CURRICULUM VITAE
JULLIE W. PAN MD, PhD

DATE OF BIRTH: 22 September 1960

EDUCATION

6/1982	AB, Chemistry, Harvard-Radcliffe College, Cambridge, MA
9/1989	PhD, Yale University, Graduate School of Arts and Sciences, Dept. of Molecular Biophysics and Biochemistry
6/1990	MD, Yale University School of Medicine

RESEARCH AND PROFESSIONAL EXPERIENCE

7/1990–6/1991	Post-doctoral Fellow, University of Alabama at Birmingham, Center for Nuclear Imaging Research and Development
7/1991–6/1992	Internal Medicine Internship, University of Alabama at Birmingham
7/1992–2/1996	Neurology Residency, University of Alabama at Birmingham Hospital
3/1996–6/1997	Assistant Professor of Neurology and Medicine, University of Alabama at Birmingham
7/1997–5/1999	Assistant Scientist, Medical Department, Brookhaven National Laboratory
5/1999–5/2000	Associate Scientist, Medical Department, Brookhaven National Laboratory
6/2000–4/2006	Associate Professor, Departments of Neurology and Neuroscience
	Associate Director, Magnetic Resonance Research Center, Albert Einstein College of Medicine
	Core Lab Director, General Clinical Research Center, Albert Einstein College of Medicine
4/2006–3/2007	Epilepsy Fellowship, Yale New Haven Hospital, S Spencer MD Program Director
4/2006–	Associate Professor, Departments of Neurosurgery, Neurology and Biomedical Engineering, Yale University School of Medicine

BOARD CERTIFICATION
National Board of Medical Examiners diplomate, 1992

Board certification, American Board of Psychiatry and Neurology 1998

State Licensure:	NY	#213314 active
	CT	#044741 active
	AL	#16556-expired 12-99

HONORS

1996	Charles A. Dana Foundation Awardee, Clinical Hypotheses in Neuroscience
1996	Harry S. Weaver Award, National MS Society
1982	John and Fanny Hertz Foundation Fellowship in Applied Physics, Finalist
1981	Phi Beta Kappa, Member, Iota Chapter of Massachusetts
1978	Westinghouse Science Search Top 40 Finalist

GRANTS

Active
1R21AT002984-01 8/05 - 7/08
NIH NCCAM $400K TDC; $175K year 1 DC
Metabolic neuroprotection: creatine supplementation in human brain
Oral creatine is widely used by the athletic community and is being tested in a variety of neurological disorders. However relatively little is known about its effects in human brain, thus the major goals of this project are to evaluate the metabolic and physiological shifts that occur with oral creatine supplementation. As dysfunctional metabolism may be contributing to the pathophysiology of epilepsy, a clinical trial is performed in collaboration with RI Kuzniecky, MD at the NYU Comprehensive Epilepsy Center. We have obtained an investigator-sponsored IND for creatine in epilepsy (FDA approved August 2005 #72,714)
Role: PI

1RO1 EB000473 (Duncan, PI, Yale University) 4/02 – 3/11
NIH NIBIB $5M TDC, $1M year 5 DC
Bioimaging of Neocortical Epilepsy
The major goals of this project are to evaluate neocortical epilepsy using multi-modal imaging methods, combining conventional imaging, magnetic resonance spectroscopy, functional MRI and to develop methodologies for overlaying and synthesizing the images appropriate for neurosurgical approaches.
Role: Investigator

Pending
NIH NINDS R01-NS59627 $975K TDC, $225K year 1 DC 4/08 – 3/12
Initial priority score 213, resubmitted 7/07

Pathophysiologic correlates of spectroscopic imaging in human epilepsy
The goals of this project are to define the pathophysiologic correlates of abnormal spectroscopic imaging in human epilepsy. In vivo MR measures of NAA/Cr and GABA are acquired in epilepsy patients and related to clinical and microdialysis measures. This work is performed in collaboration with D Spencer MD and S Spencer MD, Yale University SOM.
Role: PI

Inactive
1RO1 NS40550 2/02 – 1/06
NIH NINDS $700K TDC; $225K annual DC
Human Brain Metabolism in Ketosis
The goals of this project are to physiologically define how the human brain accumulates and uses ketones in normal adults.
Role: PI

R21 DK064565 9/02-7/05
NIH NIDDK $300K TDC, $150K year 2 DC
Cerebral activation in hypoglycemia and hyperketonemia
The major goal of this work is to evaluate the response of brain physiology in hypoglycemia and effect of ketones.
Role: PI

5MO1RR1224 (Purpura, PI) 12/06 – 11/11
NIH NCRR- $12M TDC; $2.8M annual DC Albert Einstein GCRC
The Einstein GCRC has developed a new Core Laboratory, comprised of the human 4T MR facility within the Einstein Magnetic Resonance Research Center, and an Analytic Lab facility. The goals of the MR component of the Core Lab are to provide guidance and oversight to GCRC investigators in the utilization of the non-invasive measurements at the Einstein MRRC.
Role: Core Lab Director

5P01 AG003949 (Lipton PI) 7/04 – 6/09
NIH NIA Einstein Aging Study
The major goals of this program project are to study aging and dementia in the multiethnic community of the Bronx NY. Cross sectional studies of hippocampal spectroscopy and MR imaging will be performed in years 1-3 of this 5year grant. These studies will evaluate the predictive power of hippocampal spectroscopy for the prediction of dementia.
Role: Investigator

Shen J, Principle Investigator, NIH. Multiple quantum chemical shift imaging of GABA in the human brain, 12-98 through 11-03, $475K (total direct),

Pan JW, Principle Investigator. Charles A. Dana Foundation Neuroscience Fellowship, June 1996. Cerebral metabolism in ketosis and epilepsy: 31P and 1H spectroscopic studies at 4T. 1-97 through 12-2002, $100K , no salary requested.

Pan JW, Principle Investigator. Harry Weaver Junior Faculty Award, National Multiple Sclerosis Society. 1H spectroscopic imaging of multiple sclerosis: subtypes and effects of immunomodulatory therapy, 7-96 through 9-2001, $530K.

Shamoon H. Principle Investigator. NMR studies of liver glycogen metabolism in the counterregulation of hypoglycemia. Agency: NIH NIDDK DRTC feasibility grant 12/01 – 12/02, Role, Investigator. The major goals of this project are to apply non-invasive MR spectroscopic approaches to dynamic measurements of liver glycogen in humans.

Hetherington HP, Program Director. National Center for Research Resources. Clinical NMR studies at 4.1T- a research resource. NIH NCRR RR-11811. 2-97 through 2-2002 $633,952 (total, direct).

Pohost GM Program Director. National Center for Research Resources, Clinical NMR studies at 4.1T- a research resource. NIH NCRR P41-RR-7723. 4-92 through 2-97 $155,799 (‘96-‘97).

SELECTED ORAL/EDUCATIONAL PRESENTATIONS

Brain metabolism in neurological disease: MR spectroscopic approaches at high field. Invited speaker, Minnesota Workshops on High Field Magnetic Resonance Imaging and Spectroscopy. Minneapolis, Minnesota 15-16 October 1999.

Invited speaker, Neuroimaging and metabolism in Huntingtons' disease workshop. Hereditary Disease Foundation and the Terence Cardinal Cook Health Care Center 13 January 2000.

Ketogenic diet in epilepsy. Invited speaker, MR and epilepsy symposium. Birmingham, Alabama 20-21 October 2000.

Invited plenary speaker, Int’l Soc. Magn Res Med, Clinical and physiological studies with high field MR spectroscopy Honolulu Hawaii May 2002

Epilepsy and metabolic imaging. Thomas Jefferson University School of Medicine, Department of Neurology seminar. September 25 2002.

NIH NINDS/American Epilepsy Society/International League Against Epilepsy workshop. Imaging Markers of Epileptogenesis: New Research Directions. Marriott Wardman Park Hotel. Washington DC April 10–11 2003.

Metabolic limitations of human brain physiology by MR. Yale University School of Medicine. Bioimaging sciences series seminar. May 4 2004

NIH NINDS/American Headache Foundation workshop. Metabolic brain imaging for migraine. Advances in Prevention and Management of Migraine Headaches. Park Plaza Hotel, Boston MA October 13–14 2004.

Human brain ketone metabolism. University of Cincinnati College of Medicine. Department of Neurology seminar. January 12 2005

Invited speaker, “Magnetic resonance spectroscopy of human epilepsy”, at 2005 ISMRM Workshop on Psychiatric Diseases and Magnetic Resonance, Banff, Alberta Canada October 2005.

“Magnetic resonance spectroscopy studies for translational research”, Department of Medicine and GCRC seminar, University of Illinois Chicago October 10 2005.

“Cerebral metabolic dysfunction in human epilepsy”, Emory University School of Medicine Department of Neurology Grand Rounds. October 21 2005.

PROFESSIONAL SERVICE

Study sections:	NIH NCRR Standing GCRC Parent Committee 2002-2006 NIH CSR ad hoc Biomedical Imaging Technology Committee 2005 NIH NCRR ad hoc for SIG, Diagnostic imaging NIH/NINDS: ad hoc member BDCN-2 NIH CND 2007
Advisory Group:	Metabolism in Huntington's Disease, Hereditary Disease Foundation 2000
Conference review:	International Society for Magnetic Resonance in Medicine 2004 International Society for Cerebral Blood Flow and Metabolism 2004
Editorial Board:	Magnetic Resonance in Medicine 1/05–

PUBLICATIONS (Peer reviewed)

1. **Pan JW**, Hamm JR, Rothman DL, Shulman RG. Intracellular pH in human muscle by 1H NMR. Proc Natl Acad Sci USA 1988 85:7836.

2. **Pan JW**, Hetherington HP, Hamm JR, Rothman DL, Shulman RG. Volume localized spectroscopy using a single surface coil. J Mag Res 1989 81: 608.

3. Hetherington HP, Hamm JR, **Pan JW**, Rothman DL, Shulman RG. A fully localized 1H NMR observation of lactate production in human muscle after aerobic exercise. J Magn Res 1989 82:86.

4. **Pan JW**, Macnab RM. Steady state measurements of E. coli sodium and proton potentials at alkaline pH support the hypothesis of electrogenic antiport. J Biol Chem 1990 265(16):9247.

5. **Pan JW**, Hetherington HP, Hamm JR, Shulman RG. Quantitation of metabolites by 1H NMR. Mag Res Med 1991 20:48-53.

6. **Pan JW**, Hamm JR, Hetherington HP, Rothman DL, Shulman RG. Correlation of lactate and pH in human skeletal muscle after exercise by 1H NMR. Magn Res Med 1991 20:57.

7. Vaughan JT, Hetherington HP, Harrison JG, Otu JO, **Pan JW**, Noa PJ, den Hollander JA, Pohost GM. High frequency coils for clinical NMR imaging and spectroscopy. Physica Medica 1993 9(2-3):147-153.

8. Hetherington HP, Mason GF, **Pan JW**, Ponder SL, Vaughan JT, Twieg DB, Pohost GM. Evaluation of cerebral gray and white matter metabolite differences by spectroscopic Imaging at 4.1T. Magn Res Med 1994 32:565-571.

9. Vaughan JT, Hetherington HP, Otu JO, **Pan JW**, Noa PJ, Pohost GM. High frequency volume coils for clinical NMR imaging and spectroscopy. Magn Res Med 1994 32:206-218.

10. Hetherington HP, **Pan JW**, Mason GF, Ponder SL, Twieg, DB, Deutsch G, Mountz J, Pohost GM. 2D spectroscopic imaging of the human brain at 4.1T without field of view restriction. Magn Res Med 1994 32:530-534.

11. Mason GF, **Pan JW**, Ponder SL, Twieg DB, Pohost GM, Hetherington HP. Detection of brain glutamate and glutamine in spectroscopic images at 4.1T. Magn Res Med 1994 32:142-145.

12. **Pan JW**, Vaughan JT, Kuzniecky R, Pohost GM, Hetherington HP. High resolution neuroimaging at 4.1. Magn Res Imag 1995 13(7):915-921.

13. Hetherington HP, Luney DJE, Vaughan JT, **Pan JW**, Ponder SL, Tschendel O, Twieg DB, Pohost GM. 3D 31P spectroscopic imaging of the human heart at 4.1T. Magn Res Med 1995 33:427-431.

14. Hetherington HP, Kuzniecky R, **Pan JW**, Mason G, Morawetz R, Harris C, Faught E, Vaughan JT, Pohost GM, ^{1}H NMR spectroscopic imaging of human temporal lobe epilepsy at 4.1 Tesla. Ann Neurol 1995 38:396-404.

15. Hetherington HP, Kuzniecky R, **Pan JW**, Vaughn MJ, Twieg DB, Pohost GM. Application of high field spectroscopic imaging in the evaluation of temporal lobe epilepsy. Magn Res Imag 1995 13(8):1175-1180.

16. **Pan JW**, Mason GF, Pohost GM, Hetherington HP. Observation of human brain glutamate by J-refocused spectroscopic imaging at 4.1T. Magn Res Med 1996 36:7-12.

17. **Pan JW**, Hetherington HP, Vaughan JT, Mitchell G, Pohost GM, Whitaker JN. Evaluation of multiple sclerosis by ^{1}H spectroscopic imaging at 4.1T. Magn Res Med 1996, 36:72-77.

18. Hetherington HP, **Pan JW**, Mason GF, Adams D, Vaughn MJ, Twieg DB, Pohost GM. Quantitative ^{1}H spectroscopic imaging of human brain at 4.1T using image segmentation. Magn Res Med 1996, 36:21-29.

19. **Pan JW**, Mason GF, Chu WJ, Zhang Y, Pohost GM, Hetherington HP. ^{13}C edited J refocused spectroscopy to observe glutamate turnover at 4.1T. Magn Reson Med 1997, 37:355-358.

20. Kuzniecky RI, Hetherington HP, **Pan JW**, Hugg J, Palmer C, Gilliam F, Faught E and Morawetz R. 1H spectroscopic imaging at 4.1T in patients with malformations of cortical development and epilepsy. Neurol 1997 48:1018-1024.

21. Chatterjee A, Yapundich R, Mennemaier M, Mountz JM, Inampudi C, **Pan JW**, Pohost GM. Thalamic thought disorder: on being "a bit addled". Cognition 1997, 33(3):415-40.

22. Hetherington HP, **Pan JW**, Chu WJ, Mason GF, Newcomer BR, Biological and clinical MRS at ultra High Field, NMR in Biomedicine 1997, 10(8):360-71.

23. **Pan JW**, Twieg DB, Hetherington HP. Quantitative ^{1}H spectroscopic imaging at 4.1T using B1 mapping and CSF referencing. Magn Res Med 1998 40(3):254-258.

24. Kuzniecky R, Hetherington H, Ho S, **Pan JW**, Martin R, Gilliam F, Hugg J, Faught E Topiramate increases cerebral GABA in healthy humans. Neurology 1998 51(2):627-629.

25. Hetherington HP, Newcomer BR, **Pan JW**, Measurements of human cerebral GABA at 4.1T using numerically optimized pulses, Magn Reson Med 1998 39(1):6-10.

26. Martin R, Kuzniecky R, Ho S, Hetherington HP, **Pan JW**, Sinclair K, Gilliam F, Faught E. Comparative cognitive effects of topiramate, gabapentin and lamotrigine: an acute and steady state dosing study in healthy young adults. Neurology 1999 52(2):321-326.

27. Mason GF, **Pan JW**, Chu WJ, Newcomer BR, Zhang Y, Orr R, Hetherington HP. Measurement of the tricarboxylic acid cycle rate in human gray and white matter in vivo by ^{1}H-^{13}C magnetic resonance spectroscopy at 4.1T. J Cereb Blood Flow Metab 1999 19(11):1179-88.

28. Hetherington HP, Telang FW, **Pan JW**, Sammi M, Schuhlein D, Molina P, Volkow ND,. Uptake kinetics and visibility of ethanol in human brain by spectroscopic imaging at 4T. Magn Res Med 1999 42(6): 1019-26.

29. **Pan JW**, Lane JB, Hetherington HP, Percy AK. ^{1}H spectroscopic imaging of Rett syndrome at 4.1T. J Child Neurol 1999 14(8):524-8.

30. Shen J, Rothman DL, Hetherington HP, **Pan JW**. Fast, automatic slice shimming optimizing all first-order shims, all in-slice second- and third-order shims. Mag Res Med 1999 42(6):1082-1088.

31. **Pan JW**, Bebin EM, Chu WJ, Hetherington HP. Ketosis and epilepsy: ^{31}P spectroscopic imaging at 4.1T. Epilepsia 1999 40(6):703-7.

32. Sammi MK, **Pan JW**, Telang FW, Schuhlein D, Molina PE, Volkow ND, Springer CS, Hetherington HP, Measurements of Human Brain Ethanol T2 by Spectroscopic Imaging at 4 T. Magn. Reson. Med. 2000 44 35-40.

33. **Pan JW**, Rothman DL, Behar KL, Stein DT, Hetherington HP, Human brain b-hydroxybutyrate and lactate increase in fasting induced ketosis. J. Cereb Blood Flow Metab 2000 20:1502-1507.

34. Volkow ND, Wang GJ, Fowler JS, Rooney WD, Felder CA, Lee JH, Franceschi D, Maynard L, Schlyer DJ, **Pan JW**, Gatley SJ, Springer Jr CS Resting brain metabolic activity in a 4 tesla magnetic field. Magn Reson Med. 2000 44:701-705.

35. **Pan JW**, Mason GF, Telang FW, Lee JH, Brown P, Shen J, Shulman GI, Rothman DL, Hetherington HP. Spectroscopic imaging of ^{13}C-4-glutamate turnover in human brain. Magn Reson Med 2000 44:673-679.

36. Hetherington HP, Spencer DD, Vaughan JT, and **Pan JW**, Quantitative ^{31}P Spectroscopic Imaging of Human Brain at 4T: Assessment of Gray and White Matter Differences of Phosphocreatine and ATP. Magn Reson Med 2001 45: 46-52.

37. Hwang JH, **Pan JW**, Hetherington HP, Heydari S, Stein DT, Regional differences in intramyocellular lipids in humans observed by in vivo ^{1}H spectroscopic MR imaging. J Appl Physiology 2001 90(4): 1267-74.

38. **Pan JW**, Krupp LB, Elkins L, Coyle PK. Cognitive dysfunction lateralizes with N-acetyl aspartate in multiple sclerosis. Appl Neuropsychol 2001 8(3):155-160.

39. DeGraaf RA, **Pan JW**, Telang F, Lee JH, Brown P, Novotny EJ, Hetherington HP, Rothman DL. Differentiation of glucose transport in human brain gray and white matter, J. Cereb. Blood. Flow Metab. 2001 21:483-492.

40. **Pan JW**, Coyle PK, Bashir K, Whitaker JN, Krupp LB, Hetherington HP. Metabolic differences between the disease subtypes of multiple sclerosis measured by quantitative MR spectroscopy. Multiple Sclerosis 2002 8(3):200-6.

41. **Pan JW**, Telang FW, Lee JH, DeGraaf RA, Rothman DL and Hetherington HP. Acute hyperketonemia raises brain β-hydroxybutyrate. J Neurochem 2001 79(3):539-44.

42. **Pan JW**, de Graaf RA, Petersen KF, Shulman GI, Hetherington HP, Rothman DL. [2,4-$^{13}C_2$]-β-hydroxybutyrate metabolism in human brain. J Cereb Blood Flow Metab 2002 22(7):890-8.

43. Chu WJ, Mason GF, **Pan JW**, Hetherington HP, Liu HG, San Pedro EC, Mountz JM. Regional cerebral blood flow and magnetic resonance spectroscopic imaging findings in diaschisis from stroke. Stroke 2002 33(5):1243-8.

44. Hetherington HP, Kim JH, **Pan JW**, Spencer DD.1H and 31P spectroscopic imaging of epilepsy: spectroscopic and histologic correlations. Epilepsia 2004;45 Suppl 4:17-23 2004

45. CohenGadol A, **Pan JW**, Kim JH, Spencer DD, Hetherington HP. Medial Temporal Lobe Epilepsy: A 1H MR Spectroscopic and Histopathologic Analysis. J Neurosurgery 2004 101(4):613-20.

46. Lipton RB and **Pan JW**. Is migraine a progressive disorder? JAMA 2004 291(4):493-494.

47. Williamson A, Patrylo P, **Pan JW**, Spencer DD, Hetherington HP. Correlations between granule cell physiology and bioenergetics in human temporal lobe epilepsy. Brain 2005 128(5):1199-208.

48. Kennan RP, Takahashi K, Pan C, Shamoon H and **Pan JW**. Human cerebral blood flow and metabolism in acute insulin induced hypoglycemia. J Cereb Blood Flow Metab 2005 25(4):527-34.

49. **Pan JW,** Kim JH, Cohen-Gadol A, Pan C, Spencer DD, Hetherington HP, Regional energetic dysfunction in hippocampal epilepsy. Acta Neurol Scand. 2005 111(4): 218-214.

50. **Pan JW**, Takahashi K. Inter-dependence of NAA and high energy phosphates in human brain. Ann Neurol. 2005 57(1):92-97.

51. **Pan JW**, Venkatraman T, Vives K, Spencer DD. Quantitative glutamate spectroscopic imaging of the human hippocampus. NMR in Biomedicine 2006 19(2):209-216

52. Hetherington HP, Kuzniecky RI, Vives K, Devinsky O, Pacia S, Luciano D, Vasquez B, Haut S, Spencer DD and **Pan JW.** A subcortical network of dysfunction in TLE measured by MR spectroscopy. In press, Neurology 2007

53. Cavus I, **Pan JW**, Hetherington HP, Abi-Saab W, Zaveri HP, Vives K, Krystal J, Spencer S, Spencer DD. Decreased Hippocampal volume on MRI is related to increased extracellular glutamate in MTLE patients. In press, Epilepsia 2007

54. Zimmerman ME, **Pan JW**, Hetherington HP, Katz MJ, Verghese J, Buschke H, Derby CA, and Lipton RB. Hippocampal neurochemistry, neuromorphometry, and verbal memory in nondemented older adults. In press, Neurology 2007

Book chapters and reviews

Hetherington HP, **Pan JW**, Chu WJ, Mason GF, Newcomer BR, Biological and clinical MRS at ultra High Field, NMR in Biomedicine 10:360-371 1997.

Petroff OAC, **Pan JW**, Rothman DL. Magnetic resonance spectroscopy: Neurotransmitters and Energy Metabolism. Epilepsia 43(Suppl 1):40-50, 2002

Pan JW. Insights from neuroimaging studies into ketosis and the ketogenic diet. In, The ketogenic diet, Humana Press, Eds CE Stafstrom and J Rho Sept 2004

Hetherington HP, **Pan JW** and Spencer DD. NMR studies of bioenergetic impairment in human epilepsy. In, Brain energetics and neuronal activity, J Wiley & Sons Eds R Shulman and D Rothman 2004.

Pan JW, Williamson A, Cavus I, Hetherington HP, Petroff OAC and Spencer DD. Neurometabolism in human epilepsy. Epilepsia Supplement 2007

SELECTED BIBLIOGRAPHY

1. **Pan JW**, Mason GF, Pohost GM, Hetherington HP. Observation of human brain glutamate by J-refocused spectroscopic imaging at 4.1T. *Magn Res Med* 1996 36:7-12. This paper describes the theory and development of a method to accurately detect human brain glutamate in vivo.

2. Mason GF, **Pan JW**, Chu WJ, Newcomer BR, Zhang Y, Orr R, Hetherington HP. Measurement of the tricarboxylic acid cycle rate in human gray and white matter in vivo by ^{1}H-^{13}C magnetic resonance spectroscopy at 4.1T. J Cereb Blood Flow Metab 1999 19(11):1179-88. Modification and implementation of the above methodology was used to establish the gray and white matter TCA cycle rates in the centrum semi-ovale and cingulate gray matter.

3. ***Pan JW**, Bebin EM, Chu WJ, Hetherington HP. Ketosis and epilepsy: ^{31}P spectroscopic imaging at 4.1T. *Epilepsia* 1999 40(6):703-7. This paper was the first to examine the ketogegnic diet in patients with epilepsy, finding changes in cerebral energetics with 4 week use of the diet. This study raised questions to us as to how alternate fuels are used in comparison to glucose, and how they might influence hyperexcitability.

4. ***Pan JW**, Mason GF, Telang FW, Lee JH, Brown P, Shen J, Shulman GI, Rothman DL, Hetherington HP. Spectroscopic imaging of ^{13}C-4-glutamate turnover in human brain. Magn Reson Med 2000 44:673-679. This was the first paper to measure and model oxidative flux in human brain using 13C inverse detection spectroscopic imaging. With the smaller voxels achieved, separate values for gray and white matter rates were obtained, demonstrating a greater than 3 fold difference.

5. **Pan JW**, Krupp LB, Elkins L, Coyle PK. Cognitive dysfunction lateralizes with N-acetyl aspartate in multiple sclerosis. Appl Neuropsychol 2001 8(3):155-160. This paper was the first to demonstrate lateralization of MR spectroscopic abnormalities with neuropsychological performance in multiple sclerosis, a neurological disease whose lesions are known to vary in both space and time.

6. ***Pan JW**, de Graaf RA, Petersen KF, Shulman GI, Hetherington HP, Rothman DL. [2,4-$^{13}C_2$]-β-hydroxybutyrate metabolism in human brain. *J Cereb Blood Flow Metab* 2002 22(7):890-8. In this paper we evaluated the metabolic fate of intravenously infused ketone bodies (β-hydroxybutyrate) in healthy controls, finding that ketone bodies appear to be preferentially used by neurons over glia. This opened the possibility that circumventing glial influence may be a contributing factor in the ketogenic diet's therapeutic effect on seizure control.

7. *Kennan RP, Takahashi K, Pan C, Shamoon H and **Pan JW**. Human cerebral blood flow and metabolism in acute insulin induced hypoglycemia. *J Cereb Blood Flow Metab* 2005 25(4):527-34. In this paper our group collaborated with diabetologists to examine how acute mildly decreased plasma glucose concentrations (60mg/dl, provoked by insulin) would affect cerebral perfusion and reactivity as measured by BOLD fMRI. We found increased basal blood flow, decreased BOLD reactivity (provoked by finger tapping), arguing that in mild hypoglycemia, perfusion and oxygen consumption remain coupled, although in response to elementary task activation these processes are decreased overall.

8. **Pan JW**. Insights from neuroimaging studies into ketosis and the ketogenic diet. In, The ketogenic diet, Humana Press, Eds CE Stafstrom and J Rho Sept 2004. This review article summarizes the state of the art in understanding how the ketogenic diet and metabolic perturbations have been studied with in vivo human imaging, and how such a physiological state may influence hyperexcitability in epilepsy.

9. Williamson A, Patrylo P, **Pan JW**, Spencer DD, Hetherington HP. Correlations between granule cell physiology and bioenergetics in human temporal lobe epilepsy. *Brain* 2005 128(5):1199-208. This paper was the first to directly correlate pre-operative MR spectroscopic imaging measures with post-operative electrophysiology in patients undergoing TLE surgery. This work found significant correlations with abnormal responses in membrane repolarization and inhibitory function with tissue energetics.

10. ***Pan JW**, Kim JH, Cohen-Gadol A, Pan C, Spencer DD, Hetherington HP, Regional energetic dysfunction in hippocampal epilepsy. *Acta Neurol Scand*. 2005 111(4): 218-214. This paper demonstrated that in hippocampal epilepsy, direct energetic dysfunction occurs in a network fashion that correlates with hippocampal neuropathology.

11. ***Pan JW**, Takahashi K. Inter-dependence of NAA and high energy phosphates in human brain. *Ann Neurol*. 2005 57(1):92-97.In this paper we observed that in human brain N-acetyl aspartate, a well established measure of neuronal mitochondrial function correlated positively with concentrations of ADP. While the existence of a relationship was not surprising, this positive correlation implied that NAA may be regulated depending upon energetic state, rather than energetic state resulting from mitochondrial function. The implications are that mitochondria are responding to demand (as integrated through ADP) rather than controlling energetic output.

12. ***Pan JW**, Venkatraman T, Vives K, Spencer D. Quantitative glutamate spectroscopic imaging of the human hippocampus. *NMR Biomedicine* 2006 19(2):209-216. In this paper we demonstrate with simulation and experiment that an adiabatic moderate spin echo provides suppression of J-modulation to provide excellent retention of coupled spin systems. As applied to a small group of epilepsy patients and controls, quantified spectra from the hippocampus show that glutamate concentrations are lower than control.

***indicates included in packet