Curriculum Vitae

Personal Details

Name: Shmuelof, Lior

Date and Place of Birth: January 14th 1977, Jerusalem, Israel

Work Address: Department of Brain and Cognitive Sciences, Ben-Gurion University of the Negev P.O.B. 653 Beer-Sheva 841050,1 Israel. Phone: 972-8-6428769.

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Education

1999-2002	B.Sc. in Psychology and Biology - program for outstanding students in life sciences and psychology, Hebrew University of Jerusalem.
2002-2004	M.Sc. in Brain and Behavioral Sciences, Neurobiology Department, Hebrew University of Jerusalem. Name of advisor: Prof. Ehud Zohary Title of thesis: "Dissociation between ventral and dorsal fMRI activation during action observation".
2004-2009	Summa cun Laude Ph.D. in Brain and Behavioral Sciences, Neurobiology Department, Hebrew University of Jerusalem. Name of advisor: Prof. Ehud Zohary. Title of thesis: " The dual properties of the parietal cortex in recognition and execution of motor actions: An fMRI study".

Employment History

2017 – present	Senior lecturer, Department of Brain and Cognitive Sciences, Ben-Gurion University of the Negev, Israel
2013 – 2017	Lecturer, Department of Brain and Cognitive Sciences, Ben-Gurion University of the Negev, Israel
2011-2013	Postdoctoral trainee at the Department of applied Mathematics and Computer science, Weizmann Institute of Science, Israel.
2008-2011	Postdoctoral Research Scientist at the Motor Performance Laboratory, Neurology Department, Columbia University Medical Center, NY, USA.

Professional Activities

a)   Positions in academic administration

2014-presesnt   Head of the neuroscience teaching program at the Brain and Cognitive Sciences Department (undergraduate), Ben-Gurion University of the Negev.

2014-present   Member of the steering committee of the Brain Imaging Research Center, Ben-Gurion University of the Negev.

2014-2015   Deputy Head of the Department of Brain and Cognitive Sciences, Ben-Gurion University of the Negev.

2018- present   Head of the Department of Brain and Cognitive Sciences, Ben-Gurion University of the Negev.

b)   Professional functions outside universities/institutions

2004-2009   Initiation of a pre-surgical fMRI evaluation service in Hadassah Medical Center.

2017-present   Scientific director of the BGU-Aleh Negev Neurorehabilitation translational clinic

c)   Significant professional consulting

d)   Editor or member of editorial board of scientific or professional journal

2012-2015   Guest Associate Editor in Frontiers in Computational Neuroscience and Frontiers in Human Neuroscience.

e)   Ad-hoc reviewer for journals

Acta Psychologica, Experimental Brain Research, Journal of Neurophysiology, Journal of Neuroscience, NeuroImage, Neuropsychological Rehabilitation, Plos One, Plos Computational Biology, Frontiers, IEEE, Elife.

f)   Membership in professional/scientific societies

2010 – present   Neural Control of Movement
2005 – present   Society for Neuroscience
2005 – present   Israeli Society for Neuroscience

Educational Activities

(a)   <u>Courses taught</u>

2013-present   Teacher, topics in motor control and motor learning. Course for graduate students in the Department of Brain and Cognitive Sciences, Ben-Gurion University of the Negev.

2013-present   Coordinator and Teacher, Core Course in Neuroscience for graduate students. Department of Brain and Cognitive Sciences, Ben-Gurion University of the Negev.

2014-present   Coordinator and Teacher, Core Course in Neuroscience for undergraduate students. Department of Brain and Cognitive Sciences, Ben-Gurion University of the Negev.

2014-present   Teacher, Advanced imaging methods, course and seminar for graduate students. Department of Brain and Cognitive Sciences, Ben-Gurion University of the Negev.

2016-present   Teacher, cognitive processes in aging. Course for graduate students in the Department of Brain and Cognitive Sciences, Ben-Gurion University of the Negev.

(b)   <u>Research students</u>

Maayan Gutkind, MSc, 2015, Ben-Gurion University of the Negev, joint supervision with Prof. Opher Donchin

Guy Avraham, PhD, Ben-Gurion University of the Negev, joint supervision with Dr. Ilana Nisky

Gil Feinstein, MSc, Ben-Gurion University of the Negev

Amjad Abu-Remileh, joint supervision with Dr. Oren Shriki, as post-doc

Guy Avraham, Ben-Gurion University of the Negev, joint supervision with Dr. Ilana Nisky, as post-doc

Current students:

Katherin Joubran, PhD, Ben-Gurion University of the Negev

Inbar Avni, PhD, Ben-Gurion University of the Negev

Reut Binyamin, PhD, Ben-Gurion University of the Negev

Or Symonitz, MEng, Ben-Gurion University of the Negev, together with Rami Puzis

- **Awards, Citations, Honors, Fellowships**

(a) Honors, Citation Awards

2010	Dr. Shlomiuk award from the board of The Hebrew University of Jerusalem for outstanding Ph.D. Research
2017	Toronto Prize for young investigator, BGU

(b) Fellowships

2008	NCM fellowship, Neural Control of Movement, Florida
2009	MACHIAH Foundation/JCF Life science fellowship to support advanced training in the United States.
2011	Fellowship for Postdoctoral trainee at the Weizmann Institute of Science
*2014	Alon Fellowship for young faculty members from the Israeli Council for Higher Education

- **Scientific Publications**

a)   *h-index = 14 (ISI web of science)*
b)   *Total number of citations of all articles= 1265*

(a) Authored books

(b) Editorship of collective volumes

* Shmuelof L[PI] and Krakauer[PI], JW. 2015. Recent insights into perceptual and motor skill learning. Ebook published by Frontiers in Neuroscience.

(c) Refereed chapters in collective volumes

(d) Refereed articles

1. **Shmuelof[S] L**, Zohary[PI] E. 2005. Dissociation between ventral and dorsal fMRI activation during object and action recognition. Neuron 47:457–470.

2. **Shmuelof[S] L**, Zohary[PI] E. 2006. A mirror representation of others' action in the human anterior parietal cortex. Journal of Neuroscience 26: 9736-9742.

3. **Shmuelof[S] L**, Zohary[PI] E. 2007. Watching others' actions: Mirror representations in the parietal cortex. The Neuroscientist 13: 667-672. Review.

4. **Shmuelof[S] L**, Zohary[PI] E. 2008. Mirror-image representation of action in the anterior parietal cortex. 2008. Nature Neuroscience 11: 1267-1269.

5. Eisenberg[S] M[#], **Shmuelof[S] L[#]**, Vaadia[C] E, Zohary[PI] E. 2010. Functional Organization of Human Motor Cortex: Directional Selectivity for Movement. Journal of Neuroscience 30: 8897-8905. [#] - equal contribution.

6. Eisenberg[S] M, **Shmuelof[S] L**, Vaadia[C] E, Zohary[PI] E. 2011. The Representation of Visual and Motor Aspects of Reaching Movements in the Human Motor Cortex. Journal of Neuroscience 31:12377-12384.

7. **Shmuelof L[PD]**, Krakauer JW[PI]. 2011. Are we ready for a natural history of motor learning? Neuron 72: 469-76. Review.

8. **Shmuelof[PD] L**, Krakauer[C] J, Mazzoni[PI] P. 2012. How is a motor skill learned? Change and invariance at the levels of task success and trajectory control. Journal of Neurophysiology 108: 578:594.

9. **Shmuelof[PD] L**, Huang[PD] V, Haith[PD] A, Delnicki[T] RJ, Mazzoni[C] P, Krakauer[PI] JW. 2012. Overcoming motor "forgetting" through reinforcement of learned actions. Journal of Neuroscience 32: 14617-14621.

10. Mawase F[S], **Shmuelof[C] L**, Bar-haim[C] S, Karniel A[PI]. 2014. Savings in locomotor adaptation task explained by dual-rate context-dependent learning process. Journal of Neurophysiology 111: 1444-54.

11. **Shmuelof[C] L**, Yang J[S], Caffo[C] B, Mazzoni[C] P, Krakauer JW[PI]. 2014. The neural correlates of learned motor acuity. Journal of Neurophysiology 112: 971-980.

12. Yang J[S], **Shmuelof[C] L**, Xiao L[S], Krakauer[C] J, Caffo B[PI]. 2015. On tests of activation map dimension for fmri-based studies of learning. Frontiers in Neuroscience 14;9.

13. Vaswani P[S], **Shmuelof L[C]**, Haith A[C], Delnicki R[T], Huang V[PD], Mazzoni[C] P, Shadmehr R, Krakauer J[PI]. 2015. Exploratory escape from persistent residual errors in motor adaptation tasks. Journal of Neuroscience 35: 6969-6977.

14. Mawase F[S], Bar-Haim S[C], Joubran K, Rubin L[S], Karniel A[C], **Shmuelof L[PI]**. Increased adaptation rates and reduction in trial-by-trial variability in subjects with Cerebral Palsy following a multi-session locomotor adaptation training. 2016. Frontiers in Human Neuroscience 10:203.

15. Reichenthal M[S], Avraham G[S], Karniel A[C], **Shmuelof L[PI]**. Target size matters: Target errors contribute to the generalization of implicit visuomotor learning. 2016. Journal of Neurophysiology 116: 411-424.

16. Mawase F[PD], Bar-Haim S[C], **Shmuelof L[PI]**. Formation of long-term locomotor memories is associated with functional connectivity changes in the cerebellar-thalamic-cortical network. 2017. Journal of Neuroscience 37(2):349-361.

17. Kohen D[S], Karklinsky M[PD], Meirovitch Y[C], Flash T[C], **Shmuelof L[PI]**, Shortening preparation time for curved trajectories reveals an ongoing control of movement segments. 2017. Frontiers in Human Neuroscience 11:333.

18. Avraham G[PD], Mawase F[C], Karniel A[C], **Shmuelof L[C]**, Donchin O[C], Mussa-Ivaldi FA[C] and Nisky I[PI], Representation of Delayed Velocity-Dependent Force Field in the Sensorimotor System. 2017. Journal of Neurophysiology 118(4): 2110-2131.

19. Avraham G[PD], Leib R[PD], Karniel A[C], **Shmuelof L**[C], Mussa-Ivaldi FA[C] and Nisky I[PI], Running Behind Time – State-Based Delay Representation and Its Transfer from an Ecological Interception Task to Reaching and Tracking. 2017. eNeuro. 2017 Dec 26;4(6).

20. Abu-Rmileh A[PD], Zakkay E[S], **Shmuelof L**[C]*, Shriki O[C]*. Co-adaptive Training Improves Efficacy of a Multi-Day EEG-Based Motor Imagery BCI Training. Front Hum Neurosci. 2019 Oct 14;13:362. * equal contribution.

21. Gonda S[S], Shkedy Rabani A[S], Horesh N[S], Shmuelof L[C]. Fast and specific: insights into the acquisition and generalization of motor acuity. J Neurophysiol. 2019 Dec 1;122(6):2354-2363.

22. Avraham G[PD], Keizman M[S], Shmuelof L[C]. Environmental consistency modulation of error sensitivity during motor adaptation is explicitly controlled. J Neurophysiol. 2020 Jan 1;123(1):57-69.

23. Jossinger S[S], Mawase F[C], Ben-Shachar M[C], Shmuelof L[C]. Locomotor Adaptation Is Associated with Microstructural Properties of the Inferior Cerebellar Peduncle. Cerebellum. 2020 Feb 7.

(e) Published scientific reports and technical papers

(f) Unrefereed professional articles and publications

* Shmuelof L[PI], Krakauer JW[PI]. 2014, Recent insights intro perceptual and motor skill learning. Editorial. Frontiers in Human Neuroscience 8:683. [Impact Factor – 3.6, journal ranked 115/252 in Neuroscience, Q2].

(g)   Classified articles and reports

- **Lectures and Presentations at Meetings and Invited Seminars**

(a)   Invited plenary lectures

1.   2011. What can motor skill learning tell us about brain plasticity? International Conference on Visual & Cross-Modal Plasticity, Toronto, Canada. http://www.yorku.ca/yfile/special/plastic_vision_abstract_book.pdf

2.   2012. The puzzle of Motor learning: Bridging the laboratory real world divide. ELSC special seminar. Jerusalem, Israel. http://elsc.huji.ac.il/content/elsc-special-seminar-lior-shmuelof

3. 2013. The puzzle of motor learning: from skill learning to adaptation. Computational Motor Control Workshop, BGU, Israel. http://in.bgu.ac.il/en/engn/biomed/CMCW/Documents/CMCW%202013%20Call%20for%20Speakers.pdf

4. *2014. The neural basis of motor acuity. German-Israeli Minerva School on Cognitive Robotics, Berlin, Germany. http://minerva2014.de/.

(b)   Presentation of papers at conferences/meetings

1. Shmuelof, Zohary E. 2004. Dissociation between dorsal and ventral fMRI activation patterns during object and action recognition. Society for Neuroscience Annual Meeting, San-Diego, CA, USA.

2. Shmuelof L, Eisenberg M, Vaadia E, Zohary E. 2008. Representation of motor and visual aspects of movement in the human primary motor cortex. Society for Neuroscience Annual Meeting, Washington, DC, USA.

3. Shmuelof L, Hertz U, Zohary E. 2008. Hierarchal representation of observed actions in the parietal cortex. Vision Science Society Annual Meeting, Naples, FL, USA.

4. Shmuelof L, Hertz U, Zohary E. 2008. Mirror-like representation of observed actions. Neural Control of Movement Annual Meeting, Naples, FL, USA.

5. Shmuelof L, Zarahn E, Krakauer J, Mazonni P. 2009. Learning a new motor skill: Generalization, offline learning, and variation in practice strategies. Society for Neuroscience Annual Meeting, Chicago, IL, USA.

6. Shmuelof L, Zarahn E, Mazonni P, Krakauer J. 2010. What can functional imaging tell us about motor skill learning? Israeli Society for Neuroscience Meeting, Eilat, Israel.

7. Shmuelof L, Zarahn E, Mazonni P, Krakauer J. 2010. In search of motor skill representation in the brain: Training-dependent changes in speed-accuracy trade-off functions. Israeli Society for Neuroscience Meeting, Eilat, Israel.

8. Shmuelof L, Zarahn E, Mazonni P, Krakauer J. 2010. Finding the "sweet spot" for motor skill Learning: local versus generalized changes in speed-accuracy trade-off functions. The 2nd International Workshop on Perceptual Learning, Eilat, Israel.

9. Shmuelof L, Zarahn E, Krakauer J, Mazonni P. 2010. Skill learning as training-dependent changes in speed-accuracy trade-off functions. Advances in Computational Motor Control, San Diego, CA, USA.

10. Shmuelof L, Zarahn E, Mazonni P, Krakauer J. 2010. What can functional imaging tell us about motor skill learning? Society for Neuroscience Annual Meeting, San Diego, CA, USA.

11. Shmuelof L, Defining motor skill learning as improvement in movement execution. 2011. 33rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society, Boston, USA.

12. Shmuelof L, Huang VS, Haith AM, Delnicki RJ, Mazzoni P, Krakauer JW. 2011. Forgetting visuomotor mappings: Adapted states decay back to reinforced states. Israeli Society for Neuroscience Meeting, Eilat, Israel.

13. Shmuelof L, Delnicki RJ, Huang VS, Haith AM, Mazzoni P, Krakauer JW. 2011. Error-based adaptation is suppressed and model-free mechanisms activated when actions and outcomes are uncorrelated. Society for Neuroscience Annual Meeting, Washington, DC, USA.

14. Shmuelof L, Kodl J, Flash T. The compositional representation of trajectory in the motor cortex: An fMRI Study. 2012. ISFN, Israel.

15. Shmuelof L, Huang V, Haith A, Delnicki RJ, Mazzoni P, Krakauer JW. 2012. Overcoming motor "forgetting": adapted states decay back to reinforced states. Computational Motor Control Workshop, BGU, Israel.

16. Shmuelof L, Flash T, Krakauer JW. The neural basis of error-based and reinforcement learning in response to a visuomotor rotation. 2013. International Basal Ganglia Society Meeting, Israel.

17. Kohen D, Karklinsky M, Flash T, Shmuelof L. The building blocks of curved trajectories: studying the effect of shortened preparation time on execution variables. 2013. Computational Motor Control Workshop, BGU, Israel.

18. Mawase F, Shmuelof L, Bar-haim S, Karniel A. 2013. Savings in locomotor adaptation task explained by dual-rate context-dependent learning process. Computational Motor Control Workshop, BGU, Israel

19. *Kohen D, Karklinsky M, Meirovitch Y, Flash T, Shmuelof L. 2014. Shortening preparation time for curved trajectories reveals an ongoing control of movement segments. Neural Control of Movement Annual meeting, Amsterdam, Holland.

20. *Mawase F, Shmuelof L, Bar-Haim, S, Karnierl A. Locomotor adaptation in Cerebral Palsy patients is constrained by their increased performance variability. 2014. Society of Neuroscience Annual meeting, Washington DC, USA.

21. *Gutkind M, Karniel A, Shmuelof L. Target size matters: Goal-based errors contribute to the generalization of implicit visuomotor learning across tasks. 2014. ISFN, Israel.

22. *Mawase F, Bar-Haim, S, Karnierl A, Shmuelof L. Execution variability restricts locomotor adaptation in Cerebral Palsy patients. 2015. Neural Control of Movement Annual meeting, Charleston, North Carolina, USA.

23. *Avraham G, Mawase F, Shmuelof L, Donchin O, Mussa-Ivaldi FA, Nisky I. How Does the Sensorimotor System Represent Delayed Velocity-Dependent Force Field?
2015. Neural Control of Movement Annual meeting, Charleston, North Carolina, USA.

24. *Groweiss O, Shmuelof L. A common representation of intentionally curved reaching trajectories during planning and execution – an fMRI study. 2015. ISFN. Israel.

25. *Shmuelof L. Planning beyond preparation time: on the fly trajectory planning of curved trajectories. 2016. Computational Motor Control Workshop. BGU, Israel.

26. *Avraham G, Shkedy-Rabani A, Groweiss O, Nisky I, Shmuelof L The neural substrates of error processing in face of a visuomotor rotation. 2016. ISFN. Israel.

27. *Gonda S, Horesh N, Shkedy-Rabani A, Shmuelof L. Motor acuity acquisition is rapid and does not generalize within and cross effectors. 2016. ISFN. Israel.

28. *Mawase F, Bar-Haim S, Shmuelof L. Formation of long term locomotor memories is associated with separable functional connectivity changes in cerebellar-thalamic-cortical network. 2016. ISFN. Israel.

(c)   Presentations at informal international seminars and workshops

(d)   Seminar presentations at universities and institutions

1.   2013. Department of Psychology, Tel-Aviv University. Motor Skill Learning.
2.   2013. Department of Neurobiology, Haifa University. The puzzle of motor learning: bridging the laboratory real world divide.
3.   2013. Department of Biomedical Engineering, Ben-Gurion University of the Negev. The puzzle of motor learning: bridging the laboratory real world divide.
4.   2013. Gonda Brain Research center. Bar-Ilan University. The puzzle of motor learning: bridging the laboratory real world divide.
5.   *2014. Department of Physical Therapy, Tel-Aviv University. The puzzle of motor learning: from skill learning to adaptation.
6.   *2014. The neural basis of motor skill learning. ABC robotics special seminar, BGU, Israel.
7.   *2014. The neural basis of motor acuity. Zlotowski Center Annual retreat, Ben-Gurion University.
8.   *2016. Locomotor adaptation as a model for motor learning and memory. Brain & Cognition colloquium, Tel-Aviv University.

9. *2016. Investigation of motor planning processes during the preparation of curved trajectories. Brain Links Brain Tools Lecture, Freiburg University.
10. *2016. Planning beyond preparation time: on the fly trajectory planning of curved trajectories. Center for integrative neuroscience. University of Tubingen.

- **Patents**

- **Research Grants**

*2014- 2017   Keep walking, Tactile Perception, Research Development Projects supported by ABC robotics initiative at BGU (total support of ~ 200,000 dollar). Investigator in two consortiums.

*2015 - 2016   The hierarchical representation of action in the motor cortex during planning and execution. German-Israel Foundation startup grant (40,000 euro). Principle Investigator.

*2016-2018   The neural basis of model-based and model-free motor learning in response to a visuomotor rotation. Young Investigator Research Grant from the National Institute for Psychobiology in Israel (50,000 dollar). Principle Investigator.

*2016-2019   The neural basis of error sensitivity and savings in motor adaptation Israel Science Foundation (200,000$). Principle Investigator.

*2016-2020   The neural basis of trajectory planning. U.S. – Israel Binational Science Foundation (126,000$). Principle Investigator.

- **Present Academic Activities**

Research in progress

1. EEG study of locomotor adaptation, with Dr. Simona Bar Haim and Dr. Firas Mawase, 2017.
2. Representation of abstract and concrete trajectory in the motor cortex, 2017.
3. Neural basis of motor acuity learning, 2017.
4. Brain Computer Interface as a model system for skill learning, with Dr. Oren Shriki, 2017.
5. Study of structural deficits of CVA and TBI subjects using DTI, together with Dr. Simona Bar Haim, 2018.
6. The neural basis of sensitivity to error during learning, 2018.

7.   Motor planning, 2019.

- **Additional Information**

2013–present   Organizer of the annual international workshop "Karniel
                Computational Motor Control Workshop" at Ben-Gurion University.
2017-present   Head of steering committee, Brain Imaging Research Center