

Sungshin Kim, PhD

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Research interests

- Computational modeling of human movement control, learning, and memory
- Neuroscientific approach to augmentation and optimization of human learning
- Brain inspired artificial intelligence (Reverse engineering the brain to understand learning and memory)
- Cognitive and neural mechanisms underlying decision making in the framework of reinforcement learning

Education

- 2009-2013 Ph.D., Neuroscience, University of Southern California, Los Angeles, California, USA
(Thesis advisor: Nicolas Schweighofer)
- 2005-2008 M.S., Biomedical Engineering, Duke University, Durham, North Carolina, USA
- 2003-2005 M.S., Electrical & Computer Engineering, Seoul National University, Seoul, Korea
(Thesis advisor: Sung June Kim)
- 1998-2003 B.S., Electrical & Computer Engineering, Seoul National University, Seoul, Korea
- 1998-2003 B.S., Chemical Engineering, Seoul National University, Seoul, Korea

Training

- 2015-2017 Postdoctoral Fellow, Northwestern University, Chicago, Illinois (PI: Joel L Voss)
- 2014-2015 Postdoctoral Fellow, University of Chicago, Chicago, Illinois (PI: Sliman J Bensmaia)
- 2013 Visiting Scholar, Max Planck Institute for Intelligent Systems, Tuebingen, Germany (PI: Stefan Schaal)
- 2009-2013 Visiting Student, Advanced Telecommunications Research Institute International, Kyoto, Japan
- 2008-2009 Research Assistant, Image Computing Systems Laboratory in University of Washington, Seattle, Washington
- 2007-2008 Research Assistant, Optical Coherence Tomography Lab in Duke University, Durham, North Carolina
- 2004-2005 Research Assistant, Nanobio Electronics & Systems Center, Seoul, Korea
- 2004 Research Engineer, Nurobiosis Corp., Seoul, Korea

Academic Appointments

- 2020-Present Assistant Professor
Department of Cognitive Sciences, Hanyang University, Seoul, Korea
- 2017-2020 Research Assistant Professor (Principal Investigator/Non-tenure Track)
Sungkyunkwan University, Suwon, Korea
- 2017-2020 Young Scientist Fellow

Honors and Awards

2019	*Postdoctoral travel Award, Annual Meeting of Cognitive Neuroscience Society, San Francisco, California, USA (*eligible for this award as a postdoc with graduation of PhD in 2013 or later)
2018	Selected as a scientist by BRIC with three high-impact papers (Hanbitsa) published in three years
2017	Young Scientist Fellowship, Institute of Basic Sciences, Korea
2013	3 rd prize in Neuroscience Symposium at University of Southern California, Los Angeles, California, USA
2009	Graduate student fellowship, University of Southern California, Los Angeles, California, USA

Professional Activities

Research advisor

2019-present	Research advisor, Human Plus Fusion Research & Development Challenge, Hanyang (Erica) University
2017-2020	Principal investigator, Computational Learning & Memory Neuroscience Lab, Center for Neuroscience Imaging Research, Institute of Basic Sciences
2018-Present	Research advisor, Department of Neurology, Samsung Medical Center, Korea
2016-Present	Research advisor, Department of Rehabilitation Medicine, Seoul Bundang Hospital, Sungnam, Korea

Teaching

2020	Advanced Python Programming
2020	AI and Decision Making
2018-2019	Instructor, CNIR summer internship training
2018	Guest lecturer for undergraduate course, "Mind Brain and Computer", Spring and Fall semester
2010-2011	Teaching assistant, Fundamentals of Neuroscience, University of Southern California
2010	Teaching assistant, General Biology, University of Southern California
2003	Teaching assistant, Electrical Engineering Lab, Seoul National University
2003	Teaching assistant, Electronic Circuits, Seoul National University

Trainees

Postdoctoral fellow and researchers

2019-present	In-gyu Choi, post-master researcher Seongbin Park, post-master researcher
2018-2020	Emily Yunha Shin, post-master researcher Yera Choi, post-master researcher
2018-2019	Hyungjung Lee, post-master researcher
2017-2019	Dr. Kyusung Lim, postdoctoral fellow
2017-2018	Heeae Kim, post-master researcher Yujin Jeong, post-master researcher

Undergraduate/graduate student

2020	Joonwoo Kang, undergraduate student at Stanford University
2020	Ho Hyun Kang, undergraduate student at Joongang University
2019-2020	Jisu Lee, graduate student at Yonsei University

2019 Spring Seung-yeon Lee, undergraduate student at Ewha Womans University
2018 Summer Nayeon Kwon, graduate student at Seoul National University
2018 Summer Mina Kwon, undergraduate student at Seoul National University
2018 Summer Ji-Hyeun Kim, undergraduate student at Kumoh National Institute of Technology
2018 Summer Jihye Hyun, undergraduate student at Kumoh National Institute of Technology

Community service

2020 Special lecturer, career counseling in Jeonnam Foreign Language High School, Naju, Korea
2019 Special lecturer, career counseling in Jeonnam Science High School, Naju, Korea
Science SLAM-D, Science talk to the public
2018 Discussion panel, Neuroethics workshop, Seoul, Korea
Grant reviewer, Korean brain research institute neuroethics research service
Special lecturer, Science Day event in Jeonnam Science High School, Naju, Korea

Media

2019 IBS news, "Brain map connecting dots"
Electronic Times, "In search of memory"
2019 Korea Broadcasting System (KBS, Daejun), HomoScience, "Revealing the secret of the brain"
YTN Science, "Story of neuroscience"
2018 TheScientist, "Noninvasive Brain Stimulation Modulates Memory Networks"
JoongAng Daily News, "Movie comes true: Memory jump by magnetic stimulation of the brain"
2015 DongA Science, "Brain region of learning and memory for movement"

Extramural Membership

Society for Neuroscience
Cognitive Neuroscience Society

Ad-hoc reviewer for:

eNeuro
Restorative Neurology and Neuroscience
Scientific reports
Perception
Human Movement Science
Journal of Neuroscience

Grant Awards

Principal Investigator:

2017-2020 Young Scientist Fellowship, 750,000 \$ in total (over 250,000 \$/year), **conditional on this position**
Role: PI Institute of Basic Sciences, Republic of Korea
Title: Computational neuroscience for learning & memory with neuroimaging and neuromodulation

Invited Lectures and Symposium

2020 Invited speaker at BME seminar, Sungkyunkwan University, Seoul, Korea

- 2020 Title: Recent studies of human learning and memory with neuroimaging and brain stimulation
Invited lecturer, Kookmin University, Seoul, Korea
- 2019 Title: Movement science- Understanding motor learning and memory
Invited speaker, Ulsan National Institute of Science and Technology (UNIST), Ulsan, Korea
Title: Neuroimaging studies of human learning & memory with neuromodulation
Invited speaker, The 6th SNUBH Rehabilitation Science & Technology Symposium, Seongnam, Korea
Title: Sophisticated Neuromodulation Approach to Enhance Cognition Based on Brain Connectivity
Symposium speaker, Fall Conference Korean Society for Human Brain Mapping, Sungkyunkwan University, Suwon, Korea
Title: Neural substrates related to supervised and reinforcement motor learning
Invited speaker, Seminar series for biomedical engineering, Asan Medical Center, Seoul, Korea
Title: Investigation of human learning and memory with fMRI and non-invasive brain stimulation
Symposium speaker, Cognitive Neuroscience Symposium, Sungkyunkwan University, Suwon, Korea
Title: Movement science in fMRI: Neural mechanisms underlying motor learning and memory
Invited speaker, Hanyang University, Ansan, Korea
Title: Investigation of neural mechanisms underlying motor learning and memory
Invited speaker, Chosun University, Gwangju, Korea
Title: Non-invasive stimulation targeting hippocampal-cortical network for improvement of associative memory of humans
Invited speaker, Korea Brain Research Institute (KBRI), Daegu, Korea
Title: Network-targeted non-invasive stimulation for enhancement of human associative memory
- 2018 Invited speaker, Symposium on Frontiers in Bio-IT Healthcare, Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Korea
Title: A recent study using transcranial magnetic stimulation to enhance human associative memory
Invited speaker, Samsung Medical Hospital
Title: In search of 'holy grail' of cognitive neuroscience: Human memory enhancement
Invited speaker, Hokkaido University, Sapporo, Japan
Title: Research on learning & memory with neuromodulation in Computational Learning & Memory Neuroscience (CLMN) Lab in Korea
- 2017 Invited speaker, Center for Information and Neural Networks, Osaka, Japan
Title: Research on Learning & Memory with Neuromodulation in CLMN lab
Invited speaker, Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Korea
Title: Restoring sensorimotor functions through intracortical microstimulation to somatosensory cortex- Next generation of Brain-Machine Interfaces
- 2016 Invited speaker, Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Korea
Title: Cache memory and hard disk in the brain: Combined approach of computational models and neuroimaging techniques
Invited speaker, Kyunghee University, Yongin, Korea
Title: Cache memory and hard disk in the brain: Combined approach of computational models and neuroimaging techniques
Invited speaker, Korea Institute of Science and Technology (KIST), Seoul, Korea
Title: Cache memory and hard disk in the brain: Combined approach of computational models and neuroimaging techniques

- 2015 Invited speaker, Joint Workshop of Dankuk Wearable Thinking Research Center and National Rehabilitation Center, Seoul, Korea
 Title 1: Computational models and model-based fMRI studies in motor learning
 Title 2: Restoring sensorimotor functions through intracortical microstimulation to somatosensory cortex – Next generation of Brain-Machine Interfaces
- Invited speaker, Daegu-Gyeongbuk Medical Innovation Foundation, Daegu, Korea
 Title: The psychometric properties of intracortical microstimulation – restoring touch for brain-machine interface
- 2014 Invited speaker, Ulsan National Institute of Science and Technology (UNIST), Ulsan, Korea
 Title: Computational models and model-based fMRI studies in motor learning
- Invited speaker, Korea Institute of Science and Technology (KIST), Seoul, Korea,
 Title: Computational models and model-based fMRI studies in motor learning
- Invited speaker, Department of Psychology, Korea University, Seoul, Korea,
 Title: Computational models and model-based fMRI studies in motor learning
- 2013 Invited speaker, Ewha Womans University, Seoul, Korea,
 Title: Computational models and model-based fMRI studies in motor learning
- Symposium speaker, Translational and Computational Motor Control Conference, San Diego, California
 Title: Neural correlates of motor memory with multiple time scales in sensorimotor adaptation

Publications (* denotes corresponding authorship)

International Journals

1. Choi Y, Shin EY, **Kim S***. Spatiotemporal dissociation of fMRI activity in the caudate nucleus underlies human de novo motor skill learning , *Proceedings of National Academy of Sciences U. S. A.*, Early Edition, 2020
2. **Kim S***. Bidirectional competitive interactions between motor memory and declarative memory during interleaved learning. *Preprint in bioRxiv*, 2020
3. **Kim S***. Competitive interactions between motor and episodic memory systems during learning. *Preprint in bioRxiv*, 2020
4. Choi Y, Shin EY, **Kim S***. Double dissociation of fMRI activity in the caudate nucleus supports *de novo* motor skill learning. *Preprint in bioRxiv*, 2019
5. **Kim S***, Voss JL. Large-scale network interactions supporting item-context memory formation. *PLoS One*, Vol. 14, Issue 1, 2019 (IF: 2.776)
6. **Kim S[§]**, Nilakantan AS[§], Hermiller MS, Palumbo R, VanHaerents SA, Voss JL*. Selective and coherent activity increases due to stimulation indicate functional distinctions between episodic memory networks. *Science Advances*, Vol. 4, Issue 8, 2018 ([§]co-first author)
7. **Kim S**, Callier T, Bensmaia SJ*. A computational model that predicts behavioral sensitivity to intracortical microstimulation. *Journal of Neural Engineering*, Vol. 14, Issue 1, 2017
8. Lee JY, Oh Y, **Kim SS**, Scheidt RA, Schweighofer N*. Optimal Schedule in Multi-task Motor Learning. *Neural Computation*, Vol. 28, Issue 4, 2016
9. **Kim S[§]**, Ogawa K[§], Lv J, Schweighofer N*, Imamizu H. Neural substrates related to motor memory with multiple time scales in sensorimotor adaptation. *PLoS Biology*, Vol. 13, Issue 12, 2015 ([§]co-first author)

10. **Kim S**, Callier T, Tabot GA, Gaunt RA, Tenore FV, Bensmaia SJ*. Behavioral assessment of sensitivity to intracortical microstimulation of primate somatosensory cortex. *Proceedings of National Academy of Sciences U. S. A.*, Vol. 112, Issue 49, 2015
11. Callier T, Saal HP, Tabot GA, **Kim S**, Bensmaia SJ, "Feeling through a bionic hand, *Journal of the Homeland Defense and Intelligence Analysis Center*, 1, 19-22, 2015 (IF: NA)
12. Tabot GA, **Kim SS**, Winberry JE, Bensmaia SJ*. Restoring tactile and proprioceptive sensation through a brain interface. *Neurobiology of Disease* Vol. 83, pp. 191-198, 2015
13. **Kim S***, Y. Oh, N. Schweighofer. Between-trial forgetting due to interference and time in motor adaptation. *PLoS One*, Vol. 10, Issue 11, 2015
14. **Kim S**, Callier T, Tabot GA, Tenore FV, Bensmaia SJ*. Sensitivity to microstimulation of somatosensory cortex delivered simultaneously through multiple electrodes. *Frontiers in Systems Neuroscience*, 9: 47, 2015
15. Schweighofer N, Lee JY, Goh HT, Cho Y, **Kim SS**, Stewart JC, Lewthwaite R, Winstein CJ*. Mechanisms of the contextual interference effect in individuals post-stroke. *Journal of Neurophysiology*, Vol. 105, Issue 5, 2011
16. Kim KH*, **Kim SS**, Kim SJ. Superiority of nonlinear mapping in decoding multiple single-unit neuronal spike trains: A simulation study. *Journal of Neuroscience Methods*. Vol. 150, Issue 2, pp. 202-211, 2006
17. Kim KH*, **Kim SS**, Kim SJ. Improvement of spike train decoder under spike detection and classification errors using support vector machine. *Medical & Biological Engineering & Computing*, Vol. 44, pp. 124-130, 2006

Manuscripts under review/preparation

1. Shin EY, Choi Y, Ogawa K, **Kim S***. Dissociation of neural substrates for motor learning and execution in multiple visuomotor mapping. *In preparation*
2. Shin EY, Choi Y, Lee J, **Kim S***. Neural representations of a complex de novo motor skill learning. *In preparation*
3. Jisu Lee, **Kim S***. Neural computations underlying human reinforcement learning in continuous state and choice space. *In preparation*

Conferences

1. Choi Y, Shin EY, Lee H, **Kim S** (2019). Dissociation of fMRI activities in the caudate nucleus supports reinforcement learning of motor skills. *Presented at the annual meeting of the Society for Neuroscience*, Chicago, USA
2. Lee J, **Kim S** (2019). Neural mechanisms underlying human reinforcement learning in a continuous choice space. *Presented at the annual meeting of the Society for Neuroscience*, Chicago, USA
3. Choi Y, Shin EY, Lee H, **Kim S** (2019). Double dissociation of fMRI activity in caudate nucleus supports human de novo motor skill learning. *Presented at IBS Conference on Neuroimaging*, Suwon, Korea
4. Choi Y, Shin EY, Lee H, **Kim S** (2019). Building a cognitive map of a reward-based motor skill learning. *Presented at Organization for Human Brain Mapping*, Rome, Italy
5. Shin EY, Choi Y, Lee H, **Kim S** (2019). Distinct neural correlates of a reward-based motor skill learning in early and advanced stages. *Presented at Organization for Human Brain Mapping*, Rome, Italy

6. **Kim S**, Choi Y, Shin EY (2019). Competitive and independent encoding of episodic versus procedural memory. *Presented at the annual meeting of the Cognitive Neuroscience Society*, San Francisco, California, USA
7. **Kim S**, Lim K (2018). Dissociation of neural substrates for motor planning and execution in learning multiple visuomotor mappings. *Presented at the annual meeting of the Society for Neuroscience*, San Diego, California, USA
8. **Kim S**, Hermiller MS, Palumbo R, Van Haerents SA, Voss JL (2017). Enhanced stimulus-evoked hippocampal-cortical activity during memory formation following network-targeted noninvasive brain stimulation. *Presented at the annual meeting of the Society for Neuroscience*, Washington DC, USA
9. Voss JL, **Kim S** (2017). Dynamic interaction between episodic and motor memory systems. *Presented at the annual meeting of the Society for Neuroscience*, Washington DC, USA
10. Warren KN, **Kim S**, Hermiller MS, Nilakantan AS, O'Neil JT, Palumbo R, Voss JL (2017). Increased functional connectivity during autobiographical memory retrieval. *Presented at the annual meeting of the Cognitive Neuroscience Society*, San Francisco, California, USA
11. **Kim S**, Voss JL (2016). Competitive and independent encoding of episodic versus procedural memory. *Presented at the annual meeting of the Cognitive Neuroscience Society*, San Francisco, California, USA
12. **Kim SS**, Hermiller MS, Voss JL (2016). Hippocampal-cortical fMRI network distinctions between two types of item-context memory. *Presented at the annual meeting of the Society for Neuroscience*, San Diego, California, USA
13. **Kim SS**, Callier T, Tabot GA, Tenore FV, Bensmaia SJ (2014). Discrimination of electrical stimulation to primary somatosensory cortex. *Presented at the annual meeting of the Society for Neuroscience*, Washington DC, USA
14. Sargent BA, **Kim SS**, Schweighofer N, Fetters L (2012). The contribution of exploration to learning in young infants. *Presented at the annual meeting of the Society for Neuroscience*, New Orleans, Louisiana, USA
15. **Kim S. -S**, Schaal S, Scheidt RA, Schweighofer N (2012). Directed exploration during learning of a high dimensional motor task. *Presented at the annual meeting of the Society for Neuroscience*, New Orleans, Louisiana, USA
16. Ogawa K, **Kim SS**, Imamizu H, Schweighofer N (2012). Multiple time constants in sensorimotor adaptation: a model-based fMRI study. *Presented at the annual meeting of the Society for Neuroscience*, New Orleans, Louisiana, USA
17. Oh Y, **Kim S**, Schweighofer N (2012). Optimal spacing effect in motor adaptation. *Presented at the annual meeting of the Society for Neuroscience*, New Orleans, Louisiana, USA
18. **Kim SS**, Scheidt RA, Schaal S, Schweighofer N (2011). Learning a new motor skill with a high dimension motor system: Preliminary results. *Presented at the annual meeting of the Society for Neural Control of Movement*, San Juan, Puerto Rico, USA
19. **Kim SS**, Callan DE, Schaal S, Schweighofer N (2010). Fast reinforcement learning of a motor task via adaptive exploration in humans. *Presented at the annual meeting of the Society for Neuroscience*, San Diego, California, USA
20. **Kim SS**, Lee JY, Schweighofer N (2010). In search of the optimal schedule for multi-task motor adaptation. *Presented at the annual meeting of the Society for Neural Control of Movement*, Naples, Florida, USA

21. Kim KH, **Kim SS**, Kim SJ (2005). Advantage of support vector machine for neural spike train decoding under spike sorting errors. *Presented at IEEE-EMBS, 27th annual international conference, Shanghai, China*
22. **Kim SS**, Kim KH, Kim SJ (2004). Neuronal spike train decoding for the brain-computer interface using nonlinear filter based on support vector machine. *Presented at the 7th Conference on Brain and Neural Science, Seoul, Korea*

Theses

1. **Kim SS** (2013). Computational models and model-based fMRI studies in motor learning. *PhD thesis, University of Southern California, Los Angeles, California, USA*
2. **Kim SS** (2005). Performance assessment of motor cortex spike train decoding algorithm. *Master thesis, Seoul National University, Seoul, Korea*