Raton Regional Hospital). The Center also has several common research interests with the recently established private research institutes (MPFI, Scripps, VGTI) that may enhance collaborations or the hiring of junior researchers to the Center at the end of their training.

CCSBS research is supported by a strong record of federal/state grants (NIH, NSF, ONR, AFSOR, American Heart Association, Florida Department of Health). This sponsored activity enhances FAU's infrastructure and personnel (research Faculty and postdoctoral fellows). The Center has also been active in the field of Tech Transfer with 8 patent applications, and associated commercialization efforts underway. CCSBS's research benefits from intensive international exposure, with numerous attendance at international lectures, and international invited lectures and the local organization of 3 international conferences by its members (2007, Coordination Dynamics; 2010: Neurocognitive Networks; 2010: Brain Coordination Dynamics, a Conference at Sea). CCSBS has been a co-organizer (with NIH as a sponsor) of 20 highly successful and seminal symposia on "Dynamical Neuroscience" between 1992 and 2013 that preceded the annual meeting of the Society for Neuroscience.

Center Faculty received numerous research awards in the last 7 years, for instance Dr Blanks was elected an ARVO (Association of Research in Vision and Ophthalmology) "Gold" fellow at the Inaugural Class of 2009. Dr Kelso was awarded the Pierre de Fermat Laureate, Midi Pyrenées Region & Republic of France; he was elected President of Foyle College (est. 1617) by the Former Pupils Association; he received the Bernstein Prize from International Society for Motor Control (ISMC), and he was elected a Fellow, Society for Experimental Psychology (SEP); Dr Prentice was nominated four times an International Faculty for the International Congress on Coronary Artery Disease. Dr Shen was selected as Researcher of the Year in 2011 both by the College of Medicine and by FAU, and Dr Stackman was selected as Researcher of the Year at the Associate Professor level by FAU in 2010.

Interdisciplinary efforts and community engagement efforts:

CCSBS was established as an interdisciplinary, research-intensive unit that would bring together investigators from Behavioral Sciences, Biology, Psychology, Mathematics, Physics, Chemistry, Engineering with the goal of understanding the "dynamic brain in action" to paraphrase President Obama's grand challenge. The Center's wide interdisciplinary outreach has led to engagement of the scholarly community at FAU (e.g. organization of the weekly Neuroscience Seminar, at first in partnership with the Max Planck Florida Institute, that provides a scientific and education event that consolidates the Campus-wide Neuroscience community). It has also led CCSBS to public-private-partnerships, especially in the area of medical services. The long-lasting partnership between University-MRI (uMRI), a private bioimaging and diagnosis facility in Boca Raton (Dr. Steinberg, Director, and an Affiliate Professor in the Center) and CCSBS resulted in a fruitful exchange of expertise and resources. Dr Steinberg's team contributed clinical technicians, fMRI/PET equipment access time *in kind* and educational/research experience opportunities for our trainees; while FAU contributed to uMRI's

research engagement, expertise sharing, and design and acquisition of specialized research equipment. Similar synergies are currently being explored with the recently opened Marcus Neuroscience Institute at the Boca Raton Regional Hospital (Dr. Robert Levy, Director, was recently elected to be an Affiliate Professor in the Center).

One arm of our community outreach comes with the delivery of fully-trained and graduated researchers from our PhD program, that enrich the business and business-support communities locally, nationally and internationally (please see Appendix A for details). Some of our recent graduates (2008-2014) are now in biotechnology companies, private publishing, private delivery of health services, business consulting or defense contracting corporations. Due to their unique training, our graduates are highly sought out. Some are retained in the state of Florida but the majority take positions nationally and internationally (Appendix A).

Establishment of goals for research:

The Center for Complex Systems and Brain Sciences, as the name implies, serves to integrate the principles of dynamical complex systems with the brain, behavioral and cognitive sciences in the study of the way people function and adapt to their environment. To achieve these lofty goals, the Center has assembled a world renowned faculty in various disciples who work together to address common issues of the mind, brain and behavior, and disorders thereof. In addition to the collaborative research among members of the Center, the faculty of CCSBS have teamed with biophysicists in the Department of Physics, cellular and molecular neurobiologists in the College of Medicine and the Department of Biology, behavioral and cognitive psychologists in the Department of Psychology and electrical and computer engineers from the Department of Computer & Electrical Engineering and Computer Science at FAU in the pursuit of shared research goals.

In recent years, the Center has been strongly affected by the loss of key faculty without replacement. Even with its depleted ranks, the Center continues to be a leader in research as demonstrated by the continued productivity of its faculty. Numerous Center publications appear in leading journals, significant external grant support has been maintained and faculty continue to participate in major conferences worldwide. Nevertheless, the recent loss of faculty members has placed a severe strain on the Center's ability to maintain its previous level of excellence. At the same time, several developments within the university and the community also make this a unique time of opportunity for the Center to grow and flourish as a center of excellence at FAU. These opportunities include the recent large-scale neuroscience initiative at FAU, centered around the development of collaborative efforts between the Department of Biology and the Max Planck Florida Neuroscience Institute and the Scripps Florida Institute in Jupiter as well as the recent establishment of the Marcus Neuroscience Institute at Boca Regional Hospital, across the street from the Boca campus. The opportunities afforded by these developments are clear: the Center, which for many years has been carrying the banner of neuroscience research and training at FAU, must serve an active, participatory role in the broader neuroscience initiatives at FAU and the establishment of alliances with these major neighboring neuroscience programs. With its strong national/international reputation for excellence in research, the Center provides a major draw for prominent neuroscientists seeking to join FAU and offers a natural home for many of them. More importantly, several essential subfields of neuroscience, including human, systems, computational/theoretical and social neuroscience, are exclusively represented at FAU by the Center. Thus, it is essential that the Center's reputation and capabilities be leveraged in the development of the university's larger goals.

In light of this overall picture, the broad goals of the Center are two-fold: 1) to build on its established excellence and reputation in treating the brain as a complex, dynamical system, by hiring core faculty that complement the neuroscience initiative at FAU and 2) to establish research and funding collaborations with major neighboring neuroscience programs -- especially those involving the human brain-- (e.g. Marcus Neuroscience Institute, Max Planck Florida Institute). These goals are already being addressed at some level: The laboratories of some faculty members associated with the Center are

now located on the Jupiter campus, and Dr Levy, Director of the Marcus Neuroscience Institute, has accepted our invitation to join the Center Faculty. We are planning to invite other members of the MNI to join our Faculty as they are being hired in the coming months, and this strategy is well-aligned with Dr. Levy's plan to maintain a research intensive activity amongst his clinical staff – which is a beneficial investment for putting cutting edge clinical research into practice. It is of the utmost importance that future hires be made with the potential for further building relationships with these allied endeavors.

Specific research goals for the Center

The goals of the Center directly coincide with The White House's B.R.A.I.N. initiative (aimed at revolutionizing studies of the human brain) and with growing emphasis on neuroscience at FAU. Faculty in the Center are well positioned to become key players in these initiatives. For instance, Drs. Kelso, Bressler, Fuchs and Tognoli, working within and outside of FAU, are acknowledged experts in the fields of structural and functional brain imaging and electrophysiology. These techniques are currently the major tools used in the investigation of human brain activity.

Multi-disciplinary collaborations at FAU

Newly emergent research themes are driving the forging of cooperative research efforts across disciplines. As a historically multi-disciplinary research unit at FAU, the Center is well positioned to initiate and facilitate research projects that require the participation of different units at FAU and her partner institutions. For example, projects in neurotechnology will require experts in Complex Systems and Brain Sciences (COS), as well as in Computer & Electrical Engineering and Computer Science (COE). They will also need clinical expertise from medical researchers and care providers (COM and Marcus Neuroscience Institute at BRRH). Such projects that focus on the development of new neuromedical sensor technologies may additionally require the participation of sensor engineers and nanoengineers.

Goals for the research in the coming years

The Center has been decimated by the loss of tenured professors without replacement. Professors Mingzhou Ding, Betty Tuller and Larry Liebovitch, Associate Professor Viktor Jirsa, and recently, Professor Ed Large (all original Center hires) have left the university to pursue careers elsewhere. Other research/non-tenured faculty (Drs. Dawei Dong, Gonzalo de Guzman and Silke Dodel, Computational Neuroscience and Physics) have also left the Center and FAU due to the loss of funds. Therefore, we need to be able to recruit at least 5-6 junior Faculty in areas that will: (1) sustain the integrity of the Center's PhD program and create new opportunities for our students, both graduate and undergraduate. This point must be highlighted. *If the pedagogical mission of FAU is to prepare students for the future, junior hires in the Center in quantitative areas not covered by neuroscience developments elsewhere, --namely computational, theoretical, as well as cognitive and behavioral neuroscience-- are of the utmost importance;* (2) enhance the unique niche that the Center has occupied nationally and internationally; (3) promote and create collaborative research opportunities with the newly formed Marcus Neuroscience Institute at Boca Regional Hospital; and (4) complement the developments in molecular and cellular neuroscience that have occurred at FAU in recent years as well as those of the Max Planck Florida Institute and the Scripps Florida Institute located on the Jupiter campus.

Moreover, numerous opportunities exist for application of the unique skill set of the Center faculty to other disciplines such as bioengineering and biotechnology, nursing and rehabilitation. If the foregoing strategy were to be fully

implemented, the University (with its various partners) would be well positioned to serve a leading national and international role in in Complex Systems and Brain Sciences.

To summarize: For the Center to continue to be a national and international force in dynamical systems and neuroscience research and in order to complement the existing neuroscience initiative at FAU (including collaboration with regional neuroscience institutes) would require additional faculty (at least 5-6 junior positions) with research foci in computational/theoretical, cognitive and systems neuroscience.

Assessment of how well goals are being met

As noted above, despite the depletion in the Center's ranks in recent years, current members have continued the Center's record of achievement in yielding high impact research and maintaining an internationally recognized training program. Assessment of future goals, laid out in the previous section, however, will require a broader set of measurements that take into account synergistic activities between the Center and other units within the university as well as those within the scientific community. Such an assessment regime should give specific emphasis to measures of interdisciplinary activity and may include the following:

- Publications
- External grant awards
- Interdepartmental or external research collaborations
- Number of awards received
- Invited lectures
- Cross-membership on interdepartmental or external advisory or executive committees
- Participation in, or sponsorship of, colloquia or conferences involving potential research partners

Given its history of achievement, the Center is highly likely to meet and exceed the research goals laid out here. However, this success will depend on the provision of sufficient resources to achieve this vision.

E. Service/Community Engagement for Department/School

Community engagement:

- Dr. J. A. Scott Kelso is a member of the NIH review panel for K99/R00 NIH Pathway to Independence awards; a Member of the NIMH Board of Scientific Counselors; a Member of the Special Emphasis panel for the NIH B.R.A.I.N. initiative and a Member of the NSF panel to review the International Science Collaboration (ORA) Program. He also serves as reviewer for international agencies, including the Welcome Trust (UK), The Riken Brain

Institute, Japan (Professorial Tenure Committee), MRC (Canada), Australian Medical Research Council, the Templeton Foundation, Israel Research Foundation, and Netherlands Organization for Scientific Research. Several members also participate in federal and national agencies' grant review panels, such as Dr Prentice (currently Chair of the American Heart Association's Genetics and Epigenetics study section), Dr Blanks (panel member for NIH's National Center for Research Resources), Dr Bressler (DOD/MRP/FP/NP, NSF/CNIC, NIH/ZRG1F02B-D, NIH/CSR CP, NSF/NS/DIOS, NSF SLC SVT, NSF/IOSE/PIRE/RSV, NSF/CRCNS, and NSF/EFRI).

- Members of the Center organized 3 international conferences (Coordination Dynamics 2007; Neurocognitive Networks, 2010; Brain Coordination Dynamics, a conference at Sea, 2010), and Dynamical Neuroscience XX, The Neurophysiology of Social Neuroscience, New Orleans, 2012.

- The Center initiated the Award of two FAU honorary doctorates to nationally and internationally recognized leaders in the field of cognitive neuroscience: Dr. Michael Turvey (May 5th 2011) and National Medal of Science award winner, Dr. Michael Posner (December 8th, 2011).

- A number of scientific lectures generated in local conferences and special lectures were archived (archive.org and others), and thus are freely available to the public and to scholars worldwide.

- The Award to one of our alumni Dr John Jeka of FAU's Distinguished Alumni Award in 2014 was delivered at a Ceremony that supports FAU's alumni fundraising efforts

- CCSBS members co-organized "Images of Science" in 2010, an exhibit at FAU's Art Gallery for FAU's community and the public to high-light Brain Awareness Week (a Society for Neuroscience event).

- Members of the Center regularly contribute to local, national and international press communications that provide exposure of its scientific findings to the public and decision-makers, and provides expert advice at the request of journalists.

- Dr. Janet Blanks (with Dr. Rod Murphey, Chairman of the Biology Dept. as Co-Principal Investigator) received a $500,000 award from the Division of Research for a collaborative project entitled Brain Function, Damage and Repair". The project involved faculty in the College of Science, College of Medicine and to a limited extent, the Honors College in Jupiter. The grant had a "no-cost" extension until June 30, 2014.

- Drs. Blanks and Stackman worked with the Department of Biology and with the newly formed Max Planck Florida Institute (MPFI) to design a graduate program between MPFI and the Integrative Biology Ph.D. program – the new program is called "IBAN" (Integrative Biology and Neuroscience). Drs. Blanks, Shen, Stackman and Vertes are listed as mentors in this collaborative program.

- Center students are encouraged to participate in campus-wide and external events that showcase brain science. Recently 6 of our students participated in the two Saturday "Access" events where prospective high school students and their parents flocked to the open area near the Administration building to view the plethora of disciplines and studies available at FAU. Our graduate students demonstrated cow eyes and the dissection of sheep brains to engage teenagers. A similar event is planned for exhibition in the "Breezeway" during Brain Awareness Week in March 2015.

- Dr. Blanks helped to start the Palm Beach Chapter of the Society for Neuroscience. She serves as President with Tatiana Vienna, a Center graduate student serving as interim Chapter Secretary. She and her colleagues in Jupiter have enlisted the following Universities and research institutions to join the chapter: Nova Southeastern University, FAU, Scripps Florida Institute, Torrey Pines Molecular and Cell Biology Institute, MPFI and VGTI.

- Members of the Center serve on editorial boards for several important and high-impact Neuroscience journals. Dr Kelso serves or has served on 12 Editorial Boards in the last 7 years and a number of Scientific Advisory Boards, including the Plexus Institute and the Einstein Institutes. Recently, Dr. Vertes was appointed to the Editorial Board for the Journal of Comparative Neurology. Center members serve the scientific community by also reviewing manuscripts for PLOS one, PNAS, Neuron, Journal of Neuroscience, Journal of Neurophysiology, several important vision journals, plus others.

- In the area of local service, Dr. Blanks has chaired the Institutional Animal Care and Use Committee (IACUC) for the past 5 years and Dr. Prentice has chaired the University Biosafety Committee for a number of years. Members of the Center serve or have served on Promotion and Tenure Committees both at the Departmental level or at the University level. Dr Kelso served on the College of Engineering Committee to select three Distinguished Professors.

- Joint mentorship of research students involving Center and other FAU faculty is encouraged. As a result, Center members serve on Thesis Committees of students within our Ph.D. program as well as on Committees in Integrative Biology, the IBAN program and Experimental Psychology, and in the College of Engineering and the College of Nursing.

- Several members of CCSBS also participate in the "Exit Exams" offered as part of the newly formed Masters program in the Dept. of Biomedical Science in the COM.

Review of part III of the departmental dashboard indicators for Department/School

(none indicated for this feature).

Establishment of goals for service

Faculty in the Center will continue to perform both local and national service. There is every reason to believe that they will continue to be sought after as reviewers for grant applications and papers, as well as asked to serve on thesis committees both locally and at other institutions.

We aim to maintain productivity in the following areas:

-participation in review and strategic advice to federal agencies

-public dissemination of science (press releases, Brain Awareness Week and scientific lecture reposition online)

-conferences, special sessions organized

-outreach and inclusion of undergraduate and K-12 students in research.

-committee service at FAU and under solicitation from other Universities. Award nomination, collegial career development support

-editorial activities

-peer-review of grant applications

Assessment of how well goals are being met

We track the outcomes in the categories of Service and Community engagement listed above in Establishment of goals for service. All Faculty list numerous activities both locally and nationally in the area of service therefore this goal is met at a better than average level for most faculty and some faculty exceed expectations in their national and international service.

F. Other Program Goals for School or College

The University has initiated a Neuroscience hub at its Jupiter campus with the adjacent Scripps Research Institute and the MPFI. Neuroscience on the Jupiter campus is focused in the area of cellular and molecular neuroscience using *Drosophila* and mice as experimental animals. In full complementarity with this effort focused on the small-scale circuitry of the brain of animal models, the Center, along with its partner departments and private clinical partners, plans on emphasizing human neuroscience on the Boca Raton Campus, with emphasis on the use of imaging techniques.

Two further goals of our Faculty are:

-To continue to serve the University with interdisciplinary research opportunities offered to undergraduate and graduate students from other departments and colleges

-To support the career of alumni through continuous mentoring and recommendations at various stages in their career.

Describe and assess how well goals are being met

The Center participates in the QEP (Quality Enhancement Program) at FAU which emphasizes the participation of Undergraduates in research and scholarly activity. As noted earlier, a number of undergraduates volunteer for a summer experience in our laboratories, as well as participate in research in the Center during the academic year. These students come from the Departments of Psychology, Biology and Physics at FAU, as well as from local high schools. The undergraduate major in Complex Systems (proposed below) will further enhance STEM training in the Center.

Members of the Center often have an opportunity at the annual meeting of Society for Neuroscience meetings to visit posters and presentations of former CCSBS students. This venue allows for mentoring as well as social interaction. The long list of the current positions of former faculty, post-docs and students (Appendix A) suggests a significant level of communication between the Center and former personnel, called “Centerites”.

G. Strengths and opportunities that support achievement of program goals for School or College

Strength: Analysis suggests that CCSBS is the University's leading entity in the area of Neuroscience (appendix C), and a world-renowned leader in Complex Systems and Brain Sciences, with its Faculty members participating in numerous invited lectures worldwide, in the publication of research in prestigious journals and with the accomplishment of a large volume of sponsored research that advances knowledge and helps society. It also has tremendous impact on training the future leaders of Academia and Industry (Appendix A).

Opportunity: To help FAU to move into a future with a broader contribution to state education and revenue, the Faculty of the Center for Complex Systems and Brain Sciences proposes to develop an undergraduate degree in Complex Systems (see draft curriculum, appendix D). This undergraduate major would provide the concepts, methods and tools for a variety of disciplines (social sciences, economics, neuroscience, physics, psychology, engineering, medical and environmental science, etc.) and problems (climate change, water management, diseases of the nervous system, health care management etc.) to prepare the workforce for the complex challenges of today's world, with emphasis on Florida's needs and unique challenges. There is a strong suggestion from the business community that undergraduates with such knowledge would be in high demand (similar to our PhD graduates).

In the coming decades, we anticipate a trend in which Universities will transform their undergraduate education from a strictly disciplinary core to an interdisciplinary one, with STEM, quantitative skills and computational abilities taking the lead. The proposed undergraduate major would be at the cutting edge of this trend.

In 2010, the National Academy outlined the importance of complex problem solving and systems thinking in a landmark report *"Exploring the Intersection of Science Education and 21st Century Skills"*. The goal is for every student, not just a small elite, to develop those competencies and be prepared for the 21th Century with a knowledge- and information-based economy. These concepts are very much at the core of the Center's graduate curriculum. The PhD program in Complex Systems and Brain Sciences, the world's first established in 1992 from a partnership between FAU and the NIH via a national training program, was a place where FAU has been able to claim the status of pioneer in education and research in the past. With the addition of an undergraduate component and suitable recruitment efforts, FAU will be able once again to claim its pre-eminence as an innovator in the entire field of secondary education.

H. Weaknesses and threats that impede program progress for Center

In summary:

- Longstanding lack of infrastructure in the area of human brain imaging, especially a Human Brain Imaging Facility in which key imaging modalities are integrated (including a research-dedicated MRI scanner to tackle the important matter of brain health and disease, --Obama's grand challenge and an important stake for the State of Florida).
- Aging of the Faculty in the Center
- Loss of key Faculty, especially in the area of Computational Neuroscience
- Reduced success rate at Federal Agencies for support of research across the board is a growing concern, though to date, Center Faculty has done well in maintaining its sponsored effort.

- For the last two years, we have met with high quality students interested in joining our PhD Program, but who turned down our offer due to uncompetitive student stipends. Loss of first class researchers in key areas of computational neuroscience is also a factor (see section K, student feedback). Enrollment of outstanding students has always been a key to the success of the Center, with high standards for educational success and research engagement. We are currently exploring solutions to redress the competitiveness of our stipends and hope that our efforts will be joined by University-wide policy change.

Growth at FAU has been hampered in many areas due to severe budgetary constraints. The Center has suffered immeasurably from the lack of funding. Not only have we had productive, energetic faculty leaving at the height of their scientific careers but we have also had the infrastructure within the Center cut drastically. With no core hires in the last 15 years, the Center has not benefited from start-up funds as a mechanism for Facility renewal, even as it was a major contributor to overhead with numerous federally funded grants. As a result, some of our equipment is no longer state-of-the-art and needs to be replaced, and our support staff has been dismantled by lack of resources. If the Center is to continue as a primary source of interdisciplinary research in the brain and behavioral sciences at FAU then it must be allowed to hire more Faculty and replenish its dwindling infrastructure by re-instituting to full-time status the Administrative Assistant and the Program Assistant, and restoring technical/engineering support for the research and research training effort. A budget needs to be prepared for equipment replacement as soon as possible.

I. Resource analysis for Center

Infrastructure (including Support Staff)

Summary: The Center's E and G budget was cut 20% in 2008 and the Program Assistant's position was reduced to 50% in July 2012 in the massive cuts incurred by the University and dictated by the State. In 2010 one of the supporting personnel moved from E&G support to sponsored funding (this person has since retired and funds are not available for a replacement position). The Center needs an infusion of monetary support if it is to continue its national and international preeminence and to continue to recruit high quality graduate students.

Federal sponsored funding has historically been available to support effort for Principal Investigator's, Graduate Research Assistants, purchase of laboratory supplies and equipment fully dedicated to the Center's research.

i. Laboratory and Office Facilities: The Center for Complex Systems & Brain Sciences at Florida Atlantic University is comprised of three major shared facilities. The first component is designed for studies of human brain, cognition and behavior; the second is for theoretical/computational neuroscience including scientific visualization; and the third for "wet" neuroscience research. The center includes a computer room, a terminal/workstation room, a machine and electronics shop for general laboratory needs, offices for faculty, post-doctoral fellows and students, laboratories (~4000 sq ft), and meeting and class rooms.

ii. Computational Facilities: The Center's computational resources consist of approximately 60 servers, workstations and Personal Computers in various configurations running Windows 7, Linux, and several Apple iMac's under current versions of Mac O/S. The vast majority of these have been purchased from Federal grant funds.

iii.a. Behavioral capture and analysis: The Center is equipped with two major 3D behavior capture systems covering a spatial range up to 35 feet with precision of 1 mm, with a temporal resolution of up to 2000Hz: an 8 camera VICON MX; and an OPTOTRAK 2010. It is complemented with a collection of sensors and apparatii for minimally-intrusive transduction of movement and pressure (goniometers, axial potentiometers, laser-based azimuth finger detection devices,

variable resistance flex bands, pressure sensitive sensors), and associated multichannel I/O acquisition cards and Analog-To-Digital Converters from National Instrument.

iii.b. EEG Recording: Four EEG amplifiers are available, including two of contemporary manufacture, and two older equipment for specialized applications: (1) Brain Products, 64 channel, ActiChamp active electrode amplifier with six actiCap caps (purchased 2013); (2) a high density (up to 140 channels) high resolution (24bit) EEG system (Neuroscan synamp 2, Compumedics, TX, El Paso) with 10 G ohms input impedance, DC recording and fMRI compatible capabilities (purchased 2004); (2) a MANSCAN system (SAM Technology, Inc., San Francisco, CA) with 132 channels (purchased late 90s); and (3) an older Grass (Model 12) 64 channels amplifier / Neurodata Acquisition System maintained for special applications when the parameters of amplification need to be individualized between channels (purchased early 90s). Recordings are hosted in a sound-insulated, double-walled chamber (Industrial Acoustics Company, Inc., Bronx, NY) having a floor surface of 80 sq.ft, and shielded to electromagnetic interference through a dedicated large-diameter ground mesh making single-point connection to earth. This is complemented with a multimodal-imaging analysis workstation (integration of EEG, fMRI, MRI), and two electromagnetic 3D scanning systems to capture accurate spatial configurations of electrode locations with submillimeter errors (Polhemus). These devices are necessary to reconstitute adequate spatial relationships between sensor locations and the modeled three-dimensional geometry of the underlying cortical tissue (MRI) prior to source estimation.

iii.c. MRI/fMRI/DTI Facilities: Until 2010, the Center for Complex Systems & Brain Sciences had close collaboration with University MRI & Diagnostic Imaging, a private clinical imaging facility located on the campus of Florida Atlantic University. It provided access to 1.5 and 3.0T Signa Excite scanners with real-time extension for structural, functional MRI and DTI; and a CT LightSpeed16 (General Electric, Milwaukee, WI). Unfortunately, these machines have been retired. Their re-instatement however is possible through matched funding from private and public resources (if made available).

iv. Wetlab: The Center has a wet lab Facility on the 5th floor of BS12-Boca Raton Campus, for tracing, electrophysiology and surgery of small animal especially rodents (Robert Vertes), and another Facility on the Jupiter Campus (Robert Stackman), equipped with two Plexon in vivo neurophysiological recording systems (one 16- and the other 32-channel), for acquisition of single unit activity and local field potentials from freely moving rodents.

Research and Education Personnel

E&G funds from the State of Florida are used to support approximately 15 Graduate Teaching Assistants every semester. Unfortunately, our TAships are not competitive since they have not kept pace with the increase in the cost of living over the past 7-8 years and they do not include health insurance. Not only is this a hardship for our current graduate students but we are no longer competitive in attracting the best applicants to our graduate program. FAU must address this issue by raising graduate student stipends as soon as possible. If not, FAU will never attain the category of a research-intensive university.

Private funding has intermittently been available to support student travel to scientific meetings. For the past two years, the majority of the funds for travel, hotel and honoraria to support the Neuroscience seminar series has come from the Jupiter Initiative in Neuroscience. Funds from the Davimos Endowment were used to pay for meals associated with the seminar speakers. It is unclear how long the Jupiter Neuroscience funds will support the series so it is important that the budget to continue this important activity be transferred to CCSBS.

Budget for Research Efforts

Federal sponsored funding has historically been available to support equipment fully dedicated to the Center's research. The Center desperately needs access to "state-of-the-art" equipment for human brain imaging if we are to regain our pre-eminence in this field as well as become "players" in the Human Brain Initiative. Although, CCSBS may be able to work out MOUs with the neighboring Marcus Neuroscience Institute at BRRH, FAU should embrace the goal of having its OWN Imaging Center (see below).

The imaging facility - at a minimum - needs to be equipped with a state of the art 3T MR scanner that is capable of running functional MRI and diffusion tensor imaging sequences and an MRI compatible EEG system that allows for simultaneous recording of fMRI and EEG. Such systems are about $2-3 million to purchase and install, and $100-200k annually to operate and maintain. In addition, technical and administrative personnel to maintain, facilitate and coordinate the research are necessary to guarantee efficient use, promote or "seed" fundable research projects, and ensure subject safety.

J. Future directions for Center

The Center for Complex Systems & Brain Sciences is internationally unique in two main ways. First, it has a strong record of research productivity that has raised FAU's national and international profile. Second, it has a pioneer PhD program in Complex Systems and Brain Sciences that was started with NIMH funding. The Center's achievements are in part due to its organizational structure, which has fostered interdisciplinary collaborations that cut across traditional academic departmental boundaries. The Center is currently well positioned to promote new collaborations in research and teaching with other departments in the College of Science, with the Colleges of Medicine and Engineering, and with non-University institutions such as the Marcus Neuroscience Institute at BRRH. Our principal goals for the upcoming years are to:

- Ground Center Research in a solid collaboration with the Marcus Neuroscience Institute and other clinical partners to reinforce the clinical arm of its core Human Brain Sciences research.
- Establish a broader interdisciplinary basis at FAU, with for example, increased collaborative efforts with the College of Medicine and the College of Engineering.
- Set in place a new undergraduate program in Complex Systems which will feature the quantitative methods, concepts and tools needed to address the problems that confront society at all levels (Appendix D).

Questions for Center Reviewers:

Question 1: Can you comment on our hiring plan and identify emerging trends that are good matches for our programs (research , PhD, and planned undergraduate degree in Complex Systems)?

Question 2: Can you discuss the infrastructure investments that you see as most profitable for our Faculty, their expertise and research goals?

Question 3: Can you comment on the timeliness and required Faculty hires necessary to initiate an interdisciplinary undergraduate degree in Complex Systems?

K. Student Feedback

Graduate Student Questionnaire

(15 questionnaires distributed with 80% compliance. Excerpts below are taken from several students and are thought to be representative)

What has been your experience thus far as a Graduate Student in the Center for Complex Systems and Brain Sciences?

"It has been very intellectually engaging because besides having the learning opportunity provided by attending classes, there are ongoing seminars in varied aspects of complex systems and neuroscience to cater to different interests. These are further supplemented with vibrant discussions during lab meetings and other center-level meetings".

"I have had a good experience overall. The courses I have taken have provided me with a wide range of knowledge within the field of neuroscience."

"My experiences thus far have been good. I have learned a few new techniques and are taking really interesting classes."

"I feel that the curriculum is poorly organized and integrated. The center is sold as a place where complex systems ideas, and the mathematical literacy that is required to trade in them, are central. Yet there is no Methods in Complex Systems course offered any more—accepted in its place is a psych stats course, which while important", is not about complex systems… "Many of these students lack the foundational math to even begin DS and quickly become lost. This points to a problem either with the admissions criteria, or the availability of remedial efforts to shore up gaps in knowledge."

"Overall, an excellent experience! I have learned so much in such a short time. My advisor treats me like a colleague, which I enjoy very much."

Are you progressing toward all of your academic targets in a timely fashion?

Most students answered "yes":

"Yes. I am on track to graduate in a timely manner. In the time I have been in the program, I have also authored many publications that have contributed to the completion of my academic targets."

But there was also a negative comment.

"I think I am not progressing as systematically as I hope to be; sometimes I feel clueless in terms of the expectations of the department, Center, and lab that I am supposed to meet."

Who specifically has been helpful to you within the Center for Complex Systems and Brain Sciences?

Other students were mentioned but both Dr. Blanks and her Administrative Assistant, Ms. Thamsten were almost unanimously applauded.

Many also mentioned that their mentor was especially helpful.

What are some good things that have happened to you since becoming a graduate student in the Center for Complex Systems and Brain Sciences?

"I am surrounded by very knowledgeable faculty, staff, and students, such that I am highly motivated to gain as much knowledge as I can, too. I have also greatly benefited from the scientific mind framing of arguments that my current superiors and colleagues closely adhere to."

"I learn how to be a critical thinker, articulate a vision, focus a debate, and cut to the essence of an argument, making a point compelling, even to those who disagree."

"Great advisors and research team. Excellent physics classes offered."

"There really are some interesting and wonderful people in our Center who I am happy to call friends."

"Meeting some of the speakers before their talks are really good to understand what is available to you once you leave this program. It also starts the process of networking to help with collaborations or future employment opportunities".

"Published and presented posters at conferences. Had the opportunity to study outside the center."

"Presented at SfN, listened to interesting talks at Neuroseminar"

What are some things/resources that you do not have that would be helpful to you?

"Closer guidance by mentor(s) in showing me the ropes of doing rigorous research."

"I hope we will have the opportunity to write grant proposals."

"Additional faculty that is well-versed in rodent research and more funding opportunities for professional conference attendance."

"Hope there are more classes with complexity science focus."

"Greater access to courses that are specific to studying complex systems and applying them to studying the brain and biology in general."

…"the lack of technology available at FAU. … the answer then is more money for equipment, which is everyone's problem everywhere. Also, I think the process of attaining candidacy and progressing towards a defense is too loosely structured. I think there should be more of a milestone for establishing some foundation of requisite knowledge in addition to the required poster/abstract/paper. Without that, it feels like we are potentially left behind our peers at other institutions where these kinds of milestones exist and are more rigorous."

"More focus on complex systems, especially a course or two. Something to facilitate communication between labs. A boot camp like they used to have. Perhaps a library with common books, and a place for students to sit a gather and talk, with couches, etc (most department have something like this)."

What are some things that you would like to see happen within the Center for Complex Systems and Brain Sciences?

"More inter-lab and even inter-department collaboration within the campus, that is, interdisciplinary research not just within the same lab".

"More financial support for travelling to other centers and conferences."

"Additional faculty that is well-versed in rodent research and more funding opportunities for professional conference attendance."

"Having more complex system scientists in the Center, especially who have a computational or mathematical focus".

"Currently, the Center's requirements only list Nonlinear Dynamics and Chaos under Fuchs as necessary for an introduction to studying complexity. I hope for future years other courses, such as the second half of this course or others that would focus on swarm dynamics, pattern formation, networks and graph theory, would be available for Center students. It would be beneficial to us if they offered more classes based on research techniques that we might come across in our studies".

"More core courses that better convey what a complex systems approach to neuroscience actually is. …what if all (or a few?) faculty worked together to compile a body of what they feel is foundational neuroscience research that takes complexity seriously? …This could be a companion to proseminar."

"A platform for students to share their research with other students and faculty. For instance, by giving a talk, which would serve as practice and a chance to get helpful feedback from others."

"More focus on complex systems, more integration between people. Perhaps hiring a few more people interested in cognitive neuroscience. I hope to see the Center like I have heard it has been: busy, active, highly energetic!"

Do you feel that when you do have a problem that a Faculty or Staff member is accessible to talk to?

Most students answered "Yes".

"Yes. Faculty availability is generally adequate."

"I have not had difficulty solving a problem during the time when I have requested the help of a Faculty or Staff member."

"I have found this is a very easy thing to do. Everyone that I have come in contact with has been very understanding and helpful".

One negative comment: "Not all the time."

Undergraduate Research Experiences

The Center is also a research home for many undergraduate research trainees from FAU's various departments and other Universities. A sample feedback is attached below.

"I want to thank you all for all the hard work, support, and time you spent helping me over the course of my research and in developing and defending my thesis. Without all your insightful comments and ideas I wouldn't be where I am today."

"People usually says "a good teacher is like a lamp that lights on the student's road of learning". You make me feel that way"

"It was wonderful working with you and being part of such a distinguished team of scientists. This was my first research experience and I have learned and grown a lot because of it. It definitely made me fall in love with the brain and all the amazing things it can do, so I am planning to pursue a research career in Neuroscience."

"Thank you for spending the time to help me advance my research. I could not have advanced to this point so quickly without you"

"In particular I'd like to thank [mentor] who has infinite patience in dealing with the likes of me as well as a sincere concern for meticulous research practices and promoting the advancement of aspiring scientists. I have witnessed [mentor] take on several young scientists in my time raising them from naive students to careful, critical empiricists and her energy and commitment to the task is remarkable."

"My most special thanks though must be reserved for [mentor] alone. Her great intelligence and consummate integrity in the pursuit of the truth about the brain sets a high standard that I shall strive constantly to meet."

"I completely understand and appreciate all that you have helped me achieve in the past few years"

"Thanks so much for all your help in this process. Your patience and teaching during my assistantship will forever be valued"

"Thanks for all your support, inspiration and encouragement." "I think I grew a lot in this process, much under your guiding words. Thank you"

"Thank you so much for helping me get on the path of research! I started in your lab and have Loved it since :)"

"Working on this project with you was a great experience. Your knowledge and patience helped me reach my goal. Thanks"

Appendix A, Broad interdisciplinary and geographical outcome of Center Alumni

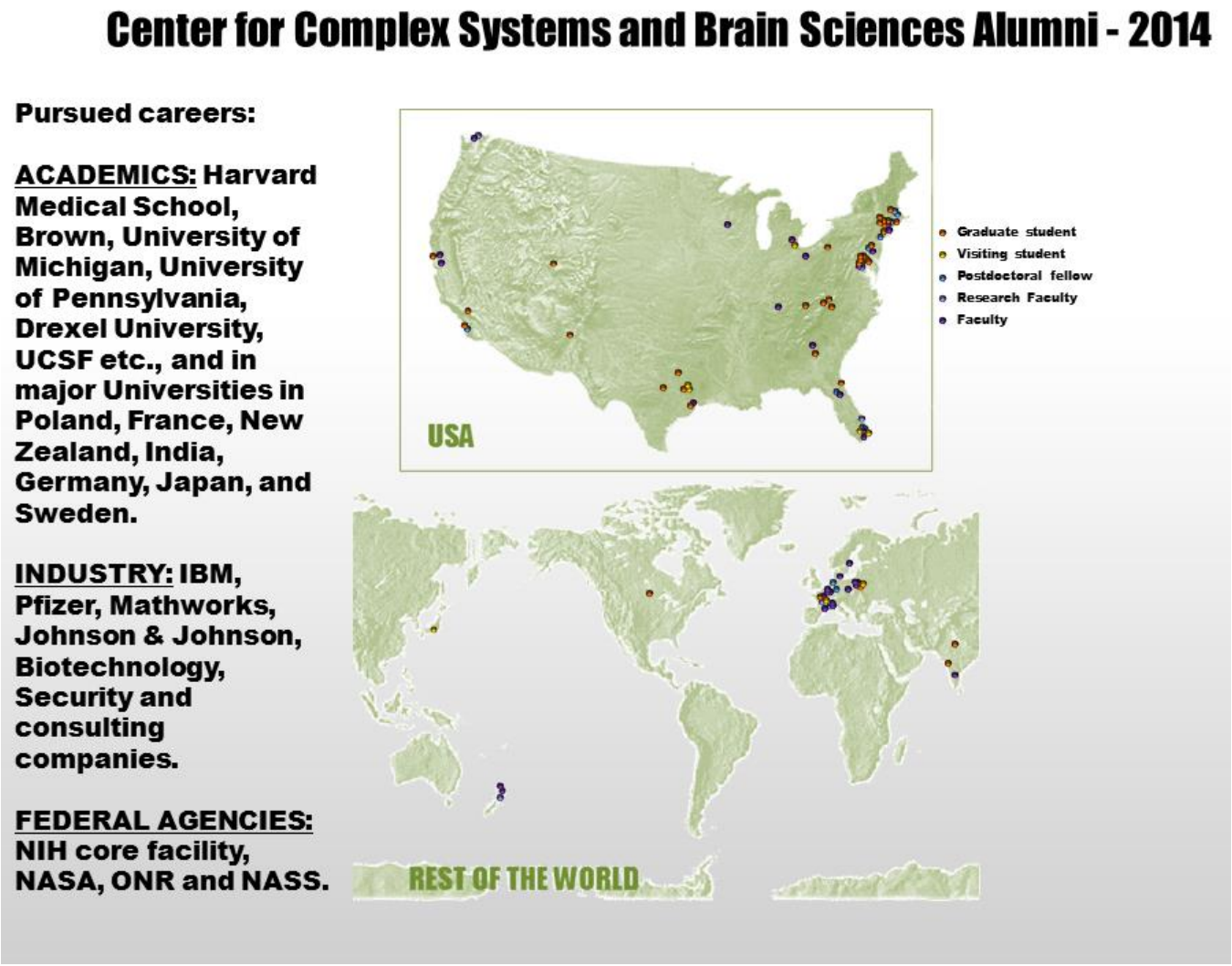

Figure 4: geographical distribution of Center Alumni, color coded according to alumni's last position held at the Center.

LEADERS

- Cohn, Joseph; Commander, Medical Service Corps, US Navy, Deputy Director of Research, STEM, Office of Naval Research, Washington, DC
- Ferrari, Paul; Research Director of the MEG laboratory at Dell Children's Medical Center of Central Texas, Austin, TX
- Jeka, John; Professor and Chair, Department of Kinesiology, Temple University, Philadelphia, PA
- Jirsa, Viktor; Director of the Institute de Neurosciences des Systèmes and Director of Research at the CNRS, Marseille, France
- Kirk, Ian; Co-director of the Cognitive Neuroimaging, Neuroplasticity and Neurodevelopment Laboratory, Associate Director of the Centre Brain Research and Professor, University of Auckland, Auckland, New Zealand
- Murata, Tsutomu; Director, Kobe Advanced ITC Research Center, Kumamoto, Japan
- Rusek Marian; Head of the Division of Technical Physics, Polish Academy of Science, Warsaw, Poland
- Schoener, Gregor; Chair, Theory of Cognitive Systems, Ruhr University, Bochum, Germany

- Wallenstein Gene; Senior Director, Inflammation & Immunology, Group Leader of Outcomes & Evidence, Global Health and Value at Pfizer Inc

UNIVERSITY, FEDERAL FUNDING AGENCIES AND STATE OFFICALS

- Case, Pamela; Retired, former Dean, St. Andrews Presbyterian College, & Jefferson-Pilot Associate Professor of Psychology, Laurinburg, NC
- Ramcharan, Eion; Director of the Office of Sponsored Research, Max Planck Florida Institute, Jupiter, FL
- Wodarczyk, Linda; Program Manager for the Human Services Department Brain Injury Program, Santa Fe, New Mexico
- Zanone, Pier; Vice-Dean for Research, Faculty of Sports and Human Movement Sciences, University of Toulouse and Director, Program in Sport and Human Movement Sciences, France

FACULTY & STAFF SCIENTISTS

Highlights: former Centerites now in tenured position at Harvard Medical School, Brown, University of Michigan, Unniversity of Pennsylvania, Drexel University, UCSF etc., and in major Universities in Poland, France, New Zealand, India, Germany, Japan, and Sweden

- Albo, Zimbul; Instructor, Baylor College of Medicine, Houston, TX
- Assisi, Collins; Assistant Professor and Wellcome Trust-DBT Intermediate Fellow, Indian Institute of Science Education and Research, India (formerly postdoc at Salk Institute)
- Banerjee, Arpan; Associate Professor, National Brain Research Centre, Haryana, India
- Billock, Vincent; Research Associate Professor at College of Optometry, Ohio State University
- Borsky, Susan; Retired Professor, University of North Florida, Jacksonville, FL
- Brovelli, Andrea; CNRS Research Scientist, Institut de Neurosciences de la Timone, Marseille, France
- Buchanan, John; Professor of Health and Kinesiology, Texas A&M University, College Station, TX
- Colgin, Laura; Assistant Professor of Neuroscience at Center for Learning and Memory, University of Texas, Austin, TX
- Dastjerdi, Mohammad; Researcher at Loma Linda University, Department of Neurology, Loma Linda, CA
- Dhamala, Mukeshwar; Associate Professor Georgia State University, Atlanta, Georgia
- Ding, Mingzhou; Professor, Department of Biomedical Engineering, University of Florida, Gainesville, FL
- Dumas, Guillaume; Research Fellow, Institut Pasteur de Paris, France
- Fink, Philip; Lecturer in Exercise & Sport Science: Biometrics, Massey University, New-Zealand
- Foo, Patrick; Associate Professor, Dept. of Psychology, and Director of the Neuroscience Minor, University of North Carolina, Asheville, NC
- Grzywna, Zbigniew; Professor of Physical Sciences, Silesian University of Technology, Gliwice, Poland
- Hashemiyoon, Rowshanak; Chief, Laboratory for Behavioral Neurophysiology and Computational Neuroscience, University of Cologne, Germany
- Jantzen, Kelly J; Associate Professor, Human Cognition and Neural Dynamics Lab, Western Washington University, Bellingham, WA
- Jantzen, McNeel; Assistant Professor, Human Cognition and Neural Dynamics Lab, Western Washington University, Bellingham, WA
- John Scholz; Professor, Department of Physical Therapy, University of Delaware, Newark, DE (deceased, 2013)
- Kaminski, Maciej; Assistant Professor, Institute of Experimental Physics, Warsaw, Poland
- Kiemel, Timothy; Research Assistant Professor, University of Maryland, MD
- Kocsis, Bernat; Associate Professor, Harvard Medical School, Cambridge, MA
- Kovacs, Attila; Assistant Professor at Department of Exercise and Sport Science, University of Wisconsin La Crosse, Madison, WI
- Krekora, Piotr; Assistant Professor, Institute of Physics, Polish Academy of Science, Warsaw, Poland

- Lagarde, Julien; Associate Professor, University of Montpellier, Montpellier, France
- Large, Edward; Professor, Department of Psychology, University of Connecticut, Storrs, CT
- Ledberg, Anders; Senior Researcher, The Centre for Social Research on Alcohol and Drugs, Stockholm University, Stockholm, Sweden
- Leonardi, Giuseppe; Lecturer, Nicolaus Copernicus University, Torun, Poland
- Liang, Hulaou; Professor, Drexel University, Philadelphia, PA
- Magne, Cyrille; Associate Professor, Middle Tennessee State University, Murfreesboro, TN
- Majumdar, Kaushik; Associate Professor, Indian Statistical Institute, West Bengal, India
- McKenna, James; Assistant Professor, Harvard Medical School, Cambridge, MA
- Modestino, Edward; Research Assistant Professor, Boston University School of Medicine, Boston, MA
- Nair, Dinesh; Neurologist, Massachusetts General Hospital/Harvard Medical School
- Oullier, Olivier; Professor, Provence University, Aix-en-Provence, France
- Pillai, Ajay; Research Faculty, Kennnedy Krieger Institute at John Hopkins Hospital, Baltimore, MD
- Raczaszek, Joanna; Professor of Psychology, University of Warsaw, Warsaw, Poland
- Sambrook, Roger; Researcher at the National Institute of Science, Space and Security Systems, University of Colorado, Colorado Springs, CO
- Sha, Di; Research Associate, Department of Pharmacology, Emory University, Atlanta, GA
- Shehadeh, Lina; Assistant Professor of Medicine, Univ. Miami Miller School of Medicine, Miami, FL USA
- Taylor, Debra; Faculty and MRI Program Director, Forsyth Tech. Coll. Winston-Salem, NC
- Truccolo, Wilson; Pablo J. Salame '88 Goldman Sachs Assistant Professor of Computational Neuroscience, , Brown University, Providence, RI
- Viana di Prisco, Gonzalo; Research Associate, Barrow Neurological Institute, Phoenix, Arizona & Assistant Professor, Baylor College of Medicine, Houston, TX
- Winchester, Jeanna; International University of Health Sciences Medical School, Winnipeg, Manitoba, Canada
- Zanto, Theodore; Assistant Professor, University of California San Francisco, School of Medicine, San Francisco, CA
- Zochowski, Michal; Professor of Physics, University of Michigan, Ann Arbor, MI

GOVERNMENT, NIH, MILITARY RESEARCH AGENCIES, NASA

Highlights: former Centerites at NASA, ONR, NIH core facilities, National Agriculture and Statistics Services and in foreign public research agencies

- Athenes, Sylvie; Scientist, Direction for Techniques and Innovation in Civil Aviation, Toulouse, France
- Carver, Frederick; System Analyst, MEG Core Imaging Group, NIMH, Rockville, MD
- Holroyd, Tom; Staff Scientist, MEG Core Imaging Facility, NIMH, Rockville, MD
- Rajamoni, Sreenivasan; Research Fellow, NIMH MEG Core Imaging Facility, Rockville, MD
- Romano, Tracy; Mathematical statistician at National Agriculture and Statistics Service, Washington, DC
- Stassinopoulos, Dimitris; Scientist at NASA Ames Research Cente, Mountain View, CA

RESEARCH SUPPORT STAFF

- Chen, Yonghong; Statistical Research Coordinator, University of Florida College of Medicine, Gainesville, FL
- Scheurle, Daniela; Coordinator of academic programs, FAU Department of Biological Sciences, Boca Raton, FL

POSTDOCTORAL FELLOWS

Highlights: After PhD, Centerites are often recruited in Medical and Pharmacology School, or in areas relating to Human Health (the PhD program was funded for over a decade by a NIH training grant)

- Gordon, Reyna; VKC Research Fellow, Vanderbilt University, Nashville, TN
- Kim, Ji Chul; Postdoctoral Fellow, University of Connecticut, Storrs, CT
- Norman, Joseph; Postdoctoral Researcher, New England Complex Systems Institute, Cambridge, MA
- Rankin, Summer; Postdoctoral Fellow at Johns Hopkins School of Medicine, Baltimore, MD
- Rho, Young-Ah; Postdoctoral Associate, Department of Mathematics, University of Pittsburgh, Pittsburgh, PA
- Richter, Craig; Postdoctoral fellow at Ecole Normale Superieure, Paris, France
- Stefanescu, Roxana; Dept. of Otolaryngology, Kresge Hearing Res. Inst., Univ. of Michigan, Ann Arbor, MI
- Tang, Wei; Research Fellow at the Martinos Center for Biomedical Imaging at Massachusetts General Hospital & Department of Radiology, Harvard Medical School, Cambridge, MA

INDUSTRY, PRIVATE RESEARCH INSTITUTES

Highlights: former Centerites at IBM, Pfizer, Mathworks, Johnson & Johnson, Biotechnology, Security and consulting companies

- Ballan, Meltem; Senior Animal Behavior and Technology Consultant, Plexon Inc - Neurotechnology Research Systems, Dallas, TX
- Chen, Yanqing; Senior Scientist - Computational Biology at Johnson and Johnson, San Diego, CA (formerly scientist at the Neuroscience Institute, G. Edelman director)
- Dodel, Silke; Ocean Ridge Biosciences, Palm Beach Gardens, FL
- Gleason, Phil; Retired researcher, IBM
- Mayville, Justine; Independent Research and Strategic Consultant, Giant Leap Consulting, Ashville, NC
- Norman, Michael; Senior Software Research Engineer at MITRE, Bedford, MA
- Tan, Miao; Scientist at Multispan Inc., Hayward, CA
- Treffner, Paul; Consultant, Statistical analysis, University of Waikato, School of Business, Hamilton, New Zealand
- Vallabha, Gautam; Senior Software Developer at The Mathworks (MATLAB), Boston, MA
- Verschoor, Frans; Vice President Research and Development, Westbury Research Management Intelligence, Sassenheim, Netherlands

WRITERS AND PUBLISHERS

- Chapin, Heather; Medical Science Writer and Editor, Education & Training Systems International (ETSI), Chapel Hill, NC
- Ditzinger, Thomas; Senior Editor, Springer, Heidelberg, Germany
- Engstrøm, David; Copenhagen, Denmark

Appendix B: list of publications for the last 5 years

JOURNALS

Allen D, Bond CT, Luján R, Ballesteros-Merino C, Lin MT, Wang K, Klett N, Watanabe M, Shigemoto R, Stackman RW, Maylie J, Adelman JP (2011) The SK2-long isoform directs synaptic localization and function of SK2-containing channels. Nature Neurosci 14: 744-749.

Anastassov, I W Shen, H Ripps, RL Chappell (2013) Zinc modulation of calcium activity at the photoreceptor terminal: a calcium imaging study. Exp. Eye Res., 112:37-44.

Azzopardi, P., & Hock, H.S. (2011). Illusory motion perception in blindsight. Proceedings of the National Academy of Sciences, 108, 876-881.

Banerjee, A., Tognoli, E., Kelso, J.A.S., Jirsa, V.K. (2012). Spatiotemporal (re)organization of sensorimotor networks underlying unimanual and bimanual coordination. Neuroimage, 62(3): 1582-1592.

Barenholtz, E. (2010). Convexities move because they contain matter. Journal of Vision.

Barenholtz, E. (2013) Quantifying the Role of Context in Visual Object Recognition, Visual Cognition (21), 1-27

Barenholtz, E. and Tarr, M.J. (2011). Visual Learning of Statistical Relations Among Non-adjacent Features: Evidence for Structural Encoding. Visual Cognition, 19, 469-475.

Barenholtz, E., Davidson, M. and Lewkowicz, D. (2011). Multisensory Associative-Pair Learning: Evidence for 'Unitization' as a specialized mechanism. Proceedings of the Cognitive Sciences Society, 33, 225-230

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Stackman, R.W. Lora, J.C. and Williams, S.B. (2012). Directional responding of C57BL/6J mice in the Morris water maze is influenced by visual and vestibular cues and is dependent upon the anterior thalamic nuclei. *Journal of Neuroscience.* 32(30): 10211-10225.

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Sur A., Baronas-Lowell, D., Kesaraju S., Prentice, H.M., Weissbach, H. and Blanks, J.C. PPAR alpha activation is involved in protection of Retinal Pigment Epithelial Cells by Sulindac. To be submitted in September 2013 to "Experimental Eye Research."

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Tognoli, E., Kelso, J.A.S. (2014). The metastable brain. Neuron, 81(1): 35-48. [Free feature article in January; Altmetric 98th percentile, high impact]

Tognoli, E., Kovacs, A.J., Suutari, B., Afergan, D., Coyne, J., Gibson, G., Stripling, R., Kelso, J.A.S. (2011). Behavioral and brain dynamics of team coordination, Part I: task design. In Hutchison, D.; Kanade, T.; Kittler, J.; Kleinberg, J. M.; Mattern, F.; Mitchell, J. C.; Naor, M.; Nierstrasz, O.; Pandu Rangan, C.; Steffen, B.; Sudan, M.; Terzopoulos, D.; Tygar, D.; Vardi, M. Y.; Weikum, G.; Schmorrow, D. D. & Fidopiastis, C. M. (Eds.). Foundations of Augmented Cognition. Directing the Future of Adaptive Systems, Springer Berlin Heidelberg, 6780: 257-264.

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Wade, J.J., McDaid, L.J., Harkin, J., Crunelli, V., & Kelso, J.A.S. (Eds.) (2013). Biophysically-based computational models of astrocyte~neuron coupling and their functional significance. Frontiers in Computational Neuroscience, e-Book

Wade, J.J., McDaid, L.J., Harkin, J.G., Crunelli, V., & Kelso, J.A.S. (2011) Exploring retrograde signaling via astrocytes as a mechanism for self-repair. *IEEE Proceedings of International Joint Conference on Neural Networks*, pp.3149-3155.

Wade, J.J., McDaid, L.J., Harkin, J.G., Crunelli, V., & Kelso, J.A.S. (2012). Self-repair in a bidirectionally coupled astrocyte-neuron system based on retrograde signaling. *Frontiers in Computational Neuroscience.*

Wade, J.J., McDaid, L.J., Harkin, J.G., Crunelli, V., & Kelso, J.A.S. (2011) Bidirectional coupling between astrocytes and neurons mediates learning and dynamic coordination in the brain: A multiple modeling approach. PLoS ONE, 6,e29445.

Woodman, M., Perdikis, D., Pillai, A. S., Dodel, S., Huys, R., Bressler, S., & Jirsa, V. K., (2011). Building neurocognitive networks with a distributed functional architecture. *Adv Exp Med Biol*, 718:101–109.

Wu, JY and Prentice, H Role of taurine in the central nervous system. J. Biomed. Sci., 2010 Aug 24; 17 (Suppl 1) S1.

Zhang G, Ásgeirsdóttir HN, Cohen SJ, Munchow AH, Barrera MP and Stackman RW (2013). Stimulation of serotonin 2A receptors facilitates consolidation and extinction of fear memory in C57BL/6J mice. Neuropharmacol 64: 403-413.

Zhang, G., Rios, L.M., Martínez-Hernández, J., Luján, R. and Stackman, R.W. (2013). Stimulation of hippocampal serotonin 2A receptors enhances consolidation of non-spatial object memory and hippocampal neurophysiology in C57BL/6J mice. Neuropsychopharmacology.

BOOKS

Armin Fuchs: Nonlinear Dynamics in Complex Systems: Theory and Applications for the Life-, Neuro- and Natural Sciences, Springer Verlag, Berlin (2013)

Bremner, A. J., Lewkowicz, D. J., Spence, C. (Eds.). Multisensory Development. Oxford University Press. 2012.

Stein, B. (Ed.). The New Handbook of Multisensory Processing. Lewkowicz, D. J. & King, A. J. (Section editors: Development, Plasticity, and Evolution). MIT Press. 2012.

Vertes R.P. and R. W. Stackman (Eds.), Electrophysiological Recording Techniques. Humana Press, New York, 2011.

Appendix C: Analysis of Center leadership in FAU's Neuroscience

This analysis of Society for Neuroscience's Annual Meeting abstract submission aims to emphasize the Center's unique contribution to the Neuroscience at FAU. We analyze the Society for Neuroscience's Annual Meeting Itinerary Planner with keywords "Florida Atlantic Univ" and "Florida Atlantic University" to record the contribution of FAU's community to the meeting, and we provide a descriptive statistics of our findings.

	2008	2009	2010	2011	2012	2013	2014	Total 7 years
Center	13	12	16	15	28	10	13	107
All FAU	24	26	26	23	37	15	17	168
%	54%	46%	62%	65%	76%	67%	76%	64%

Table 8: Abstracts by FAU investigators submitted at SfN

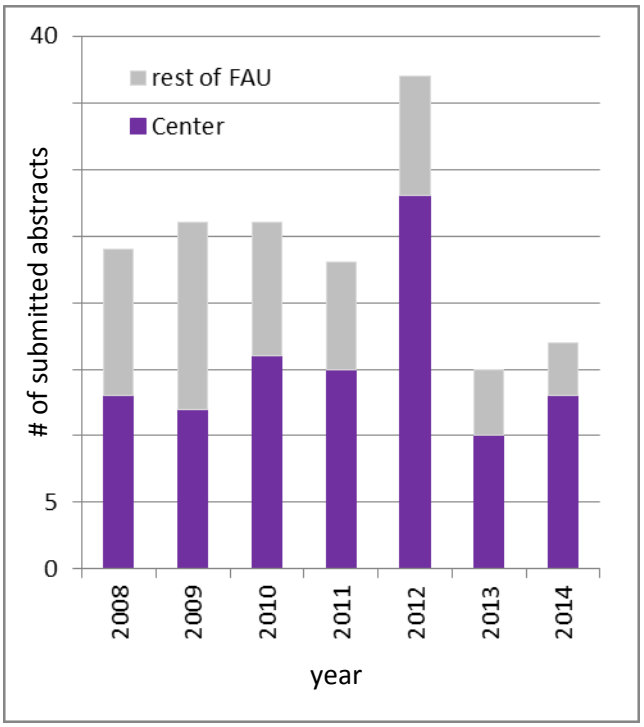

Figure 5: Center and other investigators' contribution to SfN

Summary: Despite the small size of its Faculty, over the past 7 years, the Center for Complex Systems and Brain Sciences authors close to 2/3rd of all the contributions to the Society for Neuroscience's Annual Meeting recorded to FAU. The Society for Neuroscience is the reference meeting for Neuroscience, with an annual attendance over 30.000 participants. Center contribution has greatly increased as a proportion of the University's submission (from about ½ submissions in 2008-2009 to 72% in the last two years), even as other Neuroscience-related departments (Biomedical Science and Biology) were increasing in size and the Center was struck by severe loss of Core Faculty.

Appendix D: proposed curriculum for interdisciplinary undergraduate program in Complex Systems

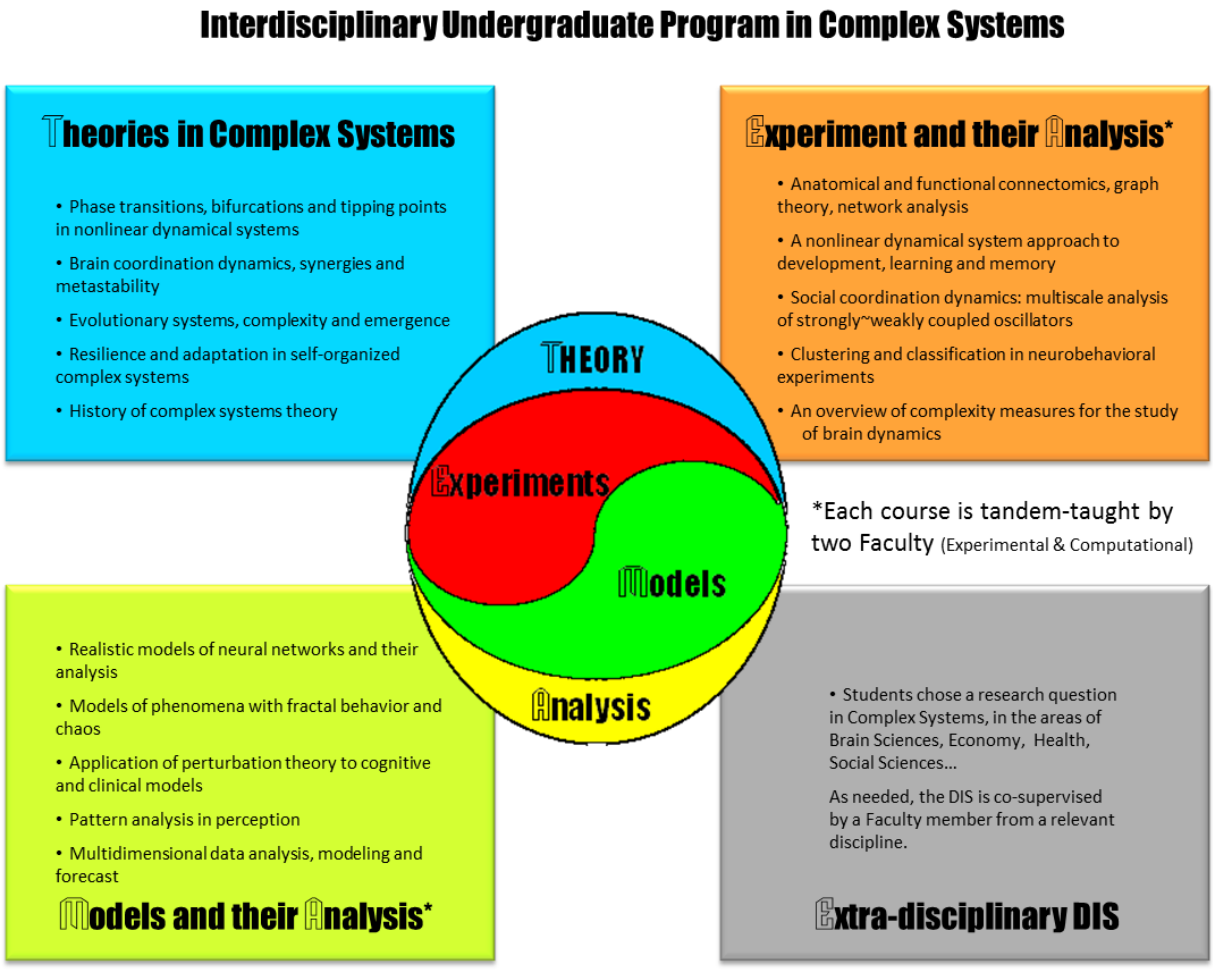

Figure 6: The proposed interdisciplinary undergraduate program aims at providing students with a broad but focused understanding of, and associated reasoning skills in, complex systems; and literacy in quantitative methods such as complex data analysis and modeling. The program nurtures the student's ability to work in teams and seamlessly cut across different disciplinary environments. It brings three educational innovations: (1) it would become FAU's first undergraduate interdisciplinary program, (2) a large number of its courses are team taught by Faculty (complementary experimental and quantitative approaches), and (3) in its efforts to address a variety of real-world problems, it outreaches to other disciplines by encouraging "extra"disciplinary DIS (DIS co-supervised by CCSBS Faculty and Faculty from another discipline, e.g. Environmental Science, Economy, Health Sciences, etc.). STEM is in high demand by employers, and "big data" even more so, and we anticipate students to take positions in data analytics and information management in government and industry.

Appendix E: Center Faculty Biosketches

BIOGRAPHICAL SKETCH

NAME	POSITION TITLE
Barenholtz, Elan	Associate Professor of Psychology
eRA Commons User Name EBARENHOLTZ	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	YEAR(s)	FIELD OF STUDY
Yeshiva University	B.A.	1996-1999	Psychology
Rutgers University/New Brunswick	M.S/Ph.D.	1999-2004	Psychology
Brown University		2004-2007	Cognitive Science

A. Personal Statement

My research concerns the integration of multiple sources of information in object representation and recognition. Specific examples include the combination of contextual and feature-based information in visual object recognition as well as learning and memory of associations among multisensory object properties. Findings from this research have been published in leading journals and my research program has received funding from NIH, DoD and NSF. My background in these diverse areas of research of object representation makes me particularly well suited to the topic of the current proposal: the association of multiple properties into unitized, multisensory object.

B.Positions and Honors.

Positions and Employment

1999-2004 Doctoral Student, Psychology, Rutgers University/New Brunswick, New Brunswick, NJ
2004-2007 Postdoctoral Research Fellow, Cognitive Science, Brown University, Providence, RI
2007-2013 Assistant Professor, Psychology, Florida Atlantic University, Boca Raton, FL
2013-Present Associate Professor, Psychology, Florida Atlantic University, Boca Raton, FL

Honors

1999 Rutgers University Graduate Fellowship, 2001-2002
2001 National Institute of Health (NIH) NRSA Institutional Pre-doctoral Fellowship
2004 National Institute of Health (NIH) NRSA Postdoctoral Fellowship

C. Peer-reviewed publications (in reverse chronological order)

1) **Barenholtz,** E., Lewkowicz, D. J., Mavica, L., & Davidson, M. (2014). Categorical congruence facilitates multisensory associative learning. *Psychonomic Bulletin & Review*. Advance online publication. doi:10.3758/s13423-014-0612-7.
2) **Barenholtz, E.** (2013) Quantifying the Role of Context in Visual Object Recognition, *Visual Cognition* (21), 1-27
3) Mavica, L. and **Barenholtz, E.** (2013). Matching voice and face identity from static images. *Journal of Experimental Psychology: Human Perception and Performance*, 39, 307–312
4) **Barenholtz, E**., Davidson, M. and Lewkowicz, D. (2011). Multisensory Associative-Pair Learning: Evidence for 'Unitization' as a specialized mechanism. *Proceedings of the Cognitive Sciences Society*, 33, *225-230*
5) **Barenholtz, E.** and Tarr, M.J. (2011). Visual Learning of Statistical Relations Among Non-adjacent Features: Evidence for Structural Encoding. *Visual Cognition, 19, 469-475.*
6) Marques, O. **Barenholtz, E.** and Charvillat, V. (2010). Context modeling in computer vision: techniques, implications, and applications. *International Journal of Multimedia Tools and Applications.*
7) **Barenholtz, E.** (2010). Convexities move because they contain matter. *Journal of Vision.*

8) **Barenholtz, E**. & Tarr, M. J. (2009). Figure–ground assignment to a translating contour: A preference for advancing vs. receding motion. *Journal of Vision,* 9, 1-9.
9) **Barenholtz, E**. & Tarr, M.J. (2008). Visual judgment of similarity across shape transformations: Evidence for a compositional model of articulated objects. *Acta Psychologica*, 128, 331-338.
10) **Barenholtz, E**. & Tarr, M.J. (2007) Reconsidering the role of structure in vision. *The Psychology of Learning and Motivation*, Vol. 47, Markman, A., & Ross, B. (Eds.).
11) **Barenholtz, E**. & Feldman, J. (2006). Determination of visual figure and ground in dynamically deforming shapes. *Cognition*, 101, 530-544.
12) Cohen, E.H., **Barenholtz, E**., Feldman, J. & Singh, M. (2005). What change detection tells us about the visual representation of shape. *Journal of Vision*, 5, 313-321.
13) **Barenholtz, E**., Cohen, E.H., Feldman, J. & Singh, M. (2003). Detection of change in shape: An advantage for concavities. *Cognition,* 89, 1-9.
14) **Barenholtz, E**. & Feldman, J. (2003) Visual comparisons within and between object-parts: Evidence for a single-part superiority effect. *Vision Research,* 43, 1655-1666.

D. Research Support

Pending Research Support
National Institutes of Health. Neural mechanisms of multisensory identity formation: an electroencephalographic approach. 2015-2017. Award Requested: $391,190

Completed Research Support
National Geospatial Intelligence Agency (NGA) HM1582-04-C-0051, “Visual Perception of Articulating Objects,” E. Barenholtz and M. Tarr, P.I.s, 2004-2007. Award Amount: $494,352. Role: Co-Investigator

National Sciecne Foundation (NSF) Award No.BCS-0958615. “Identifying Objects Within Scenes: Combining Context and Features in Visual Object Recognition”. 2010-2013. Award Amount: $196,647. Role: P.I.

BIOGRAPHICAL SKETCH

NAME	POSITION TITLE
Janet C. Blanks, Ph.D.	Professor and Director, Complex Systems & Brain Sciences, Florida Atlantic University

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	YEAR(s)	FIELD OF STUDY
University of California, Los Angeles	PhD	1973	Anatomy
Jules Stein Eye Institute, UCLA	Post-Doc	1973-1974	Retinal cell biology
Max Planck Inst. Brain Research (Germany)	Post-doc	1974-1976	Neuroanatomy
Harvard Medical School, Boston	Post-doc	1976-1978	Developmental Neuroanatomy

A. Personal Statement

My long-term goal is to use my knowledge and skills as a retinal cell biologist to design therapeutic strategies to treat retinal diseases. My past research focused on rodent models of retinal degeneration, involving mutant mice and mice exposed to bright light leading to the degeneration of photoreceptor cells. I am actively involved in designing novel approaches to treat retinal diseases, such as Age-related Macular Degeneration (AMD) and Diabetic Retinopathy (DR) by using targeted gene therapy to reduce abnormal vascularization in the eye, a hallmark of both DR and the "wet" or neovascular form of AMD.

B. Positions and Honors

1974 – 1976 Visiting Scientist, Max Planck Institute for Brain Research, Frankfurt, Germany

1976 – 1978 Instructor, Department of Neuroscience, Children's Hospital Medical Center, and Department of Neuropathology, Harvard Medical School, Boston, MA

1978 – 1997 Assistant to Full Professor of Ophthalmology and Anatomy & Cell Biology, USC School of Medicine; and Director, Electron Microscopy Laboratory, Estelle Doheny Eye Foundation, CA

1996 – 2001 **Executive Vice President, Association for Research in Vision and Ophthalmology (ARVO)**

1997 – 2002 Professor of Biomedical Sciences, and Director, Eye Research Institute, Oakland University, Rochester, MI

2002 – 2007 Professor of Biomedical Science, Department of Biomedical Science, Florida Atlantic University, Boca Raton, Florida

2007 – Present Director and Professor of Center for Complex Systems and Brain Sciences, Florida Atlantic University, Boca Raton, Florida

Honors

2009 ARVO Fellow, Inaugural Class of 2009. Voted an inaugural "Gold" Fellow by the Association of Research in Vision and Ophthalmology (ARVO) trustees.

2012 Awarded "Distinguished Teacher of the Year" from the College of Science at FAU

2012 The FAU National Alumni Association "Degree of Difference" award

C. Selected Peer-reviewed Publications (70 publications total)

Relevant publications

1. Organisciak, D.T., Jiang, Y.-L., Wang, H.-M., Pickford, M., and Blanks, J.C.: Retinal light damage in rats exposed to intermittent light. Invest. Ophthalmol. Vis. Sci. 30:795-805, 1989.
2. Blanks, J.C., Pickford, M.S., and Organisciak, D.T.: Ascorbate treatment prevents accumulation of phagosomes in RPE in light damage. Invest. Ophthalmol. Vis. Sci. 33:2814-2821, 1992.
3. Organisciak, D.T., Darrow, R.M., Jiang, Y.L., Marak, G.E., and Blanks, J.C.: Protection by dimethylthiourea against retinal light damage in rats. Invest. Ophthalmol. Vis. Sci. 33:1599-1609, 1992.
4. Organisciak, D.T., Darrow, R.M., Jiang, Y.L., and Blanks, J.C.: Retinal light damage in rats with altered levels of rod outer segment docosahexaenoate. Invest. Ophthalmol. Vis. Sci. 37:2243-2257, 1996.
5. Nachman-Clewner,M., Giblin, FJ., Dorey, C.K., Blanks, R.H.I., Dang, L., Dougherty, C.J. and Blanks J.C.: Selective Degeneration of Central Retinal Photoreceptors Following Hyperbaric Oxygen Treatment in Normal and Metallothionein-Knockout Mice. *Invest. Ophthalmol. Vis. Sci. 49:3207-3215, 2008.*

Recent Publications of Importance to the Field of Gene Therapy in the Eye:

1. Pang, J., Cheng, M. Stevenson, D., Trousdale, M.D., Dorey, C.K. and Blanks, J.C.: Adenoviral-mediated gene transfer to retinal explants during development and degeneration. Exp. Eye Res. 79:189-201, 2004.
2. Pang, J., Cheng, M., Haire, S.E., Barker, E., Planelles, V., and Blanks J.C.: Efficiency of lentiviral transduction during development in normal and rd mice. MolecularVision 12:756-767, 2006 <http://www.molvis.org/molvis/.
3. Dougherty, C.J., Smith, G.W., Prentice, H.M., Dorey, C.K., Webster, K.A. and Blanks, J.C.(2008). "Robust Hypoxia-Selective Regulation of an RPE-Specific AAV Vector". *Molecular Vision.* <http://www.molvis.org/molvis/v14/a56/>
4. Schmidt-Kastner R, Kreczmanski P, Preising M, Diederen, R, Schmitz C, Reis D, Blanks JC, Dorey, CK. Expression of the diabetes risk gene Wolframin (WFS1) in the human retina. Exp Eye Res. 89:568-74, 2009.
5. Prentice, H.M., Biswal, M., Dorey, C.K. and Blanks, J.C.: Hypoxia-regulated, retinal glial cell-specific promoter for potential gene therapy in disease. *Invest. Ophthalmol. Vis. Sci.*, E-sPublished on September 29, 2011 as Manuscript IOVS.10-6835.
6. Smith GW, Dorey CK, Prentice H, Blanks J. The Importance of Hypoxia-Regulated, RPE-Targeted Gene Therapy for Choroidal Neovascularization. Adv Exp Med Biol. 2012, 723:269-77.
7. Biswal MR, Prentice H, Dorey CK, Blanks JC. A hypoxia responsive glia cell-specific gene therapy vector for targeting retinal neovascularization. Invest Ophthalmol Vis Sci. 2014 Nov 6. Pii: IOVS-14-13932. [Epub ahead of print] PMID:25377223.
8. Sur A, Kesaraju S, Prentice H, Ayyanathan K, Baronas-Lowell D, Zhu D, Hinton DR, Blanks J, Weissbach H. Pharmacological protection of retinal pigmented epithelial cells by sulindac involves PPAR-α. Proc Natl Acad Sci USA. 2014 Nov 10. Pii: 201419576. [Epub ahead of print] PMID:2538631.

9. Smith, G W., Biswal, M R., Hernandez, E, Prentice, H, Dorey, C.K. and Blanks, J.C. Hypoxia-regulated, RPE-specific gene therapy reduces choroidal neovascularization in mouse model of AMD. To Be Submitted Molecular Vision.

D. Patents:

MATERIALS AND METHODS FOR THE TREATMENT OF PATHOLOGICAL NEOVASCULARIZATION IN THE EYE, Patent awarded in July 2014 to Janet Blanks, Howard Prentice and C. Kathleen Dorey.

USE OF SULINDAC TO TREAT RETINOPATHY, Provisional Patent filed in Spring 2013, Janet C. Blanks, Howard Prentice and Herbert Weissbach.

E. Research Support

Ongoing:

Bridge funding from College of Science: "Use of decorin to block neovascularization in oxygen induced retinopathy model of diabetic retinopathy."

Completed:

R03EYO16119 "Hypoxia Regulated Gene Therapy for Neovascularization" dates 01/01/05 – 12/31/09, No cost extension granted until 12/31/09, Total Direct and Indirect Cost: $421,500. The goal of this grant was to develop cell-specific, hypoxia-regulation gene therapy vectors to reduce neovascularization present in animal models of neovascular Age-related Macular Degeneration (AMD) and diabetic retinopathy.

American Heart Association, Principal Investigator: Manas Biswal. I serve as mentor on this grant with Dr. Howard Prentice as co-Mentor. 07/01/08 to 06/30/10 Total Direct Costs: $43,400 Title: "Reversal of Oxidative Damage in an In-Vitro Model of Stroke."
I co-mentored a project to pay the stipend of my doctoral student, Manas Biswal, to design cell-specific, hypoxia-regulated gene therapy vectors to reduce neuronal cell death present in an *in vitro* model of stroke.

FAU Research Theme Grant Award: "Brain Function Damage and Repair" dates 07/01/2010 – 06/30/2013. Total Cost: $500,000. Janet Blanks and Rod Murphey
This project was a collaborative project to bring together neuroscientists at FAU in order to promote collaboration between investigators and develop new, exciting research projects in the field. Drs. Blanks and Murphey were responsible in reviewing competitive applications from faculty members in order to award SEED grants of up to $20,000/yr. Grand funds were also used to foster communication and collaboration between scientists at Scripps Research Institute Florida and the newly developed Max Planck Institute Florida, both located on the Jupiter campus of FAU.

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FOUR PAGES.**

NAME	POSITION TITLE
Bressler, Steven L	Professor of Psychology Professor of Complex Systems & Brain Sciences
eRA COMMONS USER NAME (credential, e.g., agency login) stevenlbressler	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	MM/YY	FIELD OF STUDY
Johns Hopkins University	B.A.	06/72	Biopsychology
University of California, Berkeley	Ph.D.	06/82	Neurophysiology
EEG Systems Laboratory, San Francisco	Postdoctoral	08/86	Bioengineering

A. Personal Statement

I am Professor of Psychology at Florida Atlantic University, where I direct the Cognitive Neurodynamics Laboratory in the Center for Complex Systems and Brain Sciences. My research is aimed at investigating the dynamic functional organization of large-scale networks in the brain. Over the past 20 years, I have contributed to the understanding of large-scale brain networks with support from NIH and NSF. My papers have been cited over 2600 times in leading research journals. In my career, I have developed sophisticated analyses of physiological time series data in both monkeys and humans in order to examine temporal interactions between different brain areas. I will contribute to the proposed research by insuring that the analysis methods are state-of-the-art. I will specifically guide the development of analysis on directional interactions. I will also be involved in weekly discussions on theoretical issues and data interpretation.

B. Positions and Honors

Positions and Employment

1986-1990	Senior Scientist, EEG Systems Laboratory, San Francisco, CA
1988-1990	Lecturer, Pacific Graduate School of Psychology, Palo Alto, CA
1990-1997	Associate Professor of Complex Systems, Associate Professor of Psychology, Florida Atlantic University, Boca Raton, FL
1997-present	Professor of Complex Systems & Brain Sciences, Professor of Psychology, Florida Atlantic University, Boca Raton, FL

Other Experience and Professional Memberships

1979-present	Society for Neuroscience
1999-present	International Neural Network Society
2007	NSF Panel on New Frontiers in Dynamical Systems
2007	Co-Organizer, NSF Conference on Brain Network Dynamics
2008	Scientific Committee, International Conference on Cognitive Neuroscience
2008	Program Co-Chair, International Joint Conference on Neural Networks (IJCNN09)
2008-2009	Program Co-Chair, International Joint Conference on Neural Networks (IJCNN09)
2008-2009	Program Committee, International Joint Conference on Neural Networks (IJCNN09)
2009	Organizer, Symposium on Top-Down Mechanisms of Visual Attention, Computational Cognitive Neuroscience Conference
2009-2012	Board of Governors, International Neural Networks Society (INNS)
2009-present	Action Editor, Neural Networks

2010	Organizer, NSF Conference on Neurocognitive Networks
2010-2011	Special Sessions Chair, International Joint Conference on Neural Networks

Honors

1972	Phi Beta Kappa, Johns Hopkins University
1980	Shev Award, Western EEG Society
1982	Shev Award, Western EEG Society
1999	Best Presentation Award, International Joint Conference on Neural Networks
2001	Teaching Incentive Program Award, Florida Atlantic University
2006	Best Presentation Award, International Joint Conference on Neural Networks

C. Selected Peer-reviewed Publications (Selected from 97 peer-reviewed publications)

Most relevant to the current application (reverse chronological order)

1. Salazar RF, Dotson NM, **Bressler SL**, Gray CM. Content specific fronto-parietal synchronization during visual working memory, Science, 338, 1097-1100, 2012, http://www.sciencemag.org/content/338/6110/1097.short
2. Fuster JM, **Bressler SL**. Cognit activation: a mechanism enabling temporal integration in working memory, Trends in Cognitive Sciences, 16, 207-218, 2012, http://www.cell.com/trends/cognitive-sciences/abstract/S1364-6613(12)00060-5
3. Meehan TP, **Bressler SL**. Neurocognitive networks: findings, models, and theory, Neuroscience and Biobehavioral Reviews, 36, 2232-2247, 2012, http://www.sciencedirect.com/science/article/pii/S0149763412001273
4. **Bressler SL**, Menon V. Large-scale brain networks in cognition: emerging methods and principles, Trends in Cognitive Sciences, 14, 277-290, 2010, http://www.cell.com/trends/cognitive-sciences/abstract/S1364-6613(10)00089-6
5. Brovelli A, Ding M, Ledberg A, Chen Y, Nakamura R, **Bressler SL**. Causal influences between beta-frequency oscillatory neuronal assemblies in monkey sensorimotor cortex, Proceedings of the National Academy of Sciences USA, 101, 9849-9854, 2004, http://www.pnas.org/content/101/26/9849.abstract?sid=a8bc64de-7c63-43ba-ad2b-d998a6465ed9

Additional publications of importance to the field (reverse chronological order)

1. Bressler SL, Tang W, Sylvester C, Shulman G, Corbetta M. Top-down control of human visual cortex by frontal and parietal cortex in anticipatory visual spatial attention, Journal of Neuroscience 2008, 28:10056-10061.
2. Bressler SL. Neurocognitive networks. Scholarpedia 2008, 3(2):1567.
3. Ledberg A, Bressler SL, Ding M, Coppola R, Nakamura R. Large-scale visuomotor integration in the cerebral cortex, Cerebral Cortex 2007, 17:44-62.
4. Bressler SL, Richter CG, Chen YH, Ding M. Cortical functional network organization from autoregressive modeling of local field potential oscillations. Statistics in Medicine 2007, 26:3875-3885.
5. Bressler SL, Tognoli, E. Operational principles of neurocognitive networks. International Journal of Psychophysiology 2006, 60:139-148.
6. Bressler SL. Cortical coordination dynamics and the disorganization syndrome in schizophrenia. Neuropsychopharmacology 2003, 28:S35-S39.
7. Bressler SL, Kelso JAS. Cortical coordination dynamics and cognition. Trends in Cognitive Sciences 2001, 5:26-36.
8. Bressler SL. Interareal synchronization in the visual cortex. Behavioral Brain Research 1996, 76:37-49.
9. Bressler SL. The gamma wave: a cortical information carrier? Trends in Neurosciences 1990, 13:161-162.
10. Gevins A, Morgan N, Bressler S, Cutillo B, White R, Illes J, Greer D, Doyle J, Zeitlin G. Human neuroelectric patterns predict performance accuracy. Science 1987, 235:580-585.

D. Research Support

Ongoing Research Support

RO1 MH081162 NIMH Gray (PI) 07/01/09 – 06/30/14
Distributed Cortical Processing in Visual Working Memory
The goal of this study is to advance understanding of the cortical basis for the storage, maintenance, and retrieval of information in visual working memory.
Role: Co-Investigator

Completed Research Support

BCS-1110883 NSF Minai (PI) 03/14/11 – 04/13/12
From Brains to Machines: A Special Program at the 2011 International Joint Conference on Neural Networks
The goal of this project is to present a program on the underpinning of neural network research in the neural and cognitive sciences at the premiere international conference for researchers in neural networks.
Role: Co-Investigator

BCS-0924414 NSF Bressler (PI) 09/15/09 – 08/31/11
Conference on Neurocognitive Networks
The goal of this project is to foster increased understanding of neurocognitive networks through a conference (held in January 2010), an ongoing website, and subsequent publications.
Role: PI

BCS-0652375 NSF Menon (PI) 01/26/07 – 01/25/08
Conference on Brain Network Dynamics
The goal of this project was to present a high-quality scientific program that examined the dynamics of distributed brain function from a multidisciplinary approach.
Role: Co-Investigator

R01 MH072034 NIMH Liang (PI) 09/01/06 – 07/31/09
Attention Related Ensemble Activity in Visual Cortex
The goal of this study was to analyze and interpret multi-electrode multi-unit spike and local field potential recordings from visual cortical areas of macaque monkeys performing a visual spatial selective attention task.
Role: Co-Investigator

R01 NS054314 NINDS Liang (PI) 07/15/05 – 04/30/09
Quantitative Tools for Analyzing Brain Circuits
The goal of this study was to develop a sophisticated, integrated software tool set for the analysis of multi-channel electrophysiological data.
Role: Co-Investigator

R21 MH069374 NIMH Gray (PI) 12/01/03 – 11/30/05
Corticocortical Interactions in Visual Working Memory
The goal of this study was to investigate the neural basis for the integration of object identity and location, the maintenance of this information in working memory, and its utilization for directed motor action.
Role: Co-Investigator

R01 MH64204 NIMH Bressler (PI) 03/01/02 – 02/28/08
Dynamics of Large Scale Cortical Networks
The goal of this study was to study the coordinated activities of neuronal ensembles in visual perception.

Role: PI

IBN-0090717 NSF Bressler (PI) 09/15/01 – 08/31/04
Large-Scale Distributed Cortical Networks in Vision
The goal of this study was to enhance our understanding of the role played by large-scale cortical networks in visual function.
Role: PI

R03 MH58190 NIMH Bressler (PI) 04/01/98 – 03/31/00
Development of Advanced Techniques for Analyzing Cortical Dynamics
The goal of this study was to develop new analytical tools to investigate the coordinated activity of distributed neuronal ensembles in the cerebral cortex of humans and non-human primates performing simple visuomotor tasks.
Role: PI

Curriculum Vitae

Armin Fuchs, Ph.D.

DOB: March 13, 1959 in Nuertingen, Germany

Citizenship: German, US permanent resident

Address:

Center for Complex Systems & Brain Sciences and Department of Physics
Florida Atlantic University
777 Glades Road
Boca Raton, FL 33431

Office: Behavioral Sciences, BS 12, room #307

Phone: 561-297-0125

FAX: 561-297-3634

Email: afuchs@fau.edu

Web: www.ccs.fau.edu/~fuchs

Employment:

2001-present: Associate Professor, Center for Complex Systems & Brain Sciences and Department of Physics, Florida Atlantic University, Boca Raton, FL

1995-2001: Assistant Professor, Center for Complex Systems & Brain Sciences and Department of Physics, Florida Atlantic University, Boca Raton, FL

1994-1995: Akademischer Rat (tenured staff), Institut fuer Theoretische Physik und Synergetik, Universitaet Stuttgart, Stuttgart, Germany

1993-1994: Postdoctoral fellow, funded by NIMH grant (MH42900, P.I.: J.A.S. Kelso), Center for Complex Systems, Florida Atlantic University, Boca Raton, FL

1991-1992: Individual postdoctoral fellowship, funded by DFG (German Research Foundation), Center for Complex Systems, Florida Atlantic University, Boca Raton, FL

1990-1991: Akademischer Rat (tenured staff), Institut fuer Theoretische Physik und Synergetik, Universitaet Stuttgart, Stuttgart, Germany

1985-1990: Wissenschaftlicher Angestellter (comparable: Research Assistant), Institut fuer Theoretische Physik und Synergetik, Universitaet Stuttgart, Stuttgart, Germany

Education:

Postdoctoral fellow, Center for Complex Systems, Florida Atlantic University, 1991-1994

Ph.D. (Theoretical Physics), Universitaet Stuttgart, Stuttgart, Germany, 1990

Diploma (Theoretical Physics), Universitaet Stuttgart, Stuttgart, Germany, 1985

Publications

Textbooks:

Armin Fuchs: Nonlinear Dynamics in Complex Systems: Theory and Applications for the Life-, Neuro- and Natural Sciences, Springer Verlag, Berlin (2013)

Edited Books:

Armin Fuchs, Viktor K. Jirsa, eds.: Coordination: Neural, Behavioral and Social Dynamics, Springer Verlag, Berlin (2008)

Recent Articles:

A. Fuchs, A. Hotiu, K.J. Jantzen, F. Steinberg, J.A.S. Kelso: `Diffusion Tensor Imaging in Mild Traumatic Brain Injuries - Acute State and Short-Term Recovery', Journal of Neurotrauma, revised version submitted

A. Fuchs: `Spatial Spectral Methods', in: Encyclopedia of Computational Neuroscience, D. Jaeger, R. Jung, eds., Springer Verlag, Berlin, to appear November 2014

M. Jing, T.M. McGinnity, S. Coleman, A. Fuchs, J.A.S. Kelso: `Longitudinal Study of Temporal Changes in Diffusion Patterns in Mild Traumatic Brain Injury Using Semi-Blind Source Separation', Journal of Biomedical and Health Informatics, accepted (2014), currently available under 'Early Access' on the journal's webpage

V. Murzin, A. Fuchs, J.A.S. Kelso: `Detection of Correlated Sources in EEG Using Combination of Beamforming and Surface Laplacian Methods', Journal of Neuroscience Methods, 218: 96-102 (2013)

V. Kostrubiec, P.G. Zanone, A. Fuchs, J.A.S. Kelso: `Beyond the blank slate: routes to learning new coordination patterns depend on the intrinsic dynamics of the learner - experimental evidence and theoretical model', Frontiers in Human Neuroscience, 6: 1-14 (2012)

M. Jing, T.M. McGinnity, S. Coleman, H. Zhang, A. Fuchs, J.A.S. Kelso: `Enhancement of fibre orientation distribution reconstruction in diffusion weighted imaging by single channel blind source separation', IEEE Transactions on Biomedical Engineering, 59: 363-373 (2012)

V. Murzin, A. Fuchs, J.A.S. Kelso: `Anatomically Constrained Minimum Variance Beamforming Applied to EEG', Experimental Brain Research, 214: 515-528 (2011)

A. Fuchs: `Dynamical systems in one and two dimensions: a geometrical approach', in: Nonlinear dynamics in human behavior, R. Huys, ed., Springer Verlag, Berlin, pp. 1-34 (2010)

A. Fuchs, J.A.S. Kelso: `Movement Coordination', in: Encyclopedia of Complexity and Systems Science, B. Meyers, ed. in chief, Springer Verlag, Berlin, pp. 5718-5736 (2009)

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. DO NOT EXCEED FOUR PAGES.

NAME	POSITION TITLE
Howard S. Hock	Research Professor
eRA COMMONS USER NAME (credential, e.g., agency login)	

EDUCATION/TRAINING (Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.)

INSTITUTION AND LOCATION	DEGREE (if applicable)	MM/YY	FIELD OF STUDY
Polytechnic Institute of Brooklyn, Brooklyn, NY	B.S.E.E.	June 1962	Electrical Engineering
New York University, Bronx, NY	M.S.E.E.	June 1967	Electrical Engineering
The Johns Hopkins University, Baltimore, MD	M.A.	June 1969	Experimental Psychology
The Johns Hopkins University, Baltimore, MD	Ph.D.	Dec 1971	Experimental Psychology

A. Personal Statement

my research has been about the perception of motion. This includes: 1) the study of the mechanisms in the visual system that are used for the detection of the different kinds of motion information that serve different perceptual functions, namely the perception of object motion, and the perception of optic flow, 2) the ways in which locally detected motions are organized into global patterns, including the role of global-to-local neural feedback in motion pattern formation, 3) the development of computational mechanisms for motion detection and the perception of bistable motion patterns, 4) the motion mechanisms that are spared by cortical brain damage, 5) the development of a new methodology, based on the perception of motion, for determining the perceptual organization of the connected surfaces constituting geometric objects.

B. Positions and Honors

1971-present: Assistant Professor, Associate Professor, Full Professor and Research Professor at Florida Atlantic University, Boca Raton, FL

1979-1982; 1989: Chair, Department of Psychology, Florida Atlantic University, Boca Raton, FL

1989-1992: Associate Director, Training Grant in Complex Systems and the Brain Sciences. National Institute of Mental Health, July 1989 - June 1992

2006 Teaching Award, Florida Atlantic University

Memberships: The Psychonomic Society (past), The Association for Research in Vision and Ophthalmology (past), The Vision Sciences Society (current)

C. Selected Peer-Reviewed Publications (10 most recent)

Norman, J., Hock, H.S., & Schöner, G. (2014). Contrasting accounts of direction and shape discrimination in short-range motion: Counterchange compared with motion energy detection. *Attention, Perception & Psychophysics.*

Seifert, M. & Hock, H.S. (2014). Independent detection of motion energy and counterchange: Flexibility in motion detection. *Vision Research*.

Pelah, A., Barbur, J., Thurrell, A., & Hock, H.S. (2014). The coupling of vision with locomotion in cortical blindness. *Vision Research*.

Hock, H.S. (2014). Dynamic grouping motion: A method for determining perceptual organization for objects with connected surfaces. *The Handbook of Perceptual Organization.* Editor: J. Wagemans.

Hock, H.S. & Nichols, D.F. (2013). The perception of object vs. objectless motion. *Attention, Perception & Psychophysics.*

Odic, D., Hock, H.S.,& Halberda, J. (2013). The effect of confidence hysteresis on approximate number discrimination in young children. *Journal of Experimental Psychology: General.*

Hock, H.S. & Nichols, D.F. (2012). Motion perception Induced by dynamic grouping: A probe for the compositional structure of objects. *Vision Research*, *59,* 45-63.

Daniels, L.B., Nichols, D.F., Seifert, M.S., & Hock, H.S. (2012). Changes in pupil diameter entrained by cortically initiated changes in attention. *Visual Neuroscience, 29,* 131-142.

Hock, H.S., Schöner, G., Brownlow S., & Taler, D. (2011). The temporal dynamics of global-to-local feedback in the formation of hierarchical motion patterns: Psychophysics and computational simulations. *Attention, Perception & Psychophysics. 73,* 1171-1194.

Azzopardi, P., & Hock, H.S. (2011). Illusory motion perception in blindsight. *Proceedings of the National Academy of Sciences, 108*, 876-881.

D. Research Support for Past Three Years (non-Federal, locally supported)

1. *Dynamic Grouping:* Psychophysical experiments entailing a motion percept whose direction is relevant to the perceptual organization of connected object surfaces.

2. The Temporal Dynamics of Global-to-Local Feedback in Hierarchical Pattern Formation: Psychophysical experiments and computational modeling of bistable motion patterns for which global motion (the perceived "whole" depends on feed-forward from the parts of the pattern), and through global-to-local feedback, the global "whole" influences the perception of the parts.

3. Dual Pathways: Psychophysical distinction between the detection of counterchange (oppositely signed changes in luminance contrast) and the detection of motion energy. The research is based on the proposition that these detection mechanisms have different functions, counterchange for the perception of object motion and motion energy for the processing of optic flow, and thus, visually guided locomotion. These pathways are related to alternate neural pathways in the brain.

4. *Shape from motion:* Psychophysical experiments and computational modeling are providing evidence that the perception of shape-from-motion is based on motion detected by counterchange rather than Reichardt (motion energy) mechanisms.

5. *Motion model:* Extension of the computational model for counterchange detection to account for the near-threshold stability of perceived motion and perceived non-motion, and for the formation of bistable global motion patterns.

6. Pupil Dynamics: Psychophysical and eye-tracking evidence that alternations in attentional spread can entrain the diameter of the pupil. Pupil dilation is associated with broadly spread attention and pupil contraction with narrowly focused attention.The urrent application is to test for pupil contractions as a measure of stimulus change in movies.

Biographical Sketch: Sang Wook Hong (PI)

(a) Professional Preparation

Institution	Major/Area	Degree & Year
Yonsei University, Seoul, South Korea	Psychology	B.S., 1997
Yonsei University, Seoul, South Korea	Experimental Psychology	M.A., 1999
University of Chicago, Chicago, IL	Experimental Psychology	Ph.D., 2005
Vanderbilt University, Nashville, TN	Cognitive Neuroscience	Post-doc 2006-2011

(b) Appointments

Institution	Position	Year
Florida Atlantic University, Boca Raton, FL	Assistant Professor	2011-present

(c) Publications

(c.1*) Five most related*

Hong, S. W., & Shevell, S. K. (2008). Binocular rivalry between identical retinal stimuli with an induced color difference. *Visual Neuroscience*, *25*, 361-364.

Hong, S. W., & Shevell, S. K. (2008) The influence of a chromatic surround on binocular rivalry: Perception and neural representation. *Vision Research, 48,* 1074-1083.

Hong, S. W., & Blake, R. (2009). Interocular suppression differentially affects achromatic and chromatic mechanisms. *Attention, Perception, and Psychophysics, 71,* 403-411.

Hong, S. W., & Shevell, S. K. (2009). Color-binding errors during rivalrous suppression of form. *Psychological Science*, *20*, 1084-1091.

Hong, S. W., & Kang, M. -S. (2013). Perceptual consequence of normalization revealed by a novel brightness induction. *Vision Research, 91,* 78-83.

(c.2) *Five other significant*

Hong, S. W., & Shevell, S. K. (2004). Brightness contrast and assimilation from patterned inducing backgrounds. *Vision Research, 44*, 35-43.

Hong, S. W., & Shevell, S. K. (2006). Resolution of binocular rivalry: Perceptual misbinding of color. *Visual Neuroscience*, *23*, 561-566.

Hong, S. W., & Blake, R. (2008). Early visual mechanisms do not contribute to synesthetic color experience. *Vision Research*, *48*, 1018-1026.

Kang, M. -S., Hong, S. W., Blake, R., & Woodman, G. (2011). Visual working memory contaminates perception. *Psychonomic Bulletin and Review, 18,* 860-869.

Hong, S. W., Tong, F., & Seiffert, A. E. (2012). Direction-selective patterns of activity in human visual cortex suggest common neural substrates for different types of motion. *Neuropsychologia*, *50*, 514-521.

(d) Synergistic Activities

(d.1) *Service to the scientific community outside of the immediate organization*

- Developing facial expression database for research and education (1999, in Korea)
- Advising a high school, female student in a research outreach program at Vanderbilt University (2011, publish the outcome in peer reviewed journal)
- Peer reviewer for psychological and neuroscience journals, and NSF grant proposal

(d.2) ***Broadening the participation of groups underrepresented in science***

- From 2010-current, there were 5 women or minority graduate and undergraduate students who spent significant time training in our lab.

(e) Collaborators and other affiliations

Collaborators

Randolph Blake (Vanderbilt University), Nancy Carlisle (UC Davis), Davis Glasser (U of Rochester), Jutta Joormann (U of Miami), Min-Suk Kang (Sungkyunkwan Unviersity), Para Kang (UIC), Sohee Park (Vanderbilt University), Won Mok Shim (Dartmouth College), Duje Tadin (U of Rochester), Adriane Seiffert (Vanderbilt University), Frank Tong (Vanderbilt University), Melonie Williams (Vanderbilt University), Geoffrey Woodman (Vanderbilt University), Linda Xu (Harvard University), Eunice Yang (UC Berkeley), Lira Yoon (U of Maine)

Graduate Advisors & Postdoctoral Sponsors

- Steven K. Shevell (The University of Chicago; graduate advisor);
- Randolph Blake (Vanderbilt University; postdoctoral sponsor);
- Frank Tong (Vanderbilt University; postdoctoral sponsor)

Thesis Advisor & Postgraduate-Scholar Sponsor

- 1 PhD students: Dustin Cox (Florida Atlantic University
- 1 MA students: Sophia Peaco (University of Central Florida)
- Advising 6 Ph. D. dissertations and 2 Master thesis

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors in the order listed on Form Page 2.
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NAME	POSITION TITLE
J. A. Scott Kelso	Glenwood & Martha Creech Chair in Science Professor, Complex Systems & Brain Sciences, Psychology, Biomedical Sciences, Biological Sciences
eRA COMMONS USER NAME (credential, e.g., agency login) SKelso	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	MM/YY	FIELD OF STUDY
University of Calgary, Alberta, Canada	B.S.	05/1972	Motor Control
University of Wisconsin, Madison	M.Sc.	12/1973	Motor Control/Neurology
University of Wisconsin, Madison, WI	PhD	12/1975	Motor Control /Psychology

A. Personal Statement

Kelso is a contributor to the development of the dynamical systems approach to behavior and brain within psychology and neuroscience. He has published approximately 300 research articles including the MIT publication “Dynamic patterns: the self-organization of brain and behavior.” His current work focuses on whether the same principles and mechanisms of coordination dynamics apply also to human brains working together in social settings. Using large EEG electrode arrays and behavioral measures he and his co-workers have identified signatures in the brain that correspond to whether humans coordinate together or act independently. In another line of research, Kelso and colleagues created a novel paradigm called Virtual Partner Interaction (VPI)—the human dynamic clamp--to understand the real-time interaction between humans and avatars. In VPI humans interact with a virtual partner whose behavior is driven by a computerized version of the HKB equations known to govern basic forms of human coordination. Akin to its counterpart in cellular neuroscience, VPI enables parametric control (and hence detailed study) of reciprocal forms of social coordination. Both these lines of research are developed further here and complemented by new methods to quantify intra- and inter-brain coupling along with multi-level computational and dynamical modeling--which may be viewed as foundational to the emergence of a computational social neuroscience. Kelso was senior research scientist at Yale’s Haskins Laboratories for 7 years where he led a large NIH Program Project on the physiological mechanisms of speech production. He has been the Creech Eminent Scholar Chair in Science at FAU since 1985, founding the Center for Complex Systems and Brain Sciences and obtaining the first NIMH National Training Program in this multidisciplinary field which ran for 20 years. As a testament to his leadership, Kelso can point to 97 posters and verbal research presentations of current and former Center students and postdocs at the 2011 Society for Neuroscience meeting in Washington, DC. In addition, three of the principal scientists from this project’s team were invited speakers at the recent Dynamical Neuroscience XX meeting in New Orleans on the Neurophysiology of Social Neuroscience, sponsored by the NIMH.

B. Positions and Honors

1976-1978 Assistant Professor and Director, Motor Behavior Laboratory, The University of Iowa
1978-1982 Senior Research Staff, Haskins Laboratories, Yale University; Associate Professor, Departments of Psychology and Biobehavioral Sciences (Behavioral Genetics), University of Connecticut
1982-1985 Senior Research Staff, Haskins Laboratories, Yale University; Professor, Departments of Psychology and Biobehavioral Sciences (Behavioral Genetics), University of Connecticut
1985-2005 Founder and Director, Center for Complex Systems and Brain Sciences, FAU

1985- Glenwood and Martha Creech Eminent Scholar Chair in Science; Professor of Psychology, Biology and Biomedical Sciences
2009- Visiting Professor of Computational Neuroscience, University of Ulster
1995 Co-Director, Santa Fe Institute Summer School in Complex Systems
1986 Fellow, American Psychological Association
1990 Fellow, American Psychological Society
1990 Distinguished Alumni Achievement Award, University of Wisconsin-Madison
1991 W. J. Bryan Lectures in Cognitive Science, Indiana University
1995-1998 President, *Sigma Xi* (Scientific Research Society), South Florida Chapter
1996 Professorial Excellence Award, State University System of Florida
1997 Senior Scientist Award, National Institute of Mental Health
1998 Elected Fellow, Center for Advanced Studies in the Behavioral Sciences, Stanford University.
1999 Brain Bursary Award, by the Guarantors of *Brain*, for five lectures at the Welcome Institute of Cognitive Neurology
1999 Distinguished Scholar Award, NASPSPA
2002 Docteur Honoris Causa, Republic of France and University of Toulouse (est. 1228)
2004 Fellow, AAAS "For innovative use of brain imaging and behavioral techniques to uncover the principles and mechanisms of coordination"
2005 F.J. McGuigan Prize lecture for Understanding the Mind, APA, Washington, DC
2006 Director's Innovations Award (NIMH)
2007 Pierre de Fermat Laureate, Midi Pyrenées Region & Republic of France
2009-2010 President, Foyle College (est. 1617), Former Pupils Association
2011 Bernstein Prize, International Society for Motor Control (ISMC)
2012 Fellow, Society for Experimental Psychology (SEP)

- Kelso currently serves or has served on the Editorial Boards of 12 scientific journals and monographs, and is Founding Editor of *Springer Complexity* and the Springer Series *Understanding Complex Systems* (currently 62 volumes). He regularly reviews for funding agencies around the world, including The Welcome Trust (UK), The Riken Brain Institute (Professorial Tenure Committee), Japan, NSF, MRC (Canada), Australian Medical Research Council, Templeton Foundation, Israel Research Foundation, Netherlands Organisation for Scientific Research
- Since 1987, organized regular satellite meetings to the Society for Neuroscience, sponsored by the National Institutes of Health (and occasionally the Office of Naval Research and the National Science Foundation), dealing with various topics surrounding neurobehavioral dynamical systems, including Dynamical Neuroscience I (1991) to the last edition Dynamical Neuroscience XX, "The neural choreography of social interaction: How people and brains couple" (New Orleans, October 11-12, 2012).
- Inaugural Review Panel, Theoretical/Mathematical /Computational Neuroscience, NIMH, 1989-1990
- Special Emphasis Review Panel, NIH, *Neuroinformatics/Human Brain Project*, Washington, D.C.
- Consultant, NIMH, *New Directions for Neuroscience:The Next 10 Years*. Washington, D.C., 1995.
- Advisory Board*, Restructuring NIH Peer Review Process and Study Sections in Cognitive and Behavioral Neuroscience,* Washington, DC 1997
- Invited Speaker, *Future Career Opportunities in Neuroscience: Computational Neuroscience.* Special meeting for NIH Predoctoral Fellows. Washington, D.C., 1999.
- NIMH/US delegation to inaugurate the National Brain Research Institute of India, New Delhi, 1999
- Invited Speaker, NIH Training Director's meeting for recruitment of minority students in the Neurosciences: *Computational Neuroscience: The brain as a complex dynamical system*, Washington, D.C., 2000
- Member, Review Panel for Sylvio O.Conte Centers for Neuroscience Research, NIH/NIMH, 2005
- Member, Review Panel, NIH/NINDS Fellowship Program, 2005
- Member, Review Panel, K99/R00 NIH Pathway to Independence Awards, 2012
- Invited Seminar, NINDS Human Motor Control Section "The Neural Choreography of Behavior: Multiscale Coordination Dynamics", November, 30, 2012.

C. Selected Peer-reviewed Publications (from over 300 research articles, book, chapters)

Kelso, J.A.S., Cook, E., Olson, M.E., & Epstein, W. (1975). Allocation of attention and the locus of adaptation to displaced vision. *Journal of Experimental Psychology: Human Perception and Performance, 1,* 237-245.

Kelso, J.A.S. (1977). Motor control mechanisms underlying human movement reproduction. *Journal of Experimental Psychology: Human Perception and Performance, 3,* 529-543.

Kelso, J.A.S., Southard, D., & Goodman, D. (1979). On the nature of human interlimb coordination. *Science, 203,* 1029-1031.

Kelso, J.A.S., Tuller, B., Bateson, E.-V., & Fowler, C.A. (1984). Functionally specific articulatory cooperation following jaw perturbations during speech: Evidence for coordinative structures. *Journal of Experimental Psychology: Human Perception and Performance, 10,* 812-832.

Kelso, J.A.S. (1984). Phase transitions and critical behavior in human bimanual coordination. *American Journal of Physiology: Regulatory, Integrative and Comparative, 15,* R1000-R1004.

Haken, H., Kelso, J.A.S., & Bunz, H. (1985). A theoretical model of phase transitions in human hand movements. *Biological Cybernetics, 51*, 347-356.

Kelso, J.A.S., Scholz, J.P. & Schöner, G. (1986). Nonequilibrium phase transitions in coordinated biological motion: Critical fluctuations. *Physics Letters A, 118*, 279-284.

Thelen, E., Kelso, J.A.S., & Fogel, A. (1987). Self-organizing systems and infant motor development. *Developmental Review. 7,* 39-65.

Saltzman, E.L., & Kelso, J.A.S. (1987). Skilled actions: A task dynamic approach. *Psychological Review, 94,* 84-106.

Schöner, G. & Kelso, J.A.S. (1988) Dynamic pattern generation in behavioral and neural systems. *Science, 239,* 1513-1520.

Zanone, P.G. & Kelso, J.A.S. (1992). The evolution of behavioral attractors with learning: Nonequilibrium phase transitions. *Journal of Experimental Psychology: Human Perception and Performance, 18/2,* 403-421.

Kelso, J.A.S. (1992). Coordination dynamics of human brain and behavior. *Springer Proc. in Physics, 69,* 223-234

Kelso, J.A.S., Bressler, S.L., Buchanan, S., DeGuzman, G.C., Ding, M., Fuchs, A. & Holroyd, T. (1992). A phase transition in human brain and behavior. *Physics Letters A, 169,* 134-144.

Kelso, J.A.S. & Haken, H. (1995). New laws to be expected in the organism: Synergetics of brain and behavior. In M. Murphy & L. O'Neill (Eds.) *What is Life? The Next 50 Years.* Cambridge University Press.

Kelso, J.A.S., Fuchs, A., Holroyd, T., Lancaster, R., Cheyne, D., & Weinberg, H. (1998) Dynamic cortical activity in the human brain reveals motor equivalence. *Nature, 392,* 814-818.

Bressler, S.L. & Kelso, J.A.S. (2001) Cortical coordination dynamics and cognition. *Trends in Cognitive Sciences, 5,* 26-36.

Kelso, J.A.S., Fink, P., DeLaplain, C.R., & Carson, R.G. (2001). Haptic information stabilizes and destabilizes coordination dynamics *Proceedings of the Royal Society* B, 268, 1207-1213.

Jantzen, K.J., Steinberg, F. L. & Kelso, J.A.S. (2004) Brain networks underlying timing behavior are influenced by prior context. *Proceedings of the National Academy of Sciences*, 101, 6815-6820.

Jirsa, V.K. & Kelso, J.A.S. (2005) The excitator as a minimal model for the coordination dynamics of discrete and rhythmic movements. *Journal of Motor Behavior,* 37, 35-51.

Kelso, J.A.S. & Engstrøm, D.A. (2006) *The Complementary Nature,* The MIT Press, MA. Cambridge.

Lagarde, J., & Kelso, J.A.S. (2006) Binding of movement, sound and touch: Multimodal coordination dynamics. *Experimental Brain Research*, 173, 673-688.

Jantzen, K.J. & Kelso, J.A.S. (2007) Neural coordination dynamics of human sensorimotor behavior: A Review. In V.K Jirsa & R. MacIntosh (Eds.) *Handbook of Brain Connectivity*. Heidelberg: Springer.

Tognoli, E., Lagarde, J., DeGuzman, G.C., & Kelso, J.A.S. (2007) The phi complex as a neuromarker of human social coordination. *Proceedings of the National Academy of Sciences*, 104, 8190-8195.

Kelso, J.A.S. & Tognoli, E. (2007) Toward a complementary neuroscience: Metastable coordination dynamics of the brain. In R.Kozma & L. Perlovsky (Eds.) *Neurodynamics of Cognition and Consciousness*. Springer, Heidelberg, pp.39-60.

Oullier, O., DeGuzman, G.C., Jantzen, K.J., Lagarde, J., & Kelso, J.A.S. (2008) Social coordination dynamics: Measuring human bonding. *Social Neuroscience*, 3, 178-192. DOI:10.1080/17470910701563392

Banerjee, A., Tognoli, E., Jirsa, V.K., Assisi, C., Kelso, J.A.S. (2008) Mode Level Cognitive Subtraction (MLCS) quantifies spatiotemporal reorganization in large-scale brain topographies. *NeuroImage, 15,* 663-674.

Tognoli, E., & Kelso, J.A.S. (2009). Brain coordination dynamics: true and false faces of phase synchrony and metastability. *Progress in Neurobiology*, 87, 31-40. Available online doi:10.1016/j.pneurobio.2008.09.014

Kelso, J.A.S., DeGuzman, G.C., Reveley, C., & Tognoli, E. (2009). Virtual Partner Interaction (VPI): Exploring novel behaviors via coordination dynamics. *PLoSONE,* 4(6):e5749

Kelso, J.A.S. (2009). Synergies: Atoms of brain and behavior. *Advances in Experimental Medicine and Biology, 629,* 83-91.

Jantzen, K.J., Steinberg, F.L., & Kelso, J.A.S. (2009) Coordination dynamics of large-scale neural circuitry underlying sensorimotor behavior. *Journal of Cognitive Neuroscience,* 21, 2420-2433. doi:10.1162/jocn.2008.21182

Chapin, H.L., Jantzen, K.J., Kelso, J.A.S., Steinberg, F.L., & Large, E. (2010). Dynamic emotional and neural responses to music depend on performance expression and listener experience. *PLoS ONE*, 5 (12):e13812 doi:10.1371/journal.pone.0013812

DeLuca, C., Jantzen, K.J., Comani, S., Bertollo, M., & Kelso, J.A.S. (2010) Striatal activity during intentional switching depends on pattern stability. *Journal of Neuroscience*, 30 (9) 3167-3174.

Engel, A.K., Friston, K., Kelso, J.A.S. König, P., Kovács, I., MacDonald, A., Miller, E.K.,. Phillips, W.A., Silverstein, S.M., Tallon-Baudry, C., Triesch, J., & Uhlhaas, P. (2010) Coordination in behavior and cognition. In: *Dynamic Coordination in the Brain: From Neurons to Mind,* C. von der Malsburg, W. A. Phillips, and W. Singer. (Eds). Strüngmann Forum Report, vol. 5. Cambridge, MA: MIT Press, pp. 267-299.

Wade, J.J., McDaid, L.J., Harkin, J.G., Crunelli, V., & Kelso, J.A.S. (2011) Bidirectional coupling between astrocytes and neurons mediates learning and dynamic coordination in the brain: A multiple modeling approach. *PLoSONE, 6,*e29445.

Naeem, M., Prasad, G., Watson, D. R., and Kelso, J. A. S. (2012). Electrophysiological signatures of intentional social coordination in the 10-12Hz range. *NeuroImage* 59, 1795-1803. *doi:10.1016/j.neuroimage.2011.08.010*

Kelso, J.A.S. (2012) Multistability and metastability: Understanding dynamic coordination in the brain. *Phil. Trans. Royal Society B, 367,* 906-918.

Kostrubiec, V., Zanone, P.-G., Fuchs, A., & Kelso, J.A.S. (2012) Beyond the blank slate: Routes to learning new coordination patterns depend on the intrinsic dynamics of the learner —experimental evidence and theoretical model. *Frontiers in Human Neuroscience*, 6, 212 *doi: 10.3389/fnhum.2012.00222*

Banerjee, A.., Tognoli, E., Kelso, J.A.S., & Jirsa, V.K. (2012) Spatiotemporal reorganization of large-scale neural assemblies mediates bimanual coordination. *NeuroImage doi.org/10.1016/j.neuroimage.2012.05.046*

Kelso, J.A.S., Dumas, G., & Tognoli, E. (2013) Outline of a general theory of behavior and brain coordination. *Neural Networks*, 37, 120-131. (25th Commemorative Issue)

Murzin, V., Fuchs, A., & Kelso, J.A.S. (in press) Detection of correlated sources in EEG using a combination of beamforming and surface Laplacian methods. *Journal of Neuroscience Methods*

Naeem, M., Mc Ginnity, T.M., Watson, D., Wong-Lin, K., Prasad, G., & Kelso, J.A.S. (2012). Inter-brain mutual information in social interaction tasks. *IEEE Proceedings of International Workshop on Pattern Recognition in Neuroimaging (PRNI, 2012)*, University of London, July 2-4.

Wade, J.J., McDaid, L.J., Harkin, J., Crunelli, V., & Kelso, J.A.S. (Eds.) (2013). Biophysically-based computational models of astrocyte~neuron coupling and their functional significance. *Frontiers in Computational Neuroscience,* **e-Book**

Tognoli, E. & Kelso, J.A.S. (2013). On the brain's dynamical complexity: Coupling and causal influences across spatiotemporal scales. *Advances in Cognitive Neurodynamics,* 3, 259-265.

Tognoli, E. & Kelso, J.A.S. (under review). The metastable brain

Tognoli, E. & Kelso, J.A.S. (submitted). Enlarging the scope: grasping brain complexity

Tognoli, E. & Kelso, J.A.S. (submitted). The coordination dynamics of social neuromarkers

D. Research Support

1. NIMH No cost extension
Period: April 2013 - April 2014

2. Florida Atlantic University (Division of Research, College of Science, FAU Foundation) to support Co-PI's, Postdocs, Graduate Students, Travel, Expenses, etc.
Amount Funded: $241,000.
Period: May 2013 - June 2014

3. R01MH080838 National Institute for Mental Health (P.I.)
Neuromarkers of Social Coordination: A Dynamical Approach
Amount Funded: $ 1,738,750
Period: 2008-2013

4. National Science Foundation: Human Social Dynamics (Co-PI)
Social Coordination Dynamics: Intertwining Self with Others
Amount Funded: $ 744,219
Period: 2008-2012 (No cost extension)

5. U.S. Office of Naval Research (Co P.I.)
Brain Dynamics of Coordinated Teams
Amount Funded: $700,000
Period: 2008-2011

BIOGRAPHICAL SKETCH: Howard M. Prentice, Ph.D.

Provide the following information for the Senior/key personnel and other significant contributors in the order listed on Form Page 2.
Follow this format for each person. **DO NOT EXCEED FOUR PAGES.**

EDUCATION/TRAINING	DEGREE	YEAR(S)	FIELD OF STUDY
University of Southern California, Los Angeles, California; Supervisor Dr. Laurence H. Kedes, M.D.	Postdoctoral	09/89-08/93	Molecular Genetics
Stanford University School of Medicine, Palo Alto, California; Supervisor Dr. Laurence H. Kedes, M.D.	Postdoctoral	09/87-01/89	Molecular Genetics
University of London, England	Ph.D.	08/87	Biochemistry
University of London, England	M.Sc.	06/84	Neurochemistry
L'INSERM, Paris, France	D.E.A.	06/81	Neurobiology
University of Aberdeen, Scotland	M.A. (Hons)	06/80	Exptl. Psychology

A. Personal Statement

My primary research emphasis is on ischemia in age related diseases and mechanisms of neuroprotection. My studies have included analysis of myocardial protection through antioxidant mechanisms and through pharmacological preconditioning. In retina studies in a model of laser induced choroidal neovascularization I have developed new gene therapy approaches based on hypoxia regulated transgene expression. To analyze the effect of preconditioning agents in preventing oxidative damage in the in the eye I am employing the mouse constant light damage model. With respect to neuronal function I am currently analyzing regulation of GABAergic neurotransmission and employing rodent stroke models to examine the mechanism of action of key ischemic preconditioning agents, neuro-protectants and stem cell mobilizing agents.

B. Positions and Honors

Positions and Employment

2007 - Present	Associate Professor with Tenure, Department of Biomedical Science, Charles E. Schmidt College of Medicine, Florida Atlantic University, Boca Raton, FL.
7/1/13 – 6/30/14	Visiting Associate Professor, Harvard Medical School, Martinos Center for Molecular Imaging, Mass. General Hospital, Boston, MA.
2000 - 2007	Associate Professor, Biomedical Sciences, Charles E. Schmidt College of Science, Florida Atlantic University, Boca Raton, FL.
2007-Present	Member of the Center for Complex Systems and Brain Sciences, Florida Atlantic University, Boca Raton, FL.
2000-Present	Member of the Center for Molecular Biology and Biotechnology (CMBB) Florida Atlantic University, Boca Raton, FL.
1997 - 2000	Senior Lecturer with Tenure, Division of Molecular Genetics, Institute of Biomedical and Life Sciences, University of Glasgow, Scotland.
1993-1997	Lecturer (equivalent to Assistant Professor), Division of Molecular Genetics and Department of Medicine and Therapeutics, University of Glasgow, Scotland.

Honors

2014: Nominated as International Faculty for the International Congress on Coronary artery disease (2015 Congress).
2012: Nominated as International Faculty for the International Congress on Coronary artery disease (2013 Congress).

2010: Nominated as International Faculty for the International Congress on Coronary artery disease (2011 Congress).
2009: Nominated as International Faculty for the International Congress on Coronary artery disease (2009 Congress).

Other Experience and Professional Memberships

Associate Editor of Frontiers in Genomic Physiology (2011-2013)
Editorial Board Member of Scholarena Journal of Case Reports
Editorial Board Member of ISRN Vascular Medicine
Member of ARVO
American Heart Association Basic Science Council Member

C. Selected Peer-reviewed Publications (17 out of 63 total)

Most relevant to the current application:

1) Gharibani, P.M., P.M., Modi, J., Menzie, J., Genove, R., Ma, Z., Tao, R., **Prentice, H.,** and Wu, J.-Y Mode of action of S-Methyl-N, N-diethylthiocarbamate sulfoxide (DETC-MeSO) as a novel therapy for stroke in a rat model. Mol. Neurobiol. (DOI 10.1007/s12035-014-8658-0, 2014, Feb 28)**.**
2) Modi, J.P., Gharibani PM., Ma Z, Tao R., Menzie J., **Prentice H*** and Wu JY*. Protective Mechanism of Sulindac in an Animal Model of Ischemic Stroke. Brain Res. (2014), http://dx.doi.org/10.1016/j.brainres.2014.06.019 (*co-corresponding authors).
3) Moench I., **Prentice H.,** Rickaway Z. and Weissbach H., Sulindac confers high level ischemic protection to the heart through late preconditioning mechanisms. Proc. Natl. Acad. Sci. USA. 2009 Nov 17;106(46):19611-6.
4) Dougherty C., Smith G., Dorey CK., **Prentice H.**, Webster KA, and Blanks J., Robust Hypoxia-Selective Regulation of an RPE-Specific AAV Vector. Mol Vis. 2008 Mar 7;14:471-80.
5) **Prentice HM.**, Biswal MR., Dorey CK., Blanks JC., Hypoxia-regulated retinal glial cell-specific promoter for potential gene therapy in disease. Invest Ophthalmol Vis Sci. 2011, Nov 1; 52(12): 8562-70.
6) Gharibani P., Modi J., Pan C., Ma Z., Menzie J., Chen P-C., Tao R., **Prentice H.*** and Wu JY.,* The Mechanism of Taurine Protection against Endoplasmic Reticulum Stress in an Animal Stroke Model of Cerebral Artery Occlusion and Stroke Related conditions in Primary Neuronal Cell Culture. Taurine 8, Ed. El Idrissi, Vol. 1, Chapter 23 and Adv Exp Med Biol. 2013, 776: 241-58 (*co-corresponding authors).
7) Buddhala C., Suarez M., Modi J., **Prentice H.**, Ma Z., Tao R., Wu JY., Calpain Cleavage of Brain Glutamic Acid Decarboxylase 65 Is Pathological and Impairs GABA Neurotransmission. PLoS One. 2012, 7(3):e33002.

Additional Recent Publications of Importance to the Field:

1) Milton SL., Nayak G., Kesaraju, S., Kara L. and **Prentice, H**: Suppression of reactive oxygen species production enhances neuronal survival in vitro and in vivo in the anoxia-tolerant turtle Trachemys scripta. J Neurochem. 2007 May;101(4):993-1001.
2) **Prentice H**., Moench I A; Rickaway, Z.T.; Dougherty, C.J.;Webster, KA; Weissbach H, Ph.D. MsrA protects cardiac myocytes against hypoxia/reoxygenation induced cell death. Biophys Res Commun. 2008 Feb 15; 366(3):775-8.
3) Milton SL, Dirk LJ, Kara LF, **Prentice HM**. Adenosine modulates ERK1/2, PI3K/Akt, and p38MAPK activation in the brain of the anoxia-tolerant turtle Trachemys scripta. J Cereb Blood Flow Metab. 2008 Aug; 28(8):1469-77.
4) Leon R, Wu H, Jin Y, Wei J , Buddhala C, **Prentice, H** and Wu J-Y: Protective Function of Taurine in Glutamate-induced Apoptosis in Cultured Neurons. J Neurosci Res. 2009 Apr; 87(5):1185-94.
5) Nayak G, **Prentice HM**, Milton SL. Role of neuroglobin in regulating reactive oxygen species in the brain of the anoxia-tolerant turtle Trachemys scripta. J Neurochem. 2009 Jul; 110(2):603-12.

6) Wu, JY and **Prentice, H** Role of taurine in the central nervous system. J. Biomed. Sci., 2010 Aug 24; 17 (Suppl 1) S1.
7) Chunliu Pan, Gupta, A, **Prentice, H** and Jang-Yen Wu. Protection of taurine and granulocyte colony-stimulating factor against excitotoxicity induced by glutamate in primary cortical neurons. J. Biomed. Sci., 2010 Aug 24;17 (Suppl 1) S18. Prentice and Wu-corresponding authors.
8) **Prentice, H** and Weissbach, H.: Two Novel approaches providing cardiac protection against oxidative stress. (in Ischemic Heart Disease, Intech) Ed. Lakshmanadoss, U., 2011. 229-246.
9) Nayak GH, **Prentice HM**, Milton SL. Neuroprotective signaling pathways are modulated by adenosine in the anoxia tolerant turtle. J Cereb Blood Flow Metab. 2011 Feb; 31(2): 467-75.
10) Pan C, **Prentice H**, Price AL, Wu JY. Beneficial effect of taurine on hypoxia- and glutamate-induced endoplasmic reticulum stress pathways in primary neuronal culture. Amino Acids. 2012 Aug; 43(2):845-55. Prentice and Wu corresponding authors.

D. Research Support

Ongoing Research Support

Title of the Research Project: Brain Diseases and Functions; Amount awarded: $450,000; Period Covered: July 1, 2010 – June 30, 2013; Source of Funding: Florida Atlantic University Research Initiative; Role in the project: Key Personnel (PI: Janet Blanks).

Completed Research Support

1) American Heart Association (Pre-doctoral): PI: Manas Biswal. Mentor Janet C. Blanks; Co-mentor, Howard Prentice. 07/01/08 to 06/30/10. Total Direct Costs: $43,400. Title: “Reversal of Oxidative Damage in an *In-Vitro* Model of Stroke.” The long range goal of this project is to evaluate expression and protective function of hypoxia regulated MsrA gene therapy vectors in ischemic brain *in vivo*.
2) James and Esther King Biomedical Research program-Florida Challenge grant: Grant # 09KW-11. G-CSF, DETC-MeSO and Sulindac as multidrug therapy for TBA and stroke. Total award: $748,046 from 01/01/2010 – 12/31/2012 (H. Prentice Co-PI-7%).
3) NIH:IR15 AG033374-01 to Dr. Sarah Milton. 01/01/09-12/31/10. Molecular mechanisms of oxidative stress resistance in an animal model of aging without senescence. $160,000 (H. Prentice Co-Investigator-7%).
4) American Heart Association (Florida Affiliate): Grant in Aid. Methionine Sulfoxide Reductase –A and Myocardial Ischemic Protection: PI: H. Prentice. Total Award: $120,000 (2005-2008).
5) National Institutes of Health (National Eye Institute) - Principal Investigator, Janet C. Blanks; Co-Investigator, Howard Prentice. 2005-2009 - R03 EYO16119 "Hypoxia Regulated Gene Therapy for Neovascularization", Total Direct and Indirect Costs: $421,500. The goal of this project is to design tissue-specific vectors to stop neovascularization in animal models of diabetic retinopathy and macular degeneration.
6) Equipment Grant: Bankhead Coley- Florida State Equipment Grant on Cancer Related Diseases: Purchase of a Fluorescent Activated Cell Sorter (H. Prentice; One of six PIs.) ($500,000 Total) 2007-2008.

BIOGRAPHICAL SKETCH

Provide the following information for the key personnel and other significant contributors in the order listed on Form Page 2.
Follow this format for each person. **DO NOT EXCEED FOUR PAGES.**

NAME	POSITION TITLE
Wen Shen	Associate Professor
eRA COMMONS USER NAME wenshen	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	YEAR(s)	FIELD OF STUDY
Shanghai University, Shanghai, China	B.S.	1983	Electrical Engineering
SUNY at Buffalo, New York, USA	Ph.D.	1998	Physiology & Biophysics

A. Personal Statement

The long-term goal of my research is to determine how the individual cell and complex of neuronal circuits interact at processing of visual information in retina. We use in vivo animal models and in intro retinal tissues to address the fundamental questions regarding the neural plasticity in physiology and pathology of visual system. We are focusing on the role of interplexiform cells in regulation of cone visual sensitivity in light adaptation. The success of this study will advance the research field and will provide a new concept of glycine as an important element in retinal function and diseases. I have a strong background in neurophysiology and receptor pharmacology and have broad experiences in the research area of this application. Moreover, my laboratory is capable of using multiple techniques, including electrophysiology, immunocyto-chemistry, Ca^{2+} imaging, quantitative-PCR, Western blotting etc. to approach the specific aims of this project. We have all necessary equipment either in my laboratory or in the college core facility at Florida Atlantic University. Over the years, as a PI, I received several research grants from both federal agents and private foundation: NIH, NSF and Fight for Sight, Prevent Blindness of American. I have developed both research and administrative skills for carrying out research projects. This study opens a new avenue for my laboratory to conjugate basic science and translational research.

B. Positions and Honors:

Positions and Employment:

1983-1988 Engineer, Institute of Environmental Control and Protection, Shanghai Municipal Bureau of Chemical Industry.
1988-1993 Research Specialist, Shanghai Institute of Physiology, Chinese Academy of Science.
1993-1998 Graduate Research Assistant, Department of Physiology and Biophysics, SUNY at Buffalo.
1998-1999 Research Associate, Department of Physiology and Biophysics, SUNY at Buffalo.
1999-2003 Research Assistant Professor, Department of Physiology and Biophysics, SUNY at Buffalo
2003-2007 Assistant Professor, Department of Biomedical Science, Florida Atlantic University
2007-present Associate Professor, Department of Biomedical Science, Florida Atlantic University

Awards and Honors:

1998 Mark Diamond Research Award
1998 Dean's Award for Outstanding Thesis Dissertation, School of Medicine and Biomedical Science, SUNY at Buffalo

2000 ARVO-Retinal Research Foundation-Lawrence Travel Fellowship Grant
2001 Postdoctoral Research Fellowship Award, Fight for Sight, Prevent Blindness of America
2002 Grant-in-Aid, Fight for Sight, Prevent Blindness of America
2002 International Eye Research Congress Travel Fellowship, Geneva, Switzerland
2002 R01 research grant, National Eye Institute (NEI), NIH
2006 New Project Development Award, Florida Atlantic University
2010 NSF Research Grant Award
2011 Researcher of the Year 2010-2011, Florida Atlantic University
2011 Researcher of the Year 2010-2011, College of Medicine, Florida Atlantic University

Professional Memberships:

1994- present Member of Associate for Research in Vision and Ophthalmology
2004- present Member of Society for Neuroscience

C. Selected peer-reviewed publications:
Most relevant to the current application:

1. **W Shen** (2005) Repetitive light stimulation inducing glycine receptor plasticity in the retinal neurons. *J Neurophysiol.,* 94:2231-2238.
2. Z Jiang, BQ Li and **W Shen** (2007) Differential distribution of glycine transporters in Muller cells and neurons in amphibian retinas. Vis. Neurosci., 24:157-168.
3. **W Shen**, Z Jiang and BQ Li (2008) Glycinergic input induces the synaptic facilitation in amphibian photoreceptors. J Biomed. Sci. 15: 743-754.
4. BQ Li, KA McKernan and **W Shen** (2008) Spatial and temporal distribution patterns of Na-K-2Cl-cotransporter in adult and developing mouse retinas. Vis. Neurosci., 25:109-123.
5. Z Jiang and **W Shen** (2010) Role of neurotransmitter receptors in mediating light-evoked response of retinal interplexiform cells. *J Neurophysiol*., 103:924-933.
6. M JM Rowan, H Ripps and **W Shen** (2010) Fast glutamate uptake via EAAT2 shapes the cone-mediated light offset response in bipolar cells. *J Physiol.(London), 588: 3943-3956.*
7. **W Shen**, LA Purpura, Baoqin Li, CL Nan, IJ Chang and H Ripps (2013) Regulation of Synaptic Transmission at the Photoreceptor Terminal: A Novel Role for the Cation-Chloride Cotransporter NKCC1*. J Physiol. (London*), 591:133-147.
8. Z Jiang, JN Yang, LA Purpura, YF Liu, H Ripps, **W Shen** (2014) Glycinergic feedback enhances synaptic gain in the distal retina. *J Physiol. (London),* 592: 1479-1492.

Additional recent publications of importance to the field (in chronological order):

1 X.L.Yang, T.X.Fan and **W. Shen** (1994) Effects of prolonged darkness on light responsiveness and spectral sensitivity of cone horizontal cells in carp retina in vivo. J Neurosci. 14(10):326-334.
2 J. Zhang, **W. Shen** and M.M. Slaughter (1997) Two metabotropic GABA receptors differentially modulated calcium currents in retinal ganglion cells. J Gen Physiol. 110:45-58.
3 **W. Shen** and M.M. Slaughter (1998) Metabotropic and ionotropic glutamate receptors regulate calcium channel currents in salamander retinal ganglion cells. J Physiol. 510(3): 815-828.
4 **W. Shen** and M.M. Slaughter (1999) Internal calcium modulates apparent affinity of metabotropic GABA receptors. J Neurophysiol. 82:3298-3306.
5 **W Shen** and MM Slaughter (1999) Metabotropic GABA receptors facilitate L-type and inhibit N-type calcium channels in single salamander retinal neurons. *J Physiol.(London),* 516(3):711-718.
6 **W Shen** and MM Slaughter (2001) Multireceptor GABAergic regulation of synaptic communication in amphibian retina. *J Physiol. (London),* 530(1):55-67.
7 **W. Shen** and M.M. Slaughter (2002) A non-excitatory paradigm of glutamate toxicity.
8 J Neurophysiol. 87:1629-1634.
9 **W. Shen**, S.G. Finnegan, P. Lein, S. Sullivan, M.M. Slaughter and D Higgins (2004) Bone morpho-genetic proteins regulate ionotropic glutamate receptors. *Eur. J Neurosci.,* 20:2031-2037.
10 **W. Shen** and S.G Finnegan, M.M Slaughter (2004) Glutamate receptor subtypes in human retinal horizontal cells. *Vis. Neurosci.,* 21(1): 89-95.

11 BQ Li and W **Shen** (2007) Cation Cl- cotransporters in the dendrites of goldfish bipolar cells. NeuroReport 18(7)625-630.
12 H Ripps and **W Shen** (2012) Taurine: An exceedingly 'Essential' amino acid. *Mol. Vis., 18:2673-2686.*
13 S Bulley, YF Liu, H Ripps, and **W Shen** (2013) Taurine Activates Delayed Rectifier K_V Channels via a Metabotropic Pathway in Retinal Neurons". *J Physiol. (London),* 591:123-132.
14 I Anastassov, **W Shen**, H Ripps, RL Chappell (2013) Zinc modulation of calcium activity at the photoreceptor terminal: a calcium imaging study. *Exp. Eye Res.,* 112:37-44.

C. Research Supports

ONGOING RESEARCH SUPPORT

NSF 1021646 (PI)
Research Grant 08/15/2010-08/14/2015
Title: The function of glycine in modulation of cone visual sensitivity
The goal of this project is to determine the role of glycine in regulation of glutamate synapse in photoreceptors in an amphibian model.

COMPLETED RESEARCH SUPPORT

EY14161 (Role PI), R01 Research Grant
National Eye Institute, NIH 08/01/2002 – 07/31/2008
The goals of this project are to explore the role of glycinergic interplexiform cells in retina and to determine the effect of glycine feedback on distal retinal neurotransmission.

NO. 1180-074 (Role, PI)
Florida Atlantic University
Division of Sponsored Research 01/01/2006-10/31/2007
The major goal of this project was to study effects of bone morphogenetic proteins in protection of glaucoma caused ganglion cells death

GA01032 (Role, PI)
Grant-in-Aid Research Award, Fight for Sight
Research Division of Prevent Blindness America 07/01/2001-06/30/2002
The major goal of this project was to define the regulation of glutamate receptors by bone morphogenic proteins, BMP-7, in human retinal horizontal cells.

PD20047 (Role, PI)
Postdoctoral research Fellowship, Fight for Sight
Research Division of Prevent Blindness America 07/01/2000-06/30/2001
The mean goal of this project was to study the mechanism of Ca^{2+} permeable kainate receptors in ganglion cell degeneration in human retina

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors in the order listed on Form Page 2.
Follow this format for each person. **DO NOT EXCEED FOUR PAGES.**

NAME	POSITION TITLE
Stackman Jr., Robert William	Associate Professor
eRA COMMONS USER NAME (credential, e.g., agency login) STACKMANR	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	MM/YY	FIELD OF STUDY
Allegheny College, Meadville, PA	B.S.	06/86	Psychology
Rutgers University, New Brunswick, NJ	M.S.	12/90	Behavioral Neuroscience
Rutgers University, New Brunswick, NJ	Ph.D.	05/95	Behavioral Neuroscience
Dartmouth College, Hanover, NH	Postdoctoral Fellow	1995-1998	Neurophysiology

A. Personal Statement

My expertise is in the neuronal mechanisms of long-term or explicit memory – a form of memory that is subserved by a brain region called the hippocampus. My lab uses behavioral, neuropharmacological and neurophysiological tools to define the cells and circuits of the rodent brain that are essential for explicit spatial and non-spatial memory. The overall objective of this research program is to improve our understanding of the behavioral, cellular and molecular mechanisms of long-term memory in the brain. Current projects are examining the influence of small conductance calcium-activated potassium channels on long-term memory in mice; testing the differential contributions of the rodent hippocampus and perirhinal cortex to object recognition memory, and determining the neurophysiological mechanisms that support hippocampal-dependent object memory in mice.

B. Positions and Honors

Positions and Employment

2013-pres. Associate Director, FAU Neuroscience Cluster, Florida Atlantic University, Jupiter, FL
2010-pres. Associate Professor, Center for Complex Systems & Brain Sciences, Florida Atlantic Univ
2006-pres. Associate Professor *(tenured 2010)*, Department of Psychology, Florida Atlantic University
11/98-2005 Assistant Professor, Dept of Behavioral Neuroscience, Oregon Health & Science University
Spring 1998 Visiting Assistant Professor, Dept of Brain & Psychological Sciences, Dartmouth College
1995-11/98 NIH NRSA Postdoctoral Fellow, Dept of Brain & Psychological Sciences, Dartmouth College
1988-1994 Teaching Assistant, Program in Biopsychology & Behavioral Neuroscience, Department of Psychology, Rutgers, The State University of New Jersey, New Brunswick, NJ.

Other Experience and Professional Memberships

2014 Ad hoc panel member, NIH CSR PMDA Study Section, October 2014
2014 Ad hoc scientific review, NSF, Modulation II, pre-proposal panel, April 2014
2008-pres. Ad hoc panel member, NIH CSR F02a Behavioral Neuroscience Fellowships
2008-pres. Member, International Behavioral Neuroscience Society
2000-2010 Ad hoc grant review, NSF, Division of Integrative Organismal Systems
1989-pres. Member, Society for Neuroscience

Honors

2011 Teacher of the Year, Charles E. Schmidt College of Science, Florida Atlantic University
2010 Researcher of the Year, Associate Professor level, Florida Atlantic University

C. Selected Peer-reviewed Publications (Selected from 48 peer-reviewed publications)

Most relevant to the current application

1. Vick KA, Guidi M and Stackman RW (2010). In vivo pharmacological manipulation of small conductance Ca^{2+}-activated K^+ channels influences motor behavior, object memory and fear conditioning. Neuropharmacol 58(3), 650-659.
2. Stackman RW, Lora JC and Williams SB (2012). Directional responding of C57BL/6J mice in the Morris water maze is influenced by visual and vestibular cues and is dependent upon the anterior thalamic nuclei. J Neurosci 32(30): 10211-10225.
3. Cohen SJ, Munchow AH, Rios LM, Zhang G, Ásgeirsdóttir HN and Stackman RW (2013). The rodent hippocampus is essential for nonspatial object memory. Current Biology 23: 1685-1690. **
   ** Highlighted in: Clark, R.E., 2013. Recognition memory: an old idea given new life. *Current Biology* 23, R725-727.
4. Rabinowitz A, Cohen SJ, Finn DA, Stackman RW (2014) The neurosteroid allopregnanolone impairs object memory and contextual fear memory in male C57BL/6J mice. Hormones Behav, Epub 05-30-2014
5. Cohen SJ and Stackman RW (in press). Assessing rodent hippocampal involvement in the novel object recognition task. A review. Behav Brain Res, Epub 08-26-2014.

Additional recent publications of importance to the field (in chronological order)

1. Stackman RW and Taube JS (1997). Firing properties of head direction cells in the rat anterior thalamic nucleus: Dependence upon vestibular input. J Neurosci 17, 4349-4358.
2. Stackman RW and Taube JS (1998). Firing properties of rat lateral mammillary nuclei single units: Head direction, head pitch, and angular head velocity. J Neurosci 18, 9020-9037.
3. Walsh TJ, Gandhi C, Stackman RW (1998). Amnestic effects following temporary inactivation of rat medial septum and nucleus basalis: Dissociation of memory and performance. Behav Neurosci, 112, 1114-1124.
4. Stackman RW, Tullman ML and Taube JS (2000). Maintenance of rat head direction cell firing during locomotion in the vertical plane. J Neurophysiol, 83: 393-405.
5. Stackman RW, Hammond RS, Linardatos E, Gerlach A, Maylie J, Adelman J and Tzounopoulos T (2002). Small conductance Ca^{2+}-activated K^+ channels modulate synaptic plasticity and memory encoding. J Neurosci, 22, 10163-10171.
6. Stackman RW and Herbert AM (2002). Rats with lesions of the vestibular system require visual landmark for spatial navigation. Behav Brain Res, 128, 27-40.
7. Stackman RW, Clark AS and Taube JS (2002). Hippocampal spatial representations require vestibular input. Hippocampus, 12: 291-303.
8. Stackman RW, Eckenstein F, Frei B, Kulhanek D, Nowlin J and Quinn JF (2003). Prevention of age-related spatial memory deficits in a transgenic mouse model of Alzheimer's disease by chronic *Gingko biloba* treatment. Exp Neurol, 184, 510-520.
9. Stackman RW, Golob EJ, Bassett JP and Taube JS (2003). Passive transport disrupts directional path integration by rat head direction cells. J Neurophysiol, 90: 2862-2874.
10. Bond CT, Herson PS, Strassmaier T, Hammond RS, Stackman RW, Maylie J and Adelman JP (2004). Small conductance Ca^{2+}-activated K^+ channel knock-out mice reveal the identity of calcium-dependent afterhyperpolarization currents. J Neurosci, 24: 5301-5306.
11. Hammond RS, Tull LE and Stackman RW (2004). On the delay-dependent involvement of the hippocampus in object recognition memory. Neurobiol Learn Mem 82(1), 26-34.
12. Hammond RS, Bond CT, Ngo-Anh TJ, Adelman JP, Maylie J and Stackman RW (2006). Small-conductance Ca^{2+}-activated K^+ channel 2 (SK2) overexpression impairs hippocampal learning, memory, and synaptic plasticity. J Neurosci, 26(6), 1844-1853.
13. Stackman RW, Bond CT and Adelman JP (2008). Contextual memory deficits observed in mice overexpressing small conductance Ca^{2+}-activated K^+ type 2 ($K_{Ca}2.2$, SK2) channels are caused by an encoding deficit. Learn Memory, 15, 208-213.
14. Stackman RW (2010) Behavioral correlates of neuronal activity acquired as single-units. Promises and pitfalls as illustrated by the rodent head direction cell signal. In: Electrophysiological Recording Techniques. (Eds: RP Vertes and RW Stackman). Neuromethods Series, Vol. 54. Humana Press, NJ, pp 127-167.

15. Allen D, Bond CT, Luján R, Ballesteros-Merino C, Lin MT, Wang K, Klett N, Watanabe M, Shigemoto R, Stackman RW, Maylie J, Adelman JP (2011) The SK2-long isoform directs synaptic localization and function of SK2-containing channels. Nature Neurosci 14: 744-749.
16. Zhang G, Ásgeirsdóttir HN, Cohen SJ, Munchow AH, Barrera MP and Stackman RW (2013). Stimulation of serotonin 2A receptors facilitates consolidation and extinction of fear memory in C57BL/6J mice. Neuropharmacol 64: 403-413.

D. Research Support

Ongoing Research Support

R01 MH086591-01 (R. Stackman, PI) 08-01-09 to 04-30-15
National Institute of Mental Health
Memory modulation by SK channels
This project examines the differential influence of SK channels in brain regions that are critical for memory. The project focuses on the influences of SK channel subtypes on hippocampal-dependent memory and amygdala-dependent memory.

1R15 MH099590-01 (R. Vertes, PI) 09-01-13 to 08-31-16
National Institute of Mental Health
Role of midline thalamus in arousal, attention and cognition
Role: Consultant

Completed Research Support

Research Priority Pilot Project (R. Stackman & K. Dawson-Scully, Co-PIs) 09-01-10 to 05-30-14
Division of Research, Florida Atlantic University
Selective manipulation of PKG pathway activity in the hippocampus of C57BL/6J mice to modulate memory processes

Research Priority Project Award (J. Blanks & R. Murphey, Co-PIs) 09-01-10 to 08-31-13
Division of Research, Florida Atlantic University
Brain Function, Damage and Repair
Role: Co-I

IOS 0630522 (R. Stackman, PI) 07-01-05 to 06-30-11
National Science Foundation
Influence of SK channels on hippocampal memory

R21 AA014407 (R. Stackman, PI) 09-01-05 to 08-31-09
National Institute on Alcohol and Alcoholism
Ethanol's influence on neural mechanisms of navigation

R01 NS038880 (J. Adelman, PI) 08-01-04 to 07-31-08
National Institute of Neurological Disorders and Stroke
Molecular physiology of SK channels in CA1 neurons
Role: Co-I

F31 MH070124 (R. Hammond, PI) 09-01-04 to 08-31-05
National Institute of Mental Health
SK channel modulation of hippocampal function
Role: Sponsor

F32 DC00236 (R. Stackman, PI) 01-01-96 to 10-31-98
National Institute on Deafness and Other Communicative Disorders

BIOGRAPHICAL SKETCH

NAME: Emmanuelle TOGNOLI eRA COMMONS USER NAME: TOGNOLI	POSITION TITLE Research Associate Professor, Human Brain & Behavior Laboratory, Center for Complex Systems and Brain Sciences, Florida Atlantic University

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	YEAR(s)	FIELD OF STUDY
Lycee - Epinal – France (*Summa Cum Laude*)	*baccalaureate*	1992	Mathematics/Physics
University Nancy 2 – France (*Summa Cum Laude*)	Master	1997	Psychology
University Nancy 2 – France (*Summa Cum Laude*)	PhD	2003	Psychology
Center for Complex Systems - FAU - USA	postdoc	2003-2007	Electrophysiology

PERSONAL STATEMENT

My overarching scientific motivation is to understand brain function using the concepts and tools of complexity science, in particular coordination dynamics. I am well versed in collaborative science, with doctoral and postdoctoral trainings in interdisciplinary environments (PhD in a clinically oriented basic research laboratory that combined psychiatry, neurology and ophthalmology; postdoctoral work with physicists, mathematicians, behavioral and biological scientists; junior faculty work added several collaborations with engineers).

POSITIONS AND HONORS

2013-now	Associate Research Professor, HBBL, Center for Complex Systems and Brain Sciences, FAU - Boca Raton - Florida
2007-2012	Research Assistant Professor, HBBL, Center for Complex Systems and Brain Sciences, FAU - Boca Raton - Florida
2006	Recipient of the INNS-Sigcom award - WCCI 2006
2003-2007	Postdoctoral Research Scholar, Center for Complex Systems and Brain Sciences - Boca Raton – Florida
2002-2003	Research Associate, Functional Neuroscience and Pathologies Laboratory - CNRS - Lille - France
1999	Awardee by "fondation CETELEM
1998-2003	PhD student and teaching assistant, Psychology Laboratory - Nancy - France

PROFESSIONAL SERVICE

Ad Hoc grant reviewer: National Science Foundation (NSF), Cognitive Neuroscience Program; Perception Action Cognition program; Developmental and Learning Sciences Program.

Site reviewer for federal agencies: National Science Foundation (NSF), Science of Learning Center.

Peer reviewer for book proposals: World Scientific Publishing/Imperial University Press.

Peer Reviewer for journal articles: Journal of Cognitive Neuroscience, PLoS Computational Biology, PLoS One, Neuroinformatics, Neurocomputing, Journal of Biological Physics, Chaos, Solitons & Fractals, Psychopharmacology, Brain Research, NeuroImage, European Journal of Neuroscience, Neurosurgery, Human Brain Mapping, Experimental Brain Research, Schizophrenia Bulletin, Journal of Integrative Biological Science, The International Journal of Neuropsychopharmacology, Journal of Neuroscience Methods, Cognitive Neurodynamics, Intellectica, Computational Intelligence and Neuroscience, IEEE Transactions on Neural Systems & Rehabilitation Engineering, Human Movement Science

Research Advisory Committee: FAU College of Science.

Conferences and scientific events: 2013 Chair: ICCN2013, special session, social neurodynamics | 2011 Co-organizer: A Mini Symposium to celebrate the 25/26th anniversary of the Center for Complex Systems and Brain Sciences, December 8th, 2011 | 2011 Co-organizer: Minisymposium in honor of Michael Turvey. Boca Raton, FL, May 5th. 2010 Co-organizer, The History of Science Lecture, by James McGuire, professor Emeritus, to Celebrate the 25/26th anniversary of the Center for Complex Systems and Brain Sciences, October 29th, 2010 | 2010 Co-organizer and program director: Brain Coordination Dynamics, An International Conference at Sea.

SELECTED PUBLICATIONS (Complete list at http://scholar.google.com/citations?user=1oQwbxQAAAAJ&hl=en)

[1] Dumas G., de Guzman G.C., Tognoli, E., Kelso, J.A.S. (2014). The Human Dynamic Clamp as a Paradigm for Social Interaction. Proceedings of the National Academy of Sciences. 111(35):E3726-34. [High impact factor, Altmetric[1] 98th percentile]

[2] Tognoli, E., Kelso, J.A.S. (2014). Enlarging the scope: grasping brain complexity. Frontiers in System Neuroscience, 8:122. [Altmetric 97th percentile]

[3] Huang, S., Tognoli, E. (2014). Brainware: synergizing software systems and neural inputs. ICSE Companion, New Ideas and Emerging Results, pp. 444-447.

[4] Tognoli, E., Kelso, J.A.S. (2014). The metastable brain. Neuron, 81(1): 35-48. [Free feature article in January; Altmetric 98th percentile, high impact]

[5] Tognoli, E., Kelso, J.A.S. (2013). Spectral dissociation of lateralized brain rhythms. arXiv:1310.7662

[6] Tognoli, E., Kelso, J.A.S. (2013). The coordination dynamics of social neuromarkers. arXiv:1310.7275

[7] Kelso J.A.S., Dumas G., Tognoli E. (2012). Outline of a General Theory of Behavior and Brain Coordination. Neural Networks, 37: 120-131.

[8] Banerjee, A., Tognoli, E., Kelso, J.A.S., Jirsa, V.K. (2012). Spatiotemporal (re)organization of sensorimotor networks underlying unimanual and bimanual coordination. Neuroimage, 62(3): 1582-1592.

[9] Tognoli E., Kelso J.A.S. (2009). Brain Coordination Dynamics: True and False Faces of Phase Synchrony and Metastability. *Progress in Neurobiology*, 87(1): 31-40. [Cover of the journal, high impact]

*[10]*Kelso, J.A.S., de Guzman G.C., Reveley C., Tognoli, E. (2009). Virtual Partner Interaction (VPI): Exploring Novel Behaviors via Coordination Dynamics. PLoS ONE 4(6) e5749.

[11]Tognoli, E., (2008). EEG coordination dynamics: neuromarkers of social coordination. In Fuchs A, Jirsa VK (eds.) Coordination: Neural, Behavioral and Social Dynamics. Springer, pp.309-323.

[12]Banerjee, A., Tognoli, E., Assisi, C., Kelso, J.A.S., Jirsa, V.K. (2008). Mode Level Cognitive Subtraction (MLCS) quantifies spatiotemporal reorganization in large-scale brain topographies. *NeuroImage*, 15, 663-674.

[13]Kelso, J.A.S. , Tognoli, E. (2007). Toward a Complementary Neuroscience: Metastable Coordination Dynamics of the Brain. In R. Kozma & L. Perlovsky (Eds.) Neurodynamics of Higher-level Cognition and Consciousness. Springer, Heidelberg. Reprinted in Murphy, N., Ellis, G. F. R., O'Connor, T. (2009). Downward Causation and the Neurobiology of Free Will. Springer, Heidelberg.

[14]Tognoli, E., Lagarde, J., De Guzman, G.C., Kelso, J.A.S. (2007). From the cover: The phi-complex as a neuromarker of human social coordination. *Proceedings of the National Academy of Sciences*, 104, 8190-8195. [Cover, highly cited]

[15]Bressler S.L., Tognoli, E. (*2006*). Operational principles in neurocognitive networks. *International Journal of Psychophysiology*, 60: 139-148. [Highly cited]

[1] Altmetric is an index of public and media interest: www.altmetric.com

PATENTS

1. System and method for analysis of spatio-temporal data. Provisional Application filed on July 9, 2008 -Serial No. 61/134,349. US utility patent filed on July 8, 2009 - 12/500,187. PCT filed on July 9, 2009 PCT/US2009/50049. Patent awarded, Awarded, August 2013
2. patent in preparation. FAU has retained the rights on the invention.

RESEARCH SUPPORT

Ongoing

2014-2019 Neuromarkers of Social Coordination: a Dynamical Approach. National Institute for Mental Health, R01. , $1,966,784 total cost. PIs Kelso and Tognoli

Completed

2008-2011 Brain dynamics of coordinated teams. Office of Naval Research, Code 30. 630,000$ total cost. PIs Kelso and Tognoli

2009-2012 Social Coordination Dynamics: Intertwining self with others, NSF-08-508: "Human and Social Dynamics". 747.331$ total cost. PI. de Guzman, Co-PIs Kelso and Tognoli

2008-2013 Neuromarkers of Social Coordination: a Dynamical Approach. National Institute for Mental Health: "Basic and Translational Research Opportunities in the Social Neuroscience of Mental Health". 1.635.000$ total cost. Key personnel

2003-2004 Psychometric properties of BAaM attention-memory inventory for short-carrier pilots. INRS/French Institute of Safety, 80.000F total cost. Lead-investigator

2002-2003 Elaboration of an attention-memory inventory for short-carrier pilots. INRS/French Institute of Safety, 80.000F total cost. Lead-investigator

INVITED LECTURES

Sigtuna, Sweden | New-Orleans, LA | Carmona, Spain | Sendai, Japan | Florida International Univ. FL | University of Memphis, TN | University of Cincinnati, OH | Conference at Sea, Western Caribbean | Hangzhou, China | Amsterdam, The Netherlands | Orlando, FL | Boca Raton, FL | West Point, PA | Dallas, TX | Vancouver, Canada

SAMPLE PUBLIC OUTREACH AND PRESS COVERAGE

Scientific American Mind, August 2007 | Director's report to the National Advisory Mental Health Council, September 2007 | ScienceDaily, 2007. | Plexus Institute, June, 2009 | Boca Raton News, July 2009 | Physorg, June 2009 | Palm Beach Post, June 2009 | Simons Foundation Autism Research Initiative, March 2009 | Plexus Institute, February 2009 | News Wise, January 2009 | Science Daily, January 2009 | ONR's NRE navigator, 2010 | Simons Foundation Autism Research Initiative, March 2011 | Datanami Big Data, November 2013 | Sciencedaily, November 2013 | Newswise, November 2013 | Sciencedaily, March 2014 | Integral Options, April 2014 | Discover Magazine, July 2014 | Physorg, August 2014 | Newswise, August 2014 | Sciencedaily, August 2014 | Dailynews, August 2014 | Complexity Digest, August 2014

BIOGRAPHICAL SKETCH

NAME Robert P. Vertes	POSITION TITLE Professor
eRA COMMONS USER NAME Rvertes	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	YEAR(s)	FIELD OF STUDY
University of Dayton, Dayton, OH	B.A.	1968	Psychobiology
The New School University, New York, NY (doctoral training and dissertation done at The Rockefeller University under Dr. Neal E. Miller)	Ph.D.	1975	Neurophysiology
University of Michigan, Ann Arbor, MI	Post-doc	1975-1977	Neurophysiology

A. Personal Statement

My research has focused on defining ascending brainstem-diencephalic-septohippocampal systems responsible for controlling of states of the hippocampal EEG (particularly the theta rhythm of the hippocampus) and the functional significance of theta. In recent years, my research program has expanded to include investigations of the anatomical, physiological and behavioral properties of nuclei of the midline thalamus with a concentration on the nucleus reuniens of the midline thalamus. The midline thalamic nuclei are intimately interconnected with structures of the limbic system and appear to serve a critical role in affective behavior and cognitive functions.

As described in the expanded Facilities and Resources section, the PI has been actively engaged in undergraduate and graduate education at FAU having mentored numerous students at all levels from undergraduate to doctoral students. Students have, and continue to, directly participate in the research of the PI's lab which in most circumstances leads to solid publications for the students. The PI's lab currently consists of the following: Dr. Walter Hoover (postdoctoral fellow); Shannon Sanguinetti (an African-American female and doctoral student in the Center for Complex Systems and Brain Sciences; Argira Glama (a Hispanic female and Master's student in the Department of Psychology), Lindsey Perez (undergraduate student, Psychology); and Nethaniel Agam (undergraduate student, Biopsychology). Charles Corbitt (doctoral student in Psychology) will be joining the lab in the fall of 2012.

B. Positions and Honors

1978-1981	Assistant Research Scientist, Department of Physiology, University of Michigan, Ann Arbor, MI
1982-1984	Assistant Professor, Department of Physiology, Wayne State University, Detroit, MI.
1984-1986	Assistant Professor, Division of Basic Medical Sciences, Mercer University School of Medicine, Macon, GA
1986-1989	Associate Professor, Division of Basic Medical Sciences, Mercer University School of Medicine, Macon, GA
1989-1993	Associate Professor, Center for Complex Systems and Brain Sciences, Florida Atlantic University, Boca Raton, FL
1993-pres.	Professor, Center for Complex Systems and Brain Sciences, Florida Atlantic University, Boca Raton, FL

C. Selected Peer Reviewed Publications

Kocsis, B. and Vertes, R.P. Dorsal raphe neurons: Synchronous discharge with the theta rhythm of the hippocampus in the freely behaving rat. J. Neurophysiol. 68: 1463-1467, 1992.

Kocsis, B. and Vertes, R.P. Characterization of neurons of the supramammillary nucleus and mammillary body that discharge rhythmically with the hippocampal theta rhythm in the rat. J. Neurosci. 14: 7040-7052, 1994.

Vertes, R.P. and Kocsis, B. Brainstem-diencephalo-septohippocampal systems controlling the theta rhythm of the hippocampus. Neuroscience 81: 893-926, 1997.

*Vertes, R.P., Albo, Z and Viana Di Prisco, G. Theta rhythmically firing neurons in the anterior thalamus: Implications for mnemonic functions of Papez's circuit. Neuroscience 104:619-625, 2001.

*Viana Di Prisco, G., Albo, Z., Vertes, R.P. and Kocsis, B. Discharge properties of neurons of the median raphe nucleus during the hippocampal theta rhythm in the rat. Exp. Brain Res. 145:383-394, 2002.

Vertes, R.P. Dfferential projections of the infralimbic and prelimbic cortex in the rat. Synapse 51:32-58, 2004.

*McKenna, J.T. and Vertes, R.P. Afferent projections to nucleus reuniens of the thalamus. J. Comp. Neurol. 480: 115-142, 2004.

Vertes, R.P. Memory consolidation in sleep: Dream or reality. Neuron 44: 135-148, 2004.

Vertes, R.P. Hippocampal theta rhythm: a tag for short term memory. Hippocampus 15:923-935, 2005.

Viana Di Prisco, G. and Vertes, R.P. Excitatory actions of the ventral midline thalamus (rhomboid/reuniens) on the medial prefrontal cortex in the rat. Synapse 60:45-55, 2006.

*Vertes, R.P., Hoover, W.B, do Valle, A.C., Sherman, A. and Rodriguez, J.J. Efferent projections of reuniens and rhomboid nuclei of the thalamus in the rat. J. Comp. Neurol. 499:768-796, 2006.

Vertes, R.P. Interactions among the medial prefrontal cortex, hippocampus and midline thalamus in emotional and cognitive processing in the rat. Neuroscience 142:1-20, 2006.

*Vertes, R.P., Hoover, W.B, Szigeti, K. and Leranth, C. Nucleus reuniens of the midline thalamus: link between the medial prefrontal cortex and the hippocampus. Brain Res. Bull. 71:601-609, 2007

*Vertes, R.P., Linley, S.B., and Hoover, W.B. Pattern of distribution of serotonergic fibers to the thalamus of the rat. Brain Struct Funct 215:1-28, 2010.

*Hoover, W.B. and Vertes, R.P. Collateral projections from nucleus reuniens of thalamus to hippocampus and medial prefrontal cortex in the rat: a single and double retrograde fluorescent labeling study. Brain Struct Funct 217:191-209, 2012.

(*) denotes publications done with students of the PI

Current Research Support:

2013-2016 Agency, NIMH, Project Title: Role of the midline thalamus in arousal, attention and cognition. Role: PI; Total award: $423,421.

Service

Local:

Personnel Committee, Department of Psychology
Graduate Committee, Center for Complex Systems and Brain Sciences

National:

Editorial Board: Journal of Comparative Neurology
Editorial Board: Journal of Chemical Neuroanatomy
Review Editor, Frontiers in Neuroscience
Review Editor, Frontiers in Sleep and Chronobiology