BIOGRAPHICAL SKETCH

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NAME: **Peterson, Daniel A.**

eRA COMMONS USER NAME (credential, e.g., agency login): petersondan

POSITION TITLE: Professor and Vice-Chairman, Department of Neuroscience;
Director, Center for Stem Cell and Regenerative Medicine

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
University of Southern California, Los Angeles	B.S.	05/1984	Psychobiology
University of Otago, Dunedin, New Zealand	Ph.D.	01/1991	Anatomy
University of California at San Diego, San Diego	Post-Doc	05/1994	Neuroscience (Mentor- Rusty Gage)

A. Personal Statement

My lab is interested in understanding the regulation of endogenous stem and progenitor cell activity within tissue with the goal of obtaining sufficient knowledge to develop therapeutic approaches to activate endogenous tissue stem cells, and direct their lineage commitment to contribute to tissue repair. We are particularly interested in understanding the effects of aging and disease on the biology of stem cells and on the activity of their supporting environmental niche. This knowledge is necessary to understand how age-related organ dysfunction may arise and how aging tissue stem cells can be manipulated to contribute to repair. We have primarily focused on neural stem cells, but also in the last few years expanded to address peripheral wound healing with projects examining the biology of skin and bone marrow-derived stem cells, including models of Type 2 diabetes.

Repair of the nervous system has been the focus of my interest since my postdoctoral training with Rusty Gage. I was fortunate to contribute to the initial studies on hippocampal neurogenesis, including the landmark study that the adult human hippocampus supports neurogenesis (*Nature Medicine* 4:1313 1998). The foundation in gene therapy, intracerebral cell transplantation, and quantitative confocal microscopy studies from that period continues to guide my research approaches. We have long advocated the recruitment of endogenous stem and progenitor cells as an optimal approach for tissue repair (*J Clin Invest* 112:1128 2003). With recent advances in lineage reprogramming, the tools are now available to explore the biological ramifications of in vivo reprogramming and assess its suitability as a therapeutic approach (see our review *J Comp Neurol* 522:2857 2014). Together with my co-Investigator Bob Marr, an expert in gene therapy, we now show successful cortical reprogramming of non-reactive NG2 glia in the cortex (Bazarek et al., under review).

Animal studies are not always predictive of success with human tissue as shown by many failed clinical trials. To better understand the potential for reprogramming human glial progenitors, I used a Fulbright Senior Scholar Award to support a sabbatical visit to the laboratory of Oliver Brüstle (Bonn, Germany), one of the leading researchers using human ESCs and IPSCs. This sabbatical visit was intellectually enriching and allowed me to practically contribute to fate regulation of human iPSC-derived neural progenitor cells (*Glia* 63:2152 2015). Oliver and I conceived that, by grafting lineage selected human glial progenitor cells in to the rat cortex, we could model the human cortex and perform experimental studies that cannot be done with

patients to understand the fundamental properties of fate respecification in human cells. Continuation of this collaboration will be supported by our pending multi-PI R01 award.

We employ rigorous quantitative analyses for both histological and gene expression studies. We are particularly strong in design-based stereological approaches and have helped advance the development of high-throughput, high-content quantitative microscopy. I have taught extensively on this subject and have trained over 500 scientists from 24 countries in the international workshops on confocal microscopy and design-based stereology that I conduct. The sabbatical leave in Germany also allowed me to interact with Martin Schwarz, an outstanding neuroscientist and one of the developers of transsynaptic labeling methods, brain clearing technology, and light sheet fluorescence microscopy. I was excited to be able to contribute quantitative stereological approaches to the analysis of these three-dimensional data sets (*Nature Communications* 8:14162 2017 DOI: 10.1038/ncomms14162). The continuing collaboration with Martin will also be supported by the pending R01 application, which will enable the connectivity of newly engineered neurons to be studied with unprecedented three-dimensional resolution.

B. Positions and Honors

Positions and Employment

6/94-5/95	Research Assistant Professor, Neuroscience	Univ. of California, San Diego
6/95-10/98	Staff Scientist, Laboratory for Genetics	The Salk Institute, La Jolla, CA
11/98-6/02	Assistant Professor, Neuroscience	The Chicago Medical School
7/02-7/12	Associate Professor, Neuroscience	The Chicago Medical School
5/07-present	Director, Center for Stem Cell and Regenerative Medicine	Rosalind Franklin University of Medicine and Science
7/11-present	Vice-Chairman, Dept. of Neuroscience	The Chicago Medical School
7/12-present	Professor of Neuroscience	The Chicago Medical School

Other Experience and Professional Memberships

Professional Societies

Society for Neuroscience, AAAS, American Society of Gene and Cell Therapy, American Society for Neural Therapy and Repair, International Society for Stem Cell Research (Charter Member)

Editorial/Advisory Boards/Federal, non-Federal, and International Review Panels

2003 – present	Editorial Board Member- *Neurobiology of Aging*
2007 – present	Editorial Board Member- *Stem Cells and Development*
2008 – present	Editorial Board Member- *Frontiers of Neuroscience-Neuroanatomy*
2009 – present	Editorial Board Member- *Frontiers of Neuroscience-Neurogenesis*
2010 – present	Editorial Board Member- *Aging and Disease*
2010 – present	Editorial Board Member- *Recent Patents on Regenerative Medicine*
2011 – present	Editorial Board Member- *ISRN Stem Cells*
2002 – 2006	American Federation for Aging Research National Scientific Advisory Committee
2002 – 2003	Ad-hoc Reviewer, NIH-CSR, MCDN-6 Study Section
2003 – 2007	Regular Member, NIH-CSR, NCF (*Neurogenesis and Cell Fate*) Study Section
2007 – 2008	Chairman, NIH-CSR, NCF (*Neurogenesis and Cell Fate*) Study Section
2008 – present	Chairman, State of New York *NYSTEM* Review Panel
2011 – present	Member, American Federation for Aging Research Scientific Advisory Committee
2013 – 2015	Commissioner, Abilitazione Scientifica Nazionale Italia, Concorsuale 06/D6-Neurologia
2013 – 2015	Chairman, NIH-CSR, JPF (*Juvenile Protective Factors*) Study Section
2013 – present	Member, Brain Research Foundation Scientific Review Committee
2016 – present	Member and Co-Chair, NIH-CSR, SRB-A (*Zika Virus Complications*) Study Section

Honors

1987 to 1990	W & B Miller Post Graduate Fellowship from the New Zealand Neurological Foundation
1991 to 1994	Individual National Research Service Award, National Institute on Aging
1998 to 2000	Temple Foundation/Alzheimer's Association Award
1998 to 1999	American Federation for Aging Research Award
2000 to 2003	Schweppe Foundation Career Development Award

2000	Board of Trustees Research Achievement Award, The Chicago Medical School
2003	Nair Research Fellowship Award
2005 to 2006	President, Chicago Chapter of the Society for Neuroscience
2006	Morris L. Parker Senior Investigator Award, The Chicago Medical School
2010-11	President, American Society for Neural Therapy and Repair
2011	Congress President, 11th International Neural Transplantation and Repair Meeting
2013-	Scientific Review Committee Member, The Brain Research Foundation
2013-15	Abilitazione Scientifica Nazionale Italia, Concorsuale 06/D6-Neurologia, Commissario OCSE (Italian National Scientific Review Panel for Tenure and Promotion, Neurology Division, External Commissioner)
2014-15	Fulbright Senior Scholar Award, US Dept. of State/German-American Fulbright Commission
2016	Elected Fellow, The American Society for Neural Therapy and Repair

C. Contribution to Science

Current h-index: 40 *Current citation count: 14375* *Current i10-index: 56*
https://scholar.google.com/citations?user=-Uj6td8AAAAJ&hl=en&oi=ao

Adult Neurogenesis
While most tissues in the body continue to generate replacement cells throughout life, all neurons in the brain are generated before birth. This was the dogma prior to our pioneering work in the early 1990's that established that adult neurogenesis occurs in two small regions of the mammalian brain. In a landmark study, we demonstrated that neurogenesis persists in one of those regions (the dentate gyrus) in adult humans and neurogenesis extends into old age. Understanding the regulation of adult neurogenesis is an important continuing focus of the lab.

a. Ray, J., Peterson, D.A., Schinstine, M., and Gage, F.H. (1993) Proliferation, differentiation and long-term culture of primary hippocampal neurons. *Proc. Natl. Acad. Sci., USA* 90:3602-3606. PMCID: PMC46349
b. Eriksson, P.S., Perfilieva, E., Björk-Eriksson, T., Alborn, A-M., Nordborg, C., Peterson, D.A., and Gage, F.H. (1998) Neurogenesis in the adult human hippocampus. *Nature Medicine* 4(11):1313-1317.
c. Vega, C.J. and Peterson, D.A. (2005) Stem cell proliferative history in tissue revealed by temporal halogenated thymidine analog discrimination. *Nature Methods* 2:167-169.
d. Encinas, J.M., Michurina, T., Tordo, J., Peterson, D.A., Fishell, G., Koulakov, A., and Enikolopov, G. (2011) Division-coupled astrocytic differentiation of neural stem cells drives age-related decline in neurogenesis. *Cell Stem Cell* 8:566-579. PMCID: PMC3286186

Gene Therapy and Stem Cells for Brain Repair
Brain circuitry consists of long-lived neurons that are not replaced following injury or disease. Loss of these cells produces profound and irreversible neurological deficits. To protect vulnerable neurons, we have conducted gene therapy studies aimed at delivering neuroprotective factors or correcting gene mutations. The studies on Batten's disease have now moved into clinical trials. Recent work describes our new direction using direct in vivo conversion of non-neuronal cells into neurons with authentic cytoarchitectural integration.

a. Suhonen, J.O., Peterson, D.A., Ray, J. and Gage, F.H. (1996) Differentiation of adult-derived hippocampal progenitor cells into olfactory bulb neurons. *Nature* 383:624-627.
b. Kaspar, B., Schaeffer, D.S., Erickson, D.A., Hinh, L., Gage, F.H., and Peterson, D.A. (2002) Targeted retrograde gene delivery for neuronal protection. *Molecular Therapy* 5:50-56.
c. Hallbergson, A.F., Gnatenco, C. and Peterson D.A. (2003) Neurogenesis following brain injury: Managing a renewable resource for repair. *Journal of Clinical Investigation* 112:1128-1133. PMCID: PMC213498
d. Bazarek, S. and Peterson, D.A. (2014) Prospects for engineering neurons from local neocortical cell populations as cell-mediated therapy for neurological disorders. *J Comp Neurology* 522:2857-2876. PMCID: PMC4729289

Stem Cell Activity under Diabetic Conditions
One prominent complication of diabetes is impaired wound healing. Many strategies have been used to promote wound healing in diabetic patients with less than complete success. Under normal conditions, stem cell activation fuels the normal repair to combat wear and tear of tissue. We have found that bone marrow-derived mesenchymal stem cells (MSCs) are impaired in type 2 diabetes and are less efficient in promoting wound healing than MSCs from healthy subjects. These results have led us toward our current hypothesis that

stem cells throughout the body are impaired by diabetic conditions contributing to the rise of complications seen clinically in diabetic patients. Current work in the lab is focusing on the activation of skin and muscle stem cells following wounding in diabetic subjects.

a. Shin, L. and Peterson, D.A. (2012) Impaired therapeutic capacity of autologous stem cells in a model of type 2 diabetes. *Stem Cells Translational Medicine*, 1:125-135. PMCID: PMC3659680
b. Shin, L. and Peterson, D.A. (2013) Human mesenchymal stem cell grafts enhance normal and impaired wound healing by recruiting existing endogenous tissue stem/progenitor cells. *Stem Cells Translational Medicine* 2:33-42. PMCID: PMC3659748

Automated Quantitative Stereology

Estimation of cell populations in tissue is complicated by the artifacts generated in producing sections for histological analysis. The principles of stereology guide the statistically unbiased sampling of tissue to produce artifact-free estimates. This is particularly useful for assessing changes in cell populations due to disease or injury or in assessing the proliferation and lineage specification of stem cell populations. I have become a leading authority in the implementation of stereological sampling in confocal microscopy and am committed to the development of automated, computer-controlled microscopy to improve data throughput for quantitative histology.

a. Peterson, D.A., Leppert, J.T., Lee, K-F., and Gage, F.H. (1997) Basal forebrain neuronal loss in mice lacking neurotrophin receptor p75. *Science* 277(5327):837-838.
b. Peterson, D.A. (1999) Quantitative histology using confocal microscopy: Implementation of unbiased stereology procedures. *Methods: A Companion to Methods in Enzymology* 18:493-507.
c. Peterson, D.A. (2014) High-resolution quantitative histology by confocal stereology., In: Conn, M. and Cornea, A. (eds.) *Fluorescence Microscopy: Super-Resolution and Other Novel Techniques*, Academic Press (Oxford), pp. 171-184.
d. Schmitz, C., Eastwood, B.S. Tappan, S.J., Glaser, J.R., Peterson, D.A., and Hof, P.R. (2014) Current automated 3D cell detection methods are not a suitable replacement for manual stereologic cell counting. *Frontiers in Neuroanatomy* 8: Article 27. PMCID: PMC4019880

D. Research Support

Ongoing Research Support

Type: Collaborative Intramural Research Pilot Grant — Duration: 10/1/13-6/30/19
Agency: DePaul Univ. & Rosalind Franklin Univ. Med. Sci.
Chronic effects of repeat concussive impacts on brain injury and recovery
Project Director/Principle Investigator: Daniel A. Peterson, Ph.D.

Pending

Type: R01 NS100514-01A1 *(received a 4th percentile, awaiting Council)* — Duration: 08/01/17–7/31/22
Agency: National Institute on Neurological Disorders and Stroke — TDC $2,499,000
Reprogramming Cell Fate for Repair
PI/PD: Daniel A. Peterson, Ph.D. Co-PIs: Oliver Brüstle, Robert Marr, Martin Schwarz
Collaborator: Grace E. Stutzmann

Completed (within last three years)

Type: NIDDK-DRTC Feasibility Award — Duration: 02/01/14–12/31/15
Agency: University of Chicago Diabetes Research and Training Center
Defining Stem Cell Populations in Diabetic Skin
Principal Investigator: Daniel A. Peterson, Ph.D.

Type: Fulbright Senior Scholar Award — Duration: 10/01/14–4/30/15
Agency: US Department of State/ The German-American Fulbright Commission
Directing the Fate of Human Stem Cells
Personal Award to Daniel A. Peterson, Ph.D. to support research during sabbatical leave in Bonn, Germany

Type: R01 AG020047-08 — Duration: 04/01/10–6/30/14
Agency: National Institute on Aging
Stem Cells for Brain Repair
Principal Investigator: Daniel A. Peterson, Ph.D.