

CURRICULUM VITAE

NAME: Jerome N. Sanes

PROFESSIONAL ADDRESS: Department of Neuroscience
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BIRTH DATA: 5 September 1952; New York City, New York

EDUCATION:

1974 B. A. State University of New York at Binghamton, Department of Psychology.
1977 M. A. University of Rochester, Department of Psychology, Neuroscience track.
1979 Ph. D. University of Rochester, Department of Psychology, Neuroscience track.

POST-DOCTORAL TRAINING:

1979-1985 *Staff Fellow and Senior Staff Fellow*, Laboratory of Neurophysiology,
National Institute of Mental Health. Supervisor. Dr. Edward. V. Evarts.

PROFESSIONAL AND ACADEMIC APPOINTMENTS:

2004-present *Professor*. Department of Neuroscience, Brown University.
2007-2008 *Visiting Professor*. Département d'études cognitive, École normale
supérieure. Paris, France
2004-2013 *Co-Director*. Neuroscience Graduate Program, Brown University.
2001-present *Director*. Brown University Magnetic Resonance Imaging Research
Facility.
2001-2004 *Associate Professor*. Department of Neuroscience, Brown University.
1989-2000 *Assistant (1989-93) and Associate (1993-2000) Professor (Research)*.
Department of Neuroscience (1992-2000) and Center for Neural
Science (1989-92), Brown University.
1997-2000 *Director*, Laboratory of Functional Neuroimaging, Foundation Santa
Lucia, Rome, Italy.
1992-present President, Rhode Island Chapter of the Society for Neuroscience
1985-1989 *Special Expert: and Senior Staff Fellow*, Human Motor Control Section,
Medical Neurology Branch, National Institute of Neurological
Disorders and Stroke, National Institutes of Health.
1985 *Visiting Scientist*. Department of Neurology, Heinrich Heine University,
Düsseldorf, Germany.

FUNDING AWARDS: (as Principal Investigator)

2014-2015	DEANS Award, Brown University, Alpert School of Medicine, \$80,000
2013-2018	National Institutes of Health, COBRE Center for Central Nervous System Function. IDeA P20GM103645, ~\$7,000,000 (direct costs).
2015-2016	Fulbright U.S. Scholar Program. Submitted August 2014. Awarded €18,000 (dedicated for expenses incurred while in the host country, plus a travel allowance, France)
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2009-2012	National Science Foundation, 0843938, <i>Motor Intention</i> , \$505,000 (direct costs).
2008-2013	National Institutes of Health, T32 NS062443, <i>Predoctoral Neuroscience Training</i> , \$875,000 (direct costs).
2006-2008	Department of Energy, <i>MRI System and Facility</i> , \$962,000 (direct costs).
2005-2009	National Institutes of Health, Research Grant, R01EY15451, <i>Visual Motor Integration</i> . \$750,000 (direct costs).
2002-2009	Falk Foundation, <i>Parkinson's disease, Alzheimer's disease and spinal cord injury</i> , \$1,000,000 (direct costs).
2002-2007	National Institutes of Health, Research Grant, R01 NS44834, <i>Cognition and Action</i> . \$830,000 (direct costs).
2005-2006	National Science Foundation, Major Research Infrastructure Grant, <i>Purchase of a 3T MRI system</i> , \$2,000,000 (direct costs).
2004-2006	DARPA (subcontract with VSM-Medical Systems. <i>MEG Brain Computer Interface</i> , ~\$340,000 (direct costs).
1997-2003	National Institutes of Health, Research Career Development Award, KO2 NS01978, <i>Functional brain organization</i> . \$250,000 (direct costs).
1996-1999	National Institutes of Health, Research Grant. <i>Functional brain organization</i> . ~\$448,600 (direct costs).
1997	National Institutes of Health, Shared Instrumentation Program, <i>Compute Cluster</i> , \$350,000 (direct costs).
1995-1998	McDonnell-Pew Program in Cognitive Neuroscience. Research Grant. <i>Neural Mechanisms of Preparation and Choice</i> , \$105,000 (direct costs).
1991-2003	National Institutes of Health, Research Grant, R01AG10634-01, <i>Neural control of human voluntary movements</i> , \$1,800,000 (direct costs).
1990-1995	Whitehall Foundation, Research Grant, <i>Cortical motor field neuronal network control of voluntary movements in monkeys</i> , \$180,000 (direct costs).
1990-1993	Charles E. Culpeper Foundation, Research Grant, <i>Motor cortical contributions to motor learning, adaptation, and attention</i> , \$157,600 (direct costs).

FUNDING AWARDS: (as Co-Investigator)

- 2012-2017 US Veterans Administration, VA RR&D Service Center of Excellence, Center for Neurorestoration & Neurotechnology, RRDN9228C, John Donoghue, PI, Role: Co-Investigator.
- 2011-2016 National Institutes of Health, HPA and Neural Response to Peer Rejection: Biomarkers of adolescent depression risk, R01MH092450, Laura Stroud, PI, Role: Co-Investigator.
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- 2012-2013 National Institutes of Health, Shared Instrumentation Program, *Brain Science Compute Cluster*, \$600,000 (direct costs). John Donoghue, PI.
- 2005-2009 National Institutes of Health, Nicotine Dependence: Phenotype, Endophenotype and Contexts. Raymond Niaura, PI.

FUNDING AWARDS: (as Trainer)

- 2014-2019 National Institutes of Health, *Interdisciplinary Predoctoral Neuroscience Training Program*. Diane Lipscombe, Principal Investigator.
- 2012-2017 National Institutes of Health, NINDS, *Neuroscience Advanced Predoctoral Training Grant*. Diane Lipscombe, Principal Investigator.
- 2010-2015 National Eye Institute, NIH, *Predoctoral Visual Training Grant*. Michael Paradiso, Principal Investigator.

PENDING PROPOSALS:

- 2016-2017 National Science Foundation: EAGER: Brain Dynamics of Action Flexibility. Role: Principal Investigator. Submitted July 2015. Requested \$297,789 (total costs) Requested Start Date, 1 July 2016.
- 2016-2019 National Science Foundation. CRCNS: Brain Networks and Mechanisms of Eye-Hand Coordination. Role: Principal Investigator. Submitted October 2015. Requested \$1,196,740 (total costs). Requested Start Date, 1 July 2016.
- 2017-2021 US Veterans Administration, VA RR&D Service Center of Excellence, Center for Neurorestoration & Neurotechnology, RRDN9228C, Leigh Hochberg, PI, Role: Co-Investigator. Submitted January 2016. Requested Start Date, 1 October 2017.
- 2016-2018 National Institutes of Health, NIMH, R21. Neural and HPA Response to Peer Rejection: Biomarkers of Suicidality in At-Risk Adolescent Girls. Role: Co-Investigator, Laura Stroud, Principal Investigator. Submitted February 2016. Requested \$275,000 (direct costs). Requested Start Date, 1 July 2016.

PLANNED PROPOSALS:

- 2016-2019 Veterans Administration MERIT Award, *Mechanisms of motor learning in Parkinson's disease*. Role: Principal Investigator. Planned submission: June 2016. Request \$1,100,000 (direct costs)
- 2015-2018 National Science Foundation. *Motor intention*. Role: Co-Principal Investigator. Planned submission: January 2015. Request \$700,000 (total costs)
- 2016-2021 NIH. R01, *Visual motor integration*, Role: Principal Investigator. Planned submission: June 2016. Requested ~\$1,600,000 (direct costs).

ACADEMIC AWARDS

- 1995 Honorary Master of Arts, Brown University
- 1979 National Research Service Award
- 1974-1977 United States Public Health Service Trainee
- 1974-1977 Rush Rhees Fellow, University of Rochester
- 1970-1974 New York State Regents Scholarship

RESEARCH INTEREST:

- Cerebral cortical function
- Neural information processing
- Motor learning
- Behavioral and neural plasticity and adaptation
- Human brain imaging
- Neural correlates of consciousness

MEMBERSHIP IN PROFESSIONAL SOCIETIES

- Society for Neuroscience
- International Brain Research Organization
- American Association for the Advancement of Science
- Organization of Human Brain Mapping

BIBLIOGRAPHY: PUBLICATIONS (PEER REVIEWED)

1. Sanes, J., P. J. Donovan and R. G. Burrig (1979) Consummatory behavior as a function of ambient temperature in septal-lesioned and control rats. *Journal of Neuroscience Research* 1: 333-341.
2. Sanes, J. N. and J. R. Ison (1979) Conditioning auditory stimuli and the cutaneous eyeblink reflex in humans: Differential effects according to oligosynaptic or polysynaptic central pathways. *Electroencephalography and Clinical Neurophysiology* 47: 546-555.
3. Sanes, J. N. and J. R. Ison (1980) A silent period in orbicularis oculi muscle of humans. *Journal of Neurology, Neurosurgery and Psychiatry* 43: 504-509.
4. Gopinathan, G., H. Teräväinen, J. M. Dambrosia, C. D. Ward, J. N. Sanes, W. K. Stuart, E. V. Evarts and D. B. Calne, (1981) Lisuride in parkinsonism. *Neurology* 31: 371-376
5. Morgan, N. T., J. N. Sanes, W. K. Stuart and W. S. Rasband (1981) A computerized system for determination of reaction time, movement time, and movement accuracy. *Electroencephalography and Clinical Neurophysiology* 51: 563-566.
6. LeWitt, P. A., G. Gopinathan, C. D. Ward, J. N. Sanes, J. M. Dambrosia, R. Durso and D. B. Calne (1982) Lisuride versus bromocriptine in Parkinson's disease: A double blind study. *Neurology* 32: 69-72.
7. Sanes, J. N., J. A. Foss and J. R. Ison (1982) Conditions that affect the thresholds of the components of the eyeblink reflex in humans. *Journal of Neurology, Neurosurgery and Psychiatry* 45: 543-549.
8. Sanes, J. N. and E. V. Evarts (1983) Effects of perturbations on accuracy of arm movements. *Journal of Neuroscience* 3: 977-986.
9. Sanes, J. N. and J. R. Ison (1983) Habituation and sensitization of components of the human eyeblink reflex. *Behavioral Neuroscience* 97: 833-866.
10. Sanes, J. N. and V. A. Jennings (1984) Centrally programmed patterns of muscle activity in voluntary motor behaviors of humans. *Experimental Brain Research* 54: 23-32.
11. Sanes, J. N., K. -H. Mauritz, E. V. Evarts, M. C. Dalakas and A. Chu (1984) Motor deficits in patients with large-fiber sensory neuropathy. *Proceedings of the National Academy of Science* 81: 979-982.
12. Sanes, J. N. and E. V. Evarts (1984) Motor psychophysics. *Human Neurobiology* 2: 217-225.
13. Sanes, J. N. (1984) Voluntary movement and excitability of cutaneous eyeblink reflexes. *Psychophysiology* 21: 653-664.
14. Sanes, J. N. (1985) Information processing deficits in Parkinson's disease during movement. *Neuropsychologia* 23: 381-392.
15. Sanes, J. N. (1985) Absence of enhanced physiological tremor in patients without muscle or cutaneous afferents. *Journal of Neurology, Neurosurgery and Psychiatry* 48: 645-649.
16. Sanes, J. N., K. -H. Mauritz, M. C. Dalakas and E. V. Evarts (1985) Motor control in humans with large-fiber sensory neuropathy. *Human Neurobiology* 4: 101-114.
17. Sanes, J. N., T. R. Colburn and N. T. Morgan (1985) Behavioral motor evaluation for neurotoxicity screening. *Neurobehavioral Toxicology and Teratology* 4: 329-337.
18. Sanes, J. N. (1986) Kinematics and end-point control of arm movements are modified by unexpected changes in viscous loading. *Journal of Neuroscience* 6: 3120-3127.

REFEREED JOURNAL ARTICLES [CONTINUED]

19. Donoghue, J. P. and J. N. Sanes (1987) Peripheral nerve injury in developing rats reorganizes representation pattern in motor cortex. *Proceedings of the National Academy of Science* 84: 1123-1126.
20. Pullman, S. L., R. L. Watts, J. L. Juncos, T. N. Chase and J. N. Sanes (1988) Dopaminergic effects on simple and choice reaction time performance in Parkinson's Disease. *Neurology* 38: 249-254.
21. Sanes, J. N., S. Suner, J. A. Lando and J. P. Donoghue (1988) Rapid reorganization of adult rat motor cortex somatic representation patterns after motor nerve injury. *Proceedings of the National Academy of Science* 85: 2003-2007.
22. Sanes, J. N., P. L. LeWitt and K. -H. Mauritz (1988) Visual and mechanical control of cerebellar kinetic postural tremor. *Journal of Neurology, Neurosurgery and Psychiatry* 51: 934-943.
23. Donoghue, J. P. and J. N. Sanes (1988) Organization of adult motor cortex representation patterns following neonatal nerve injury in rats. *Journal of Neuroscience* 8: 3221-3232.
24. Dimitrov, B., M. Hallett and J. N. Sanes (1989) Differential influence of posture and intentional movement on human somatosensory evoked potentials evoked by different stimuli. *Brain Research* 496: 211-218.
25. Sanes, J. N., B. Dimitrov and M. Hallett (1990) Motor learning in patients with cerebellar dysfunction. *Brain* 113: 103-120.
26. Sanes, J. N., S. Suner and J. P. Donoghue (1990) Dynamic organization of primary motor cortex output to target muscles in adult rats. I. Long-term patterns of reorganization following motor or mixed peripheral nerve lesions. *Experimental Brain Research* 79: 479-491.
27. Donoghue, J. P., S. Suner and J. N. Sanes (1990) Dynamic organization of primary motor cortex output to target muscles in adult rats. II. Rapid reorganization following motor nerve lesions. *Experimental Brain Research* 79: 492-503.
28. Pullman, S. L., R. L. Watts, J. L. Juncos, and J. N. Sanes (1990) Movement amplitude choice reaction time performance in Parkinson's disease may be independent of dopaminergic status. *Journal of Neurology, Neurosurgery and Psychiatry*, 53: 279-283.
29. Ison, J. R., J. N. Sanes, J. A. Foss, L. A. Pinckney (1990) Facilitation and inhibition of the human startle blink reflexes by stimulus anticipation. *Behavioral Neuroscience*, 104: 418-429.
30. Sanes, J. N. and M. Hallett (1990) Limb positioning and magnitude of essential tremor and other pathological tremors. *Movement Disorders*, 5: 304-309.
31. Cohen L. G., J. Meer, I. Tarkka, S. Bierner, D. Lederman, R. M. Dubinsky, J. N. Sanes, B. Jabbari, B. Branscum, and M. Hallett (1991) Congenital mirror movements: abnormal organization of motor pathways in two patients. *Brain*, 114: 381-403.
32. Donoghue, J. P., S. J. Leibovic, and J. N. Sanes (1992) Organization of the forelimb area in squirrel monkey primary motor cortex: Representation of individual digit, wrist, and elbow muscles. *Experimental Brain Research*, 89: 1-19.
33. Sanes, J. N., J. Wang, J. P. Donoghue (1992) Immediate and delayed changes of rat motor cortical output representation with new forelimb configurations. *Cerebral Cortex*, 2: 141-152.
34. Sanes, J. N. and J. P. Donoghue (1992) Organization and adaptability of muscle representations in primary motor cortex. *Experimental Brain Research, Supplement*, 22: 103-127.

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35. Agostino, R., M. Hallett and J. N. Sanes (1992) Antagonist muscle inhibition before rapid voluntary movements of the human wrist. *Electroencephalography and Clinical Neurophysiology*, 85: 190-196.
36. Sanes, J. N. and J. P. Donoghue (1993) Oscillations in local field potentials of the primate motor cortex during voluntary movement. *Proceedings of the National Academy of Sciences (USA)*, 90: 4470-4474.
37. Donoghue, J. P. and J. N. Sanes (1994) Motor areas of the cerebral cortex. *Journal of Clinical Neurophysiology*, 11: 382-396.
38. Sanes, J. N. (1994) Neurophysiology of preparation, movement, and imagery. *Behavioral and Brain Sciences*, 17: 221-223.
39. Labutta, R., R. B. Miles, J. N. Sanes, and M. Hallett (1994) Motor program memory storage in Parkinson's disease patients tested with a delayed response task. *Movement Disorders*, 9: 218-222.
40. Sanes, J. N. and R. Shadmehr (1995) Sense of muscular effort in humans with large-fiber sensory neuropathy. *Canadian Journal of Physiology and Pharmacology*, 73: 223-233.
41. Sanes, J. N., J. P. Donoghue, V. Thangaraj, R. R. Edelman and S. Warach (1995) Shared neural substrates controlling hand movements in human motor cortex. *Science*, 268: 1775-1777.
42. Friedman, J. H. M. Epstein, J. N. Sanes, P. Lieberman, K. Cullen, C. Lindquist, M. Daamen (1996) Gamma knife pallidotomy in advanced Parkinson's disease. *Annals of Neurology*, 39: 535-538.
43. Schlaug, G., J. N. Sanes, V. Thangaraj, D. G. Darby, L. Jäncke, R. R. Edelman, and S. Warach (1996) Cortical activation covaries with movement rate. *NeuroReport*, 7: 879-883.
44. Agostino, R., Sanes, J. N., and Hallett, M. (1996) Movement skill learning in Parkinson's disease. *Journal of the Neurological Sciences*, 139: 218-226.
45. Sanes, J. N. and J. P. Donoghue (1997) Dynamic motor cortical organization. *The Neuroscientist*, 3: 158-165.
46. Donoghue J. P., J. N. Sanes, N. G. Hatsopoulos, and G. Gaál (1998) Neural discharge and local field potential oscillations in primate motor cortex during voluntary movements. *Journal of Neurophysiology*, 79: 159-173.
47. Marzi, C. A., C. Miniussi, A. Maravita, L. Bertolasi, G. Zanette, J. C. Rothwell and J. N. Sanes (1998) Transcranial magnetic stimulation selectively impairs interhemispheric transfer of visuo-motor information in humans. *Experimental Brain Research*, 118: 435-438.
48. Bhat, R. B. and J. N. Sanes (1998) Cognitive channels computing action distance and direction. *Journal of Neuroscience*, 18: 7566-7580.
49. Maynard, E. M., N. G. Hatsopoulos, C. L. Ojakangas, B. D. Acuna, J. N., Sanes, R. A. Normann and J. P. Donoghue (1999) Neuronal interactions improve cortical population coding of movement direction. *Journal of Neuroscience*, 19: 8083-8093.
50. Baker, J. T., J. P. Donoghue and J. N. Sanes (1999) Gaze direction modulates finger movement activation patterns in human cerebral cortex. *Journal of Neuroscience*, 19: 10044-10052.
51. Sanes, J. N. and J. P. Donoghue (2000) Plasticity and primary motor cortex. *Annual Review of Neuroscience*. 23: 393-415.

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52. Sanes, J. N. (2000) Skill learning: Motor cortex rules for learning and memory. *Current Biology*, 10: R495-497.
53. Sanes J. N. (2000) The relation between human brain activity and hand movements. *NeuroImage*, 11: 370-374.
54. Sanes J. N. and M. H. Schieber (2001) Orderly somatotopy in primary motor cortex: Does it exist? *NeuroImage*, 13: 968-974.
55. Indovina I. and J. N. Sanes (2001) On somatotopic representation centers for finger movements in human primary motor cortex and supplementary motor area. *NeuroImage*, 13: 1027-1034.
56. Galati, G., G. Committeri, J. N. Sanes and L. Pizzamiglio (2001) Spatial coding of visual and somatic sensory information in body-centered coordinates. *European Journal of Neuroscience*, 14: 737-746.
57. Indovina I. and J. N. Sanes (2001) Combined visual attention and finger movement effects on human brain representations. *Experimental Brain Research*, 140: 265-279.
58. Hagberg, G. E., G. Zito, F. Patria F, and J. N. Sanes JN (2001) Improved detection of event-related functional MRI signals using probability functions. *NeuroImage*, 14:1193-1205.
59. Eliassen, J. C., T. Souza and J. N. Sanes (2001) Human brain activation accompanying explicitly directed movement sequence learning. *Experimental Brain Research*, 141: 269-280.
60. Acuna, B. D., J. N. Sanes, and J. P. Donoghue (2002) Cognitive mechanisms of transitive inference. *Experimental Brain Research* 146:1-10.
61. Hagberg, G. E., I. Indovina, J. N. Sanes, and S. Posse (2002) Real time quantification of T2* changes using multi-echo planar imaging and numerical methods. *Magnetic Resonance in Medicine*, 48:877-882.
62. Acuna, B. D., J. C. Eliassen, J. N. Sanes, and J. P. Donoghue (2002) Frontal and parietal lobe activation during transitive inference in humans. *Cerebral Cortex* 12:1312-1321.
63. Sanes, J. N. and W. Trucculo (2003) Motor “binding:” Do functional assemblies in primary motor cortex have a role? *Neuron* 38: 3-5.
64. Sanes, J. N. (2003) Neocortical mechanisms in motor learning. *Current Opinion in Neurobiology*, 13:225-231.
65. Eliassen, J. C., T. Souza and J. N. Sanes (2003) Experience-dependent activation patterns in human brain during visual-motor associative learning. *Journal of Neuroscience*, 23:10540-10547.
66. Kim J. A., J. C. Eliassen, and J. N. Sanes (2005) Movement quantity and frequency coding in human motor areas. *Journal of Neurophysiology* 94:2504-2511.
67. Bédard, P., A. Thangavel, and J. N. Sanes (2008) Gaze influences finger movement-related and visual-related activation across the human brain. *Experimental Brain Research*, 188:63-75. PMID: PMC3065111
68. Thaut, M, M. Demartin, and J. N. Sanes (2008) Brain networks for integrative rhythm formation. *PLoS ONE*, 3: e2312.
69. Philip B. A., Y. Wu, J. P. Donoghue, J. N. Sanes (2008) Computational predictions of performance differences in visually- and internally-guided continuous manual tracking movements. *Experimental Brain Research* 190:475-491.
70. Bédard, P. and J. N. Sanes (2009) Gaze and hand position effects on finger-movement related human brain activation. *Journal of Neurophysiology*, 101: 834-842.

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71. Sheinkopf S. J., B. M. Lester, J. N. Sanes, J. C. Eliassen, E. R. Hutchison, R. Seifer, L. L. LaGasse, S. Durston, and B. J. Casey (2009) Functional MRI and response inhibition in children exposed to cocaine in utero: preliminary findings. *Developmental Neuroscience* 31:159–166.
72. Bédard P. and J. N. Sanes (2009) On a basal ganglia role in learning and rehearsing visual-motor association. *NeuroImage*, 47: 1701-1710. PMID: PMC3065103
73. Fiecas M., H. Ombao, C. Linkletter, W. Thompson, and J. Sanes (2010) Functional connectivity: shrinkage estimation and randomization test. *NeuroImage* 49:3005–3014.
74. Böhm H., H. Ombao, R. von Sachs, and J. N. Sanes (2010) Classification of multivariate non-stationary signals: the SLEX-shrinkage approach. *Journal of Statistical Planning and Inference*, 140: 3754–3763.
75. Bédard P. and J. N. Sanes (2011) Basal ganglia-dependent processes in short-term recall of visual-motor skills. *Experimental Brain Research*, 209:385-393. PMID: PMC3065111
76. Bédard P., M. Wu, and J. N. Sanes (2011) Brain activation related to combinations of gaze position, visual input and goal-directed hand movements. *Cerebral Cortex*, 21:1273-1282. NIHMS273785
77. Gorrostieta C., Ombao H., Bédard P. and J. N. Sanes (2012) Investigating brain connectivity using mixed effects vector autoregressive models. *Neuroimage*, 59:3347–3355.
78. Bédard P. and J. N. Sanes (2014) Brain representations of visual-motor adaptation learning and retention. *NeuroImage*, 101:225-235.

BIBLIOGRAPHY: PUBLICATIONS (REVIEWS, COMMENTARIES AND BOOK CHAPTERS, NON-REFEREED)

1. Ward, C. D., J. N. Sanes, J. M. Dambrosia and D. B. Calne (1983) Methods for evaluating treatment in Parkinson's disease. In: *Advances in Neurology, Volume 37, Experimental Therapeutics of Movement Disorders*. Eds. S. Fahn, I. Shoulson and D. B. Calne. Raven Press, New York, pp. 1-7.
2. Sanes, J. N. and E. V. Evarts (1983) The regulatory role of proprioceptive input in motor control of phasic or maintained voluntary contractions in man. In: *Motor Control Mechanisms in Health and Disease*. Ed. J. E. Desmedt, Raven Press, New York, pp. 47-59
3. Sanes, J. N. and E. V. Evarts (1985) Psychomotor performance in Parkinson's disease. In: *Clinical Neurophysiology in Parkinsonism*. Eds. P. J. Delwaide and A. Agnoli, Elsevier Science Publishers B. V., Amsterdam, pp. 117-132.
4. Sanes, J. N. (1987) Neuromotor psychophysical aspects of central programming and peripheral regulation of movement in humans. In: *Advances in Applied Neurological Science, vol. 4. Clinical Aspects of Sensory Motor Integration*. Eds. A. Struppeler and A. Weindl, Springer-Verlag, Berlin, 305-313.
5. Sanes, J. N. (1987) Proprioceptive afferent information and movement control. In: *Encyclopedia of Neuroscience*. Birkhäuser Boston Inc., Cambridge, Massachusetts, Volume II, 982-984.
6. Sanes, J. N. (1990) Motor representations in deafferented humans. A mechanism for disordered motor performance. In: *Attention and Performance XIII*. Ed. M. Jeannerod, Lawrence Erlbaum Associates, Hillsdale, NJ., pp. 714-735.
7. Sanes, J. N., R. Caminiti, J. P. Donoghue, G. W. Huntley, E. G. Jones, J. H. Martin, and M. H. Scheiber (1992) Representations in the primary motor cortex; Intrinsic circuitry of primate MI; Functional organization of MI arm area; Organization of muscle synergies in MI; MI and reaching; MI and skill learning. *Neuroscience Facts* 3(9) 1-4.
8. Donoghue, J. P., G. Hess and J. N. Sanes (1996) Motor cortical substrates and mechanisms for learning. *Acquisition of Motor Behavior in Vertebrates*, (ed.) J. R. Bloedel, T. J. Ebner, and S. P. Wise, MIT Press, Cambridge, pp. 363-386.
9. Sanes, J. N. and J. P. Donoghue (1997) Static and dynamic organization of motor cortex. *Advances in Neurology, vol. 73, Brain Plasticity*. H. -J. Freund, B. A. Sabel, O. W. Witte, eds. New York, Raven Press, 277-296.
10. Donoghue, J. P. and Sanes, J. N. (2000). Motor system organization. *Encyclopedia of Life Sciences*, <http://www.els.net>, London: Nature Publishing Group.
11. Sanes J. N. (2001) Primary motor cortex and primary somatic sensory cortex. In: *The Corsini Encyclopedia of Psychology and Behavioral Science, Third Edition*. Ed. W. E. Craighead and C. B. Nemeroff. John Wiley & Sons, New York, pp. 1243-1245.
12. Sanes, J. N. (2004) Primary motor cortex and primary somatic sensory cortex. In: *Concise Corsini Encyclopedia of Psychology and Behavioral Science, Third Edition*. Ed. W. E. Craighead and C. B. Nemeroff. John Wiley & Sons, New York, pp. 727-728.
13. Sanes, J. N. (2008) Cerebral Cortex: Motor Learning. In H.L. Roediger, III (Ed.), *Cognitive Psychology of Memory. Vol. 4 of Learning and Memory: A Comprehensive Reference, 4 vols.* (J. Byrne Editor). Oxford: Elsevier, pp. 423-440.
14. Sanes, J. N. (2008) Primary motor cortex and primary somatic sensory cortex. In: *Concise Corsini Encyclopedia of Psychology and Behavioral Science, Fourth Edition*. Ed. W. E. Craighead and I. Weiner. John Wiley & Sons, New York, in press.

BIBLIOGRAPHY: SELECTED RECENT PRESENTATIONS: (2008-PRESENT, FROM A TOTAL OF >130 FROM 1975-PRESENT. BOLD FONT INDICATES MANUSCRIPTS SUBMITTED FOR PUBLICATION)

1. Kang K, Ombao H, Blume J, Bedard P, Sanes JN (2009) Evaluating Evidence of Activation in fMRI via a Novel Likelihood Paradigm. 15th International Conference on Functional Mapping of the Human Brain, June 2009.
2. Bédard P, Thaweerattanasin T, Sanes JN (2010) Human parietal-frontal representations of action selection. Abstract Viewer/Itinerary Planner. Washington, DC: Society for Neuroscience.
3. Bédard P, Churchill T, Sanes JN (2011) Movement directional coding in human fronto-parietal cortex: effects of gaze position. Abstract Viewer/Itinerary Planner. Washington, DC: Society for Neuroscience.
4. Sanes JN, Bédard P (2012) Parkinson's disease and brain representations for learning and recalling internal models. Abstract Viewer/Itinerary Planner. Washington, DC: Society for Neuroscience.
5. Sanes JN, Bédard P, Caminiti R, Chappidi MR, Battaglia-Mayer A (2013) Human brain representations of online adjustments of voluntary actions. 19th International Conference on Functional Mapping of the Human Brain, June 2013, Seattle, WA.
6. Bédard P, Sanes JN (2014) Brain activity during gradual visuomotor adaptation. Abstract Viewer/Itinerary Planner. Washington, DC: Society for Neuroscience.

INVITED ADDRESSES AT INTERNATIONAL MEETINGS: (1995-PRESENT)

- Frontal motor cortical representation in primates: Implications for Learning and Rehabilitation. "Brain Plasticity." Satellite Symposium of Brain 95. Düsseldorf, Germany. July, 1995.
- Motor cortical representations of bodily motion. "Workshops in Sensorimotor Control: Measuring body motion". Bangor, Wales, UK. April, 1996.
- Organizing principles of human and monkey motor cortex. "Sensorimotor '96: Dynamics, Adaptation and Representation in Motor Cortex" Workshop preceding the Annual Meeting of the Society for Neuroscience, Washington, DC, November 1996.
- Dynamic motor cortical representations. McDonnell-Pew Program in Cognitive Neuroscience Workshop, Oxford, England, June 1997.
- Motor cortical organization in humans. International Congress on Clinical Neurophysiology. Brain Imaging Symposium. Florence, Italy, August 1997.
- Patterns of human motor cortical organization. Congress of Physiology and Neuropharmacology of Rehabilitation. Rome, Italy, August 1997.
- Dynamic movements in the human brain. Second Berlin Workshop on Cortical Plasticity. Berlin, Germany, April, 1998..
- Activation patterns of human brain during voluntary motor actions. Workshop on "Epilepsy and Movement Disorders in Children", IRCCS Stella Maris, INPE, Pisa, Italy, March 1998.
- Functional magnetic resonance imaging of human brain during motor actions. European Clinical Neurophysiology Meeting, Ljubljana, Slovenia, June 1998.
- Neural Information Processing. "McDonnell-Pew Program in Cognitive Neuroscience Workshop, Montreal, Canada, June 1998.
- Patterns of cortical activation during cognitive and motor behavior. Eighth Congress on Neurological Rehabilitation. Milano, Italy, September, 1998
- On the stability and modifiability of human cortical points revealed by functional magnetic resonance imaging. CNRS - Conference Jacques Monod : "Synaptic Plasticity, Assembly Dynamics and Flexibility of Cognitive Representations". Aussois (France). November 28–December 3, 1998.
- Are there primitives for motor representations in the human brain? European Brain and Behavioral Society, 31st Annual Meeting. Rome, Italy. September, 1999.
- Organization of the human brain revealed by functional MRI. First International Symposium on Cognitive Therapy, Perfetti Method. Staffelstein Clinic, Staffelstein, Bavaria, Germany, September 1999.
- Short-term plasticity of human movement brain representations. Third Berlin Workshop on Cortical Plasticity. Berlin, Germany, March, 2000.
- Conscious and unconscious action. Invited lecture. 7th Annual European Neurology Society, Paris, France, April 2001.
- Cortical mechanisms of explicit and implicit learning. Invited Lecture. Satellite Symposium on Motor Learning, Neural Control of Movement. Annual Meeting, Barcelona, Spain, March 2004.

COLLOQUIA AT UNIVERSITIES AND RESEARCH INSTITUTIONS: (Selected from 1994-PRESENT)

Boston University; Harvard College; Johns Hopkins University; New York University; National Institutes of Health; University of Parma, Italy; Harvard Medical School; University of Roma, “La Sapienza”; University of Verona, Italy; Mount Sinai School of Medicine, NYC; University of Padova, Italy; Oxford University, Oxford, UK; Institute of Neurology and Wellcome Department of Cognitive Neurology, Queen Square, University College London; University of Düsseldorf, Düsseldorf, Germany; IRCCS Santa Lucia, Rome, Italy; Neurology Therapy Center, Düsseldorf, Germany; Brown University, Massachusetts Institute of Technology; Colorado State University; University of Minnesota; École normale supérieure, Paris, France; Radboud University of Nijmegen; École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; Department of Motor Neuroscience, University College London; INSERM, Unit 864, Lyon, France, IRCCS San Camillo, Venice, Italy

PROFESSIONAL SERVICE:

TO BROWN UNIVERSITY

TEACHING

Primary Instructor

Principles of Neuromotor Control (BN120)
Systems and Cognitive Neuroscience (BN192)
Functional Magnetic Resonance: Theory and Practice (BN293)
Topics in Neuroscience : Special Topics in Cognitive Neuroscience (BN194)
Cognitive Neuroscience (BN105)
Advanced Systems Neuroscience (BN205, NEUR2050)
Advanced Cognitive Neuroscience (BN206, NEUR2060)
Neural Correlates of Consciousness (NEUR1940, NEUR2940)

Co- or Contributing-instructor

Introduction to Neuroscience (BN1; Contributing Lecturer).
Neural Information Processing (BN93; Contributing Lecturer).
Seminar in Cognitive Neuroscience and Motor Control (BN267).
Medical Neurobiology (BN261; Laboratory component)

DEPARTMENTAL AND PROGRAM ACTIVITIES

Task Force on Computer Acquisition for Educational Purposes (1992).
Organizer of Motor Control Journal Club (1989-1994)
Organizer of Cognitive Neuroscience Journal Club (1994-1997)
Co-organizer of Neuroscience Graduate Program Seminar Series (1991-1997;
2001-2006)
Undergraduate Concentration Advisor, Neuroscience (1991-present).
Graduate Student Doctoral Advisor (1995-present).
Task Force on Behavioral and Brain Science Curriculum (2001-2002)
Director, Brown University Magnetic Resonance Imaging Facility (2001-present)
Co-Director, Neuroscience Graduate Program (2004-2013)
Director at Brown, Brown-NIH Neuroscience Graduate Partnership Program
(2004-2013)

UNIVERSITY COMMITTEES

Sigma Xi Selection Committee (1995-1996)
Committee on Behavioral and Brain Science Curriculum (2001–2004)
Tenure, Promotion and Appointments Committee (Spring 2006; Fall 2008 –
Spring 2011, Committee Vice-Chair, 2009-2010; Committee Chair,
2010-2011)
Research Advisory Board for Vice President for Research (2014-2015)

RESEARCH ACTIVITIES

Scientific Director : Brown University, Parkinson's Disease and Motor Disorders Unit.
(1989-1994, unit disbanded in 1994)
Supervision of Post-doctoral and Medical Fellows: Jonathan H. Martin, M. D., Medical
Fellow (1990-1992); James C. Eliassen, Ph. D. (1997-2003; Patrick Bédard, Ph. D.
(2002-2008); Richard Archibald (2004-2005); Michael Kositsky (2005-2007); Ashvin
Shah (2009-2010).
Co-supervision of Post-doctoral Fellows: Gyöngyi Gaál Ph. D. (1992-1993); Nicholas
Hatsopoulos, Ph. D., (1994-1996); Catherine Ojakangus, Ph. D. (1994-1996).
Ph. D. Thesis Committee: Nicholas Hatsopoulos, Department of Cognitive and
Linguistic Sciences (1992); Bettina Acuña, Department of Neuroscience (2001); Tyler
Ard, Brown--NIH Neuroscience Graduate Program (2013).
Supervision of undergraduate students in laboratory activities, some leading to Honors
in Neuroscience (1989-present).

TO THE SCIENTIFIC COMMUNITY

GRANT AND FELLOWSHIP PROPOSAL REVIEW PANELS

National:

National Institutes of Health: Musculoskeletal and Dental Sciences, IFCN-5, BBB-3,
IFCN-8, NCCR-Regional Resource; Program Project Special Emphasis Study
Sections; Biomedical Engineering Research Partnerships, Ad-hoc member of Study
Section; NINDS Training Grant Review Panel.
National Science Foundation: Cognitive Neuroscience Panel. (multiple occasions).
Spinal Cord Research Foundation.
Veterans Administration.

International:

International Human Frontiers Science Program
France: CNRS; French Ministry of Research, Integrative and Computational
Neuroscience Program.
Israel: United States-Israel Binational Science Foundation
Italy: Ministry of Research, Science and Technology; Italian Space Agency.
Switzerland: Swiss National Science Foundation
United Kingdom: Wellcome Trust-UK Medical Research Council, Joint Infrastructure
Program; Wellcome Trust Review Panel for Laboratory Funding renewal.

SCIENTIFIC JOURNALS: EDITORIAL BOARD MEMBER

Experimental Brain Research, Neurophysiology Section. 1996 – present.

Journal of Neuroscience, 2005 – 2010.

Neuroscience, Handling Editor, Cognitive and Systems Neuroscience Section, 2006 – 2012; 2014 - present.

NeuroImage, 2000 – 2005.

Neuropharmacology, 2008 – present

SCIENTIFIC JOURNALS: CONSULTING EDITOR

Annals of Neurology, Behavioral Neuroscience, Brain, Canadian Journal of the Neurological Sciences, Cerebral Cortex, Electroencephalography and Clinical Neurophysiology, European Journal of Neuroscience, European Journal of Physiology, Experimental Brain Research, Experimental Neurology, Journal of Cerebral Blood Flow and Metabolism, Journal of Gerontology, Journal of Motor Behavior, Journal of Neurophysiology, Journal of Neuroscience, Journal of Psychiatric Research, Journal of the International Neuropsychological Society, Nature, Nature Neuroscience, Neuroimage, Neuron, Neuropsychologia, Pediatrics, Perceptual and Motor Skills, Psychobiology, Psychological Bulletin, Psychophysiology, Science.

Scientific Society: Meeting Abstract Reviewer

Organization of Human Brain Mapping (2000-2006).

INSTRUCTION

Fidia International School of Neuroscience, Adjunct Faculty, 1991.

Functional Magnetic Resonance Imaging. Faculty. CNRS Course, Marseille, France. 1999.

TO OTHER UNIVERSITIES

Thesis Committees:

Deborah Claman, Massachusetts Institute of Technology, 1984.

John Pelligrini, State University of New York at Stony Brook, 1993.

TO PROFESSIONAL SOCIETIES.

Rhode Island Chapter of Neuroscience: Organizer and President (1992-present)

Neuroscience Contact with National Society of Biology Teachers (1993)

Member, Governmental and Public Affairs Committee, Society for Neuroscience (2014-present)