The Faculty of Medicine of Harvard University
Curriculum Vitae

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Education:

2004	B.S.	Biomedical Engineering	Kyung Hee University, South Korea
2006	M.S.	Biomedical Engineering	Kyung Hee University, South Korea
2014	Ph. D.	Biomedical Engineering (Kyungmo Park)	Kyung Hee University, South Korea

Postdoctoral Training:

05/14-08/14	Research Fellow	Biomedical Engineering (Kyungmo Park, PhD)	Kyung Hee University, South Korea
09/14-08/21	Post-Doctoral Research Fellow	Radiology (Vitaly Napadow, PhD)	Athinoula A. Martinos Center for Biomedical Imaging, Department of Radiology, Massachusetts General Hospital, Harvard Medical School, USA

Faculty Academic Appointments:

2021-	Instructor	Physical Medicine and Rehabilitation	Harvard Medical School

Appointments at Hospitals/Affiliated Institutions:

2014-2021	Research Fellow	Radiology (Athinoula A. Martinos Center for Biomedical Imaging)	Massachusetts General Hospital
2014-2021	Research Fellow	Radiology	Harvard Medical School
2021-	Non-employee	Radiology (Athinoula A. Martinos Center for Biomedical Imaging)	Massachusetts General Hospital
2021-	Researcher	Physical Medicine and Rehabilitation	Spaulding Rehabilitation Hospital

Professional Societies:

2018-	International Association for the Study of Pain (IASP)	
	2018-	Member
2020-	US Association for the Study of Pain (USASP)	
	2020-	Member
2021	The Organization for Human Brain Mapping (OHBM)	
	2011, 2012, 2013, 2014	Non-member (meeting registration)
	2021-	Member
2021-	Society for Neuroscience (SfN)	
	2016	Non-member (meeting registration)
	2021-	Member
2021-	American Association for the Advancement of Science (AAAS)	
	2021-	Member

Grant Review Activities:

2021	Medical Research Council	UK Research and Innovation (UKRI)
	2021	Invited Ad hoc reviewer

Editorial Activities:

Ad hoc Reviewer

Arthritis & Rheumatology

Biosensors

Brain and Behavior

Brazilian Journal of Anesthesiology

Canadian Journal of Pain

Cells

Evidence-Based Complementary and Alternative Medicine

Frontiers in Neurology

Frontiers in Neuroscience

Frontiers in Psychology

Frontiers in Surgery

Healthcare

Integrative Medicine Research

Journal of Affective Disorders

Journal of Association for Computing Machinery

Journal of Clinical Medicine

Journal of Pain

Journal of Pain Research

Medical Engineering & Physics

Medical Engineering and Physics

Neuroimage: Clinical

PLOS ONE

Scientific Reports

Sensors

Technologies

eNeuro

Other Editorial Roles

2021	Topic Editor	Journal of Clinical Medicine
2021-2022	Topic Editor (Topic: Multimodal Neuroimaging Assessment of Pain)	Frontiers in Pain Research
2022	Review Editor on the Editorial Board of Pain Mechanisms	Frontiers in Pain Research

Honors and Prizes:

2019	Winner	Spark Award from the Martinos Center (Passion)

Report of Funded and Unfunded Projects

Past

2004-2007	Data analysis and automatic diagnosis of biological signal of oriental medicine Co-Investigator (PI: Kyungmo Park) Data analysis and automatic diagnosis of biological signal of oriental medicine
2004-2005	Optimization analysis by the effect of thermal stimulation and the control of cooling module Co-Investigator (PI: Kyungmo Park) Optimization analysis by the effect of thermal stimulation and the control of cooling module

2009-2011	Development of multi-functional acupuncture device with real time feedback Co-Investigator (PI: Kyungmo Park) Development of multi-functional acupuncture device with real time feedback
2009-2012	Phantom acupuncture for exploring acupuncture specific effects in central and peripheral nervous system Co-Investigator (PI: Kyungmo Park) Phantom acupuncture for exploring acupuncture specific effects in central and peripheral nervous system
2010-2010	Effect of natural air flow on the human pleasantness – neuroimaging study Co-Investigator (PI: Kyungmo Park) Effect of natural air flow on the human pleasantness – neuroimaging study
2011-2016	Neuroimaging Acupuncture Effects on Brain Activity in Chronic Low Back Pain NCCAM / NIH; P01-AT006663 Co-Investigator (PI: Vitaly Napadow, $6,333,600) This program project grant will investigate the different neurophysiological mechanisms underlying the clinical response for different acupuncture interventions in chronic low back pain patients.
2011-2014	Research of neuroplasticity mechanism of acupuncture – based on the neuroimaging study of idiopathic facial paralysis Co-Investigator (PI: Kyungmo Park) Research of neuroplasticity mechanism of acupuncture – based on the neuroimaging study of idiopathic facial paralysis
2014-2019	Brain mechanisms underlying CBT-related reductions in fibromyalgia NIAMS / NIH; R01-AR064367 Co-Investigator (PI: Vitaly Napadow, $3,844,035) We hypothesize that CBT in this study will reduce catastrophizing early in treatment, resulting in adaptive changes in the brain's responses to an externally applied noxious stimulus.
2016-2018	The role of brain glial activation in human knee NIAMS / NIH; R01-NS094306 Co-Investigator (PI: Vitaly Napadow, $2,057,895) In this project, we will use PET/MR imaging to test the hypothesis that low brain levels of the translocator protein (TSPO), which is upregulated in activated glial cells, predict higher likelihood of developing post-TKA pain.

2016-2023 Optimization of brain-based mechanisms supporting psychosocial aspects of acupuncture therapy – a hyperscanning fMRI study
NCCIH / NIH; R61-AT009306 / R33-AT009306
Co-Investigator (PI: Vitaly Napadow, $3,258,176 total costs)
The patient-clinician interaction is central to mind-body therapies, and key mechanisms of action likely include brain circuitries supporting social mirroring networks underlying clinician empathy and therapeutic alliance. We will use hyperscanning functional MRI to link patient/acupuncturist brain activity concordance in social mirror neuron regions during treatment, and relate this concordance with ratings of therapeutic alliance and analgesia. Our proposal will define an augmented acupuncture interaction style based on brain concordance to optimize healthcare outcomes for acupuncture and other medical therapies. This is a phased R61/R33 award with executed go / no-go criteria.

2022-2023 Optimization of brain-based mechanism supporting psychosocial aspects of acupuncture therapy – a hyperscanning fMRI study
NCCIH / NIH; R33-AT009306
Site PI (PI: Vitaly Napadow, $334,900)
This multi-site extension will continue to allow for the use of hyperscanning functional MRI to link patient/acupuncturist brain activity concordance in social mirror neuron regions during treatment, and relate this concordance with ratings of therapeutic alliance and analgesia. This is a phased R61/R33 award with executed go / no-go criteria.

Current

2015- Development of real-time fMRI neurofeedback for longitudinal clinical trial applications
PI (PI: Jeungchan Lee, $16,680)
This grant supports the development of an MRI pulse sequence, paradigm, and analysis pipeline for real-time fMRI. This development will allow us to test optimized methods for neurofeedback in chronic pain patients, and will be available to the many investigators at the Martinos Center who are interested in neurofeedback applications for longitudinal clinical trial designs. (24 MRI scan hours allowed, $695/hour)

2020-2025 Androgen Replacement to Improve Patient-Important Outcomes in Men with Opioid-Induced Hypogonadism
NIH/NIAMS; 1R01AG066921
Co-Investigator (PI: Shehzad Basaria, $1,452,870)

	The major goals of this project are: Using Androgen Replacement therapy to Improve Patient-Important Outcomes in Men with Opioid-Induced Hypogonadism.
2022-	Back Pain Consortium (BACPAC) Research Program Data Integration, Operations Development and Operations Management Center NIH/NIAMS; 1U24AR076730-01 Co-Investigator (PI: Vitaly Napadow) The BEST (Biomarkers for Evaluating Spine Treatment)-BACPAC brain imaging study will collect brain neuroimaging metrics from chronic low back pain participants that undergo deep phenotyping.
2023-	Impact of Theory of Mind Training on Brain-to-Brain Patient-Clinician Concordance NIH/NCCIH; 1R01AT012144-01 Co-Investigator (PI: Vitaly Napadow) To test the benefits and mechanisms of a theory of mind training program for patients with chronic pain.
2023-	Topological Atlas and Repository for Acupoint research (TARA) NIH/NCCIH; U24AT012560-01 Co-Investigator (PI: Vitaly Napadow) Topological Atlas and Repository for Acupoint research (TARA), forms an invaluable Research Resource Center for the acupuncture research and clinical community by strengthening the biological basis of acupoints, facilitating acupuncture integration into clinical care.

Projects Submitted for Funding

2023	*Self-regulation of real-time fMRI brain activity in chronic pain: A potential neurobiological mechanism of cognitive behavioral therapy* NIAMS; R21 PI *We will use real-time functional magnetic resonanceimaging (fMRI) neurofeedback to illuminate the role of self-regulatory capacity in shaping the negative effectsof pain catastrophizing, and the positive benefits of cognitive-behavioral therapy.*

<u>Report of Local Teaching and Training</u>
Teaching of Students in Courses:

2006-2006	Diagnosis system and experiment in oriental medicine Biomedical Engineering Undergraduate students	Kyung Hee University, South Korea 3 hours / week

Other Mentored Trainees and Faculty:

2008-2009 Yumi Maeda, DDS PhD / Post-Doctoral Research Fellow
Post-doctoral research fellow. *Mentoring role*: Co-mentored with Dr. Vitaly Napadow
Multiple first-authored publications of mentored research and transition to clinical dentistry fellowship at Boston University.

2011-2013 Eunyoung Lee, MSc /
Student mentoring (co-mentored with Dr. Kyungmo Park) and Master Degree project coordination
Master Degree at Kyung Hee University

2012-2013 Kisu Kim
Student mentoring (co-mentored with Dr. Kyungmo Park) and Bachelor Degree project coordination
Bachelor Degree at Kyung Hee University

2012-2014 Seulgi Eun, MSc
Student mentoring (co-mentored with Dr. Kyungmo Park) and PhD Degree project coordination
Researcher at Institute for Basic Science, Korea

2014 Meena Magharious, MSc
Student mentoring (co-mentored with Dr. Kyungmo Park) and PhD Degree project coordination
Postdoctoral Scholar at Harvard Medical School

2014-2017 Ishtiaq Mawla, BA / Research Assistant
Research technologist. *Mentoring role:* Co-mentored with Dr. Vitaly Napadow
First-authored publications of mentored research and successfully transitioned to PhD program at University of Michigan.

2016-2018 Changjin Jung, MS / visiting fellow from KIOM, Korea
Career stage: Visiting fellow. *Mentoring role:* Co-mentored with Dr. Vitaly Napadow

Transitioned to researcher position at Korean Institute of Oriental Medicine, Daejeon, Korea.

2016-2020 Kylie Isenburg, BA / Research Assistant
Career stage: Research technologist. *Mentoring role:* Co-mentored with Dr. Vitaly Napadow
First and co-authored publications of mentored research and successfully transitioned to PhD program at Boston University.

2019-2022 Maya Barton Zuckerman, BS / Research Assistant
Career stage: Research technologist. *Mentoring role:* Co-mentored with Dr. Vitaly Napadow
Co-authored publications and successfully transitioned to PhD program at Northeastern University.

2021-2023 Alison Goldstein, BS / Research Assistant
Career stage: Research technologist. *Mentoring role:* Co-mentored with Dr. Vitaly Napadow
Multiple poster presentations in Local/National conferences

2021- Sarasa Tohyama, PhD / Post-doctoral Research Fellow
Post-doctoral research fellow. *Mentoring role*: Co-mentored with Dr. Vitaly Napadow
Presentations at several annual meetings

2023- Melaina Gilbert, BS / Research Assistant
Career stage: Research technologist. *Mentoring role:* Co-mentored with Dr. Vitaly Napadow
Successful transition to new roles in multiple studies

Local Invited Presentations:

☒ *No presentations below were sponsored by 3rd parties/outside entities*

2017 Introduction to Machine Learning / Invited Lecture
Center for Integrative Pain NeuroImaging. Athinoula A. Martinos Center for Biomedical Imaging, Harvard Medical School

2019 Electrical Stimulation in a Nutshell / Invited Lecture
Center for Integrative Pain NeuroImaging. Athinoula A. Martinos Center for Biomedical Imaging, Harvard Medical School

2023	Phantom Acupuncture: Seeing is believing? Feeling is believing? / Invited Lecture Beth Israel Deaconess Medical Center / Harvard Medical School

Report of Regional, National and International Invited Teaching and Presentations

☒ *No presentations below were sponsored by 3rd parties/outside entities*

National

2004	Monitor calibration for color stimulus and pupil size evaluation according to light stimuli Gwangju, South Korea. Optical Society of Korea 2003.

International

2015	Acupuncture effect on functional connectivity of sensorimotor network in Bell's palsy; fMRI study (the result of a selected abstract) Boston, MA. SAR 2015 Conference.
2017	Longitudinal treatment of verum acupuncture in chronic low back pain patients reduces pain-related brain activity San Francisco, CA. SAR 2017 Conference.

Report of Technological and Other Scientific Innovations

Method for recommending personalized add-on therapy (2016)	This technology recommends individually optimized treatment options using functional MRI to maximize the effect and efficacy of treatment, which facilitates its decision-making by utilizing a database from other user's treatment information. Korea (KR) Patent awarded (2016): KR patent KR101583905B1 (https://patents.google.com/patent/KR101583905B1/ko, https://patents.google.com/patent/KR20150096206A/en)

Report of Education of Patients and Service to the Community

☒ *No presentations below were sponsored by 3rd parties/outside entities*

Recognition:

2017	Machine learning finds brain activity differs in low and high pain states during chronic low back pain	PAIN RESEARCH FORUM (Highlights From Neuroscience 2016: Part 3)
2019	How much it hurts... Pain prediction accuracy of 97% model came out	dongascience.donga.com
2021	Fibromyalgia: MRI Imaging Links Brain Metabolites and Pain	PainRelief.com
2023	CBT Reduces Pain Catastrophizing Post-Treatment in Fibromyalgia	hcplive.com
2023	Cognitive behavioral therapy can significantly reduce the burden of fibromyalgia	news-medical.net
2023	Cognitive behavioral therapy eases how fibromyalgia pain is experienced by the brain	sciencedaily.com
2023	Cognitive behavioral therapy found to ease how fibromyalgia pain is experienced by the brain	medicalxpress.com
2023	Fibromyalgia: Imaging Studies Find Cognitive Behavioral Therapy Reduces Pain Catastrophizing	PainRelief.com

Report of Scholarship

ORCID: 0000-0002-4424-175X

Peer-Reviewed Scholarship in print or other media:

Research Investigations

1. **Lee J**C, Kim JE, Park KM, Khang G. Evaluation of the methods for pupil size estimation: on the perspective of autonomic activity. Conf Proc IEEE Eng Med Biol Soc. 1;2004:1501-1504. PMID: 17271981 [4 citations]

2. **Lee J**C, Kim JE, KM Park. (2007) Development of a Pupil-size Monitoring System for Autonomic-activity Estimation. In: Magjarevic R., Nagel J.H. (eds) World Congress on Medical Physics and Biomedical Engineering 2006. IFMBE Proceedings, vol 14. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-540-36841-0_351

3. **Lee J**C, Kim JE, Park KM. Posture change affects indices of pupil size-Korean males in their twenties. Journal of Biomedical Engineering Research. 2007;28(1):1-7.

4. **Lee J**C, Kim JE, Park KM. Pupil size variability as an index of autonomic activity-from the experiments of posture, sleepiness and cognitive task. Journal of Biomedical Engineering Research. 2007;28(1):55-65.

5. **Lee J**C, Kim JE, Park K. Pupil size variability as an index of autonomic activity — A preliminary study. Autonomic Neuroscience: Basic and Clinical. 2007;135(1-2). DOI:https://doi.org/10.1016/j.autneu.2007.06.233

6. Chae Y, **Lee J**C, Park KM, Kang OS, Park HJ, Lee H. Subjective and autonomic responses to smoking-related visual cues. J Physiol Sci. 2008 Apr;58(2):139-145. PMID: 18358080, https://doi.org/10.2170/physiolsci.RP014207 [12 citations]

7. Lim SK, Lee DH, Kwon YJ, **Lee J**C, Jung CJ, Kim YS, Park KM, Lee SH. Effects of fixed-intensity and varied-intensity electroacupuncture on heart rate variability in healthy people with stress task. Journal of Acupuncture Research. 2011;28(2):107-116.

8. Kim HJ, Kim N, Kim S, Hong S, Park K, Lim S, Park JM, Na B, Chae Y, **Lee J**, Yeo S, Choe IH, Cho SY, Cho G. Sex differences in amygdala subregions: evidence from subregional shape analysis. Neuroimage. 2012 May 1;60(4):2054-2061. PMID: 22374477, https://doi.org/10.1016/j.neuroimage.2012.02.025 [30 citations]

9. Maeda Y, Kettner N, **Lee J**, Kim J, Cina S, Malatesta C, Gerber J, McManus C, Im J, Libby A, Mezzacappa P, Morse LR, Park K, Audette J, Napadow V. Acupuncture-evoked response in somatosensory and prefrontal cortices predicts immediate pain reduction in carpal tunnel syndrome. Evid Based Complement Alternat Med. 2013;2013:795906. PMID: 23843881, PMCID: PMC3703406, https://doi.org/10.1155/2013/795906 [33 citations]

10. Maeda Y, Kettner N, **Lee J**, Kim J, Cina S, Malatesta C, Gerber J, McManus C, Im J, Libby A, Mezzacappa P, Morse LR, Park K, Audette J, Napadow V. Acupuncture Evoked Response in Contralateral Somatosensory Cortex Reflects Peripheral Nerve Pathology of Carpal Tunnel Syndrome. Med Acupunct. 2013 Aug;25(4):275-284. PMID: 24761177, PMCID: PMC3746237 [11 citations]

11. Napadow V, **Lee J**, Kim J, Cina S, Maeda Y, Barbieri R, Harris RE, Kettner N, Park K. Brain correlates of phasic autonomic response to acupuncture stimulation: an event-related fMRI study. Hum Brain Mapp. 2013 Oct;34(10):2592-2606. PMID: 22504841, PMCID: PMC3646924, https://doi.org/10.1002/hbm.22091 [60 citations]

12. Maeda Y, Kettner N, Holden J, **Lee J**, Kim J, Cina S, Malatesta C, Gerber J, McManus C, Im J, Libby A, Mezzacappa P, Morse LR, Park K, Audette J, Tommerdahl M, Napadow V. Functional deficits in carpal tunnel syndrome reflect reorganization of primary somatosensory cortex. Brain. 2014 Jun;137(Pt 6):1741-1752. PMID: 24740988, PMCID: PMC4032104, https://doi.org/10.1093/brain/awu096 [53 citations]

13. **Lee J**, Napadow V, Kim J, Lee S, Choi W, Kaptchuk TJ, Park K. Phantom acupuncture: dissociating somatosensory and cognitive/affective components of acupuncture stimulation with a novel form of placebo acupuncture. PLoS One. 2014;9(8):e104582. PMID: 25101637, PMCID: PMC4125217, https://doi.org/10.1371/journal.pone.0104582 [22 citations]

14. **Lee J**, Napadow V, Park K. Pain and sensory detection threshold response to acupuncture is modulated by coping strategy and acupuncture sensation. BMC Complement Altern Med. 2014 Sep 1;14:324. PMID: 25175308, PMCID: PMC4167271, https://doi.org/10.1186/1472-6882-14-324 [6 citations]

15. Eun S, Mohamed AZ, Sayed R, **Lee J**, Lee E, Lee S, Lee HJ, Lee SM, Choi W, Park K. Facial motor-respiratory coordination in Qigong activates brain default-mode network regions. Integrative Medicine Research. 2015;4(1):88.

16. Kim H, Maeda Y, Kettner N, Holden, J, **Lee J**, Kim J, Cina S, Malatesta C, Gerber J, McManus C, Im J, Libby A, Mezzacappa P, Morse L, Park K, Audette J, Tommerdahl M, Napadow V. Acupuncture produces brain structural plasticity associated with improved clinical outcomes for carpal tunnel syndrome. Integrative Medicine Research. 2015;4(1):27-28.

17. Makary MM, **Lee J**, Lee JH, Lee E, Shin JY, Napadow V, Jahng G, Park K. Acupuncture differential effect on chronic and acute low back pain using fMRI. Integrative Medicine Research. 2015:4(1):21.

18. Mohamed AZ, Eun S, **Lee J**, Wu Y, Li C, Zhu Y, Yang J, Park K. Acupuncture induces long-term changes for Sensorimotor Network of Bell's palsy in resting state. Integrative Medicine Research. 2015:4(1):87.

19. Mohamed AZ, Eun S, **Lee J**, Wu Y, Yang J, Zhu Y, Li C, Park K. Short-term Effect of Acupuncture on Functional Brain Connectivity of Bell’s Palsy. Integrative Medicine Research. 2015;4(1):87.

20. Sayed R, Eun S, Mohamed AZ, **Lee J**, Lee E, Lee SM, Lee HJ, Lee S, Choi W, Park K. Brain correlates to facial motor imagery as a component of Qigong practice in Bell's palsy. Integrative Medicine Research. 2015;4(1):33.

21. Ko SJ, Kim H, Kim SK, Park K, **Lee J**, Lee BJ, Oh J, Lee K, Park JW. Reliability and Validity of Modified Algometer in Abdominal Examination. Evid Based Complement Alternat Med. 2016;2016:3052954. PMID: 27073401, PMCID: PMC4814660, https://doi.org/10.1155/2016/3052954 [7 citations]

22. Ko SJ, Park K, Kim J, Kim M, Kim JH, **Lee J**, Mohamed AZ, Yeo I, Kim J, Choi SM, Kim H, Park JW, Lee JH. Effect of acupuncture and its influence on cerebral activity in functional dyspepsia patients: study protocol for a randomized controlled trial. Trials. 2016 Apr 2;17:183. PMID: 27039086, PMCID: PMC4818864, https://doi.org/10.1186/s13063-016-1296-2 [4 citations]

23. Soliman RS, Lee S, Eun S, Mohamed AZ, **Lee J**, Lee E, Makary MM, Kathy Lee SM, Lee HJ, Choi WS, Park K. Brain correlates to facial motor imagery and its somatotopy in the primary motor cortex. Neuroreport. 2017 Mar 22;28(5):285-291. PMID: 28240722, https://doi.org/10.1097/WNR.0000000000000758 [1 citation]

24. Ellingsen DM, Garcia RG, **Lee J**, Lin RL, Kim J, Thurler AH, Castel S, Dimisko L, Rosen BR, Hadjikhani N, Kuo B, Napadow V. Cyclic Vomiting Syndrome is characterized by altered functional brain connectivity of the insular cortex: A cross-comparison with migraine and healthy adults. Neurogastroenterol Motil. 2017 Jun;29(6). PMID: 27910222, PMCID: PMC5423835, https://doi.org/10.1111/nmo.13004 [17 citations]

25. Garcia RG, Lin RL, **Lee J**, Kim J, Barbieri R, Sclocco R, Wasan AD, Edwards RR, Rosen BR, Hadjikhani N, Napadow V. Modulation of brainstem activity and connectivity by respiratory-gated auricular vagal afferent nerve stimulation in migraine patients. Pain. 2017 Aug;158(8):1461-1472. PMID: 28541256, PMCID: PMC5517046, https://doi.org/10.1097/j.pain.0000000000000930 [76 citations]

26. Makary MM, Eun S, Soliman RS, Mohamed AZ, **Lee J**, Park K. Functional topography of the primary motor cortex during motor execution and motor imagery as revealed by functional MRI. Neuroreport. 2017 Aug 16;28(12):731-738. PMID: 28617759, https://doi.org/10.1097/WNR.0000000000000825 [4 citations]

27. **Lee J**, Lin RL, Garcia RG, Kim J, Kim H, Loggia ML, Mawla I, Wasan AD, Edwards RR, Rosen BR, Hadjikhani N, Napadow V. Reduced insula habituation associated with amplification of trigeminal brainstem input in migraine. Cephalalgia. 2017 Oct;37(11):1026-1038. PMID: 27521844, PMCID: PMC9176411, https://doi.org/10.1177/0333102416665223 [20 citations]

28. Makary MM, **Lee J**, Lee E, Eun S, Kim J, Jahng GH, Kim K, Youn YS, Lee JH, Park K. Phantom Acupuncture Induces Placebo Credibility and Vicarious Sensations: A Parallel fMRI Study of Low Back Pain Patients. Sci Rep. 2018 Jan 17;8(1):930. PMID:

29343693, PMCID: PMC5772373, https://doi.org/10.1038/s41598-017-18870-1 [20 citations]

29. **Lee J**, Protsenko E, Lazaridou A, Franceschelli O, Ellingsen DM, Mawla I, Isenburg K, Berry MP, Galenkamp L, Loggia ML, Wasan AD, Edwards RR, Napadow V. Encoding of Self-Referential Pain Catastrophizing in the Posterior Cingulate Cortex in Fibromyalgia. Arthritis Rheumatol. 2018 Aug;70(8):1308-1318. PMID: 29579370, PMCID: PMC6105462, https://doi.org/10.1002/art.40507 [32 citations]

30. **Lee J**, Mawla I, Kim J, Loggia ML, Ortiz A, Jung C, Chan ST, Gerber J, Schmithorst VJ, Edwards RR, Wasan AD, Berna C, Kong J, Kaptchuk TJ, Gollub RL, Rosen BR, Napadow V. Machine learning-based prediction of clinical pain using multimodal neuroimaging and autonomic metrics. Pain. 2019 Mar;160(3):550-560. PMID: 30540621, PMCID: PMC6377310, https://doi.org/10.1097/j.pain.0000000000001417 [57 citations]

Cover Article

31. Kim J, Mawla I, Kong J, **Lee J**, Gerber J, Ortiz A, Kim H, Chan ST, Loggia ML, Wasan AD, Edwards RR, Gollub RL, Rosen BR, Napadow V. Somatotopically specific primary somatosensory connectivity to salience and default mode networks encodes clinical pain. Pain. 2019 Jul;160(7):1594-1605. PMID: 30839429, PMCID: PMC6586503, https://doi.org/10.1097/j.pain.0000000000001541 [43 citations]

32. Zhang B, Jung M, Tu Y, Gollub R, Lang C, Ortiz A, Park J, Wilson G, Gerber J, Mawla I, Chan ST, Wasan A, Edwards R, **Lee J**, Napadow V, Kaptchuk T, Rosen B, Kong J. Identifying brain regions associated with the neuropathology of chronic low back pain: a resting-state amplitude of low-frequency fluctuation study. Br J Anaesth. 2019 Aug;123(2):e303-e311. PMID: 30948036, PMCID: PMC6676015, https://doi.org/10.1016/j.bja.2019.02.021 [54 citations]

33. **Lee J**, Eun S, Kim J, Lee JH, Park K. Differential Influence of Acupuncture Somatosensory and Cognitive/Affective Components on Functional Brain Connectivity and Pain Reduction During Low Back Pain State. Front Neurosci. 2019;13:1062. PMID: 31636536, PMCID: PMC6788296, https://doi.org/10.3389/fnins.2019.01062 [17 citations]

34. Jung C, Kim J, **Lee J**, Napadow V, Park K. An interaction between somatosensory associated and cognitive/affective components of acupuncture treatment in the brain. Integrative Medicine Research. 2020;9:100505.

35. Kim J, Mawla I, **Lee J**, Gerber J, Chan ST, Kim H, Loggia M, Edwards R, Wasan A, Kong J, Gollub R, Rosen Bruce, Napadow V. Resting state functional brain connectivity

predicts clinical improvements in chronic low back pain following acupuncture. Integrative Medicine Research. 2020;9:100503.

36. Eun S, **Lee J**, Song EM, Rosa A, Lee JH, Park K. Brain functional connectivity changes by low back extension pain model in low back pain patients. PLoS One. 2020;15(6):e0233858. PMID: 32479547, PMCID: PMC7263586, https://doi.org/10.1371/journal.pone.0233858 [1 citation]

37. Kim H, Mawla I, **Lee J**, Gerber J, Walker K, Kim J, Ortiz A, Chan ST, Loggia ML, Wasan AD, Edwards RR, Kong J, Kaptchuk TJ, Gollub RL, Rosen BR, Napadow V. Reduced tactile acuity in chronic low back pain is linked with structural neuroplasticity in primary somatosensory cortex and is modulated by acupuncture therapy. Neuroimage. 2020 Aug 15;217:116899. PMID: 32380138, PMCID: PMC7395964, https://doi.org/10.1016/j.neuroimage.2020.116899 [30 citations]

38. Yu S, Li W, Shen W, Edwards RR, Gollub RL, Wilson G, Park J, Ortiz A, Cao J, Gerber J, Mawla I, Chan ST, **Lee J**, Wasan AD, Napadow V, Kaptchuk TJ, Rosen B, Kong J. Impaired mesocorticolimbic connectivity underlies increased pain sensitivity in chronic low back pain. Neuroimage. 2020 Sep;218:116969. PMID: 32439536, PMCID: PMC7415705, https://doi.org/10.1016/j.neuroimage.2020.116969 [32 citations]

39. Ellingsen DM, Isenburg K, Jung C, **Lee J**, Gerber J, Mawla I, Sclocco R, Jensen KB, Edwards RR, Kelley JM, Kirsch I, Kaptchuk TJ, Napadow V. Dynamic brain-to-brain concordance and behavioral mirroring as a mechanism of the patient-clinician interaction. Sci Adv. 2020 Oct;6(43):eabc1304. PMID: 33087365, PMCID: PMC7577722, https://doi.org/10.1126/sciadv.abc1304 [33 citations]

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1. Development of Phantom Acupuncture and Dissociation of Specific/Non-specific Effects of Acupuncture [dissertation]. Seoul (South Korea): Kyung Hee University; 2014.

Abstracts, Poster Presentations, and Exhibits Presented at Professional Meetings:

1. Jeungchan Lee, Paul Wighton, Stephen F. Cauley, Kawin Setsompop, Andre van der Kouwe, Marco L. Loggia, Robert R. Edwards, Vitaly Napadow, "Application of simultaneous multi-slice imaging to real-time fMRI for improved neurofeedback signal fidelity", February 12-13, Gainesville, FL, Real-time Functional Imaging and Neurofeedback (rtFIN) Conference 2015.

2. Jeungchan Lee, Ishtiaq Mawla, Jessica Gerber, Ana Ortiz, Ekaterina Protsenko, Jieun Kim, Hyungjun Kim, Suk-Tak Chan, Marco L. Loggia, Robert Edwards, Ajay Wasan, Chantal Berna, Jian Kong, Ted Kaptchuk, Randy L. Gollub, Bruce Rosen, Vitaly Napadow, "Machine learning approaches to discriminate clinical pain states using ASL brain imaging data from chronic low back pain patients", November 12-16, San Diego, CA, Neuroscience 2016.

3. Jeungchan Lee, Ishtiaq Mawla, Ana Ortiz, Jessica Gerber, Kathryn Walker, Susan Shaver, Jieun Kim, Hyungjun Kim, Changjin Jung, Suk-Tak Chan, Marco Loggia, Robert Edwards, Ajay Wasan, Chantal Berna, Jian Kong, Ted Kaptchuk, Randy Gollub, Bruce Rosen, Vitaly Napadow, "Acupuncture reduces evoked back pain-related brain activity in chronic low back pain patients", April 27-29, San Francisco, CA, The Society for Acupuncture Research 2017.

4. J. Lee, E. Protsenko, A. Lazaridiou, O. Franceschelli, D. Ellingsen, I. Mawla, K. Isenburg, M. Loggia, A. Wasan, R. Edwards, V. Napadow, "Posterior cingulate cortex is a key neural substrate for pain catastrophizing in fibromyalgia", March 4-6, Anaheim, CA, APS Scientific Summit 2018.

5. Jeungchan Lee*, Ishtiaq Mawla*, Marco L Loggia, Ana Ortiz, Jieun Kim, Hyungjun Kim, Changjin Jung, Suk-Tak Chan, Jessica Gerber, Robert R Edwards, Ajay D Wasan, Chantal Berna, Jian Kong, Ted J Kaptchuk, Randy L Gollub, Bruce R Rosen, Vitaly Napadow, "Classifying and predicting clinical pain states using multimodal neuroimaging and autonomic metrics in chronic low back pain: a machine learning approach", September 12-16, Boston, MA, THE 17th WORLD CONGRESS ON PAIN 2018.

6. Jeungchan Lee, Ovidiu C. Andronesi, Angel Torrado-carvajal, Eva-Maria Ratai, Marco L. Loggia, Akila Weerasekera, Michael P. Berry, Laura Isaro, Asimina Lazaridou, Myrella Paschali, Arvina Grahl, Ajay Wasan, Robert R. Edwards, Vitaly Napadow, "Pain Catastrophizing in Fibromyalgia is associated with insula and cingulate metabolite

concentrations – a voxel-wise 3D MR Spectroscopic Imaging study", August 4-8, Amsterdam, IASP 2020 WORLD CONGRESS ON PAIN.

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8. Jeungchan Lee, Michael P. Berry, Laura Isaro, Asimina Lazaridou, Myrella Paschali, Arvina Grahl, Marco L. Loggia, Ajay D. Wasan, Robert R. Edwards, Vitaly Napadow, "Baseline posterior cingulate cortical responses to pain catastrophizing predict cognitive behavioral therapy outcomes in fibromyalgia", April 7, MGH Scientific Advisory Committee SAC 2021 (accepted for virtual poster presentation).

9. Jeungchan Lee, Michael P. Berry, Laura Isaro, Asimina Lazaridou, Myrella Paschali, Arvina Grahl, Marco L. Loggia, Ajay D. Wasan, Robert R. Edwards, Vitaly Napadow, "Baseline posterior cingulate cortical responses to pain catastrophizing predict cognitive behavioral therapy outcomes in fibromyalgia", June 21-25, The 27th Annual Meeting of OHBM 2021 (accepted for virtual poster presentation).

10. Jeungchan Lee, Ovidiu C. Andronesi, Angel Torrado-carvajal, Eva-Maria Ratai, Marco L. Loggia, Akila Weerasekera, Michael P. Berry, Laura Isaro, Asimina Lazaridou, Myrella Paschali, Arvina Grahl, Ajay Wasan, Robert R. Edwards, Vitaly Napadow, "Pain Catastrophizing in Fibromyalgia is associated with insula and cingulate metabolite concentrations – a voxel-wise 3D MR Spectroscopic Imaging study", June 27-July 1, IASP 2021 WORLD CONGRES SON PAIN (Virtual).

11. Jeungchan Lee, Ovidiu C Andronesi, Angel Torrado-Carvajal, Eva-Maria Ratai, Marco L Loggia, Akila Weerasekera, Michael P Berry, Dan-Mikael Ellingsen, Laura Isaro, Asimina Lazaridou, Myrella Paschali, Arvina Grahl, Ajay D Wasan, Robert R Edwards, Vitaly Napadow, "3D MR Spectroscopic Imaging Reveals Links Between Brain Metabolites and Multidimensional Pain Features in Fibromyalgia Patients", August 13, 2021 Martinos Center Summer Symposium (Virtual).

12. Jeungchan Lee, Ovidiu C Andronesi, Angel Torrado-Carvajal, Eva-Maria Ratai, Marco L Loggia, Akila Weerasekera, Michael P Berry, Dan-Mikael Ellingsen, Laura Isaro, Asimina Lazaridou, Myrella Paschali, Arvina Grahl, Ajay D Wasan, Robert R Edwards, Vitaly Napadow, "3d Magnetic Resonance Spectroscopic Imaging Reveals Links

Between Brain Metabolites and Multidimensional Pain Features in Fibromyalgia", October 14, 2021, MGH Clinical Research Day 2021 (Virtual).

13. J. LEE, M. P. BERRY, L. ISARO, A. LAZARIDOU, M. PASCHALI, A. GRAHL, M. L. LOGGIA, D.-M. ELLINGSEN, A. D. WASAN, R. R. EDWARDS, V. NAPADOW, "Prediction of cognitive behavioral therapy outcomes using baseline posterior cingulate cortical responses to pain catastrophizing in fibromyalgia ", November 8-11, Society for Neuroscience 2021 Annual Meeting (Cancelled).

14. Jeungchan Lee, Michael P. Berry, Laura Isaro, Asimina Lazaridou, Myrella Paschali, Dan-Mikael Ellingson, Arvina Grahl, Marco L. Loggia, Ajay D. Wasan, Robert R. Edwards, Vitaly Napadow, "Distinct role of self-awareness of nociceptive input and emotion in Fibromyalgia", September 20-23, IASP 2022 WORLD CONGRESS ON PAIN

15. Jeungchan Lee, Asimina Lazaridou, Myrella Paschali, Dan-Mikael Ellingsen, Arvina Grahl, Marco L. Loggia, Ajay D. Wasan, Robert R. Edwards, Vitaly Napadow, "Posterior Cingulate Cortex Connectivity Underlies Reduced Pain Catastrophizing Following Cognitive Behavioral Therapy in Fibromyalgia", November 12-16, Society for Neuroscience 2022 Annual Meeting

16. Jeungchan Lee, Asimina Lazaridou, Myrella Paschali, Marco L. Loggia, Dan-Mikael Ellingsen, Alessandra Anzolin, Arvina Grahl, Ajay D. Wasan, Vitaly Napadow, Robert R. Edwards, "Cognitive Behavioral Therapy relieves fibromyalgia pain and modulates pain catastrophizing specific brain circuitry", April 11-11, 2023 Annual Scientific Meeting for the United States Association for the Study of Pain (USASP).

* Co-author, ** Mentee

Narrative Report

I am a neuroscientist and neuroimager who specializes in pain research. After completing my Ph.D. in Biomedical Engineering at Kyung Hee University, South Korea, and post-doctoral research at the Athinoula A. Martinos Center for Biomedical Imaging, Harvard Medical School, I joined the faculty at Spaulding Rehabilitation Hospital (SRH)/HMS, where I continue my pain neuroimaging research, aimed at broadening our knowledge of the brain mechanisms supporting pain experience and assessment.

Area of Excellence: Investigation

In my early career, my primary research focused on the development and evaluation of methodology to assess the autonomic nervous system in humans, which successfully improved pupil size monitoring methods for autonomic assessment. Since 2008, my research has broadened to also include acupuncture and pain research, focusing on brain mechanisms in humans using functional MRI (fMRI). I performed many studies to understand the influence of acupuncture on central/autonomic nervous system activity

and the direct/indirect effects of acupuncture in patients suffering from chronic pain. Since 2014, I have further extended my research focus on the neural mechanisms of various chronic pain disorders. I successfully applied a machine learning approach to assess brain and autonomic biomarkers underlying chronic low back pain patients' pain levels. This work was highlighted on the cover of the prestigious journal, *Pain* (March 2019) and received subsequent media recognition. Using a different MRI technique based on magnetic resonance spectroscopy, I led a whole-brain metabolite imaging study in fibromyalgia, which also received media recognition (2021). More recently, after promotion to faculty at Spaulding Rehabilitation Hospital in 2022, I became the Site-PI of our Lab's hyperscan fMRI project, which aims to reveal the brain circuitry supporting psychosocial impacts on pain, specifically the influence of the doctor-patient relationship in fibromyalgia clinical care.

In summary, since I was appointed instructor at SRH/HMS, I have endeavored to provide a better understanding and explanation of the brain processes supporting chronic pain. Through my publications (peer-reviewed original research and editorial efforts), my clinical research, and my involvement with professional societies, I have sought to 1) offer insight into the autonomic/neural mechanisms by which cognitive-emotional and somatosensory processes influence pain, 2) provide a brain target for neuro-modulatory treatments for pain, and 3) guide patients and providers to discover new therapies for chronic pain based on my pain neuroimaging research.