

CURRICULUM VITAE

NICOLAS SCHWEIGHOFER, PHD

I. BIOGRAPHICAL INFORMATION

PERSONAL INFORMATION:

Office Address: Computational Neuro-Rehabilitation Laboratory, Director
Biokinesiology and Physical Therapy
University of Southern California
Los Angeles, CA, 90089-9006
Phone: (1) 323 -442 -1838. Fax: (1) 323 -442 -1515
Email: schweigh@usc.edu Lab website: <http://pt.usc.edu/labs/cnrl>

UNIVERSITY EDUCATION:

1996-1997 Postdoctoral Fellow, Human Information Science, ATR, Kyoto, Japan:
Computational Neuroscience (Mentor: Dr. M. Kawato)
1991-1995 PhD, University of Southern California, Los Angeles: *Neuroscience*
(Advisor: Dr. M. Arbib)
1988-1990 Diplôme d'ingénieur, Ecole Nationale Supérieure de Mécanique, Nantes,
France (newly 'Ecole Centrale de Nantes'): *Mechanics and Control
System Engineering*
1985-1987 Undergraduate training: Mathématiques Spéciales P', Lycée Descartes,
Tours, France: *Advanced Mathematics and Physics*

APPOINTMENTS:

2011-Present Associate Professor (with Tenure), Division of Biokinesiology & Physical
Therapy, University of Southern California
2011-Present Joint Appointment, Biomedical Engineering, USC
2004-Present Joint Appointment, Computer Science, USC
2004-Present Joint Appointment, Neuroscience Graduate Program, USC
2016-Present Invited Professor, Computer Science, Tsukuba University, Japan
2015-2016 Invited Professor, Computer Science, Tokyo Institute of Technology
University, Japan
2012-2014 Associate Researcher, M2H, Euromov, Montpellier University I, France
2008-2017 Visiting Faculty, Keio University, Tokyo, Japan
2004-2013 Invited Researcher, Advanced Telecom Research Institute, Kyoto, Japan

2004-2010	Assistant Professor (Tenure track), Division of Biokinesiology & Physical Therapy, University of Southern California
2002-2003	Researcher, Computational Neuroscience Group, CREST, Kyoto, Japan
2000-2001	Director of R&D, Cerego Inc., Tokyo, Japan
1997-1999	Researcher, Exploratory Research Advanced Technology Organization, Kyoto, Japan

II. SCHOLARLY ACTIVITIES

PUBLICATIONS

Google Scholar profile:

<http://scholar.google.com/citations?user=S7mBXuIAAAAJ&hl=en&oi=ao>

Articles Published in Peer-Reviewed Journals:

(* indicates USC students under my supervision for this work)

1. Park H.* and **Schweighofer N.** (2017) *Nonlinear mixed-effects model reveals a distinction between learning and performance in intensive reach training post-stroke.* Journal of NeuroEngineering and Rehabilitation 14 (1), 21
2. Bakhti, K. K. A., Mottet, D., **Schweighofer, N.**, Froger, J., & Laffont, I. (2017). *Proximal arm non-use when reaching after a stroke.* Neuroscience Letters, 657, 91-96
3. **Schweighofer N.**, Lang, E.J. and Kawato (2017). *The role of the olivocerebellar pathway in motor learning and motor control, a consensus paper.* Cerebellum, DOI 10.1007/s12311-016-0787-8
4. Wang, C.*, Xiao Y*, Burdet E., Gordon, J., and **Schweighofer N** (2016). *The duration of reaching movement is longer than predicted by minimum variance,* Journal of Neurophysiology. 116 (5), 2342-2345
5. Reinkensmeyer D. J., Burdet E., Casadio M., Krakauer J.W., Kwakkel G., Lang C. E., Swinnen S., Ward N., and **Schweighofer, N.**, (2016) *Computational neurorehabilitation: Modeling plasticity and learning to predict recovery,* Journal of Neuroengineering and Rehabilitation, 13, 1
6. Lee J-Y*, Oh Y.*, Scheidt R., and **Schweighofer N.** (2016) *Optimal Schedules in Multitask Motor Learning,* Neural Computation, 28, 667–685
7. Park H. *, Kim S. *, Winstein C., Gordon J., and **Schweighofer N.** (2016) *Short-Duration and Intensive Training Improves Long-Term Reaching Performance in Individuals with Chronic Stroke ,* Neural Rehabilitation and Repair, 30, 551-561
8. Kim, S.S.*, Ogawa K., Lv. J., **Schweighofer N.** and Imamizu H. (2015) *Neural Substrates Related to Motor Memory with Multiple Timescales in Motor Adaptation* PLoS Biology, 13(12): e1002312. doi:10.1371/journal.pbio.1002312. (NS: corresponding author; co-senior author)

9. Kim S.S*, Oh Y*, **Schweighofer N.** (2015) *Between-Trial Forgetting Due to Interference and Time in Motor Adaptation*. PLoS ONE 10(11): e0142963. doi:10.1371/journal.pone.0142963
10. Gueugneau N., **Schweighofer N.**, and Papaxanthis C., (2015) *Daily update of motor predictions by physical activity*. Scientific reports, 5, doi:10.1038/srep17933
11. **Schweighofer N.**, Xiao Y.*, Gordon, J., and R. Osu (2015). *Effort, Success, and Non-use Determine Arm Choice* Journal of Neurophysiology, 2015 Jul;114(1):551-9.
12. Bains A.*, and **Schweighofer N.** (2014) *Time-sensitive reorganization of the somatosensory cortex post-stroke depends on interaction between Hebbian plasticity and homeoplasticity: a simulation study*. Journal of Neurophysiology: 112.12 (2014): 3240-3250.
13. Sargent, B.; **Schweighofer N.**; Kubo M.; Fetters L. (2014) *Infant Exploratory Learning: Influence on Leg Joint Coordination*. PloS one 9.3 (2014): e91500
14. Laffont I, Bakhti K, Coroian F., van Dokkum L., Mottet D., **Schweighofer N.**, and J Froger (2014) *Innovative technologies applied to sensorimotor rehabilitation after stroke*. Annals of physical and rehabilitation medicine 57 (8), 543-551
15. Han C.E.*, Kim SJ., Chen, S., Lai, L.*, Lee, J., Osu, R., Lee, JY.*, Winstein C., and **Schweighofer N.** (2013) *Quantifying Arm Non-use in Individuals Post-stroke* Neural Repair and Neurorehabilitation. 27:439-47
16. **Schweighofer N.**, Lang E. and Kawato M. (2013) *Role of the olivo-cerebellar complex in motor learning and control (review)* Frontiers in neural circuits;7:94
17. Onizuka M., Kawato M., **Schweighofer N.**, Katori Y., Aihara K., Lang E.J., and Toyama K., (2013) *Solution to the inverse problem of estimating gap-junctional and inhibitory conductance in inferior olive neurons from spike trains by network model simulation*, Neural Networks. 47:51-63.
18. Tokuda I.T, Hoang H., **Schweighofer N.**, and Kawato M. (2013) *Adaptive Coupling of Inferior Olive Neurons in Cerebellar Learning*, Neural Networks. 47:42-50
19. Chen, S., Lewthwaite, R., **Schweighofer, N.**, & Winstein, C. J. (2013). *Discriminant validity of a new measure of self-efficacy for reaching movements after stroke-induced hemiparesis*. Journal of Hand Therapy. 26(2):116-22;
20. **Schweighofer, N.**, Choi*, Y., Winstein, C., and Gordon J. (2012) *Task-based rehabilitation robotics*. American Journal of PM&R 91: S270-9
21. Hidaka Y*., Han C.E.* , Wolf S., Winstein C.J., and **Schweighofer N.** (2012) *Use It and Improve It or Lose It: Interactions between Arm Function and Use in Humans Post-stroke*. PLoS Computational Biology 8(2): e1002343
22. Demoto, Y., Okada, G., Okamoto, Y., Kunisato, Y., Aoyama, S., Onoda, K., Munakata, A., Nomura, M., Tanaka, S.C., **Schweighofer, N.** and Doya, K. (2012). *Neural and personality correlates of individual differences related to the effects of acute tryptophan depletion on future reward evaluation*. Neuropsychobiology, 65(2), 55-64.
23. Abe M., Schambra H., Wassermann E., Luckenbaugh D., **Schweighofer, N.**, and Cohen L.G. (2011) *Reward improves long-term retention of a motor memory through induction of offline memory gains*. Current Biology, 21: 557-562

24. Kawato M., Kuroda S., and **Schweighofer N.** (2011) *Cerebellar supervised learning revisited: bioinformatics modeling and degrees-of-freedom control*. *Current Opinion in Neurobiology*, 21:1-10
25. **Schweighofer N.**, Lee, J.Y.*, Goh H.T.*, Choi Y. G.*, Kim, S.S.*, Stewart J., Lewthwaite R. Winstein C. (2011) *Mechanisms of the contextual interference effect in individuals post-stroke*. *Journal of Neurophysiology* 106: 2632-41 (the first two authors have contributed equally)
26. Choi Y.G*, Gordon J., Park H*, and **Schweighofer N.** (2011) *Feasibility of the adaptive and automatic presentation of tasks (ADAPT) system for rehabilitation of upper extremity function post-stroke*. *Journal of NeuroEngineering and Rehabilitation*, 8:42
27. Onoda K., Okamoto Y., Kunisato Y., Aoyama S., Shishida K., Okada G., Tanaka S., **Schweighofer N.**, Yamaguchi S., Doya K. and Yamawaki S. (2011) *Inter-individual discount factor differences in reward prediction are topographically associated with caudate activation*. *Experimental Brain Research*, 2011, 212(4):593-601
28. Frey S., Fogassi L., Grafton S., Picard N., Rothwell J., **Schweighofer N.**, Corbetta, M., Fitzpatrick S. (2011). *Neurological Principles and Rehabilitation of Action Disorders: Computation, Anatomy & Physiology (CAP) model*. *Neurorehabilitation and Neural Repair*, 25: 6S-20S
29. Qi, F.*, Wu A., and **Schweighofer N.** (2011) *Fast estimation of transcranial magnetic stimulation motor threshold*. *Brain Stimulation*, 4:50-57
30. Qi, F.*, and **Schweighofer N.** (2011) *Including prior knowledge for accurate and fast MT estimation*. *Brain Stimulation*, 4:60:61
31. Tokuda I., Han C.E.*, Aihara K., Kawato M., and **Schweighofer N.** (2010) *The role of chaotic resonance in cerebellar learning*. *Neural Networks*, 23(7):836-842.
32. Gentili R., Han C.E.* , **Schweighofer N.**, Papaxanthis C. (2010) *Motor learning without doing: Trial-by-Trial Improvement in Motor Performance during Mental Training*. *Journal of Neurophysiology*, 104:774-783 (all authors have contributed equally)
33. Callan D.E. and **Schweighofer N.** (2010) *Neural correlates of the spacing effect in explicit verbal semantic encoding support the deficient-processing theory*. *Human Brain Mapping*, 31(4):645-59.
34. Tanaka S., Shishida K., **Schweighofer N.**, K., Okamoto Y., Yamawaki S., and Doya K. (2009) *Serotonin affects association of aversive outcomes to past actions* *Journal of Neuroscience*, 29:15669-15674.
35. **Schweighofer N.**, Han, C.*, Wolf, S., Arbib, M.A and Winstein C. (2009) *Understanding the Functional Threshold: Predictions from a Computational Model and Supporting Data from the Extremity Constraint-Induced Therapy Evaluation (EXCITE) Trial*. *Physical Therapy*, 89(12)

Discussion Podcast: Gert Kwakkel, PhD, Nicolas Schweighofer, PhD, and Carolee Winstein, PT, PhD, FAPTA. *Making Prognostic Judgments of the Extent of Upper-Extremity Recovery Following Stroke*

36. Choi Y.G.*, Gordon, J., Kim D., and **Schweighofer N.** (2009) *An Adaptive Automated Robotic Task Practice System for Rehabilitation of Arm Functions after Stroke*. IEEE-Transactions in Robotic, 25: 556-568
37. Lee J.Y.*, **Schweighofer N.** (2009) *Dual-adaptation supports a parallel architecture of motor memory*. Journal of Neuroscience, 29:10396-404
38. Han C.E.*, Arbib M.A. and **Schweighofer N.** (2008) *Stroke rehabilitation reaches a threshold*. PLoS Computational Biology, 4(8): e1000133
39. **Schweighofer N.**, Bertin, M., Shihida K., Tanaka S., Okamoto Y., Yamawaki S., and Doya K. (2008). *Serotonin modulation of delayed reward discounting in humans*. Journal of Neuroscience, 28:4528-32
40. Choi Y.G*., Qi F.*, Gordon J., and **Schweighofer N.** (2008) *Performance-based adaptive schedules enhance motor learning*. Journal of Motor Behavior, 40:273:280
41. Callan D. and **Schweighofer N.** (2008) *Positive and negative modulation of word learning by reward anticipation*. Human Brain Mapping, 29:237-49.
42. Tanaka S., **Schweighofer N.**, Asahi S., Okamoto Y., Yamawaki S., and Doya K. (2007) *Serotonin differentially regulates reward prediction in the striatum at short and long time scales*. PLoS ONE, 2(12):e1333.
43. Bertin M., **Schweighofer N.**, and K. Doya (2007) *Multiple model-based reinforcement learning explains dopamine neuronal activity*. Neural Networks, 20:668-675
44. **Schweighofer N.**, Tanaka S., and Doya K. (2007). *Serotonin and the Evaluation of Future Rewards: Theory, Experiments, and Possible Neural Mechanisms*. Annals of the New York Academy of Science, 1104:289-300 (special issue on “Reward and Decision Making in Cortico-basal Ganglia Networks”).
45. **Schweighofer N.**, Shishida K., Han C.E. *, Tanaka S., Okamoto Y., Yamawaki S., and Doya K. (2006) *Humans can adopt optimal discounting strategy under real-time constraints*. PLoS Computational Biology 11: 1349-1356
46. Pozzo T., Papaxanthis C., **Schweighofer N.**, Petit, J, and N. Stucchi (2006) *Kinematic features of movement tunes perception and action coupling*. Behavioral Brain Research, 169: 75-82
47. Schaal, S. and **Schweighofer N.** (2005) *Computational motor control in humans and robots*. Current Opinion in Neurobiology, 25: 1-8
48. **Schweighofer N.**, Doya K., Chiron J.V., Fukai H., Furukawa T., and Kawato M. (2004) *Chaos may enhance information transmission in the inferior olive*. Proceedings of the National Academy of Science USA, 101: 4655-4660
49. **Schweighofer N.**, Doya K., and Kuroda S. (2004) *Cerebellar aminergic neuromodulation: towards a functional understanding*. Brain Research Reviews 44: 103-106
50. **Schweighofer N.** and Doya K. (2003) *Meta-learning in reinforcement learning*. Neural Networks, 16: 5-9
51. Kuroda S., **Schweighofer N.**, and Kawato M. (2001) *Exploration and prediction of signal transduction pathways in cerebellar long-term depression by kinetic simulation*. Journal of Neuroscience 21: 5693-702

52. **Schweighofer N.**, Doya K., and Lay F. (2001) *Unsupervised learning of granule cell sparse codes enhances cerebellar adaptive control*. Neuroscience. 103: 35-50
53. Spoelstra J., **Schweighofer N.**, and Arbib MA. (2000) *Cerebellar learning of accurate predictive control for fast-reaching movements*. Biological Cybernetics 82: 321-33.
54. **Schweighofer N.** and Ferriol G. (2000) *Diffusion of nitric oxide can facilitate cerebellar learning*. Proceedings of the National Academy of Science. 97: 10661-5
55. Spoelstra J., Arbib M.A., and **Schweighofer N.** (1999) *Cerebellar adaptive control of a biomimetic manipulator*. Neurocomputing 26-27: 881-889
56. **Schweighofer N.**, Doya K., and Kawato M. (1999) *Electrophysiological properties of the inferior olive neurons: a compartmental model*. Journal of Neurophysiology, 82: 804-817
57. **Schweighofer N.** (1998) *A model of activity-dependent formation of cerebellar microzones*. Biological Cybernetics 79: 97-107
58. **Schweighofer N.** and Arbib M.A. (1998) *A model of cerebellar meta-plasticity*. Learning & Memory. 4: 421-428
59. **Schweighofer N.**, Arbib, M.A. and Kawato, M. (1998) *Role of the cerebellum in reaching movements in human. I. Distributed Inverse dynamics control*. European Journal of Neuroscience. 10: 86-94
60. **Schweighofer N.**, Spoelstra J., Arbib M.A, and Kawato M. (1998) *Role of the cerebellum in reaching movements in human. II. A neural model of the intermediate cerebellum*. European Journal of Neuroscience. 10: 95-105
61. **Schweighofer N.**, Arbib M.A., and Dominey P.F. (1996). *A model of the role of the cerebellum in saccadic gain adaptation. II. Simulation results*. Biological Cybernetics. 75: 29-36
62. **Schweighofer N.**, Arbib M.A., and Dominey P.F. (1996). *A model of the role of the cerebellum in saccadic gain adaptation. I. The model and its biological substrate*. Biological Cybernetics. 75: 19-28

Patents:

Ferriol G., **Schweighofer N.**, Smith A. (2005) *System, apparatus and method for maximizing effectiveness and efficiency of learning, retaining and retrieving knowledge and skills* (US 20030129574)

Schweighofer N., Choi Y., C Han C., J Gordon J., Winstein C.J., Osu R. (2013) *Upper Limb Measurement and Rehabilitation Method and System* (US 61114929)

Reviewed Proceedings and Book Chapters:

1. **Schweighofer N.**, (2016) *Computational Models in Motor Control*. In from Neuron to Cognition via Computational Neuroscience - MIT Press, M.A Arbib, Editor, MIT press.
2. Bains A., **Schweighofer N.** (2015) *Robust Use-Dependent Learning in Arm Movements*, TCMC, Chicago.
3. Winstein, C.J., Wolf, S. and **Schweighofer N.** (2015) *Task Oriented Training to promote upper extremity recovery*. *Stroke Recovery and Rehabilitation, 2nd Edition*, Demos Medical.

4. Kim, S.S.*, Ogawa K., **Schweighofer N.** and Imamizu H (2013) *Neural correlates of motor memory with multiple time scales in sensorimotor adaptation*. TCMC (ex ACMC) San Diego
5. Hidaka Y., Carolee Winstein C., and **Schweighofer, N.** (2012) *Task interference in constraint-induced movement therapy revealed by graph structure learning* ACMC New Orleans
6. Osu R., Schweighofer N., Hirai S., Yoshioka T., Kawato M (2010) *Initial training schedule pre-determines subsequent performance in dual adaptation to conflicting environments* Neuroscience Research 68, e148-e148
7. Callan, D; **Schweighofer, N;** FohSato, M; et al (2009) *Supervised Error Feedback Learning and Unsupervised Exemplar Learning of a Temporal Judgment Task*
8. *Differentially Activate Cerebellum and Parietal Cortex*. Neuroscience Research 65: S181-S181
9. Onizuka, M; **Schweighofer, N;** Katori, Y; et al. (2009) *Firing dynamics of the inferior olive neurons: a simulation study*. Neuroscience Research 65: S237-S237
10. Onizuka, M; **Schweighofer, N;** Katori, Y; et al. (2008) *Reproduction of intermittent, synchronized and rhythmic firings by coupled, realistic inferior olive neuron models*. Neuroscience Research 61 S193-S193
11. **Schweighofer, N** (2007) *Effect of choice in motor learning*. Journal Of Sport & Exercise Psychology. 29: S126-S126
12. Choi Y.G.*, Gordon J., and **Schweighofer N.** (2008) *ADAPT – Adaptive Automated Robotic Task Practice System for Stroke Rehabilitation*, ICRA
13. Choi Y.G. *, and **Schweighofer N.** (2007) *Simulation of Realistic Functional Tasks with a General-purpose Robot*, IROS Workshop on Assistive Technologies: Rehabilitation and Assistive Robotics.
14. Choi Y.G. *, and **Schweighofer N.** (2007) *Local online support regression for learning control*, CIRA 2007.
15. Kuroda S., **Schweighofer N.**, Amano M., Kaibuchi K., and Kawato M. (2000) *Distinct roles of Rho-kinase pathway and myosin light chain kinase pathway in phosphorylation of myosin light chain: kinetic simulation study*. In: Foundation of Systems Biology, MIT press.
16. Spoelstra J., Arbib M. A. and Schweighofer N. (1997) *Cerebellar control of a simulated biomimetic manipulator for fast movements*. NIPS 97 Workshop: Can Artificial Cerebellar Models Compete to Control Robots? Denver, CO
17. Arbib, M. A., **Schweighofer N.**, and Thach, W. T. (1995). *Modeling the cerebellum: From adaptation to coordination*. In J. Piek (Eds.), Motor control and sensory motor integration: Issues and directions. Elsevier.
18. Arbib, M.A., **Schweighofer N.**, and Thach, W. (1994). *Modeling the role of cerebellum in prism adaptation*. In: From Animals to Animats, Oxford

GRANTS AND/OR CONTRACTS

Principal Investigator:

- 2017 NIH - High Priority, Short-Term Project Award (R56)
“Optimizing sensori-motor training post-stroke”
Role: Principal Investigator
Total direct support: \$350,000
- 2016 NSF I-Corps
“Semi-automated adaptive upper extremity training for individuals post-stroke”
Role: Principal Investigator
Total direct support: \$50,000 Total direct support
- 2015 Coulter Translational Research grant
Role: Principal Investigator
Total direct support: \$60,000 Total direct support
- 2014-2016 Labex NUMEV, Montpellier, France
European Computational Motor Control Summer School
Role: Principal Investigator
Total direct support 2016: \$20,000
Total direct support 2015: \$20,000
Total direct support 2014: \$10,000
- 2013 Borchard foundation, Pasadena, CA
International colloquium in France grant, June 2013
“Computational Neurorehabilitation”
Role: Principal Investigator
Total direct support: \$35,000
- 2011-2017 NIH R01 Grant
“Optimizing dosage of rehabilitation after stroke”
Role: Principal Investigator (w/ C. Winstein, Multi-PIs)
Total direct support: \$1,057,100 directs, \$1,721,250 total
- 2013-2015 NIH R01 Grant Supplement
Supplement to “Optimizing dosage of rehabilitation after stroke”
Role: Principal Investigator (w/ C. Winstein, Multi-PIs)
Total direct support: \$113,904 directs, \$186,803 total
- 2010-2014 NSF BCS Grant
“Modeling motor memory to enhance motor learning”
Role: Principal Investigator
Total direct support: \$212,676 directs, \$344,536 total
- 2005-2008 NIH R03 Grant
“Task Practice Schedules to Enhance Recovery after Stroke”

Role: Principal Investigator.
Total direct support: \$98,825 directs, \$160,835 total

Participated as Co-PI:

2006-2010 NSF “Skill acquisition through interactive avatars”
Role: Co-Principal Investigator (PI: Stefan Schaal)
Total direct support: \$128,503 directs, \$192,696 total

2004-2007 NIH
P20 Exploratory Center for Interdisciplinary Research
“New Directions in stroke neuro-rehabilitation”
Subproject 5: Computational models of stroke neuro-rehabilitation
Role: Senior Personnel. (PI: McNeill, Thomas)
Total direct support: \$44,406 directs, \$71,789 total

HONORS, AWARDS, FELLOWSHIPS:

2012-2013 EU Marie Curie International Incoming Fellowship

2007 Society for Neuroscience abstract in Press Book

2006 Society for Neuroscience abstract in Press Book (one of 700 chosen from over 16,000 abstracts)

2004 Best paper award - Japanese Neural Network Society

2003 Research fellowship from the “Fond Medical pour la Recherche” foundation, France (20K €)