BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors in the order listed on Form Page 2.
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NAME	POSITION TITLE
Sean Mackey, MD, PhD	Chief, Division of Pain Management Associate Professor of Anesthesia & Pain Management, Neurosciences & Neurology
eRA COMMONS USER NAME (credential, e.g., agency login) MACKEY.SEAN	

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

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	MM/YY	FIELD OF STUDY
University of Pennsylvania	BSE	1986	Bioengineering
University of Pennsylvania	MS	1986	Bioengineering
University of Arizona	PhD	1994	Electrical Engineering
University of Arizona	MD	1994	Medicine

A. Personal Statement

ADD

B. Positions and Honors.

Professional Experience:

1985 Research Engineer, La Jolla Technology, La Jolla, CA
1985-1986 Research Assoc./Biomedical Engineer, Dep. of Pulmonary Medicine VA Hosp., Philadelphia, PA
1995-1996 Intern, Transitional, Tucson Medical Center, Tucson, AZ
1996-1998 Resident, Anesthesia, Stanford University Medical Center, Stanford, CA
1997-1998 Chief Resident, Anesthesia, Stanford University Medical Center, Stanford, CA
1998-1999 Fellow, Pain Management, Stanford University Medical Center, Stanford, CA
1999-2000 Acting Assist. Professor of Anesthesiology, Stanford University Medical Center, Stanford, CA
2000-2007 Asst. Prof. Anesthesia & Pain Management, Stanford University Medical Center, Stanford, CA
2000-Present Director - Regional Anesthesia Services, Stanford University Dep. of Anesthesia, Stanford, CA
2004-2007 Associate Director – Pain Management Division, Stanford University Dep. Anesth., Stanford, CA
2004-Present Co-Director – Pain Working Group – Stanford University Neuroscience Institute
2005-Present American Society of Anesthesiology Anesthesiology Continuing Education (ACE) Board
2007-Present NHLBI Workshop on Sickle Cell Disease Sub-Committee on Pain
2007-Present California Department of Workers Compensation
2007-Present Associate Prof. Anesthesia & Pain Management, Neurosciences and (by courtesy) Neurology, Stanford Univ. Medical Center, Stanford, CA
2007-Present Chief - Pain Management Division, Stanford University Dep. Anesth., Stanford, CA
2008-Present International Association for the Study of Pain Pain Clinic Guidelines Taskforce
2008-Present Director at Large, American Academy of Pain Medicine
2009-Present Institutes of Medicine Pain Committee

Honors and Awards:

1987 GTE Electrical Engineering Scholarship
1987 Etta Kappa Nu, Electrical Engineering Honor Society
1989-1990,1994 NIH Short-Term Research Fellowship Award
1991-1992 Alpha Omega Alpha Honor Society Research Fellowship Award
1992,1994 Yuma Friends of Arizona Health Sciences Center Young Investigator Award
1994 American Federation for Clinical Research Medical Student Award
1994 University of Arizona MD/PhD Academic Scholarship
1994 Van Winkle Award for Excellence in Surgical Research
1994 Upjohn Medical Student Research Superstar Award
1994 Honors and Awards Committee Research Award, AHSC

1998	Patent - "Radio Frequency Energy Delivery System For Multipolar Electrode Catheters",USO583700
2000	Cognitive Neuroscience Grant for Clark Center for Bioengineering, Biomedicine and Bioscience
2002, 2005	Top Doctors in America published in "Guide to Top Doctors" 2002, 2005
2003	Stanford Department of Anesthesia, Teacher of the Month, March 2003
2008	American Pain Society Clinical Center of Excellence Award
2010	Ellis Cohen Achievement Award, Stanford Department of Anesthesia

C. Selected peer-reviewed publications (selected from 43 total).

1. Simmons, W.N., **Mackey, S**., He, D.S., Marcus, F.I., *Comparison of Gold Versus Platinum Electrodes on Myocardial Lesion Size Using Radiofrequency Energy.*Pacing and Clinical Electrophysiology, April 1996; 19: 398-402.
2. **Mackey S,** Thornton L, He DS, Marcus FI, Lampe LF, *Simultaneous Multipolar Radiofrequency Ablation in the Monopolar Mode Increases Lesion Size*.Pacing and Clinical Electrophysiology, July 1996;19:1042-1048.
3. Macario, A., **Mackey, S**., Terris, D., *Bilateral Vocal Cord Paralysis After Radical Cystectomy in a Patient with a History of Bulbar Polio.*Anesthesia and Analgesia, 1997 Nov;85(5):1171-2.
4. Angst, M.S., **Mackey, S**., Zupfer, G., Taturu, C., Brock-Utne, J.G., *Reduction of Propofol Injection Pain with a Double Lumen IV-Set.*Journal of Clinical Anesthesia, September 1997, 9:462-66.
5. Brodsky, JB, **Mackey, S.,** *Isolation Techniques – Advances in Thoracic Anesthesia and Postoperative Care.*Seminars in Cardiothoracic and Vascular Anesthesia, September 1997, 1:3;225-35.
6. Brodsky, J.B., **Mackey, S.**, Cannon, W.B. *Selecting the Correct Size Left Double-Lumen Tube*. J CardiothoracVascAnesth, 1997 Dec;11(7):924-5.
7. **Mackey, S**., Brodsky, JB., *Selection and Placement of the Double-Lumen Tube in the Asian Patient.*Asian Cardiovascular & Thoracic Annals 1998, Vol. 6, No. 3; 199-202.
8. Leong, M., **Mackey, S.** *Delayed Subdural Anesthesia After Stellate Ganglion Block.*Anesthesiology, February 2001, 94(2); 358-59.
9. Sze, D., **Mackey, S**. *MR-Guidance of Sympathetic Nerve Blockade: Measurement of Vasomotor Response-Initial Experience in Seven Patients.*Radiology 2002 223: 574-580.
10. **Mackey S**, *Mechanisms of Inflammatory Pain: Therapeutic Implications*.Journal of Clinical Rheumatology, June 2004, Vol. 10, Issue 3S: S5-11.
11. **Mackey S,** Maeda F,*Functional Imaging and the Neural Systems of Chronic Pain*. Neurosurgery North American Clinicsof North America, July 2004, Vol. 15, No. 3; 269-288.
12. Ochsner K., Knierim K., Ludlow D., Hanelin J., Ramachandran T., Glover G., **Mackey S**. *Reflecting Upon Feelings: An fMRI Study of Neural Systems Supporting the Attribution of Emotion to Self and Other*. Journal of Cognitive Neuroscience, December 2004, 16:10; 1746-1772.
13. Shinaman RC, **Mackey S**, *Continuous Peripheral Nerve Blocks.*Current Pain and Headache Reports, 2005, 9, 24-29.
14. deCharms C, Maeda F, Glover G, Ludlow D, Pauly J, Soneji D, Gabrieli J, **Mackey S**, *Control Over Brain Activation and Pain Learned by Using Real-Time Functional MRI.*PNAS, December 2005, 102:51; 18626-31. PMC1311906
15. Ochsner K, Ludlow D, Knierim K, Hanelin J, Ramachandran T, Glover G, **Mackey S**, *Neural Correlates of Individual Differences in Pain-Related Fear and Anxiety*. Pain, January 2006, 120:69-77. PMC2914607
16. **Mackey S,** Feinberg S, *Pharmacologic Therapies for Complex Regional Pain Syndrome.*Current Pain and Headache Reports, February 2007, 11:1; 38-43. PMC2914598
17. Mitra R, Zeighami A, **Mackey S**, *Pulsed radiofrequency for the treatment of chronic ilioinguinal neuropathy*. Hernia, February 2007, 11:4; 369-71. PMC2914602
18. Younger J,**Mackey S**, *Neuroimaging the Central Nervous Components of Neuropathic Pain*. US Neurological Disease, Issue II, January 2007.
19. Kornelsen J, **Mackey S,** *Potential Clinical Applications for Spinal Functional MRI.* Current Pain and Headache Reports, June 2007, 11:3; 165-70. PMC2914611
20. Carroll I, **Mackey S,** Gaeta R,*The role of adrenergic receptors and pain:The good, the bad, and the unknown.* Seminars in Anesthesia and Perioperative Pain, March 2007, 26:1; 17-21.

21. Zaki, J, Ochsner K, Hanelin J, Wager T, **Mackey S**, *Different circuits for different pain: patterns of functional connectivity reveal distinct networks for processing pain in self and others.* Soc Neurosci, 2007. **2**(3-4): p. 276-91. PMC2913618
22. Carroll I, Gaeta R, **Mackey S**,*Multivariate Analysis of Chronic Pain Patients Undergoing Lidocaine Infusions: Increasing Pain Severity and Advancing Age Predict Likelihood of Clinically Meaningful Analgesia*. Clinical Journal of Pain, October 2007, 23:8; 702-6. PMC2919575
23. Byrd D, **Mackey S**, *Pulsed radiofrequency for chronic pain.* Current Pain & Headache Reports, January 2008, 12(1); 37-41. PMC2913603
24. Carroll I, Kaplan K, **Mackey S**,*Mexiletine Therapy for Chronic Pain: Survival Analysis Identifies Factors Predicting Clinical Success*.Journal of Pain and Symptom Management, January 2008, Vol 35:3; 321-6. PMC2925416
25. Ochsner K, Zaki J, Hanelin J, Ludlow D, Knierim K, Ramachandran T, Glover G, **Mackey S**. *Your pain or mine? Common and distinct neural systems supporting the perception of pain in self and other.* Social Cognitive and Affective Neuroscience, 2008, 3:2; 144-60. PMC2555461
26. Godfrey J and **Mackey S**, *Toward optimal health: a discussion on sex, gender, and pain.* Journal of Women's Health, July-August 2008, 17:6; 917-20.
27. Lawrence J, **Mackey S**, *Role of neuroimaging in analgesic drug development.* Drugs in R&D, 2008, 9:5; 323-34. PMC2613790
28. Younger, J, Barelka P, Carroll I, Kaplan K, Chu L, Prasad R, Gaeta R, **Mackey S**, *Reduced cold pain tolerance in chronic pain patients following opioid detoxification.*Pain Medicine, 2008. **9**(8): p. 1158-63. PMC2751584
29. Neugebauer V, Galhardo V, Maione S, **Mackey S**, *Forebrain pain mechanisms*. Brain Research Reviews, 2009, 60; 226-242. PMC2700838
30. Carroll I, Clark D, **Mackey S**, *Sympathetic Block with Botulinum Toxin to Treat Complex Regional Pain Syndrome*. Annals of Neurology, 2009, 65; 348-51. PMC2763598
31. Coleman S, and**Mackey S**, *Spinal cord stimulation compared with medical management for failed back surgery syndrome.*Current Pain and Headache Reports, 2009, 13:1; 1-2. PMC2891371
32. Younger J, McCue R, **Mackey S**, *Pain outcomes: A brief review of instruments and techniques.*Current Pain and Headache Reports, 2009, 13:1; 39-43. PMC2891384
33. Younger, J and **Mackey S**, *Fibromyalgia Symptoms Are Reduced by Low-Dose Naltrexone: A Pilot Study.*Pain Medicine, 2009, 10:4; 663-72. PMC2891387
(Faculty of 1000 Medicine factor 3.0 (recommended**):** Kenneth Candido: Faculty of 1000 Medicine, 22 Oct 2009 http://www.f1000medicine.com/article/id/1166387/evaluation)
34. Wang C, Gowda A, Barad M, **Mackey S**, Carroll I, *Serratus muscle stimulation effectively treats nostalgia paresthetica caused by long thoracic nerve dysfunction: a case series*. Journal of Brachial Plexus And Peripheral Nerve Injury, 2009, 4:17. PMC2758879
35. Shen Y, Younger J, Goddard G, **Mackey S**, *Randomized Clinical Trial of Acupuncture for Myofascial Pain of the Jaw.* Journal of Orofacial Pain, 2009, 23:4; 353-9. PMC2894813
36. Fredericks CA, Drabant EM, Edge EM, Tillie JM, Hallmeyer J,Ramel V, Kuo J, **Mackey S**, Gross J, Dhabhar FS, *Healthy young women with serotonin transporter SS polymorphism show a pro-inflammatory bias under resting and stress conditions.* Brain, Behavior, and Immunity, 2010, 24:3; 348-9. PMC2826575
37. Turk DC, Audette J, Levy RM, **Mackey S**, Stanos S, *Assessment and Treatment of Psychosocial Comorbidies in Patients with Neuropathic Pain.* Mayo Clinic Proceedings, 2010, 85:3S; S42-S50. PMC2844010
38. Dworkin RH, O'Connor AB, Audette J, Baron R, Gourlay G, Haanpää ML, Kent J, Krane E,LeBel A, Levy R, **Mackey S,** Mayer J, Miaskowski C, Raja S, Rice A, Schmader K, Stacey B, Stanos S, Treede RD, Turk DS, Walco G, Wells CD, *Recommendations for the Pharmacological Management of Neuropathic Pain: An Overview and Literature Update*. Mayo Clinic Proceedings, 2010, 85:3S; S3-S14. PMC2844007
39. Carroll I, Younger J, **Mackey S**, *Pain quality predicts lidocaine analgesia among patients with suspected neuropathic pain.* Pain Medicine, 2010, 11:4; 617-21. PMC2913605
40. Parris D, Fischbein N, **Mackey S**, Carroll I, *A Novel CT-Guided Transpsoas Approach to Diagnostic Genitofemoral Nerve Block and Ablation*. Pain Medicine, 2010, 11:5; 785-9. PMC2913614

41. Younger J, Shen Y, Goddard G, **Mackey S,** *Chronic myofascial temporomandibular pain is associated with gray matter abnormalities in the cerebral cortex, limbic system, and brainstem. Pain*. Pain, 2010, 149:2; 222-8. PMC2860657
42. Harden R, Bruehl S, Perez R, Birklein F, Marinus J, Maihofner C, Lubenow T, Buvanendran A, **Mackey S**, Graciosa J, Mogilevski M, Ramsden C, Chont M, Vatine J, *Validation of proposed diagnostic criteria (the "Budapest Criteria") for Complex Regional Pain Syndrome*. Pain, 2010 150; 268-74. PMC2914601
43. Younger J, Aron A, Parke S, Chatterjee N, **Mackey S**, *Viewing Pictures of a Romantic Partner Reduces Experimental Pain: Involvement of Neural Reward Systems.* PLoS One, 2010, 5:10; e13309. PMC2954158
44. Xiao L, **Mackey S**, Hui H, Xon D, Zhang Q, Zhang D, *Subcutaneous injection of Botulinum Toxin A is beneficial in postherpetic neuralgia.* Pain Medicine, 2010, 11; 1827-1833. PMC pending
45. Harden R, Bruehl S, Perez S, Birklein F, Marinus J, Maihofner C, Lubenow T, Buvanendran A, **Mackey S**, Graciosa J, Mogilevski M, Ramsden C, Schlereth T, Chont M, Vatine J, *Development of a Severity Score for CRPS*. Pain, 2010, 151:3; 870-6. PMC pending
46. Sam WJ, **Mackey S**, Lotsch J, Drover D, *Morphine and its metabolites after patient-controlled analgesia, considerations for respiratory depression.* Journal of Clinical Anesthesia, 2011, 23:2; 102-6. PMC pending
47. Carroll IR, Fischbein N, Barad M, **Mackey S**, *Human Response to Unintended Intrathecal Injection of Botulinum Toxin*. Pain Medicine, 2011, 12(7); 1094-7. PMC pending
48. Younger J, Chu L, D'Arcy N, Trott K, Jastrzab L, **Mackey S**, *Prescription opioid analgesics rapidly change the human brain.* Pain, 2011, 152(8); 1803-10. PMC pending
49. Lawrence J, Hoeft F, Sheau K, **Mackey S**, *Strategy-dependent Dissociation of the Neural Correlates Involved In Pain Modulation*. Anesthesiology, 2011, 115(4); 844-51. PMC pending
50. Brown, JE, Chatterjee N, Younger J, **Mackey S**, *Towards a physiology-based measure of pain: patterns of human brain activity distinguish painful from non-painful thermal stimulation*. PLoS One, 2011, 6(9); e24124. PMC3172232

D. Research Support.

Ongoing Research Support

P01 AT006651 PD: Mackey
NIH NCCAM 9/1/11 – 5/31/16
Stanford CAM Center for Chronic Back Pain

K24 DA029262 PI: Mackey
NIH NIDA 5/01/10 – 03/31/15
Neuroimaing and Mentoring in Translational Pain Research

R01 NS053961 PI: Mackey 1/09/06 – 12/31/11
NIH NINDS
fMRI of Pain in the Human Spinal Cord
The overall goal of this project is to use human spinal fMRI to elucidate mechanisms of nociceptive processing and spinal cord plasticity in healthy subjects and patients with chronic neuropathic pain.

R21 DA023609 PI: Mackey
NIH NIDA 5/15/09 – 4/30/12
Learned Control of Frontal and Limbic Systems via Real-Time fMRI

K23 DA25152 PI: Ian Carroll, Mentor & Co-Investigator: Mackey 9/1/08 – 8/31/13
Prescription Opioid Use, Misuse, and Pain in Post-Surgical Patients

U01 DK082316 (Consortium PI: Mackey) 9/15/08 – 6/30/13
NIH NIDDK / University of Pennsylvania
Central Mechanisms of Urologic Pelvic Pain: Functional and Structural Analysis by MRI

Chris Redlich Professorship in Pain Research 9/1/09 – Forever
This endowment supports pain medicine research efforts.

Dodie and John Rosekrans Pain Research Endowment Fund 2001 – Forever
This endowment is used to support projects related to functional neuroimaging of pain processing and perception.

Stanford Institute for Neuro-Innovation and Translational Neurosciences Pilot Grant 2010-2012
PI Younger, Co-I Mackey
The role of proinflammatory factors in mediating the negative consequences of chronic opioid use.

Stanford Institute for Neuro-Innovation and Translational Neurosciences Pilot Grant 2010-2012

PI Carroll, Co-I Mackey
Determinants of Time to Pain Resolution Following Surgery: Complimentary Clinical & Preclinical Models
Stanford BioX Grant PI: Mackey 1/1/08 – 12/31/10
Development and Applications of Real-Time fMRI Technology
T32 Stanford Department of Anesthesia PI: Johnson, Mentor: Mackey 7/1/10 – 6/30/12
Learned Control of Brain Connectivity via Real-Time fMRI
Cognitive Neurosciences Grant-Clark Center for Bioengineering 2000 – Present
Advanced Imaging Techniques Applied to Pain Research – Functional Magnetic Imaging of the Human Spinal Cord and Brain

Completed Research Support:
American Academy of Neurology Research Training Fellowship
PI: Meredith Barad, Mentor: Mackey 7/1/08 – 6/30/10
Learned Control of Brain Activity in Chronic Pain Patients Using Real-time fMRI
Eli Lilly Investigator Initiated Grant – PI: Mackey 12/6/06 – 5/31/10
Duloxetine: Functional MRI Neural Correlates of Efficacy in Patients with Chronic Low Back Pain
The major goal of this project is to characterize the effects of duloxetine, a balanced norepinephrine and serotonin reuptake inhibitor, on patients with chronic low back pain. This will utilize validated outcome measures and fMRI techniques.
K99 DA023609-01 PI: Jarred Younger, Mentor & Co-Investigator: Mackey
NIH NIDA 9/30/07 – 8/31/09
Mechanisms of Opioid-Induced Hyperalgesia in Pain Patients: Examination via fMRI
K99/R00. The major goal of the this project is to characterize the central neural correlates of opioid induced hyperalgesia in chronic pain patients consuming chronic opioids.
American Fibromyalgia Syndrome Association (PI: Mackey) 1/1/08 – 1/1/09
Low-Dose Naltrexone in the Treatment of Fibromyalgia
5 R44 NS050642-04 PI: deCharms, Consortium PI: Mackey 06/25/04 – 07/31/07
Omneuron Inc (Prime: NIH NINDS)
Applications of Real Time fMRI-Pzase II
The major goal of this project is to develop novel computational technologies and methods to control cognitive and behavioral training tasks using information from real time functional magnetic resonance imaging.
SBIR Phase II Fast Track Contract: Virtual Reality and Real Time fMRI
PI: deCharms, Consortium PI: Mackey 1/18/05 – 01/18/07
Omneuron Inc (Prime: NIH)
The major goal of this project is to use a combination of virtual reality and real time fMRI to significantly enhance a patient's ability to control activation in brain areas related to pain regulation.
Foundation for Anesthesia Education and Research PI: Mackey 2004-2006
Imaging Neural Systems in Complex Regional Pain Syndrome
The aim of this proposal was to investigate abnormalities of neuronal function in brain regions associated with pain processing in patients with CRPS using functional magnetic resonance imaging.
Foundation for Anesthesia Education & Research PI: Carroll, Mentor: Mackey 1/1/07 – 8/31/08
Mentored Research Training Grant:
Mechanisms of Analgesic Response During IV Lidocaine Infusion in Neuropathic Pain Patients
5 R43 MH067290-02 NIMH
Applications of Real Time fMRI Decharms (PI) 12/20/02-11/30/04
The major goal of this project is to develop novel computational technologies and methods to control cognitive and behavioral training tasks using information from real time functional magnetic resonance imaging(fMRI).
Role: Co-Investigator
NIH Short-Term Research Fellowship PI: Mackey 1989, 1990, 1994
Optimal Control of Transvenous Catheter Ablation in the Treatment of Tachyarrhythmias
The major goals of this project were to: determine the optimal delivery parameters for delivery of radiofrequency energy, apply computer modeling techniques to predict the effects of ablation energy on the

myocardium, characterize energy losses in delivery system, and determine temperatures within myocardium during ablation.

Alpha Omega Alpha Honor Society Research Fellowship PI: Mackey 1991-1992

Transvenous Catheter Delivery of Electrical Energy to Ablate Arrhythmogenic Tissue in Patients with Tachyarrhythmias

The major goal of this project was to develop techniques and tools to reliably deliver radio-frequency energy to the myocardium to ablate cardiac arrhythmias

American Heart Association Fellowship PI: Mackey 1990-1991

Characterization and Optimization of Radiofrequency Catheter Ablation for the Treatment of Cardiac Arrhythmias

The major goal of this project was to develop numerical models to predict and control the effects of radio-frequency energy on the human myocardium for the treatment of cardiac arrhythmias

American College of Cardiology Research Grant PI: Mackey 1994

Electrical and Thermal Characterization of Radiofrequency Catheter Ablation

Oxnard Foundation Grant PI: Mackey 2001 - 2004

Use of NMDA-Antagonists and Opiates in the Treatment of Fibromyalgia Using Validated Outcome Measurements and Functional Magnetic Resonance Imaging

The goals of this project are to (1) investigate the neural processing of the perception of pain in patients with fibromyalgia compared to healthy volunteers (2) determine the effects of NMDA-antagonists and opiates on quality of life, function and subjective pain experience using validated outcomes tools and fMRI

Stanford Office of Technology Licensing Grant PI: Mackey 2001-2003

Processing of Pain in the Human Central Nervous System: Analysis through Functional Magnetic Resonance Imaging

Department of Anesthesiology Research Grant PI: Mackey 1999-2003

Interventional Magnetic Resonance Imaging Applied to Regional Anesthesia and Pain Medicine

Department of Anesthesiology Research Grant PI: Mackey 1999-2003

Development of a Human Neuropathic Pain Model and Determination of Effects of Intravenous Lidocaine on the Sensory and Affective Components of Pain