

CURRICULUM VITAE

April 2017

Wan-hsun (Carolyn) Wu, Ph.D.

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Biographic Information:

Born in Hsin-Chu, Taiwan.
US /Taiwan dual citizenship.

Education and Academic Trainings:

- 2015-current Research Scientist, McGovern Inst for Brain Research, MIT, Cambridge, MA, USA
- 2008-2012 Dec Principle Investigator (tenured since 2009 Feb), Unit Chief of Brain Plasticity,
NeuroSpin, I BM, ultra-high field imaging facility, Institut d'Imagerie RMN,
Commissariat à l'Energie Atomique CEA de Saclay, France
- 2004-2008 Senior Research Fellow, Laboratory of Functional and Molecular Imaging,
National Institute of Neurological Disorders and Stroke, NIH, Bethesda, MD, USA
Research advisor: Dr. Alan P. Koretsky, Ph.D.
- 1999-2004 Postdoctoral Fellow, Human Cortical Physiology Section,
National Institutes of Neurological Disorders and Stroke, NIH, Bethesda, MD, USA
Research advisor: Dr. Leonardo G. Cohen, M.D.
- 1993-1999 Ph.D., Psychology Department, Neuroscience Program,
Vanderbilt University, Nashville, TN, USA
Dissertation advisor: Dr. Jon H. Kaas, Ph.D.
- 1991-1993 Predoctoral Fellow, Department of Physiology and Biophysics,
National Defense Medical Center, Taipei, Taiwan
Research advisor: Dr. C. S. Tung, M.D., Ph.D.
- 1987-1991 B.S., Department of Psychology,
National Taiwan University, Taipei, Taiwan
Research advisor: Dr. K. C. Liang, Ph.D. Professor

Membership at Scientific Organizations:

Society for Neuroscience (1992 - 2012)
International Society for Magnetic Resonance in Medicine (2003 - current)

Society for International Brain Research Organization (2001 - 2012)

Organization for Human Brain Mapping (2000 – 2012)

Society for the Neural Control of Movement (1999 - 2004)

The Chinese Physiological Society (1991 - 1993)

Grants, Academic Honors and Awards:

- 2009 ANR (Agence Nationale de La Recherche) Grant, Programme Blanc, France.
Title: Investigating Layer-Specific Mechanisms Underlying Progression of Cortical Plasticity and Tactile Performance using Rodent MRI Model (LSMCP_MRI).
Awarded for 480,000 Euro (September 2009-September 2013).
- 2008 Prize of permanent position award, NeuroSpin, CEA, Saclay, France
- 2005 Award for Research Excellence - National Institutes of Health, Bethesda, MD.
- 1999-2004 Intramural Research Training Award - National Institutes of Health, Bethesda, MD.
- 2004 Award for Research Excellence - National Institutes of Health, Bethesda, MD.
- 2003 Recognition and a Special Act or Service Award – National Institute of Neurological Disorders and Stroke, National Institutes of Health, Bethesda, MD.
- 1999 Travel Award - Graduate School of Vanderbilt University. Hawaii, USA.
- 1999 Travel Award - Society for the Neural Control Movement Symposium. Seville, Spain
- 1996 Travel Award - 20th Symposium of the Center for Visual Science, University of Rochester. USA.
- 1994 Travel Award - 18th Symposium of the Center for Visual Science, University of Rochester. USA.
- 1991-1993 Predoctoral Fellowship Award - S.C. Wang Foundation at the National Defense Medical Center, Taipei, Taiwan.
- 1990 Undergraduate Student Fellowship Award - National Science Council of Taiwan, Taiwan.

Referee for Scientific Journals

NeuroImage

Experimental Brain Research

IEEE Engineering in Medicine and Biology Magazine

Neuroscience Letters

Neurohabilitation and Repair

Research Interests

Plasticity and neurogenesis in neurodegenerative disorders

Plasticity and functional recovery after motor impairments

Plasticity and perception in somatosensory system

Somatosensory modulation on motor cortex and motor performance

Publications-Peer Reviewed Papers

1. **Wu WH**, Hwang NG, Yin TH, Tung CS (1993). Effect of prefrontal cooling on levels of glutamate, DOPAC, and 5-HIAA in nucleus accumbens and striatum *in vivo*. *The Chinese Journal of Physiology* 36: 1-6.
2. Tung CS, **Wu WH**, Tseng CJ, Yin TH (1994). Effect of amperozide on schedule-induced polydipsia in rats. *European Journal of Pharmacology* 256: 193-200.
3. **Wu WH**, Hwang NK, Tseng CJ, Yin TH, Tung CS (1995). Evidence that 5-HT(2) antagonism elicits a 5-HT(3)-Mediated increase in dopamine transmission. *Journal of Biomedical Science* 2: 174-182.
4. **Wu CWH**, Florence SL, Tigges MH, Kaas JH (1998). Morphology of M-cell axon arbors in striate cortex of monkeys reared with monocular aphakia. *Developmental Brain Research* 108: 47-57.
5. **Wu CWH**, Kaas JH. (1999). Reorganization in primary motor cortex of primates with long-standing therapeutic amputations. *Journal of Neuroscience* 19: 7679-7697.
6. **Wu CWH**, Bichot NP, Kaas JH (2000). Converging evidence from microstimulation, cytoarchitecture and connectivity for multiple motor areas in frontal and cingulate cortex in prosimian galagos. *Journal of Comparative Neurology* 423: 140-177.
7. **Wu CWH**, Kaas JH (2000). Spinal cord atrophy and reorganization of motoneuron connections following long-standing limb loss in primates. *Neuron* 28: 967-978.
8. **Wu CWH**, Kaas JH (2002). The effects of long-standing limb amputation on anatomical organization of the somatosensory brainstem and spinal cord. *Somatosensory and Motor Research* 19: 153-163.
9. **Wu CWH**, Kaas JH (2003). Somatosensory cortex of prosimian galagos: Physiological recording, cytoarchitecture and corticocortical connections in anterior parietal cortex and the vicinity of the lateral sulcus. *Journal of Comparative Neurology* 457: 263-292.
10. Floel A, Peoppel D, Buffalo E, Braun A, **Wu CWH**, Seo HJ, Stefan K, Knecht S, Cohen LG (2004). Prefrontal cortex asymmetry for memory encoding of words and abstract shapes. *Cerebral Cortex* 14: 404-409.
11. Pietrini P, Furey ML, Ricciardi E, Gobbin MI, **Wu WHC**, Cohen L, Guazzelli M, Haxby JV (2004). Beyond sensory images: Object-based representation in the human ventral pathway. *Proceedings of the National Academy of Science* 101: 5658-5663.
12. Hummel F, **Wu CW**, Floel A, Gerloff C, Cohen LG (2004) Improvement of skilled motor functions in elderly healthy volunteers by cortical stimulation. *NeuroImage* 01/2004; 22(S29).
13. Hummel F, Celnik P, Giraux P, Floel A, **Wu WH**, Gerloff C, Cohen LG (2005). Effects of non-invasive cortical stimulation on skilled function in chronic stroke. *Brain* 128: 490-499.
14. van Gelderen P, **Wu CWH**, de Zwart J, Hallett M, Cohen LG, Duyn J (2005). Resolution and reproducibility of BOLD and perfusion functional MRI at 3.0 Tesla. *Magnetic Resonance Medicine* 54: 569-576.
15. **Wu CWH**, van Gelderan P, Hanakawa T, Yaseen Z, Cohen LG (2005). Enduring representational plasticity after somatosensory stimulation. *NeuroImage* 27: 872-884.
16. **Wu CWH**, Bichot NP, Kaas JH (2005). Somatosensory areas S2 and PV project to the superior colliculus of a prosimian primates, Galago Garnetti. *Somatosensory and Motor Research* 22: 221-231.

17. **Wu CWH** (2005). Peripheral somatosensory stimulation induced cortical plasticity and its clinical application on functional restoration in chronic stroke *Conference Proceeding of IEEE Engineering in Medicine and Biology Society* 5:5230-5233.
18. Sawaki L, **Wu CWH**, Kaelin LA, Cohen LG (2005). Effect of somatosensory stimulation on use-dependent plasticity in chronic stroke. *Stroke* 37: 246-247.
19. Voller B, Flöel A, Werhahn KJ, Ravindran S, **Wu CW**, Cohen LG (2006). Contralateral hand anesthesia transiently improves poststroke sensory deficits. *Annals of Neurology* 59: 385-388.
20. **Wu CWH**, Seo HJ, Cohen LG (2005). Influence of electric somatosensory stimulation on paretic-hand function in chronic stroke. *Archives of Physical Medicine and Rehabilitation* 87: 351-7.
21. Silva AC, Lee JH, **Wu CWH**, Tucciarone J, Pelled G, Aoki I, Koretsky AP (2008) Detection of cortical laminar architecture using manganese-enhanced MRI. *Journal of Neuroscience Method.* 167:246-57.
22. **Wu CWH**, Vasalatiy O, Liu Ning, Wu HT, Cheal S. Chen DY, Griffiths G, Koretsky AP, Tootell R, Ungerleider LG (2011). Development of a MR-visible compound for tracing neuroanatomical connections *in vivo*. *Neuron (Neurotechnique)* 70:229-243.
23. Goloshevsky A, **Wu CWH**, Dodd SJ, Koretsky AP (2011). Mapping cortical representations of the rodent forepaw and hindpaw with BOLD fMRI reveals two spatial boundaries. *NeuroImage*, 57:526-538.
24. **Wu CWH**, Dodd SJ, Koretsky AP. *In vivo* visualization of cortical boundaries in the rodent brain using manganese enhanced MRI as a functional cytoarchitectonic marker (submitted to *NeuroImage*).
25. **Wu CWH**, Goloshevsky A, Dodd SJ. Detecting layer-specific acute cortical plasticity in rat model using high field fMRI (in preparation).
26. **Wu CWH**, Wu HT, Griffiths G, Tootell R, Koretsky AP, Ungerleider L, L *In vivo* tracing anatomical circuitry of the brains using Gadolinium. (in preparation).
27. **Wu CWH**, Chuang KH, Koretsky AP. *In vivo* anatomical tract-tracing with manganese-enhanced MRI (MEMRI): uptake, transport, and detection (in preparation).
28. **Wu CWH**, Kaas JH. Subdivisions of somatosensory thalamus and their connections with areas S1, S2 and PV in prosimian primates (in preparation).

Conference Presentation with Published Abstracts

1. Ching CP, **Wu WH**, Lu CC, Tung CS (1991). The effect of locus coeruleus and excitatory amino acid pathways on morphine dependent and withdrawal on schedule-induced polydipsia. *Eighteenth Annual Conference of Medical Science*, Taipei, Taiwan.
2. Tung CS, Lu CC, Liu YP, **Wu WH**, Yin TH (1992). The role of central mono-aminergic system in adjunctive drinking (AD) control. *Seventh Annual Conference of Biomedical Science*, Taipei, Taiwan.
3. **Wu WH**, Liu YP, Tung CS (1992). *In Vivo* measurement of dihydroxyphenylacetic acid by intracerebral dialysis: change after amperozide. *Seventh Annual Conference of Biomedical Science*, Taipei, Taiwan.
4. Liu YP, Tseng CJ, **Wu WH**, Tung CS (1992). Microdialysis studies on the 5-HT₂ analogue actions on midbrain DA neurons. *Seventh Annual Conference of Biomedical Science*, Taipei, Taiwan.
5. **Wu WH**, Liu YP, Tung CS (1992). The effect of potential antipsychotic drug, Amperozide on the schedule-induced polydipsia. *Nineteenth Annual Conference of Medical Science*, Taipei, Taiwan.

6. Yin TH, **Wu WH**, Tseng CJ, Tung CS (1993). The effect of Amperozide on schedule-induced polydipsia (SIP) in rats. *Society for Neuroscience Abstracts* 19:170. USA.
7. **Wu WH**, Florence SL, Kaas JH (1994). Effects of neonatal monocular aphakia on the morphology afferent axons to layer IV of striate cortex in macaque monkeys. *Society for Neuroscience Abstracts* 20:465. USA.
8. **Wu WH**, Beck PD, Kaas JH (1995). Ipsilateral cortical connections of S1 (3b) in prosimian primates: evidence for five somatosensory areas. *Society for Neuroscience Abstracts* 21:112. USA.
9. **Wu WHC**, Beck PD, Kaas JH (1996). Cortical and thalamic connections of the second somatosensory area, S2 in the prosimian primate, *galago garnetti*. *Society for Neuroscience Abstracts* 22:107. USA.
10. Kaas JH, **Wu CWH**, Bichot NP (1997). Projections from the second (S2) and parietal ventral (PV) somatosensory areas to the superior colliculus in a prosimian primate. *Society for Neuroscience Abstracts* 23:1042. USA.
11. **Wu CWH**, Bichot NP, Kaas JH (1997). Connections of the second (S2) and parietal ventral (PV) somatosensory areas with frontal motor cortex: a study combining electrorecording, microstimulation, cytoarchitecture, and connectivity. *Society for Neuroscience Abstracts* 23:1273. USA.
12. **Wu CWH**, Kaas JH (1998). Converging evidence from microstimulation, cytoarchitecture and connections for multiple motor areas in frontal and cingulate cortex of prosimian primates. *Society of Neuroscience Abstracts* 24:653. USA
13. **Wu CWH**, Kaas JH (1999). Reorganization in primary motor cortex (M1) of primates with long-standing therapeutic amputations. *Ninth Annual Meeting of the Society for the Neural Control of Movement*. Princeville, USA.
14. **Wu CWH**, Kaas JH (1999). Spinal cord contribution to reorganization of primate primary motor cortex (M1) following long-standing limb amputation. *Society for Neuroscience Abstracts* 25:385. USA
15. Pietrini P, Furey ML, Gobbini MI, Ricciardi E, **Wu WC**, Cohen L, Guazzelli M, Haxby JV (2000). Activation of ventral extrastriate visual cortex during tactile discrimination of faces and objects in congenitally blind subjects. *Society for Neuroscience Abstracts* 26. USA
16. **Wu CWH**, Kaas JH (2000). The effects of long-standing limb amputation on anatomical reorganization of the somatosensory afferents in the brainstem. *Society for Neuroscience Abstracts* 26. USA
17. **Wu CWH**, Bichot NP, Kaas JH (2001). Superior colliculus connection with physiologically identified somatosensory areas. *Annual Meeting of the Society for the Neural Control of Movement*. Seville, Spain.
18. van Gelderen P, **Wu CWH**, Duyn J (2002). Spatial discrimination of combo pulse in visual and somatosensory cortex. *International Society for Magnetic Resonance in Medicine*. Honolulu, USA.
19. van Gelderen P, **Wu CWH**, Hanakawa T, Cohen LG, Hallett MM, Duyn J (2002). Stability of perfusion and bold signals of combo pulse in motor tapping task. *International Society for Magnetic Resonance in Medicine*. Honolulu, USA.
20. **Wu CWH**, van Gelderan P, Hanakawa T, Kelin-Lang A, Dyne J, Hallett M, Cohen LG (2002). The effects of median nerve stimulation on the motor cortex: a fMRI study. *Society for Neuroscience Abstracts* 28. 562.11. Miami, USA.
21. van Gelderen P, **Wu CWH**, Duyn J (2002). Comparing spatial discrimination of perfusion and bold fMRI. *Human Brain Mapping*, Sendai, Japan.
22. Pietrini P, Furey ML, Ricciardi E, Gobbini MI, **Wu WC**, Cohen L, Guazzelli M, Haxby JV (2002). Neuroal activity in ventral extrastriate cortex during tactile discrimination of faces and objects in congenitally blind and sighted subjects. *International Conference on Functional Mapping of the Human Brain*, Sendai, Japan.

23. **Wu CWH**, Werhahn KJ., Stefan K, Seo HJ, Floel A, Cohen LG (2003). Neural substrates mediating enhanced tactile spatial acuity during acute anesthesia. *International Brain Research Organization*, Prague, Czech Republic.
24. Sawaki L, **Wu C**, Stefan K, Yaseen C, Robinson C, Cohen LG (2003). Training-dependent encoding of motor memory in patients with chronic stroke. *American Academy of Neurology*, Hawaii, USA.
25. **Wu CWH**, Werhahn KJ., Stefan K, Seo HJ, Floel A, Cohen LG (2003). Neural substrates underlying enhanced tactile spatial acuity (TSA) during acute hand deafferentation. *Society for Neuroscience Abstracts*, New Orleans, USA.
26. Floel A, Poeppel D, Bufflo E, Braun A. **Wu C**, Seo HJ, Stefan K, Knecht S, Cohen L (2003). Frontal cortex symmetry for memory encoding of words and pictures. *Society for Neuroscience Abstracts*, New Orleans, USA.
27. **Wu CWH**, Seo HJ, Cohen LG (2004). Improvement of paretic hand function by somatosensory stimulation in chronic stroke. *5th World Stroke Congress Abstract*, Vancouver, Canada. pp 262.
28. Sawaki L, **Wu CWH**, Cohen LG (2004). Enhancement of use-dependent plasticity with chronic stroke by peripheral nerve stimulation. *World Stroke Congress Abstract*, Vancouver, Canada. pp 236.
29. Sawaki L, **Wu CWH**, Cohen LG (2004). Enhancement of use-dependent plasticity by peripheral nerve stimulation in patients with chronic stroke. *American Academy of Neurology Abstract*, San Francisco, USA.
30. Hummel F, **Wu C**, Floel A, Gerloff C, Cohen LG (2004). Effects of transcranial direct current stimulation (tDCS) on motor function in patients with chronic stroke. *American Academy of Neurology*, San Francisco, USA.
31. **Wu CWH**, Werhahn KJ, Stefan K, Seo HJ, Floel A, Cohen LG (2004). Cortical substrates underlying enhancement in tactile spatial acuity (TSA) in one hand by acute deafferentation of the other hand. *International Conference on Functional Mapping of the Human Brain*, Budapest, Hungary.
32. Hummel F, **Wu C**, Giraux P, Gerloff C, Cohen LG (2004). Improvement of skilled motor functions in elderly healthy volunteers by cortical stimulation. *International Conference on Functional Mapping of the Human Brain*, Budapest, Hungary.
33. **Wu CWH** (2005). Peripheral somatosensory stimulation induced cortical plasticity and its clinical application on functional restoration in chronic stroke *27th Annual International Conference of the IEEE Engineering in Medicine and Biology Society*. Beijing, China.
34. **Wu CWH**, Dodd SJ, and Koretsky AP (2006) *In vivo* visualization of cytoarchitecture to define boundaries in cortex, thalamic nuclei and superior colliculus using manganese enhanced MRI. *ISMRM* oral presentation. Seattle, USA.
35. **Wu CWH**, Simmons J, Chung KH, Ortiz M, Koretsky AP (2006). *In vivo* anatomical tract-tracing with manganese-enhanced MRI (MEMRI): uptake, transport, and detection. *Society for Neuroscience Abstracts*, Atlanta, USA.
36. Goloshevsky A, **Wu CWH**, Dodd ST, Koretsky AP (2007). Mapping of adjacent somatosensory Representations with fMRI. *International Conference on Functional Mapping of the Human Brain*. Chicago, USA.
37. Goloshevsky A, **Wu CWH**, Dodd ST, Koretsky AP (2007). The effects of averaging upon the spatial representation of fMRI activation. *Experimental Nuclear Magnetic Resonance Conference*. Daytona Beach, USA.
38. **Wu CWH**, Dodds SJ, and Koretsky AP (2007). *In vivo* visualization of cortical areal boundaries using MEMRI. *The 2nd Asia-Pacific NMR Symposium*, HsinChu, Taiwan.

39. **Wu CWH**, Dodd SJ, and Koretsky AP (2007). *In vivo* defining cortical areas using MEMRI. *International Society of Magnetic Resonance*. Kenting, Taiwan.
40. **Wu CWH**, Goloshevsky A, Koretsky AP (2007). Laminar-specific cortical plasticity induced by acute denervation-high field fMRI study. *Society for Neuroscience Abstracts*, San Diego, USA
41. **Wu CWH**, Wu HT, Ebitz R, Griffiths G, Tootell R, Koretsky AP, Ungerleider L (2008) *In vivo* tracing anatomical circuitry of the brains using Gadolinium. *International Society for Magnetic Resonance in Medicine* oral presentation. Toronto, Canada.
42. **Wu CWH**, Wu HT, Griffiths G, Koretsky AP, Tootell R, Ungerleider (2009). Use of MRI visible gadolinium conjugated anatomical tracer to visualize neuronal connections *in vivo*. *Society for Neuroscience Abstracts*. Washington, DC, USA.
43. Vasalatiy O, Cheal S, **Wu WH**, Ungerleider L, Tootell RB, Koretsky AP, Griffiths GL (2009). Synthesis and characterization of gadolinium-benzyl-DOTA-cholera toxin B conjugates for MRI brain circuitry studies. *American Chemical Society meeting*, Washington, DC, USA.
44. **Wu CWH**, Liu N, Chen DY, Vasalatiy O, Koretsky AP, Griffiths GL, Tootell RB, and Ungerleider LG (2010). MRI visualization of anatomical connections *in vivo* using a gadolinium chelated neural tracer. *ISMRM* oral presentation, Stockholm, Sweden.
45. **Wu CWH**, Wu HT, Griffiths G, Koretsky AP, Tootell RBH, Ungerleider LG (2010). Visualizing anatomical connections *in vivo* using Gadolinium-a preclinical and translational study. *Human Brain Mapping*, Barcelona, Spain.
46. Vasalatiy O, Cheal S, **Wu CWH**, Ungerleider L, Tootell RB, Koretsky AP and Griffiths GL (2010). Production and preliminary testing of ultra-stable gadolinium-benzyl-DOTA-cholera toxin B conjugates as MRI brain circuitry tracking agents. *SNM-sponsored symposium on neuroscience* at Natcher at NIH, Bethesda, MD, USA.
47. **Wu CWH**, Vasalatiy O, Ungerleider L, Griffiths GL (2011). Study axonal transport rate and neuronal turnover rate of the olfactory system using novel MRI anatomical contrast agent GdDOTA-CTB. *ISMRM* oral presentation, Montreal, Canada.
48. **Wu CWH**, Goloshevsky A, Koretsky AP (2011). Detecting Acute Cortical Plasticity in Rats using High Field fMRI: Part 1- fMRI Maps and Cytoarchitectonic Boundaries. *ISMRM* E-poster presentation, Montreal, Canada.
49. **Wu CWH**, Goloshevsky A, Petiet A, Dodd SJ (2011). Detecting Acute Cortical Layer-Specific Plasticity in Rat Model using high field fMRI: Part 2- a non-thresholded, raw data analysis study. *ISMRM* E-poster presentation, Montreal, Canada.
50. **Wu CWH**, Goloshevsky A, Dodd SJ (2011). Detecting layer-specific acute cortical plasticity using MRI. *Society for Neuroscience Abstracts*. Washington, DC, USA.

Invited Colloquy, Lectures, and Seminars

February 1999 National Institute of Health, National Institute of Mental Health, Laboratory of System Neuroscience, Bethesda, MD, USA.

February 2004 Vanderbilt University, Department of Psychology, Nashville, TN, USA.

April 2006 Department of Psychology, National Taiwan University, Taipei, Taiwan.

October 2006 National Institute of Mental Health, Section on Functional Imaging Methods, NIH, Bethesda, MD, USA.

December 2006 West Virginia University, Center for Neuroscience, Morgantown, WV, USA.

January 2007 Shanghai Jiao-Tung University, Shanghai, China.

January 2007 Shanghai 2nd People's Hospital, Shanghai, China.

March 2007 Academia Sinica, Institute of Biomedical Science, Taipei, Taiwan.

March 2007 National Yang-Ming University, Institute of Neuroscience and Institute of Brain Science Taipei, Taiwan.

March 2007 Tzi-Chi University, Hualien, Taiwan.

April 2007 Brown University, Brain Science Program, Providence, RI, USA.

May 2007 University of Houston, Department of Neuroscience, Houston, TX, USA.

January 2008 NeuroSpin, Federative Institute of Research on Functional Neuroimaging, Commissariat l'Énergie Atomique (CEA), Saclay, France.

June 2008 Department of Brain and Cognitive Science, McGovern Institute, MIT, Cambridge, MA, USA.

November 2010 Graduate School of Immunology Frontier Research Center, Osaka University, Osaka, Japan.

August 2011 Department of Biological Engineering, MIT, Cambridge, MA, USA.