Michael Shvartsman

Research Scientist
Facebook Reality Labs Research

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https://mshvartsman.github.io

Research Interests

I turn theory into computational models and tools that make scientists more effective. Sometimes those scientists are just me, but I try to multiply my impact by helping people do better science. I'm passionate about understanding how humans make sense of the world, and bringing domain knowledge and structure to data-poor problems.

Education and work experience

2018–curr. **Research Scientist, Facebook Reality Labs Research**
Introduced model-based sample-efficient experimentation methods to interactions-focused research org · Created and currently leading a virtual team of engineers and researchers building out new tooling for experimentation in the service of novel device design · Past projects include predictive modeling for neuroimaging and brain-computer interfaces, and representation learning for action recognition.

2014–2018 **Postdoctoral Research Associate, Princeton University**
Advisor: J. D. Cohen

Built a theory and model of the dynamics of multi-stimulus decision making, extending the diffusion decision model and sequential probability ratio test · Developed separable covariance models for analysis high-dimensional spatiotemporal neuroimaging data · Mentored undergraduate and graduate students · Collaborated and published with applied mathematicians, statisticians, and engineers as part of industry-academic collaboration project.

2009-2014 **Ph.D., Psychology (Cognition & Cognitive Neuroscience), University of Michigan**
Committee: R. L. Lewis & S. Singh (co-chairs), J. Boland, J. Brennan, J. Hale

Designed, performed and analyzed behavioral, eye-tracking, and computational experiments to drive theoretical developments in the understanding of eye movement control for reading as a bounded-optimal sequential inference process · Mentored undergraduate and master's students.

2008-2009 **Research Assistant, Cognitive Neuroscience of Language Lab, University of Maryland**
Designed, performed and analyzed behavioral and neuroimaging experiments seeking to understand the use of working memory in sentence processing and the neural substrate for perception of language and music.

2007-2008 **Associate Product Manager, Gartner, Inc.**
Launched and oversaw worldwide expansion of new research product for small technology vendors.

2007 **B.A., Linguistics, Yale University.**
Senior thesis advisor: Maria Piñango.

Skills and Languages

Technical Skills: Scientific programming (expert Python and R, intermediate C++, basic MATLAB) · High-throughput computing · Data analysis and applied statistics (mixed effects / hierarchical models, probabilistic programming, Gaussian processes and Bayesian optimization, tensor methods).

Languages: English, Russian, Hebrew, basic French.

Open-source contributions: core developer of AEPsych package for adaptive experimentation in psychophysics · primary developer of `brainiak.matnormal` prototyping toolkit for kronecker-separable covariance models for neuroscience (included in the BrainIAK toolkit for neuroimaging analysis) · contributor to `botorch`, `gpytorch`.

Professional Activities & Awards

2015– Reviewing: **Conferences**: Cognitive Science, ICLR, ICML, NeurIPS. **Journals**: Psychological Review, Journal of Experimental Psychology: General, Journal of Memory and Language, NeuroImage, Frontiers in Psychology, Quarterly Journal of Experimental Psychology, Computational Brain and Behavior, Open Mind.

2019– Career talks: University of Puget Sound Neuroscience Department, Princeton Neuroscience Institute.

2018– Founding organizer and tech chair, Conference on the Mathematical Theory of Deep Neural Networks (DeepMath) (2018, 2019, 2020, 2021).

2015 Co-organizer, workshop on Random Walks across Decision Making Domains, Computational and Systems Neuroscience (Cosyne) 2015.

2014 Best Student Paper, Cognitive Modeling and Computational Linguistics (CMCL) 2014.

Selected Publications & Talks

For complete list, see `https://mshvartsman.github.io/publications/`.

Journal articles, book chapters, and proceedings

2021 Owen, L., Browder, J., Letham, B., Stocek, G., Tymms, C., and **Shvartsman, M.** (Submitted). Adaptive Nonparametric Psychophysics. Preprint available at arXiv: 2104.09549.

2021 Kumar, M., ..., **Shvartsman, M.**, et al. (Submitted). BrainIAK: The Brain Imaging Analysis Kit. Preprint available at OSF: osf.io/db2ev

2020 Boring, M., Ridgeway, K., **Shvartsman, M.**, and Jonker, T. (2020). Continuous decoding of cognitive load from electroencephalography reveals task-general and task-specific correlates. *Journal of Neural Engineering*. doi:10.1088/1741-2552/abb9bc

2020 Scott, T., **Shvartsman, M.**, Ridgeway, K. (2020). Unifying Few- and Zero-Shot Egocentric Action Recognition. EPIC@CVPR2020. Extended abstract available at arXiv: 2006.11393.

2020 Cai, M. B., **Shvartsman, M.**, Wu, A. Zhang, H. and Zhu, X. (2020). Incorporating structured assumptions with probabilistic graphical models in fMRI data analysis. *Neuropsychologia*, 144:107500. Preprint available at arXiv: 2005.04879.

2019 Spitzer, M., Musslick S., **Shvartsman, M.**, Shenhav A., and Cohen, J.D. (2019).

Asymmetric switch costs as a function of task strength. Proceedings of the 41st Annual Conference of the Cognitive Science Society (CogSci 2019).

2018 **Shvartsman, M.**, Sundaram, N., Aoi, M., Charles, A., Willke, T and Cohen, J. D. (2018). Matrix-variate models for fMRI analysis. In Storkey, A., and Perez-Cruz, D., Proceedings of the Twenty-First International Conference on Artificial Intelligence and Statistics (AISTATS 2018). Extended version available at arXiv: 1711.03058.

2017 Parker, D., **Shvartsman, M.**, & Van Dyke, J. A. (2017). The cue-based retrieval theory of sentence comprehension: New findings and new challenges. In Escobar, L., Torrens, V., Parodi, T. (eds.) Language Processing and Disorders. Newcastle: Cambridge Scholars Publishing.

2016 Lositsky, O., Chen, J., Toker, D., Honey, C. J., **Shvartsman., M.**, Poppenk, J. L., Hasson, U., and Norman, K. A. (2016). Neural Pattern Change During Encoding of a Narrative Predicts Retrospective Duration Estimates. *eLife*, 5:e16070. DOI:10.7554/eLife.16070

2016 **Shvartsman, M.**, Srivastava, V., Sundaram, N., and Cohen, J. D. (2016) Using behavior to decode allocation of attention in context dependent decision making. In Reitter, D., and Ritter, F., Proceedings of the 14th International Conference on Cognitive Modeling (ICCM 2016).

2015 **Shvartsman, M.**, Srivastava, V., and Cohen, J. D. (2015) A Theory of Decision Making Under Dynamically Changing Context. In Cortes C., Lawrence N.D., Lee D.D., Sugiyama M., and Garnett R., Proceedings of Advances in Neural Information Processing Systems 28 (NeurIPS 2015).

2014 **Shvartsman, M.**, Lewis, R. L., and Singh, S. Computationally Rational Saccadic Control: An Explanation of Spillover Effects Based on Sampling from Noisy Perception and Memory. Proceedings of the 5th Workshop on Cognitive Modeling and Computational Linguistics (CMCL at ACL 2014). **Best student paper award**.

2013 Lewis, R. L., **Shvartsman, M.**, & Singh, S. (2013). The adaptive nature of eye movements in linguistic tasks: how payoff and architecture shape speed-accuracy trade-offs. *Topics in Cognitive Science*, 5(3), 581–610. DOI:10.1111/tops.12032

2013 Bergelson, E., **Shvartsman, M.**, & Idsardi, W. J. (2013). Differences in mismatch responses to vowels and musical intervals: MEG evidence. *PLoS One*, 8(10). DOI:10.1371/journal.pone.0076758

2010 *Bratman, J., ***Shvartsman, M.**., Lewis, R. L., & Singh, S. (2010). A new approach to exploring language emergence as boundedly optimal control in the face of environmental and cognitive constraints. In Salvucci, D. and Gunzelmann, G., editors, Proceedings of the 10th International Conference on Cognitive Modeling. (*equal contribution) **Best Student Paper honorable mention**.

Posters and Oral Presentations (without proceedings)

2019 **Shvartsman, M.** (2019). Gaussian processes and cognitive models for joint modeling of brain and behavior. **Invited talk**, Joint Modeling Workshop, Midwest Cognitive Science Conference.

2017 **Shvartsman, M.**, Srivastava, V., Sundaram, N., and Cohen, J. D. (2017) A theory of decision making under changing context. **Invited talk** given at IBM Research; Koditschek Lab, Dept. of Eletrical and Systems Engineering, University of Pennsylvannia; Frank Lab, Dept. of Cognitive, Linguistic and Psychological Sciences, Brown University.

2017 **Shvartsman, M.**, Srivastava, V., and Cohen, J. D. (2017) Exploring fixed-threshold

and optimal policies in multi-alternative decision making. Poster presented at the Multi-disciplinary Conference on Reinforcement Learning and Decision Making (RLDM), Ann Arbor, MI.

2014 **Shvartsman, M.**, Lewis, R. L., & Singh, S. (2014) Spillover frequency effects in a sequential sampling model of reading. Talk given at the 27th annual CUNY conference on human sentence processing. <10% talk acceptance rate.

2012 **Shvartsman, M.**, Lewis, R. L., & Singh, S. (2012) The adaptive nature of eye-movement control in linguistic tasks. Talk given at the 25th annual CUNY conference on human sentence processing. <10% talk acceptance rate.

2011 **Shvartsman, M.**, Lewis, R., Singh, S., Smith, M., & Bartek, B. (2011). Predicting Task Performance from Individual Variation in Eye-Movement Control Strategies. Poster presented at the 24th annual CUNY conference on human sentence processing.

Mentoring and Teaching

2016–18 Weekly statistics workshops/tutorials for Princeton Neuroscience Institute graduate students and postdocs (jointly with Dave Kleinschmidt).

2010–16 Co-mentoring (with faculty PI) four University of Michigan honors undergraduate theses (B. Berend, C. Sanders, M. Shyam, E. Wilcox) and one accelerated masters thesis (Y. Kazerooni). Mentoring additional undergraduate research assistants.

2010–12 Graduate Student Instructor, Introduction to Linguistics and Introduction to Cognitive Psychology. Grader, Introduction to Psycholinguistics.