BIOGRAPHICAL SKETCH

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NAME	POSITION TITLE
Steven L. Small	Professor of Neurology, Psychology, Psychiatry, and the College
eRA COMMONS USER NAME SLSMALL	

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

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	MM/YY	FIELD OF STUDY
Dartmouth College, Hanover, New Hampshire	A.B.	6/76	Mathematics
University of Maryland, College Park, Maryland	Ph.D.	9/80	Computer Science
University of Rochester, Rochester, New York	M.D.	5/87	Medicine
University of Pittsburgh, Pittsburgh, Pennsylvania	Post Doc	6/91	Neurology

A. Personal Statement

The goal of the proposed application is to develop and apply basic research in neural dynamics to predicting and treating the consequences of brain damage. One of the big stumbling blocks has been the extraordinary variability in performance and physiology over time within individuals recovering from injury and across different individuals with (apparently) similar injuries. Rather than studying brain injury in terms of localized brain function, we focus on the brain as a highly interactive distributed network of nodes (at multiple levels, from neurons to assemblies to voxels to regions) and connections (anatomical pathways and statistical covariances). We will investigate brain disease in terms of these distributed networks, and work to understand the mechanisms to preserve and/or recover function by understanding how regional damage affects the function of other parts of the task-relevant network. The specific plan involves building a “Virtual Brain”, a veridical model of the human brain and to use the Virtual Brain to integrate different sources of data from individual patients into classification metrics that will allow us to better understand, predict, and guide recovery of function. I am particularly well suited to both the clinical and computational aspects of this project, and will play roles in both parts, and more importantly, in the interface between the two. As a computer scientist by original training, I am knowledgeable about software and hardware systems for high performance computing and simulation, both important for the Virtual Brain. As a neurologist, I work with patients with a variety of neurological disorders, including both stroke and epilepsy. My ongoing research in cognitive neuroscience and neural repair focuses on building network models of brain imaging data on normal language function, normal motor function, and the longitudinal changes to these networks with both injury and novel therapeutic interventions. We will move our network modeling to the more sophisticated platform of the Virtual Brain, and thereby have new ways to predict outcomes, to choose therapies, and to tailor treatments to individuals.

B. Positions and Honors

Positions and Employment

1976-80 Research Assistant, Department of Computer Science, University of Maryland.
1980-81 Fulbright Lecturer in Artificial Intelligence, Université de Paris VIII.
1980-83 Assistant Professor of Computer Science and Psychology, University of Rochester.
1983-89 Adjunct Assistant Professor of Computer Science, University of Rochester.
1988-91 Resident (1988-90) and Chief Resident (1990-91) in Neurology, University of Pittsburgh.
1989-91 Adjunct Assistant Professor of Intelligent Systems, University of Pittsburgh.
1991-96 Assistant Professor of Neurology, Intelligent Systems, Communication Science and Disorders (1993), Center for Neuroscience (1993), and Psychology (1995), University of Pittsburgh.
1993-96 Founder and Director, Aphasia Center University of Pittsburgh.

1996-99 Associate Professor of Neurology, Radiology (1997), and Physiology (1998), University of Maryland.
1999-05 Associate Professor of Neurology, Radiology (2000), Psychology (2001), and in the Committees on Neurobiology (2000) and Computational Neuroscience (2001), The University of Chicago.
1999-06 Founder and Co-Director, Brain Research Imaging Center, The University of Chicago.
1999- Medical Director, Chicago Comprehensive Aphasia Center.
2005- Professor of Neurology, Psychology, Psychiatry (2006), and the College; Member, Committees on Neurobiology and Computational Neuroscience; Senior Fellow, Computation Institute (2007); The University of Chicago.
2010- Anticipated: Professor Emeritus of Neurology and Psychology, The University of Chicago.
2010- Anticipated: Professor and Chair of Neurology, The University of California, Irvine.

Other Experience and Professional Memberships

Ongoing Occasional Reviewer, *Annals of Neurology, Archives of Neurology, Behavioral and Brain Sciences, Brain and Cognition, Brain and Language, Cerebral Cortex, Cognitive Science, Computational Intelligence, European Journal of Neurology, IEEE Transactions on Pattern Analysis and Machine Intelligence, J Cognitive Neuroscience, J Nervous and Mental Diseases, J Neuroscience, J Speech and Hearing Research, Nature Medicine, NeuroCase, Neuroimage, Neurology, Neuropsychology, New England Journal of Medicine, PNAS, Stroke, Trends in Cognitive Science.*
1983- Ad Hoc Member, National Institutes of Health Study Sections in Biotechnology Resources (83, 84, 85), NIDCD-Special Programs (95, 06), DRG-Behavioral and Neural Sciences (96), DRG-Sensory Disorders and Language (96, 97, 98), DRG-Neurological Clinical Trials (98), NINDS-Training Programs (98), CSR-Behavioral and Biobehavioral Processes (00, 05, 07), NICHD-Cooperative Multicenter TBI Clinical Trials Network (02), NINDS-Research Education Programs (09).
1993- Editorial Board (93-98), Associate Editor (98-03), Editor in Chief (04-), *Brain and Language*
1994-96 Vice President, Pittsburgh Chapter, Society for Neuroscience
1998 Panel Member, NIH Consensus Conference: Rehabilitation of Persons With Traumatic Brain Injury, NIH Office of the Director and National Institute of Child Health and Human Development
2002-04 Chairman, Steering Committee, Traumatic Brain Injury Clinical Trials Network (2002 – 2004).
2003- Member, Governing Board (03-), Treasurer (05-), Academy of Aphasia
2005-07 Member, Grant Review Panel, German Federal Ministry of Education and Research (BMBF)
2006 Ad Hoc Member, Board of Scientific Counselors, NIH-NIDCD
2008 Site Visitor, Visual Language and Visual Learning, National Science Foundation (2008).
2010 Founder, Society for the Neurobiology of Language.
2010- President-Elect, American Academy of Neurology Section on Neurorehabilitation and Neural Repair

Honors

1976 College degree awarded Magna Cum Laude with Distinction in Mathematics, Dartmouth College
1980 Fulbright Scholar
1985 George H. Whipple Award of the Rochester Academy of Medicine, Rochester, New York
1991 Clinical Investigator Development Award, NIH-NIDCD
1998 Elected Member, American Neurological Association
2000 Mary Law Lecturer, London, Manchester, Edinburgh, United Kingdom
2005 Charles van Riper Lecturer, Eastern Michigan University
2009 Elected Fellow, American Academy of Neurology

C. Selected Peer-reviewed Publications (Selected from 100 peer-reviewed publications)

Most relevant to the current application

1. Small, S. L., Hlustik, P., Noll, D. C., Genovese, C., & Solodkin, A. (2002). Cerebellar hemispheric activation ipsilateral to the paretic hand correlates with functional recovery after stroke. *Brain, 125*(Pt 7), 1544-1557.

2. Solodkin, A., Hlustik, P., Chen, E. E., & Small, S. L. (2004). Fine Modulation in Network Activation during Motor Execution and Motor Imagery. *Cerebral Cortex, 14*(11), 1246-1255.

3. Kenny, S., Andric, M., Boker, S. M., Neale, M. C., Wilde, M., & Small, S. L. (2009). Parallel workflows for data-driven structural equation modeling in functional neuroimaging. *Frontiers in Neuroinformatics, 3*(34), 1-11.

4. Cherney, L. R., Erickson, R. K., & Small, S. L. (2010). Epidural cortical stimulation as adjunctive treatment for non-fluent aphasia: preliminary findings. *Journal of Neurology, Neurosurgery and Psychiatry, 81*(9), 1014-1021.

5. Sarasso, S., Määtta, S., Poryiazova, R., Ferrarelli, F., Tononi, G., & Small, S. L. (2010). Non-fluent aphasia and neural reorganization after speech therapy: insights from human sleep electrophysiology. *Archives Italiennes de Biologie*, in press.

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

1. Ertelt, D., Small, S., Solodkin, A., Dettmers, C., McNamara, A., Binkofski, F., & Buccino, G. (2007). Action observation has a positive impact on rehabilitation of motor deficits after stroke. *NeuroImage, 36 Suppl 2*, T164-173.

2. Robinson, R. G., Jorge, R. E., Moser, D. J., Acion, L., Solodkin, A., Small, S. L., Fonzetti, P., Hegel, M., & Arndt, S. (2008). Escitalopram and problem-solving therapy for prevention of poststroke depression: a randomized controlled trial. *Journal of the American Medical Association, 299*(20), 2391-2400.

3. Walsh, R. R., Small, S. L., Chen, E. E., & Solodkin, A. (2008). Network activation during bimanual movements in humans. *NeuroImage, 43*(3), 540-553.

4. Hasson, U., Nusbaum, H. C., & Small, S. L. (2009). Task-dependent organization of brain regions active during rest. *Proceedings of the National Academy of Sciences of the United States of America, 106*(26), 10841-10846.

5. Small, S. L., Buccino, G., & Solodkin, A. (2010). The Mirror Neuron System and Treatment of Stroke. *Developmental Psychobiology, in press*.

6. Lee, J., Fowler, R., Rodney, D., Cherney, L., & Small, S. L. (2010). IMITATE: An intensive computer-based treatment for aphasia based on action observation and imitation. Aphasiology, 24(4), 449-465.

7. Andric, M., & Small, S. L. (2010). Functional imaging of putative human mirror neuron systems in neurological disease. *Experimental Neurology, 221*(1), 5-9.

8. Raja Beharelle, A., Dick, A. S., Josse, G., Solodkin, A., Huttenlocher, P. R., Levine, S. C., & Small, S. L. (2010). Left hemisphere regions are critical for language in the face of early left focal brain injury. *Brain, 133*(Pt 6), 1707-1716.

9. Schmah, T., Yourganov, G., Zemel, R. S., Hinton, G. E., Small, S. L., & Strother, S. (2010). Comparing classification methods for longitudinal fMRI studies. *Neural Computation,* in press.

10. Solodkin, A., Hasson, U., Suizdgate, R., Schiel, M., Chen, E. E., Kotter, R., & Small, S. L. (2010). Virtual Brain Transplantation: A method for accurate image registration and parcellation in large cortical stroke. *Archives Italiennes de Biologie*, in press.

D. Research Support

Ongoing Research Support

2 R01 DC03378-12 (Small) 09/30/1996 – 08/31/2013
Functional Neuroanatomy of Normal and Impaired Language

The major goals of this project are to determine the functional neuroanatomy of normal language processing, primarily the lexical and sentential levels, and in ecological context.

5 R01 DC007488-05 (Small) 04/01/2005 – 3/31/2011
Neurophysiological Measurement in Aphasia Treatment
The major goal of this project is to facilitate the use of neurophysiological (functional imaging) measures in patients with aphasia. (No-Cost Extension)

4 R33 DC008638-04 (Small) 09/01/2008 – 08/31/2011
Bioinformatics Infrastructure for Large Scale Studies of Aphasia Recovery
This project proposes to build computational infrastructure to facilitate the prospective investigation of aphasia recovery in a large group of patients (R21 phase) and then to execute such a study (R33 phase).

1 R01 N5054942-03(Co-PI; PI: Solodkin) 07/01/2007 – 06/30/2011
Mirror Imitation Therapy for Motor Recovery After Stroke
This proposal specifically focuses on methods for remediation of hand motor skill after ischemic stroke.

2PO1 HD040605-07 (PI: Goldin-Meadow) 04/01/2008 – 03/31/2013
Environmental and Biological Variation and Language Growth: Project IV (Project Leader)
This proposal focuses on development of reading and grammar in children with and without neonatal lesions.