LEON N COOPER
CURRICULUM VITAE

1. **Titles**
   Thomas J. Watson Sr., Professor of Science
   Director, Institute for Brain and Neural Systems
   Brown University, Providence RI

2. **Home Address**
   49 Intervale Road
   Providence, RI 02906

3. **Education**
   a. Undergraduate degrees
      A.B., Columbia University, 1951
   b. Higher degrees
      A.M., Columbia University, 1954
      Ph.D., Columbia University, 1954
   c. Dissertation topic:
      "Mu-Mesonic Atoms and the Electromagnetic Radius of the Nucleus"

4. **Professional Appointments**
   1954-55 Member, Institute for Advanced Study
   1955-57 Research Associate, University of Illinois
   1957-58 Assistant Professor, The Ohio State University
   1958-62 Associate Professor, Brown University
   1962-66 Professor, Brown University
   1966-74 Henry Ledyard Goddard University Professor, Brown University
   1974-   Thomas J. Watson, Sr., Professor of Science, Brown University
   Visiting Professor: various universities and summer schools.
   Consultant, various government agencies, industrial, financial and educational organizations.

5. **Academic Honors**
   1968 Comstock Prize (with J. R. Schrieffer) National Academy of Science
   1972 Nobel Prize (with J. Bardeen and J. R. Schrieffer)
   1973 Columbia University, Doctor of Science (honoris causa)
   1973 University of Sussex, Doctor of Science (honoris causa)
   1974 Award of Excellence, Graduate Faculties Alumni of Columbia University
   1974 University of Illinois, Doctor of Science (honoris causa)
   1974 Brown University, Doctor of Science (honoris causa)
   1975 Gustavas Adolphus, College Doctor of Science (honoris causa)

1975 Ohio State University, Doctor of Science (honoris causa)
1977 Universite Pierre et Marie Curie, Doctor of Science (honoris causa)
1977 Descartes Medal, Academie de Paris, Universite Rene Descartes
1982 Yrjo Reenpaa Award Finnish Cultural Foundation
1985 John Jay Award, Columbia University
1995 Alexander Hamilton Award, Columbia University
2000 College de France Medal
2013 Susan Culver Rosenberger Medal, Brown University Faculty

6. Research in Progress
Neural Networks: Memory, Learning, Language Acquisition, Visual Cortex.
Prior support: NSF, DOD, AEC, A.P. Sloan Foundation, J.S. Guggenheim, Ittleson Foundation, Inc., Charles F. Dana Foundation, Office of Naval Research.
Present support: Army Research Office.

7. Service
Director, Institute for Brain and Neural Systems
Executive Committee, Charles F. Dana Foundation
Brown University, Biomed Faculty Council
Chair, Science Advisory Board, Center for Restorative and Regenerative Medicine, Brown University

8. Fellowships
1954-55 NSF Postdoctoral Fellow
1959-66 Alfred P. Sloan Foundation Research Fellow
1965-66 John Simon Guggenheim Memorial Foundation Fellow

9. Societies
Fellow: American Physical Society, American Academy of Arts and Sciences, American Association for Advancement of Science, Phi Beta Kappa, Sigma Xi.
Member: American Philosophical Society, National Academy of Sciences, Society for Neuroscience.
Sponsor: Federation of American Scientists.

10. Listings
Who's Who, Who's Who in America, Who's Who in the World.

11. Seminars
Frontiers in the Interaction Between Physics and Biology. Fall 2003 to Present.
What Physical Scientists Can Measure, What Biological Scientists Would Like To Measure. Fall 2000, Spring 2001.
Recent Developments in Synaptic Plasticity. July 21, 2001.

12. Graduate Students
Michael Antosh

13. Post-Doctoral Researchers
Predrag Neskovic
Nicola Neretti

14. Collaborators
Mark Bear
Brian Blais
Gastone Castellani
Steve Helfand
Nathan Intrator
Nicola Neretti
Predrag Neskovic
John Sedivy
Harel Shouval

15. Publications

Cooper and Bear. The BCM theory of synapse modification at 30: interaction of theory with experiment. Nature Reviews Neuroscience **13**:798-810 (2012).

Bazzani et al. Bistability in the master equation for dual phosphorylation cycles. J. Chem. Phys. **136**(23), (2012).

Apartsin et al. Semi-coherent time of arrival estimation using regression. The Journal of the Acoustical Society of America **132**(2): 832-837 (2012).

Apartsin et al. Time of Flight Estimation in the Presence of Outliers Part I-Singe Echo Processing (submitted).

Antosh et al. CORaL: Comparison of Ranked Lists For Analysis of Gene Expression Data (submitted).

Antosh et al. Comparative transcriptional pathway bioinformatic analysis of dietary restriction, Sir2, p53 and resveratrol life span extension in Drosophila. Cell Cycle **10**(6), 904-911, (2011).

Fox et al. New comparative genomics approach reveals a conserved health span signature across species. Aging **3**(6), (2011).

Cooper, L. N *Remembrance of Superconductivity Past*. In *BCS:50 Years*. (Cooper, Feldman, eds.) Singapore: World Scientific Publishers, pp. 3-19, (2011).

Cooper, L. N, Feldman, D. (eds.) *BCS:50 Years*. Singapore: World Scientific Publishers, (2011).

Cooper. *STDP: spiking, timing, rates and beyond*. Front. Syn. Neurosci. vol. 2 pp. 1-3, (2010).

Bazzani et al. *Eigenvalue distributions for a class of covariance matrices with application to Bienenstock-Cooper-Munro neurons under noisy conditions*. Physical Review E (2010).

Neskovic, P., Sherman, I., Wu, L. and Cooper, L.N "Learning faces with the BIAS model: On the importance of the sizes and locations of fixation …." *Neurocomputing* (2009).

Castellani, G.C., Bazzani, A., and Cooper, L.N "Toward a microscopic model of bidirectional synaptic plasticity." *Proc Natl Acad Sci USA* (2009) vol. 106 (33) pp. 14091-5.

Blais, B., Shouval, H.Z., Cooper, L.N "Effect of correlated lateral geniculate nucleus firing rates on predictions for monocular eye closure versus monocular retinal inactivation." Phys Rev E (2009) vol. 80, pp. 061915-1-061915-9.

Bazzani, A., Castellani, G.C. and Cooper, L. N "Eigenvalue distributuins for a class of covariance matrices with applications to BCM neurons under noisy conditions." Submitted to *Phys. Rev. E.*

Castellani, G.C., Bazzani, A., Giampieri, E., Remondini, D. and Cooper, L. N "Stochastic analysis of dual phosphorylation cycles." Submitted.

Cooper, L.N and D. Feldman*, Bardeen-Cooper-Schrieffer theory*. Scholarpedia, 2009, 4(1):6439

Blais, B.S. and L.N Cooper, *BCM theory*. Scholarpedia, 2008, 3(3):1570

Francesconi, M., et al., *Reconstructing networks of pathways via significance analysis of their intersections.* BMC Bioinformatics, 2008. **9 Suppl 4**: p. S9.

Cooper, L.N., *Fundamental Research And Infrastructure.* Brown University Faculty Bulletin, 2008. **7**(2): p. 6-10.

Blais, B.S., et al., *Recovery from monocular deprivation using binocular deprivation.* J Neurophysiol, 2008. **100**(4): p. 2217-24.

Cooper, L.N*, The unpaid debt*. Nat Phys, 2007. **3**(12): p. 824.

Leon, N, 2007 *On the problem of consciousness*. Neural Netw., 2007. **20**(9): p. 1057-1058.

Wang, J., P. Neskovic, and L.N. Cooper*, Improving nearest neighbor rule with a simple adaptive distance measure*. Pattern Recognition Letters, 2007. **28**(2): p. 207.

Neskovic, P., et al. *How Important are the Sizes and Locations of Fixation Regions for the BIAS Model?* in *Natural Computation, 2007. ICNC* 2007. Third International Conference on. 2007.

Cai, Y., et al., *Effect of Stochastic Synaptic and Dendritic Dynamics on Synaptic Plasticity in Visual Cortex and Hippocampus*. J Neurophysiol, 2007. **97**(1): p. 375-386.

Wang, J., P. Neskovic, and L.N. Cooper, *Bayes classification based on minimum bounding spheres*. Neurocomputing, 2007. **70**(4-6): p. 801.

Wang, J., P. Neskovic, and L.N. Cooper, *A Statistical Confidence-Based Adaptive Nearest Neighbor Algorithm for Pattern Classification*, in *Lecture Notes in Computer Science: Advances in Machine Learning and Cybernetics*, D.S. Yeung, Editor. 2006, Springer: Berlin. p. 548-557.

Neskovic, P., L. Wu, and L.N. Cooper, *Learning by Integrating Information Within and Across Fixations*, in Lecture Notes in Computer Science: Artificial Neural Networks, S. Kollias, et al., Editors. 2006, Springer: Berlin. p. 488-497.

Shah, N., et al., *A Biophysical Basis for the Inter-spike Interaction of Spike-timing dependent Plasticity.* Biological Cybernetics, 2006. **95**(2): p. 113.

Wu, L., P. Neskovic, and L.N. Cooper, *Learning by Integrating Information Within and Across Fixations*, in *Artificial Neural Networks – ICANN*. 2006, Springer: Berlin. p. 488-497.

Wang, J., P. Neskovic, and L.N. Cooper, *Improving Nearest Neighbor Rule with a Simple Adaptive Distance Measure*, in *Lecture Notes in Computer Science: Advances in Natural Computation*. 2006, Springer: Berlin. p. 43-46.

Wu, L., P. Neskovic, and L.N. Cooper, *Biologically Inspired Bayes Learning and its Dependence on the Distribution of the Receptive Fields*, in *Lecture Notes in Computer Science: Advances in Natural Computation*. 2006, Springer: Berlin. p. 279-288.

Wang, J., P. Neskovic, and L.N. Cooper. *A Minimum Sphere Covering Approach to Pattern Classification*. in *ICPR*. 2006. Hong Kong.

Wu, L., P. Neskovic, and L.N. Cooper. *Biologically Inspired Hierarchical Model for Feature Extraction and Localization*. in *ICPR*. 2006. Hong Kong.

Wang, J., P. Neskovic, and L.N. Cooper, *A Statistical Confidence-Based Adaptive Nearest Neighbor Algorithm for Pattern Classification*, in *Lecture Notes in Computer Science: Advances in Machine Learning and Cybernetics*, D.S. Yeung, Editor. 2006, Springer: Berlin. p. 548-557.

Wu, L., P. Neskovic, and L.N. Cooper, *Learning by Integrating Information Within and Across Fixations*, in *Artificial Neural Networks – ICANN 2006*. 2006, Springer: Berlin. p. 488-497.

Wang, J., P. Neskovic, and L.N. Cooper, *Neighborhood size selection in the k-nearest neighbor rule using statistical confidence.* Pattern Recognition, 2006. **39**(3): p. 417-423.

Neskovic, P. and L.N. Cooper, *Visual Search for Object Features*, in *Lecture Notes in Computer Science: Advances in Natural Computation*, L. Wang, K. Chen, and Y.S. Ong, Editors. 2005, Springer: Berlin. p. 877-887.

Wang, J., P. Neskovic, and L.N. Cooper, *Training Data Selection for Support Vector Machines*, in *Lecture Notes in Computer Science: Advances in Natural Computation*, L. Wang, K. Chen, and Y.S. Ong, Editors. 2005, Springer: Berlin. p. 554-564.

Wang, J., P. Neskovic, and L.N. Cooper, *Pattern Classification via Single Spheres*, in *Lecture Notes in Computer Science: Discovery Science*, H. Hoffman, H. Motoda, and T. Scheffer, Editors. 2005, Springer: Berlin. p. 241-252.

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Wang, J., P. Neskovic, and L.N. Cooper. *Pattern classification based on minimum bounding spheres*. in *International Conference on Intelligent Computing (ICIC)*. 2005.

Britt, M., et al., *On Sums Of Consecutive Integers.* Quart. Appl. Math., 2005. **63**(4): p. 791-792.

Cooper, L.N., et al., *Theory Of Cortical Plasticity*. 2004, Singapore: World Scientific. 333.

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Wang, J., P. Neskovic, and L.N. Cooper. *Tracking Object Features Using Dynamically Defined Spatial Context*. in *ECOVISION*. 2004.

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Wang, J., P. Neskovic, and L.N. Cooper. *Partitioning a feature space using locally defined confidence measure*. in *Artificial neural networks and neural information processing-ICANN/ICONIP 2003*. 2003. Istanbul, Turkey: Springer.

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Neskovic, P., L.N. Cooper, and D. Schuster. *A recognition system that uses Saccades to detect cars from real-time video streams*. in *Neural Information Processing, ICONIP*. 2002.

Remondini, D., et al., *Optimal spontaneous activity in neural network modeling.* Neurocomputing, 2002. **44-46**: p. 591-595.

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Preprocessing Parameters, in *Lecture Notes in Computer Science: Bio-Inspired Applications of Connectionism (IWANN)*, J. Mira and A. Prieto, Editors. 2001, Springer: Berlin. p. 696-703.

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Neskovic, P. and L.N. Cooper. *Neural network based context driven recognition of on-line cursive script*. in *Proceedings of the Seventh International Workshop on Frontiers in Handwriting Recognition*. 2000. Amsterdam: International Unipen Foundation.

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Blais, B.S., H.Z. Shouval, and L.N. Cooper, *The role of presynaptic activity in monocular deprivation: Comparison of homosynaptic and heterosynaptic mechanisms.* Proc. Natl. Acad. Sci. USA, 1999. **96**(3): p. 1083-1087.

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Artun, O.B., H.Z. Shouval, and L.N. Cooper, *The effect of dynamic synapses on spatiotemporal receptive fields in visual cortex.* Proc. Natl. Acad. Sci. USA, 1998. **95**(20): p. 11999-12003.

Huynh, Q., L.N. Cooper, and N. Intrator, *Classification of underwater mammals using feature extraction based on time-frequency analysis and BCM theory.* IEEE-SP, 1998. **46**(5): p. 1202-1207.

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Blais, B.S., H.Z. Shouval, and L.N. Cooper. *Dynamics of synaptic plasticity: A comparison between models and experimental results in visual cortex*. in *Computational Neuroscience*. 1997: Plenum.

Blais, B., et al. *Receptive field formation in natural scene environment: comparison of kurtosis, skewness, and the quadratic form of BCM*. in *Neural Information Processing*. 1997: MIT Press.

Cooper, L.N., *"Shall we deconstruct science?" from Discussion: Psychology: From Hysteria to the Therapeutic Society.* Partisan Review, 1997. **LXIV**(2): p. 232-245.

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16. Teaching

PHYS0100 *Flat Earth to Quantum Uncertainty: On the Nature and Meaning of Scientific Explanation,* Spring 2009-2012. Physics has had a dramatic impact on our conception of the universe, our ideas concerning the nature of knowledge, as well as our view of ourselves. Philosophy, sometimes inspired by developments in physics, has treated their impact on our lives. In this course, through a study of physics as well as selected philosophical readings, we explore how classical and modern physical theory have affected our view of the cosmos, of ourselves as human beings, as well as our view of the relation of mathematical or physical structures to 'truth' or 'reality'. We consider questions such as how we can know anything, from seemingly simple facts to whether a machine is conscious. Topics in physics will cover the classical theories of Galileo, Newton and Maxwell with emphasis on the twentieth century revolutions: relativity, quantum theory and quantum field theory, as well as their interpretations.

Physics 10/Visual Arts 14 *Images from Science, Images for Science (with Richard Fishman) Spring 2006, Spring 2007, Spring 2008.* Images and objects that come from nature and science—from Elm trees to galaxies—can be a source of inspiration for the artist. But images, objects and animations can also help in the understanding of deep and subtle scientific ideas. In this course we present some basic ideas of physics and biology. These suggest images that can inspire works of art as well as those that can aid in explaining science.

Physics 10/Theater Arts 10 *Science in Confrontation with Authority: The Drama, the History and the Science (with the assistance of Oskar Eustis and Kenneth Miller) Spring 2004 and 2005.* Scientists and scientific ideas have had and continue to have well publicized confrontations with authority. Among the most famous are those of Galileo and Darwin. Current examples include

arguments over stem cell research, as well as the creationist/evolution controversy. In this course through a study of the science and the history, as well as through dramatic readings of several especially relevant plays, we will explore the nature and/or the necessity of these confrontations. This new course will feature a dramatic reading by Tony Award Winning Actor Brian Dennehey, and a reading from *Trumpery*, a new play by Peter Parnell.

Physics 10/Theatre Arts 10 *Encounter in Copenhagen: The Drama, The History and The Physics Behind the Visit (with the assistance of Thomas Biersteker, Oskar Eustis, and Abbot Gleason) Spring 2001, Spring 2002*. In 1941, the physicist in charge of Germany's Uranium Project, Werner Heisenberg, visited his mentor, Niels Bohr, in Nazi occupied Copenhagen. The purpose of that visit has been a subject of continuing conjecture and is explored on several levels in the recent play, Copenhagen. In this course, along with viewing the play, we present the history as well as the physics necessary to enable the student to propose her or his own answer to the question explored in Michael Frayn's play, "Why did Heisenberg visit Bohr?"

Physics 10/Visual Art 12 *Experience and Explanation – Dialogues Among the Disciplines, with Richard Fishman and Dietrich Neumann, Spring Semester 2000.* This course introduces Newtonian and quantum physics as examples of scientific thinking as well as examples from the world of visual art. Among the questions explored will be to what extent concepts of truth and beauty change with time. In spite of these evident changes do some underlying themes remain constant?

Physics 10/Classics 3/Media 120 *Experience and Explanation – Dialogues Among the Disciplines, with Nancy Armstrong and David Konstan, Spring Semester, 1999*. The dominant model of knowing today is represented by one physical science. But are there other ways of knowing? Can these explanations challenge the model of science? This course introduces Newtonian physics and modern quantum physics. as two examples of scientific thinking, but also questions the range of the scientific model (can it explain such phenomena as history, the emotions, and imaginative literature?) and presents a post-modern interpretation: who knows, how we know, and what we know.

Physics 10 *Experience and Explanation – Dialogues Among the Disciplines*: Physics 10 attempts to provide us with a deep understanding of the world in which we live. In this course we present Newtonian and quantum physics as examples of physical theory and compare them with other methods for explanation or visualization. In different years we chose different fields for comparison.

Advanced Quantum Mechanics (Physics 207): Relativistic wave equations, Dirace equation: Non relativistic limit, invariance properties, transformation properties of spinors, bilinear covariants, invariant interactions, electro-weak theory.

Current Issues in Neural Science (Physics 261-262): Various topics of current research interest in neural networks and/or the cellular and molecular basis for learning and memory storage are discussed.

Physics 1: The aim of the course is to introduce students, whose primary interest is not in the sciences, to such topics in classical and modern physics as Newtonian mechanics, relativity, and the quantum theory.

17. Ph.D. Theses Directed

Brian Benjamin Schwartz, "Flux Quantization and Generalized Pairing in Superconducting Cylinders", 1964.

Birger Stolan, "A Study of Many-Fermion Systems", 1965.

Hyung Joon Lee, "On the Theory of Absorption of Sound in Superconductors of the Second Kind", 1965.

William Silvert, "Theory of Non-Homogeneous Superconductors", 1965.

Menasche Nass, "A Theory for the Development of Feature Detecting Cells", 1975.

Ertugrul Berkcan,"One Dimensional Systems: A New Variational Solution and Relations Between Various Theories", 1978.

Fishel Liberman, "Learning by Neural Nets: A Language Acquisition System, and Fine Tuning of Receptive Fields, 1979.

Elie Bienenstock, "A Theory of Development of Neural Selectivity", 1980.

Douglas Reilly,"Neural Network Simulations of Learning and Pattern Classification", 1980.

Paul Munro, "Neural Plasticity: Single Neuron Model for Discrimination and Generalization and an Experimental Ensemble Approach", 1983.

Michael A. Paradiso, "Experimental and Theoretical Studies of the Constraints on Development and Plasticity in Visual Cortex", 1984.

Christopher Scofield, "The Development of Selectivity and Ocular Dominance in a Neural Network", 1984.

Alan B. Saul, "Visual Coritcal Unit Response Properties in Kittens Given Brief Monocular Experience Following Dark Reading", 1986.

C. Charles Law, "Development of Primary Visual Cortex According to the BCM Theory of Synaptic Plasticity," 1986.

Terrance Potter, "Storing and Retrieving Data in a Parallel Distributed Memory System", 1987.

Charles Bachmann, "Learning and Generalization in Neural Networks", 1990.

Eugene Clothiaux, "Theoretical and Empirical Study of Visual Cortex Using the BCM Neural Network Model", 1990.

Nathan Intrator, "Feature Extraction Using an Exploratory Projection Pursuit Neural Network", 1990.

Bradley Seebach, "Evidence for the Development of Phonetic Property Detectors in a Neural Net without Innate Knowledge of Linguistic Structure", 1990.

Yong Liu, "Synaptic Plasticity: From Single Cell to Cortical Network", 1991.

Michael P. Perrone, "Improving Regression Estimation: Averaging Methods for Variance Reduction with Extensions to General Convex Measure Optimization", 1992.

Harel Shouval, "Formation and Organization of Receptive fields, with an Input Environment Composed of Natural Scenes," 1994.

Brian S. Blais, "The Role of the Environment in Synaptic Plasticity: Towards an Understanding of Learning and Memory," 1998.

Ömer Artun, "Implications of Dynamic Synapses on Neural and Memory Coding," 1999.

Predrag V. Neskovic, "Feedforward, Feedback Neural Networks With Context Driven Segmentation And Recognition," 1999.

Nicola Neretti, "An Adaptive Approach to Wavelet Filter Design," 2001.

Ann B. Lee, "Statistics, Models and learning in BCM Theory of a Natural Visual Environment," 2001.

Luk Chong Yeung, "A Mechanistic Model of Calcium-Dependent Synaptic Plasticity," 2004.

Jigang Wang, "Statistical Pattern Recognition," 2005.

Ki-O Kim, "Enhanced Echolocation via Robust Statistics and Super-resolution of Sonar Images," 2007.

Liang Wu, "Analysis of brain signals with machine learning and information-theoretic methods," 2008.

Michael Antosh, "Stress, Aging and Gene Expression in Drosophila melanogaster," 2012.

18. Conferences and Lectures

2012

"Does The Moon Only Exist When You Look At It?" Houghton Symposium, Providence, RI, October 8, 2012.

"BCS: 50 Years," TcSUH 25th Anniversary Symposium, Houston, TX, November 19, 2012.

2011

"BCS: 50 Years," *APS Meeting,* Dallas, TX, March 21, 2011.

"BCS: 50 Years," Kenyon College, Hamister Distinguished Lecture, October 28, 2011.

"Superconductivity and Other Insoluble Problems: Are There Limits to Scientific Understanding?" The Graduate Center, CUNY, NY, November 14, 2011.

2010
"BCS: 50 Years," *Brown Graduate Colloquium*, December 10, 2010.

"Does The Moon Exist Only When You Look At It?" *APS Meeting*, Brown University, October 29, 2010.

2009
"A Physicist's Adventures In Neuron Land," *Brown Graduate Colloquium*, October 2, 2009.

"Albert Einstein and Constitutional Law," *Magde Colloquium*, Boston College, April 29, 2009.

"Albert Einstein and Constitutional Law: The Special Theory of Relativity," ADOCH, April 22, 2009.

2008
"Albert Einstein and Constitutional Law," ADOCH, Brown University, April 16, 2008.

2007
"Superconductivity and Other Insoluble Problems," The BCS Theory Of Superconductivity: 50 Years, Brown University, April 12, 2007.

"Can We Understand the Brain? And If We Could How Would That Effect Our Understanding of Ourselves?" Maurice and Yetta Glicksman Lecture, Brown University, May 26, 2007.

"Origins of the Theory of Superconductivity," Bardeen-Cooper-Schrieffer Theory of Superconductivity @ 50, University of Illinois at Urbana-Champaign, October 10-13, 2007.

2006
"Is Theory Possible In Neuroscience?" The Genome and the Computational Sciences: The Next Paradigms, Brown University, December 6, 2006.

"Superconductivity and Beyond," 25th Annual Army Science Conference, Orlando, FL, November 28, 2006.

"Can we understand the Brain? And if we can, how would this affect our understanding of ourselves?" Columbia Alumni Association, New York, NY, June 10, 2006.

2005
Picower Institute Inaugural Symposium, MIT, December 1-2, 2005.

Fall Humanities Weekend, Brown University, November 5, 2005.

"Nerve Cell Olympics – Gymnastics, Weightlifting, and Regeneration in the Spinal Cord," (introduction), Boldly Brown kickoff, Brown University, October 21, 2005.

"Matrices to Molecules," Regional Training seminar, Soldier Systems Center, Natick, MA, June 2, 2005.

"QFT & QCD: Past, present, and future," Harvard University, March 18-19, 2005.

"Albert Einstein and Constitutional Law: One Hundred Years," Einstein Lecture, Brown University, March 7, 2005.

Inaugural Center for Genomics and Proteomics Symposium, Laboratory for Molecular Medicine, Brown University, January 28, 2005.

2004
"Theoretical Neuroscience: Is It Possible? Can It be Useful?" Keynote Lecture, University of Maryland Bioscience Research and Technology Review Day, University of Maryland, November 4, 2004.

Keynote Lecture, "Frontiers of Fundamental and Computational Physics," Università degli Studi di Udine, Udine, ITALY, September 26-28, 2004.

Picower-RIKEN Symposium, "New Frontiers in Brain Science: from Molecules to Mind," MIT, September 22-24, 2004.

"Neural Networks in Vision," Plenary lecture, NECSI, International Conference on Complex Systems (ICCS2004), Boston, MA, May 04, 2004.

2003

"How We Learn How We Remember" Brown University, December 7, 2003.

Synaptic Plasticity Symposium, Brown University, November 25, 2003.

"Matrices to Molecules: Towards a Cellular and Molecular Basis for Learning and Memory" Brown University, November 17, 2003.

Dana Executive Committee Meeting, New Orleans, LA, November 11, 2003

"Matrices to Molecules: Towards a Cellular and Molecular Basis for Learning and Memory" Boston University, October 21, 2003.

"Towards a Cellular and Molecular Basis for Memory: Theory and Experiment" Lindau, July 1, 2003.

"Matrices to Molecules: Towards a Physiological Basis for Learning and Memory Storage" University of Illinois, April 17, 2003.

2002
Mind Body Panel, Department of Philosophy, Brown University, March 13, 2002.

Medical School Symposium on Intellectual Property, Brown University, April 26, 2002.

"An Encounter in Copenhagen," Watson Institute for International Studies Building Dedication, Brown University, May 11, 2002.

Boston Brown Club, Copenhagen Symposium, May 16, 2002.

"Calcium as the associative signal for a model of Hebbian plasticity: application to multi-input environments," (with H. Shouval, and L. Yeung), CNS, July 21-25, 2002.

Copenhagen Symposium, Parents' Weekend, Brown University, October 26, 2002.

"Development of cortical receptive fields with a unified calcium dependent plasticity model," (with H. Shouval, L. Yeung), Soc. Neurosci., November 1-7, 2002.

Dana Executive Committee Meeting, Orlando, FL, November 3, 2002.

"Vicki: Theme and Variations: A Symposium in Memory of Victor Weisskopf," MIT, Cambridge, MA, November 16, 2002.

"A recognition system that uses saccades to detect cars from real-time video streams," (with P. Neskovic), International Conference on Neural Information Processing, Singapore, November 18-22, 2002.

"Selectivity and metaplasticity in a unified calcium model," (with H. Shouval, B. Blais, and L. Yeung), Nips, December 9-14, 2002.

2001
"Physics 10 Presentation," Corporation Lunch, Brown University, February 23, 2001.

"Research in Synaptic Plasticity," Physics Department Colloquium, Brown University, February 26, 2001.

"An Encounter in Copenhagen," Commencement Forum, Brown University, May 26, 2001.

Plenary Lecture: "Bi-directionally modifiable synapses: From theoretical fantasy to experimental fact.," Fifth International Conference on Cognitive and Neural Systems, Boston University, Boston MA, May 30 – June 2, 2001.

Chair of panel: "The Need For Mission-Oriented Basic Research at the Millennium: Supporting the Army's Vision," U.S. Army Research Office, Excellence in Research: A Key to Objective Force, Research Triangle Park, NC, July 12, 2001.

Panel: "Brains of the Future—Human and Artificial," American Embassy, Paris, France, October 19, 2001.

Lecture: "A Unified Model for Dependant Synaptic Plasticity," Institut Pasteur, College de France, Paris, France, October 23, 2001.

Reception in honor of the 100th Anniversary of the Nobel Prize, The White House, Washington, DC, November 27, 2001.

Meeting on Intellectual Property, Medical School Corporation, Brown University, November 30, 2001.

Nobel Centennial Celebration, Stockholm, Sweden, December 5-10, 2001.

2000
The Dynamic Brain: Molecules, Mathematics and The Mind" Symposium, Brown University, June 1st -June 3rd 2000
Symposium Overview -The "Dynamic Brain" Meeting celebrated interdisciplinary research and education and the launch of the new Brain Science Program at Brown University. One of the main goals of the meeting was to bring together experimentalist and theoreticians to discuss how we can accelerate our understanding of the brain through interdisciplinary studies that blend mathematics, biology, computation, and cognitive and behavior sciences.

"A Physicist's Approach to Understanding the Brain: Towards a Physiological Basis for Learning, "Lindau, Germany, June 26th – June 30th 2000

Special Lecture Series, College de France, October 15th – October 30th 2000
Lecture: "Mind and Matter: Molecules to Mental States"
1. "From Neurons to Networks to Memory: In the Role of Theory in the Understanding of the Brain"
2. "Theories of Synaptic plasticity: Comparison with Experiment"
3. "On the Possible cellular and Molecular Basis for Learning and Memory Storage"
4. "Towards a Theory of Mind"

1999
Brain Science Week, DANA Alliance, Washington, D. C.

American Physical Society, Centennial Meeting, Atlanta, GA

"Memory and Memories," CN Yang Symposium, SUNY Stoneybrook, NY, May 20-22 1999.

Brain Science Program Ceremony, Honorary Degree, David Mahoney, October 8, 1999.

Brown University/Pasteur Institut Symposium, Institute Pasteur, Paris, 1999.

Meetings with Brown Alumni and Parents group, October 26 1999.

Visiting Committee to review Program on Neural Informational and Behavioral Sciences University of Southern California, (with Larry Squire and Fred Gage), November 29-30 1999.

1998

World Economic Forum, Davos, Switzerland, January 28-February 4, 1998.

Dana Brain Awareness Week, Washington, D.C., March 18, 1998.

ACI Conference, Toronto, Canada, March 23, 1998.

NIH Workshop, Washington, D.C., March 30-31, 1998.

University of Texas, San Antonio, Texas, April 2-4, 1998.

Washington University, St. Louis, MO, April 21-22, 1998.

Serber Symposium, Columbia University, April 29-May 1, 1998.

University of Bologna, Bologna, Italy, October 7-11, 1998.

Charles A. Dana Foundation, Awards Dinner, 1998.

U. S. Naval Academy, Annapolis, Maryland, November 23-24, 1998.

1997

TIAA/CREF Meeting, New York, NY, February 3-4, 1997.

Brain Awareness Week, Washington, D.C., March 17-19, 1997.

Dana Meeting on Economic Analysis, New York, NY, April 8, 1997.

ONR Meeting and Lecture, Newport, RI, May 9, 1997.

Dana Meeting, New York, NY, May 30-June 1, 1997.

House Science Committee, Science Coalition Meeting, Washington, D.C., July 15, 1997.

Neuroscience Retreat/Lecture, Haffenreffer, Newport, RI, August 28, 1997.

Keynote Address: Prism User's Group, Newport, Rhode Island, September 17, 1997.

Institut Pasteur: Symposium/Lecture, Paris, France, October 9, l997.

Daedelus Meeting (Issue on the Brain), Paris, France, October 10-11, 1997.

University College Lecture, London, England, October 17, 1997.

Symposium/Lecture, Tel-Aviv, Israel, October 27, 1997.

1996
Dana Foundation, Brain Awareness Meeting, New York, NY, February 10-12, 1996.

Neuroscience Research Program Meeting, La Jolla, California, March 17-21, 1996.

Meeting with ESP DAS of Merrill Lynch and Cecil B. Pickett and Jonathan Spicehandler of Schering Plough, New York, NY, March 25, 1996.

Dana Foundation/Remarks, Washington, D.C., May 13-14, 1996.

Lecture, Los Alamos, Sante Fe, NM, June 3-10, 1996.

Lecture, University of California, San Francisco, California, June 11-16, 1996.

Senate Committee/Remarks, Washington, D. C., June 18-20, 1996.

Office of Naval Research, Contractor's Meeting, Boston, MA, July 10-11, 1996.

Seminar, Pasteur Institut, Paris, France, September 8-21, 1996.

Seminar/University, London, England, September 22-29, 1996.

Colloquium/CERN, Geneva, Switzerland, October 9-13, 1996.

Dana Awards Dinner, New York, NY, November 6-9, 1996.

Adelphi Symposium, Lecture and Roundtable Discussion, Garden City, New York, November 6-9, 1996.

Daedalus Meeting, Issues on the Brain, Boston, MA, November 21-24, 1996.

Nobel Dinner, Swedish Consulate, New York, NY, December 9-10, 1996.

1995
Brown Parents Board Meeting, New York, NY, Jan. 31-Feb. 2, 1995.

Lecture, American Academy of Arts & Sciences, Cambridge, MA, February 8, 1995.

Seminar, Human Tech. International, Korea/New York City, February 9-13,1995.

Symposium, DOE Modeling Neurophysiological Systems, Washington, D.C., March 2, 1995.

Lecture, Neuroscience Research Program, LaJolla, California, March 19-23, 1995.

Board Meeting, Dana Cross-Cut Meeting, Dana Foundation, New York, NY, March 29, 1995.

Meeting, Dana Foundation, New York, NY, April 4, 1995.

Brain Awareness, Dana Foundation, Washington, D.C., May 7-15, 1995.

Conference, New York University, May 4-22, 1995.

Lecture, Paris, France, June 3-July 2, 1995.

Lecture, Woods Hole, August 14, 1995.

Lectures, Paris, Bologna, Berlin, Sept. 9-Oct. 17, 1995.

Bristol Meyers Squibb Meeting, New York, NY, October 19, 1995.

Dana Foundation Awards Dinner, New York, NY, November 8-9, 1995.

Alexander Hamilton Award Columbia University, New York City, NY, November 9-16, 1995.

Nobel Laureate Dinner, Boston, MA, December 7-11, 1995.

1994
Charles A Dana Foundation, New York, NY, January 18, 1994.

Brown Alumni Group at home of Louis Dreyfus, Short talk on Brown and the Institute, New York, NY, February 17, 1994.

"LTD Who ordered that?," Neurosciences Research Program, Stated Meeting, La Jolla, CA, March 15, 1994.

AIIM Conference Javits Center, New York, NY, April 20, 1994.

National Academy of Sciences, Washington, D.C., April 23-25, 1994.

"Light and Consciousness: Two Illuminations," Brown University Convocation Lecture, April 28, 1994.

"Unsupervised Learning in Cortex: LTP, LTD and Other Evidence," Nordita Lecture, Copenhagen, Denmark, June 3, 1994.

"Field Theory of Neural Processes," Proceedings of the Workshop on Quantum Infrared Physics, American University of Paris, Paris, France, June 10, 1994.

"LTP, LTD and other Evidence for Learning in Cortex," Institut Pasteur, Paris, France
June 17, 1994.

"Advances in the Treatment of Neurological Disorders," Brown University School of Medicine, Fifth Anniversary of the Department of Clinical Neurosciences, Keynote Lecture: Understanding Memory, Newport, RI, July 10, 1994.

"Neural Networks: From Algorithms to Hardware and Products," NASA Symposium on Neural Nets for Aircraft Control, Plenary Keynote Lecture, NASA Ames Research Center, Moffett Field, California, August 23, 1994.

Charles A. Dana Foundation, Consortium on Memory Loss and Aging, Presentation to the Cross Cut Committee, New York, NY, September 16, 1994.

"Does Science Have a Future - and How About Scientists?" APS/ New England Meeting, Brown University, October 7, 1994.

"The Sowing and Reaping of Science: From Flammeous Electron to Spiritous Thought," Smithsonian Associates Program, Washington, D.C., October 25, 1994.

Charles A. Dana Foundation, Ninth Annual Awards Dinner for Pioneering Achievements in Health and Education, New York, NY, November 1, 1994.

Consul General of Sweden, Nobel Dinner, New York, NY, December 10, 1994.