Joshua Jacobs, Ph.D.

Contact

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Professional

- 2015–present, Assistant Professor, Department of Biomedical Engineering, Columbia University.
  - Member of Columbia University Doctoral Program in Neurobiology and Behavior.
  - Member of Columbia University Translational Neuroscience Initiative (CTNI).
- 2010–2014, Assistant Professor, School of Biomedical Engineering and Department of Psychology, Drexel University.
- 2009–2010, Postdoctoral researcher, University of Pennsylvania.
- 2002–2003, Senior Unix Software Developer, Bloomberg L.P., NY.

Education

- 2004–2008, Ph.D., University of Pennsylvania (Neuroscience). Thesis: *Brain oscillations as a window into human cognition. Winegrad award for best dissertation in Neuroscience.*
- 2001–2002, M.Eng., Massachusetts Institute of Technology (Computer Science). Thesis: *Improving memory performance through runtime optimization.*
- 1997–2001, S.B., Massachusetts Institute of Technology (Computer Science).

Publications (peer reviewed)

- Zhang, H., Watrous, A.J., Patel. A, & **Jacobs, J.** Theta and alpha oscillations are traveling waves in the human neocortex. (In press). *Neuron*.
- Miller F. Jonathan, Watrous, A.J., Tsitsiklis, M., Lee, S.A. , Sheth, S., Schevon, C.A., Smith, E., Sperling, M.R., Sharan, A., Asadi-Pooya, A.A., Worrell, G., Meisenhelter, S, Inman, C., Davis, K.A., Lega, B., Wanda, P., Das, S.R., Stein, J.M., Gorniak, R, & **Jacobs, J.** (In press). Lateralized hippocampal oscillations underlie distinct aspects of human spatial memory and navigation. *Nature Communications.*
- Goyal, A., Miller, J., Watrous, A.J., Lee, S.A., Coffey, T., Sperling, M., Sharan, A., Worrell, G., Brent, G., Lega, B., Jobst, B.C., Davis, K., Gross, R., Sheth, S., Ezzyat, Y., Das, S., Stein, J., Gorniak, R., Wanda, P., & **Jacobs, J.** (2018). The medial temporal lobe organizes memory across time and space: Causal evidence from brain stimulation. *The Journal of Neuroscience*. Available online: 10-April-2018, 3049–17.
- Lee, S.A., Miller, J., Watrous, A., Sperling, M., Sharan, A, Worrell, G., Berry, B., Jobst, B., Davis, K., Gross, R, Lega, B., Sheth, S., Das, S., Stein, J., Gorniak, R., Rizzuto, D., & **Jacobs, J.** (2018). Electrophysiological signatures of spatial boundaries in the human subiculum. *Journal of Neuroscience*. 38 (13), 3265–3272.
- **Jacobs, J.**, Lega, B., Watrous, A. (2017). Human hippocampal theta oscillations: Distinctive features and interspecies commonalities. In: *The Hippocampus from Cells to Systems: Structure, Connectivity, and Functional Contributions to Memory and Flexible Cognition*, eds. Hannula, D., Duff, M., 37–67.
- **Jacobs, J.**, Miller, J., Lee, S. A., Coffey, T., Watrous, A. J., Sperling, M. R., Sharan, A., Worrell, G., Berry, B., Lega, B., Jobst, B., Davis, K. Gross, R. E., Sheth, S. A., Ezzyat, Y., Das, S. R., Stein, J., Gorniak, R., Kahana, M. J., and Rizzuto, D. S. (2016). Direct electrical stimulation of human entorhinal cortex impairs memory. *Neuron.* 92, 5, 983–990.
  - Media discussions: Nature, The Wall Street Journal, Time, The Atlantic, and Neurology Today.

- Zhang, H. & **Jacobs, J.** (2015). Travelling theta waves in the human hippocampus. *Journal of Neuroscience*, 35, 36, 12477–12487.
- Miller, J., Fried, I.F., Suthana, N., **Jacobs, J.** (2015). Repeating spatial activations in human entorhinal cortex. *Current Biology*, 25, 8, 1080-1085.
- van der Meij, R., **Jacobs, J.**, Maris, E. (2015) Uncovering phase-coupled oscillatory networks in electrophysiological Data. *Human Brain Mapping*, 36, 7, 2655–2680.
- Burke, J. F., Merkow, M., **Jacobs, J.**, Kahana, M. J., and Zaghloul, K. (2015). Brain computer interface to enhance episodic memory in human participants. *Frontiers in Human Neuroscience*, 8, 1055.
- Lega, B. C., Burke, J. F., **Jacobs, J.**, and Kahana, M. J. (2014). Slow theta-to-gamma phase amplitude coupling in human hippocampus supports the formation of new episodic memories. *Cerebral Cortex*.
- Ritaccio, A., Brunner, P., Gunduz, A., Hermes, D., Hirsch, L., **Jacobs, J.**, Kamada, K., Kastner, S., Knight, R.T., Lesser, R., Miller, K., Sejnowski, T., Worrell, G., Schalk, G. (2014). Proceedings of the Fifth International Workshop on Advances in Electrocorticography. *Epilepsy and Behavior* 41, 183-192.
- Misra, A., Burke, J.F., Ramayya, A., **Jacobs, J.**, Sperling, M.R., Moxon, K., Kahana, M., Evans, J. and Sharan, A.D. (2014). Methods for implantation of micro-wire bundles and optimization of single/multi-unit recordings from human mesial temporal lobe. *Journal of Neural Engineering*. 11, 2, 026013.
- **Jacobs, J.** (2014). Hippocampal theta oscillations are slower in humans than in rodents: Implications for models of spatial navigation and memory. *Philosophical Transactions of the Royal Academy of Sciences B*. 369: 20130304.
- Merzagora-Rodriguez, A., Coffey, T., Sperling, M., Sharan, A., **Jacobs, J.** (2014). Repeated stimuli elicit diminished high-gamma electrocorticographic responses. *Neuroimage*. 85, 844–852.
- Miller, J., Neufang, M., Solway, A., Brandt, A., Hefft, S., Mader, I., Polyn, S., **Jacobs, J.**, Kahana, M. Schulze-Bonhage, A. (2013). Neural activity in human hippocampal formation reveals the spatial context of retrieved memories. *Science*, 342, 6142, 1111–1114.
- **Jacobs, J.**, Weidemann, C., Burke, J., Miller, J., Wei, X., Solway, A., Sperling, M., Sharan, A., Fried, I., Kahana, M. (2013). Direct recordings of grid cells in human spatial navigation. *Nature Neuroscience*. 16(9), 1188–1190.
  - Featured image on the journal cover.
  - Media discussions: Nature Reviews Neuroscience, New York Times, Fox News, Huffington Post, and Live Science.
- van Gerven, M., Maris., E., Sperling, M., Sharan, A., **Jacobs, J.** (2013). Decoding individual brain states with direct human brain recordings. *NeuroImage*. 70, 223–232.
- Burke, J. F., Zaghloul, K. A., **Jacobs, J.**, Sperling, M. R., Sharan, A. D., and Kahana, M. J. (2013). Synchronous and asynchronous theta and gamma activity during human verbal episodic memory formation. *The Journal of Neuroscience*. 33(1), 292–304.
- **Jacobs, J.**, Lega, B. & Anderson, C. (2012). Explaining how brain stimulation can evoke memories. *Journal of Cognitive Neuroscience.* 24(3), 553–563.
- **Jacobs, J.**, Miller, K., Edwards, E., & Voytek, B. (2011). Spurious report of high-frequency electrocorticographic oscillations. [Electronic response to Nonuniform High-Gamma (60–500 Hz) Power Changes Dissociate Cognitive Task and Anatomy in Human Cortex., Gaona et al.] *The Journal of Neuroscience.* Published online Feb. 28, 2011.
- Lega, B., **Jacobs, J.**, & Kahana, M.J. (2011). Human hippocampal theta oscillations and the formation of episodic memories, *Hippocampus*, 22(4), 748–761.
- **Jacobs, J.**, Kahana, M.J., Ekstrom, A.D., Mollison, M., & Fried, I. (2010). A sense of direction in human entorhinal cortex. *Proceedings of the National Academy of Sciences*. 107(14), 6487–6492.
- **Jacobs, J.**, Kahana, M.J. (2010). Direct brain recordings fuel advances in cognitive electrophysiology. *Trends in Cognitive Sciences*. 14(4), 162–171.
- **Jacobs, J.**, Korolev, I.O., Caplan, J.B., Ekstrom, A.D., Litt, B., Baltuch, G., Fried, I., Schulze-Bonhage, A., Madsen, J. R., & Kahana, M.J. (2010). Right-lateralized brain oscillations in human spatial navigation. *Journal of Cognitive Neuroscience*. 22(5), 824–836.

- **Jacobs, J.**, Manning, J.R., Kahana, M.J. (2010). Response to Miller: "Broadband" vs. "high gamma" electrocorticographic signals. *The Journal of Neuroscience.* 30, online.
- Manning, J.R., **Jacobs, J.**, Fried, I., & Kahana, M.J. (2009). Broadband shifts in LFP power spectra are correlated with single-neuron activity in humans. *The Journal of Neuroscience*. 29(43), 13613–3620.
- **Jacobs, J.**, & Kahana, M.J. (2009). Neural representations of individual stimuli revealed by gamma-band electrocorticographic activity. *The Journal of Neuroscience*, 29(33), 10203–10214.
- **Jacobs, J.**, Kahana, M.J., Ekstrom, A.D. & Fried, I. (2007). Brain oscillations control timing of single-neuron activity in humans. *The Journal of Neuroscience*, 27(14), 3839–3844.
- Geller, A.S., Schleifer, I.K., Sederberg, P.B., **Jacobs, J.**, & Kahana, M.J. (2007). PyEPL: A cross-platform experiment-programming library. *Behavior Research Methods*, 39(4), 950–958.
- Ekstrom, A., Viskontas, I., Kahana, M.J., **Jacobs, J.**, Upchurch, K., Bookheimer, S., & Fried, I. (2007). Contrasting roles of single neuron activity and local field potentials in human memory. *Hippocampus*, 17(8), 606–17.
- **Jacobs, J.**, Hwang-Grodzins, G., Curran, T., & Kahana, M.J. (2006). EEG oscillations and recognition memory: Theta correlates of memory retrieval and decision making. *NeuroImage*, 32, 978–987.
- Hwang-Grodzins, G., **Jacobs, J.**, Geller, A., Danker, J., Sekuler, R., & Kahana, M.J. (2005). EEG correlates of verbal and nonverbal working memory. *Behavioral and Brain Functions*, 1:20.
- Kahana, M.J. & **Jacobs, J.** (2000). Inter-response times in serial recall: Effects of intraserial repetition. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 26, 1188–1197.

Manuscripts Under Review

- Maidenbaum, S., Miller, J., Stein, J.M., **Jacobs, J.** A grid-cell signal in human entorhinal theta oscillations. Invited revision for *Proceedings of the National Academy of Sciences*.
- Watrous, A.J., Miller, J., Qasim S., Fried, I., **Jacobs, J.** Phase-tuned neuronal firing encodes human contextual representations for navigational goals. Invited revision for *eLife*.
  - Preprint: https://www.biorxiv.org/content/early/2017/12/15/202374
- Bahramisharif, A., Jensen, O., **Jacobs, J.**,* & Lisman, J.* Properties of oscillations underlying working memory at content-specific cortical sites. Invited revision for *Public Library of Science: Biology.* (* equal contributions.)
  - Preprint: http://www.biorxiv.org/content/early/2017/08/02/171660

News and views articles

- Qasim, S. & **Jacobs, J.** (2016). Human hippocampal theta oscillations during movement without visual cues. *Neuron*, 89, 6, 1121–1123.
- **Jacobs, J.** & Lee, S. A. (2016). Spatial Cognition: Grid cells support imagined navigation. *Current Biology*, 26, 7, R277–R279.

Current funding (PI: Jacobs)

- NIMH R01-MH104606. Title: "Role of grid and place cells in human spatial navigation and memory." 8/2015–7/2020. PI: Jacobs. $2,664,846.
- NSF: Collaborative Research in Computational Neuroscience (CRCNS). Title: "USA-Germany Research Proposal: Probing the role of grid cells in human episodic memory." $811,502. 11/17–10/20.
- NIH U01 Administrative Supplement: Developing Virtual Reality Software for Probing the Role of Space in Multisensory Perception. $100,000 (direct costs).
- Neurtex Brain Research Institute. Title: "Neurtex Brain Research Institute Research Project." 7/1/2018–6/31/2019. PI: Jacobs. $145,623.

Current funding (Jacobs subcontract recipient)

- DARPA Restoring Active Memory (RAM). Title: "Memory Enhancement with Modeling, Electrophysiology, and Stimulation (MEMES)." Cooperative Agreement N66001-14-2-4032. Subcontract from U. Penn. $1,200,250. 7/2014–7/2019.

- NIMH R01-MH061975. Title: "Electrophysiology of human spatial navigation and memory." PI: Kahana. Subcontract to Jacobs, coinvestigator. $497,666. 5/2014–4/2019.
- NIMH U01: Title: "Dynamic Neural Mechanisms of Audiovisual Speech Perception". PI: Schroeder. Jacobs, coinvestigator (1.5 months salary support). 9/2016–8/2019.
- NIMH/Brain Initiative: U03: Decoding resting state functional connectivity mapping using SCAPE microscopy (0.5 months salary support). PI: Hillman, E. Jacobs, coinvestigator. 9/2017–8/2022.

Pending funding

- NIMH R21. Title: "Brain stimulation for cognitive enhancement based on modulation of cortical traveling waves." 9/2018–8/2020. $275,000 (direct costs).
- National Science Foundation. Collaborative research in Computational Neuroscience (CRCNS). Title: "Functional and computational properties of theta and alpha traveling waves." 9/2018–8/2021 $603,780 (total).

Completed funding

- NIMH R01-MH104606-A3 *Administrative Supplement Program Providing Research Experiences for Physicians and Medical Students from Diverse Backgrounds.* Supplement to R01-MH104606. 9/2015–7/2016. $72,619.
- Brain and Behavior Research Foundation (formerly NARSAD) New Investigator Award. $60,000, 1/2013–12/2015.
- Drexel Human Cognition Enhancement Program. $10,000, (11/2011–10/2012).
- NIH Neuroimaging training grant postdoctoral fellowship (1/2009–8/2010).
- NIH Predoctoral National Research Service Award (5/2008–12/2008).
- NIH Computational Neuroscience Training fellowship (5/2007–4/2008).
- NSF Integrative Graduate Education and Research Traineeship (IGERT) fellowship (11/2005–5/2007).

Awards

- Brain and Behavior Research Foundation (NARSAD) New Investigator Award (2013).
- Outstanding Dissertation in Neuroscience (2009). Saul Winegrad, M.D., Award.
- Computational Cognitive Neuroscience Annual Meeting, selected as one of the top posters (2009).
- Westinghouse (Intel) Science Talent Search Finalist (1997).
- International Science and Engineering Fair: Second Place in Social Science & Naval Science Award (1997).

Teaching

- 2018 (Spring), 2017 (Spring), *Seminar in Human Memory and Navigation*, Columbia University (BMEN-E4050).
- 2017 (Fall), *Computational Modeling of Physiological Systems*, Columbia University (BMEN-E6003). Fall 2017
- 2016 (Fall), *Biostatistics for Engineers*, Columbia University (BMEN-E4110).
- 2011, 2012, 2013, & 2014 (Spring), Drexel University, *Principles in Neuroengineering* (BMES-478/BMES-711). Average rating: 4.9 out of 5.
- 2013 & 2014 (Winter), Drexel University, *Research Methods in Biomedical Engineering* (BMES-315/515). Average rating 4.5/10.
- 2012 (Winter), Drexel University, *Programming and Modelling for Biomedical Engineering* (BMES-202). Average rating: 4.6/5.
- 2009, 2010, 2011, & 2012. Director of the University of Pennsylvania's Undergraduate Summer Training Program in Computational Neuroscience (sponsored by NIH grant T90 DA 22763-01).

Current Mentoring

- Shachar Maidenbaum (Ph.D., 3/2017–present). Project: *Correspondence between fMRI and electrical activity underlying human spatial memory.*

- Honghui Zhang (Ph.D., 5/2017–present). Project: *Travelling alpha and theta oscillations in the human brain.*
- Andrew Watrous (6/2015–present). Postdoctoral researcher.
- Jonathan Miller (Ph.D., 9/2011–6/2015; post-doctoral fellow: 7/2015–present). Defended Ph.D. under my supervision. Title: *Neural mechanisms of spatial navigation and memory.*
- Salman Qasim (9/2015–present). Columbia University graduate student in Biomedical Engineering. Project: *Phase precession with human theta oscillations and single-cell recordings.*
- Uma Mohan (1/2016–present). Columbia University graduate student in Biomedical Engineering. Project: *Cross-frequency phase coupling in the human hippocampus.*
- Melina Tsitsiklis (9/2015–present). Columbia University graduate student in Neurobiology and Behavior. Jointly advised with Daphna Shohamy.
- Honghui Zhang. Ph.D. student at Drexel University. (12/2010–5/2017.) Project: *Travelling theta waves in the human neocortex.*
- Tora Bonnevie (1/1/2016–present). Research fellow in the laboratory of Edvard and May-Britt Moser (Norwegian University of Science and Technology, Trondheim, Norway).
- Simon Khuvis, (1/1/16–present). MD/PhD student, Northwell North Shore University Hospital. Project: *Hippocampal electrical signals underlying spatial navigation and perception.*
- Tamara Gedankien (8/2017–present). Columbia University graduate student in Biomedical Engineering.

Past Mentoring

- Honghui Zhang. Ph.D. student at Drexel University. (12/2010–5/2017.) Project: *Travelling theta waves in the human neocortex.*
- Tom Coffey (6/2012–9/2015). Project: *Deep brain stimulation stimulation and human spatial memory.* Current status: Graduate student at Drexel University.
- Walter Hinds (9/2010–8/2012). Project: *Human theta oscillations and the recognition memory processes.* Current status: Graduate student at Drexel University.
- Shady El Damaty (9/2011–6/2013). Defended M.S. under my supervision. Title: *Cohort-Selective Gamma Rhythms Support Hierarchical Visual Processing During Word Recognition.* Currently a Ph.D. student at Georgetown University.
- Hagai Lalazar (1/2016–5/2017). Postdoctoral researcher. Jointly advised with Larry Abbott.

Invited Talks

- Princeton University (March, 2011)
- Hahnemann Hospital (March, 2011)
- University of Pennsylvania Computational Neuroscience Retreat (April, 2011).
- Drexel University Medical School (May, 2011),
- Drexel Human Cognition Enhancement Program Annual Symposium (May, 2011)
- Workshop on High Frequency Oscillations. Montreal Neurological Institute. (May 2011).
- University of Pennsylvania Department of Psychiatry's Workshop on Gamma oscillations (October 2011).
- University of Wisconsin, Milwaukee (December, 2011)
- Drexel Chronobiology and Sleep Symposium (September, 2012)
- University of Pennsylvania Center for Cognitive Neuroscience (September, 2012)
- Space in the Brain, Royal Society, UK (May, 2013).
- Brandeis University (September, 2013).

- Fifth International Workshop on Advances in Electrocorticography (November, 2013).
- NeuroFutures. Seattle. (June, 2014).
- Single-neuron studies of the human brain. Johns Hopkins University. (November, 2014)
- Neurosurgery Department Grand Rounds, Columbia University Medical Center (February, 2015).
- Epilepsy Research Group, Columbia University Medical Center (February, 2015).
- NeuroTheory Center, Columbia University Medical Center (June, 2015).
- Department of Psychology, Columbia University (October, 2015).
- Center for Neural Engineering and Computation, Columbia University (October, 2015).
- Neurology Department, Cognitive Neuroscience Division, Columbia University (February, 2016).
- Department of Biomedical Engineering Seminar, Columbia University (February, 2016).
- NAVIGO 2016: A Symposium on Human Spatial Navigation. Munich, Germany (March, 2016).
- iNAV (Interdisciplinary Navigation Symposium). Bad Gastein, Austria (June, 2016).
- Third Human Single Neuron Recordings Conference, 2016. Pasadena, CA. (November, 2016).
- Minisymposium speaker at The Annual Meeting of the Society for Neuroscience, "Object encoding, semantic representation, and memory formation by single neurons in the human medial temporal lobe." San Diego, CA. (November, 2016).
- Statistical Analysis of Neural Data (SAND8). Pittsburgh, PA. (June, 2017).
- Hippocampus Meeting, session on Neuronal Oscillations, Sicily, Italy. (June, 2017).
- International Conference for Cognitive Neuroscience (ICON), workshop on neuronal oscillations and memory. Amsterdam, NL. (August, 2017).
- New York University Department of Cognitive Science (October, 2017).
- iNAV (Interdisciplinary Navigation Symposium). Montreal, Canada (June, 2018).
- Boston University, Neuroscience department, invited lecture (Fall, 2018).

Society memberships

- Society memberships: Society for Neuroscience (2003–present).
- Cognitive Neuroscience Society (2004–present).
- Psychonomic Society (2005–present).

Service at Columbia University

- Member of Columbia Department of Biomedical Engineering (DBME) Graduate Student Evaluation Committee.
- DBME representative on the Columbia Translational Neuroscience Initiative.
- Member of DBME Hiring Committee in Magnetic Resonance Imaging (2015–2016 academic year).

Service outside Columbia University

- National Institutes of Health: Special Emphasis Panel (ZRG1 IFCN-T (55); October, 2016).
- National Institutes of Health: Special Emphasis Panel (ZRG1 IFCN-B (55); June, 2017).
- National Institutes of Health: Special Emphasis Panel (ZNS1 SRB-N (16); April, 2018).
- National Science Foundation. Invited review panelist (October, 2017).
- National Science Foundation. Invited review panelist (April, 2018).

- Mentor for underrepresented medical student Omar Elfanagely. (August 2015–May 2016.)
- Peer reviewing (one to two reviews per month): Current Biology, Human Brain Mapping, NeuroImage, The Journal of Neuroscience, Science, Computational and Systems Neuroscience (COSYNE), Cerebral Cortex, Neuron, Journal of Cognitive Neuroscience, Public Library of Science: Computational Biology, Hippocampus, MIT Press, Neuroscience, Epilepsia, Army Research Office, Nature Neuroscience, National Science Foundation, Journal of Neurophysiology, European Union Grant Office, Psychological Reports, Journal of Neuroscience Methods, Nature Neuroscience, Royal Society: Open Science, Poland National Science Center, Wellcome Trust, National Science Foundation, Nature Communications.

Collaborators

- Daphna Shohamy (Psychology, Columbia University).
- Sameer Sheth, Catherine Schevon, & Charles Schroeder (Epilepsy Center, Columbia University).
- Itzhak Fried (Neurosurgery, University of California, Los Angeles).
- Michael Sperling, Joseph Tracy, Aswhini Sharan, Mijail Serruya (Neurology & Neurosurgery, Thomas Jefferson University).
- Brian Litt, Gordon Baltuch, Tim Lucas, & Michael Kahana (University of Pennsylvania).
- Barbara Jobst (Neurology, Dartmouth–Hitchcock Medical Center).
- Gregory Worrell (Neurology, Mayo Clinic).
- Bradley Lega (Neurosurgery, University of Texas, Southwestern Medical Center).
- Robert Gross (Neurosurgery, Emory University).

Last updated: May 3, 2018