Joshua Jacobs, Ph.D.

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Professional

- 2021–present, Associate Professor (tenured), Department of Biomedical Engineering and Department of Neurological Sciences (in Neurological Surgery), Columbia University.
  - Affiliations: Zuckerman Mind Brain Behavior Institute (ZMBBI), Doctoral Program in Neurobiology and Behavior, & Data Science Institute.
- 2015–2020, Associate and Assistant Professor (tenure track), Department of Biomedical Engineering, Columbia University.
- 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).

Peer-Reviewed Publications

61. Kunz, L., Staresina, B.P., Reinacher, P.C., Brandt, A., Guth, T.A., Schulze-Bonhage, A., **Jacobs, J.*** (In press). Human associative memory is tied to ripple-locked coactivity of object and place-like cells. *Nature Neuroscience*. [link]

60. Mohan, U., Zhang, H., Ermentrout, G., **Jacobs, J.*** (In press). The direction and timing of theta and alpha traveling waves modulate human memory processing. *Nature Human Behaviour*. Preprint: [link].

59. Donoghue, T., Maesta-Pereira, S., Han, C.Z., Qasim, S., **Jacobs, J.*** (2023). spiketools: a Python package for analyzing single-unit neural activity. Journal of Open Source Software 8 (91), 5268. [link]

58. Zabeh, E., Foley, N., **Jacobs, J.**,* Gottlieb, J.* (2023). Traveling waves in the monkey frontoparietal network predict recent reward memory. *Nature Communications*. 14,1, 5428. [link] (* co-senior authors.)

57. Gedankien, T., Tan, R.J., Qasim, S.E., **Jacobs, J.**,* Lega, B.* (2023). Acetylcholine modulates memory-related theta oscillations in the human hippocampal formation. *Nature Communications*, 14, 1, 5283. [link] (* co-senior authors.)

56. Donoghue T., Cao, R, Han, C., Holman, C.M., Brandmeir, N.J., Wang, S., **Jacobs, J.**. (2023). Single neurons in the human medial temporal lobe flexibly shift representations across spatial and memory tasks. *Hippocampus*, 33, 5, 600–615. [link]

55. Han, C.Z., Donoghue, T., Cao, R., Kunz, L., Wang, S., **Jacobs, J.**. (2023). Using multi-task experiments to test principles of hippocampal function. *Hippocampus*, 33, 5, 646–657. [link].

54. Qasim, S., Mohan, S., Stein, J., **Jacobs, J.*** (2023). Neuronal activity in the human amygdala and hippocampus enhances emotional memory encoding. *Nature Human Behaviour*. [link]. Published online: January 16, 2023.

53. Das, A., Zabeh, E., & **Jacobs, J.**.* (2023). How can we detect and analyze traveling waves in the human brain. Chapter in *Intracranial EEG for cognitive neuroscientists*. Editor: Nikolai Axmacher. [link]

52. Liu, A., Henin, S., Bragin, A., Buffalo, E.A., Farrell, J., Foster, D. J., Frank, L.M., Gedankien, T., Gotman, J., Guidera, J., Hoffman, K., **Jacobs, J.**, Kahana, M.J., Li, L, Liao, Z., Lin, J., Losonczy, A., Malach, R, van der Meer, M., McClain, K., McNaughton, B., Norman, Y, Navas-Olive, A., de la Prida, L., Rueckemann, J., Sakon, J., Skelin, I., Soltesz, I., Staresina, B., Weiss, S. A., Wilson, M. A., Zaghloul, K. A., Zugaro, M., Buzsaki, G.* (2022). A consensus statement on detection of hippocampal sharp wave ripples and differentiation from other fast oscillations. *Nature Communications.* 13, 6000. [link]

51. Umbach, G., Tan, R., **Jacobs, J.**, Pfeiffer, B., Lega, B.* (2022). Flexibility of Functional Neuronal Assemblies Supports Human Memory. *Nature Communications*. 13, 6162. [link]

50. Das, A., Myers, J., Mathura, R., Shofty, B., Metzger, B., Bijanki, K., Wu, C., **Jacobs, J.**,* Sheth, S.* (2022). Spontaneous Neuronal Oscillations in the Human Insula are Hierarchically Organized Traveling Waves. eLife. 11, e76702. (* equal contributions.) [link]

49. Lorusso, N. D., Mohan, U., **Jacobs, J.*** (2022). Jose Delgado: A controversial trailblazer in neuromodulation. *Artificial Organs*, 46, 4, 531–540. [link]

48. Qasim, S., Fried, I., **Jacobs, J.*** (2021). Phase precession in the human hippocampus and entorhinal cortex. *Cell*. 184, 12, 3242–3255. [link]

47. Kunz, L., Brandt, A., Reinacher, P.C., Staresina, B.P., Reifenstein, E., Weidemann, C.T., Herweg, N.A., Tsitsiklis, M., Kempter, R., Kahana, M.J., Schulze-Bonhage, A., **Jacobs, J.*** (2021). A neural code of egocentric spatial information in human medial temporal lobe. *Neuron*, 109, 17, 2781–2796. [link]

46. Umbach, G., Kantak, P., **Jacobs, J.**, Kahana, M.J., Pfeiffer, B., Sperling, M.R., Lega, B.* (2020). Time cells in the human hippocampus and entorhinal cortex support episodic memory. *Proceedings of the National Academy of Sciences.* 117, 45, 28463–28474. [link]

45. Goyal, A., Miller, J., Qasim, S.E., Watrous, A.J., Stein, J., Inman, C., Gross R., Willie, J. T., Lega, B., Lin, J.-J., Sharan, A., Wu, C, Sperling, M.R., Sheth, S., McKhann, G., Smith, E.H., Schevon, C., & **Jacobs, J.*** (2020). *Nature Communications*. Functionally distinct high and low theta oscillations in the human hippocampus. 11, 1, 1–10. **Selected for Nature Communication's special collection on Brain and Behavior.** [link]

44. Mohan, U. R., Watrous, A., Miller, J., Lega, B., Sperling, M.R., Worrell., G. A., Gross, R. E., Zaghloul, K., Jobst, B. C. Davis, K. A., Sheth, S. A., Stein, J.M., Das, S.R., Gorniak, R., Wanda, P. A., Rizzuto, D., Kahana, M. J., & **Jacobs, J.*** (2020). *Brain Stimulation*. The effects of direct brain stimulation in humans depend on frequency, amplitude, and white-matter proximity. 13, 5, 1183–1195. [link]

43. Maidenbaum, S., Patel, A., Gedankien, T., **Jacobs, J.*** (2020). The Effect of Navigational Aids on Spatial Memory in Virtual Reality. *2020 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW)*, 645–646. [link]

42. Tsitsiklis, M., Miller, J., Qasim, S., Inman, C., Gross, R., Willie, J., Smith, E., Sheth, S., Schevon, C., Sperling, M., Sharan, A., Stein, J., & **Jacobs, J.*** (2020). Single-neuron representations of spatial targets in humans. *Current Biology*, 30, 1–9. [link]

41. Qasim, S.E., Miller, J., Inman, C., Gross R., Willie, J. T., Lega, B., Lin, J.-J., Sharan, A., Wu, C, Sperling, M.R., Sheth, S., McKhann, G., Smith, E.H., Schevon, C., Stein, J., & **Jacobs, J.*** (2019). Memory retrieval modulates spatial tuning of single neurons in the human entorhinal cortex. *Nature Neuroscience.* 22, 2078–2086. **Featured on the cover of the December 2019 issue of Nature Neuroscience.** [link]

40. Maidenbaum, S., Patel, A., Stein, E., & **Jacobs, J.*** (2019). Spatial Memory Rehabilitation in Virtual Reality: Generalizing from Epilepsy Patients to the General Population. *IEEE: Proceedings of the 13th International Conf. on Virtual Rehab*. WG Wright, S Subramanian, G Fluet, M Agmon, RM Proffitt, M Roberts (Eds), Tel Aviv, Israel, 21–24 July, 2019. **Awarded best paper of the 2019 conference.** [link]

39. Kunz, L., Maidenbaum, S., Chen, D., Wang, L.,* **Jacobs, J.**,* & Axmacher, N.* (2019). Observing the neural code of spatial navigation via large-scale electrophysiology. *Trends in Cognitive Sciences.* 23, 7, 615–630. (* equal senior authors.) [link]

38. Maidenbaum, S., Miller, J., Stein, J.M., & **Jacobs, J.*** (2018). Grid-like hexadirectional modulation of human entorhinal theta oscillations. *Proceedings of the National Academy of Sciences*. 115, 42, 10798–10803. [link]

37. Staudigl, T., Leszczynski, M., **Jacobs, J.**, Sheth, S., Schroeder, C.E., Jensen, O., & Doeller, C.* (2018). Hexadirectional modulation of high-frequency electrophysiological activity in the human anterior medial temporal lobe maps visual space. *Current Biology*. 28, 1–5. [link]

36. Zhang, H., Watrous, A.J., Patel, A., & **Jacobs, J.*** (2018). Theta and alpha oscillations are traveling waves in the human neocortex. *Neuron*. 98, 6, 1269–1281. [link]

35. Miller, J.F., 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.*** (2018). Lateralized hippocampal oscillations underlie distinct aspects of human spatial memory and navigation. *Nature Communications.* 9, 1, 2423. [link]

34. Bahramisharif, A., Jensen, O.,* **Jacobs, J.**,* & Lisman, J.* (2018). Properties of oscillations underlying working memory at content-specific cortical sites. *Public Library of Science: Biology.* 16, 8, e2003805. (* equal senior authors.) [link]

33. Watrous, A.J., Miller, J., Qasim, S., Fried, I., **Jacobs, J.*** (2018). Phase-tuned neuronal firing encodes human contextual representations for navigational goals. *eLife*, 7, e32554. [link]

32. Goyal, A., Miller, J., Watrous, A.J., Lee, S.A., Coffey, T., Sperling, M., Sharan, A., Worrell, G., Berry, B., Lega, B., Jobst, B.C., Davis, K., Gross, R., Sheth, S., Ezzyat, Y., Das, S., Stein, J., Gorniak, R., Wanda, P., & **Jacobs, J.*** (2018). Electrical stimulation in hippocampus and entorhinal cortex impairs spatial and temporal memory. *The Journal of Neuroscience*. 38, 19, 4471–4481. [link]

31. 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. *The Journal of Neuroscience*. 38, 13, 3265–3272. [link]

30. **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. [link]

29. **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., & Rizzuto, D. S. (2016). Direct electrical stimulation of human entorhinal cortex impairs memory. *Neuron.* 92, 5, 983–990. [link]

28. Zhang, H. & **Jacobs, J.*** (2015). Travelling theta waves in the human hippocampus. *Journal of Neuroscience*, 35, 36, 12477–12487. [link]

27. Miller, J., Fried, I.F., Suthana, N., & **Jacobs, J.*** (2015). Repeating spatial activations in human entorhinal cortex. *Current Biology*, 25, 8, 1080–1085. [link]

26. van der Meij, R., **Jacobs, J.**, & Maris, E*. (2015) Uncovering phase-coupled oscillatory networks in electrophysiological data. *Human Brain Mapping*, 36, 7, 2655–2680. [link]

25. Burke, J. F., Merkow, M., **Jacobs, J.**, Kahana, M. J., & Zaghloul, K*. (2015). Brain computer interface to enhance episodic memory in human participants. *Frontiers in Human Neuroscience,* 8, 1055. [link]

24. Lega, B. C., Burke, J. F., **Jacobs, J.**, & Kahana, M. J.* (2014). Slow theta-to-gamma phase amplitude coupling in human hippocampus supports the formation of new episodic memories. *Cerebral Cortex*. [link]

23. 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. [link]

22. Misra, A., Burke, J.F., Ramayya, A., **Jacobs, J.**, Sperling, M.R., Moxon, K., Kahana, M., Evans, J., & 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. [link]

21. **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. [link]

20. Merzagora-Rodriguez, A., Coffey, T., Sperling, M., Sharan, A., & **Jacobs, J.*** (2014). Repeated stimuli elicit diminished high-gamma electrocorticographic responses. *Neuroimage*. 85, 844–852. [link]

19. 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. [link]

18. **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 on the journal cover.** [link]

17. 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. [link]

16. Burke, J. F., Zaghloul, K. A., **Jacobs, J.**, Sperling, M. R., Sharan, A. D., & 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. [link]

15. **Jacobs, J.***, Lega, B. & Anderson, C. (2012). Explaining how brain stimulation can evoke memories. *Journal of Cognitive Neuroscience.* 24(3), 553–563. [link]

14. **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. [link]

13. Lega, B., **Jacobs, J.**, & Kahana, M.J*. (2011). Human hippocampal theta oscillations and the formation of episodic memories, *Hippocampus,* 22(4), 748–761. [link]

12. **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. [link]

11. **Jacobs, J.*** & Kahana, M.J. (2010). Direct brain recordings fuel advances in cognitive electrophysiology. *Trends in Cognitive Sciences*. 14(4), 162–171. [link]

10. **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. [link]

9. **Jacobs, J.**, Manning, J.R., & Kahana, M.J. (2010). Response to Miller: "Broadband" vs. "high gamma" electrocorticographic signals. *The Journal of Neuroscience.* 30, online. [link]

8. 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. [link]

7. **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. [link]

6. **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. [link]

5. 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. [link]

4. 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. [link]

3. **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. [link]

2. 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. [link]

1. 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. [link]

Preprints

3. Long, L., Yang, M., Kriegeskorte, N., **Jacobs, J.**, Remez, R., Sperling, M., Sharan, A., Lega, B., Burks, A., Worrell, G., Gross, R, Jobst, B., Davis, K., Zaghloul, K., Sheth, S., Stein, J., Das, S., Gorniak, R., Wanda, P., Kahana, M., Mesgarani, N. Feed-forward, feed-back, and distributed feature representation during visual word recognition revealed by human intracranial neurophysiology. Preprint: [link]

2. Umbach, G., Rugg, M., Worrell, G., Sperling, M., Gross, R., Jobst, B., **Jacobs, J.**, Zaghloul, K., Stein, J., Davis, K., & Lega., B. Intracranial EEG reveals bihemispheric parietal and extra parietal brain networks supporting mental arithmetic. Preprint: [link]

1. Maidenbaum, S., Patel, A., Carlin, I., & **Jacobs, J.**. Studying Spatial Memory in Augmented and Virtual Reality. Preprint: [link]

Preview/news Articles

2. Qasim, S. & **Jacobs, J.** (2016). Human hippocampal theta oscillations during movement without visual cues. *Neuron*, 89, 6, 1121–1123. [link]

1. **Jacobs, J.** & Lee, S. A. (2016). Spatial Cognition: Grid cells support imagined navigation. *Current Biology*, 26, 7, R277–R279. [link]

Manuscripts Invited

- **Jacobs, J.** (Commissioned.) Functional properties of traveling waves in the human brain. *Trends in Cognitive Sciences.*

Note: $*$ indicates senior or corresponding author. Underlining indicates Jacobs' mentees.

Pending funding

- National Institutes of Health, BRAIN Initiative. R61-MH135405-01. Title: "Developing the Context-Aware Multimodal Ecological Research and Assessment (CAMERA) Platform for Continuous Measurement and Prediction of Anxiety and Memory State" 12/1/2023–11/30/2028. PI: Jacobs. $5,804,921.

Current funding

- National Institutes of Mental Health, 2R01-MH104606 (renewal). Title: "The Role of Place and Grid Cells in Human Spatial and Non Spatial Memory." PI: Jacobs. 9/1/2020–8/31/2025, $3,520,228.
- National Institutes of Mental Health, BRAIN Initiative. U01. Title: "Mapping Algorithmic State Space in the Human Brain". 6/1/2021–5/31/2026. PI: Sheth, S. Subcontract to Jacobs $1,450,000.
- National Institute of Health, BRAIN Initiative. U01-NS113198. Title: "Using Direct Brain Stimulation to Study Cognitive Electrophysiology". 9/2019–8/2024. Subcontract to Jacobs for $1,283,131.
- National Science Foundation. Title: "CRCNS: Modeling Traveling Waves in the Human Neocortex." PI: Jacobs. 9/1/2023–8/31/2026, PI: Jacobs. $1,000,000 total costs.
- National Science Foundation. Title: "CAREER: Characterizing mechanisms of navigation and memory using direct human brain recording and stimulation." 9/2019–8/2024. PI: Jacobs. $564,000 total costs.
- Neurtex Brain Research Institute. Title: "Neurtex Brain Research Institute Research Project." 7/1/2018–11/30/2023. PI: Jacobs. $475,000 total costs.
- Columbia University SURE Program. Title: "The Neural Basis of Naturalistic Memory." 7/1/2023-6/30/2024. PI: Jacobs. Total Costs: $85,000.

Completed funding

- National Science Foundation: Collaborative Research in Computational Neuroscience (CRCNS). Title: "USA-Germany Research Proposal: Probing the role of grid cells in human episodic memory." 11/2017–10/2021. PI: Jacobs. $811,502 total costs.
- National Institute of Mental Health R21-MH117682. Title: "Brain stimulation for cognitive enhancement based on modulation of cortical traveling waves." 9/2018–6/2021 (NCE). PI: Jacobs. $440,000 total costs.
- NIH 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.
- National Institute of Mental Health R01-MH104606. Title: "Role of grid and place cells in human spatial navigation and memory." 8/2015–5/31/2020. PI: Jacobs. $2,664,846 total costs.
- Research Initiatives in Science & Engineering (RISE) fund, Columbia University. Title: "High-resolution measurements of cortical traveling waves for brain-computer interfacing and cognitive control." PIs: Jacobs, J. & Gottlieb, J. (9/2020–8/2022). Total costs: $160,000.

- 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.
- National Institute of Mental Health R01-MH061975. Title: "Electrophysiology of human spatial navigation and memory." Subcontract to Jacobs, coinvestigator. $497,666.
- National Institute of Mental Health U01-NS098976: Title: "Dynamic Neural Mechanisms of Audiovisual Speech Perception". PI: Schroeder. Jacobs, coinvestigator (1.5 months salary support). 9/2016–2/2020.
- NIH U01 Administrative Supplement: Developing Virtual Reality Software for Probing the Role of Space in Multisensory Perception. $100,000 (direct costs).
- 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).

Awards

- Faculty Early Career Development Program (CAREER), National Science Foundation (2019).
- Elected to the Memory Disorders Research Society (2019). (MDRS is an invitation-only professional society dedicated to the study of memory and memory disorders, see: https://clm.utexas.edu/mdrs/.)
- New Investigator Award, Brain and Behavior Research Foundation (NARSAD) (2013).
- Winegrad Award, Best Ph.D. dissertation in Neuroscience at University of Pennsylvania (2009).
- NIH Predoctoral National Research Service Award (5/2008–12/2008).
- Westinghouse (Intel) Science Talent Search Finalist (1997).
- International Science and Engineering Fair: Naval Science Award (1997), Second Place in Social Science (1997).

Selected invited Talks

2024: Keynote talk at Korean Society for Brain and Neural Sciences (October, 2024).

2023: Hippocampus meeting (May 2023), Neurtex Annual meeting (August, 2023), New York University Department of Neuroscience (September 11, 2023), University of Pennsylvania Department of Neurosurgery (Oct 12, 2023).

2022: Park City Winter Conference on the Neurobiology of Learning and Memory (1/6/2022), Columbia University Frontiers in Engineering & Medicine: Neuromodulation Symposium (3/4/2022), University of Minnesota Symposium on Computational Neuroscience (4/2022), Organization for Human Brain Mapping (6/2022), Neuroergonomics (7/2022), 6th International Human Single Neuron Meeting (Nov 11–12, 2022), Regrounding podcast (10/27/2022).

2021: SUNY Downstate, Department of Neuroscience (12/8/2021), 8th Iranian Human Brain Mapping Conference (11/15/2021), University of Lethbridge, Department of Neuroscience (10/18/2021), NYU Discussion on Ripple detection Methods (5/10/2021), Otto-von-Guericke University of Magdeburg, Germany (1/27/2021).

2020: Worcester Polytechnic Institute (12/7/2020), Baylor University College of Medicine (12/4/2020), Amazon.com Symposium on Alzheimer's Disease (8/27/2020), CNRS-Centre de Recherche Cerveau et Cognition, Toulouse, France (5/14/2020; cancelled due to pandemic), Bernstein Center for Computational Neuroscience (5/13/2020), Max Planck Institute for Empirical Aesthetics (April, 23 2020), Northwestern University (2/27/2020), Columbia University Engineering in Medicine Symposium (2/20/2020), Winter Conference on Neuroplasticity (2/14/2020).

2019: City College of New York Graduate Center (11/2019), Yale University (11/2019), Society for Neuroscience minisymposium (10/2019), Society for Psychophysiological Research (9/2019), Bernstein Conference on Computational Neuroscience (9/2019), NSF 15th CRCNS Investigator meeting (9/2019), Rutgers University (4/2019), University of Texas, Austin (2/2019), City College of New York (1/2019), Princeton Neuroscience Institute (1/2019), Columbia Division on Substance Use Disorders (1/2019).

2018: University of Freiburg, Germany (10/2018), Boston University (9/2018), University of Connecticut (9/2018), iNAV (Interdisciplinary Navigation Symposium), Cognitive Neuroscience Society Annual Meeting (3/2018), Computational and Systems Neuroscience (COSYNE) workshop (3/2018).

2017: International Conference for Cognitive Neuroscience (8/2017), Hippocampus Meeting (6/2017), Statistical Analysis of Neural Data 8 (SAND8) (6/2017).

2016: Third Human Single-Neuron Recordings Conference (10/2016), iNAV (6/2016), Columbia CTNI (6/2016), Grossman Center for the Statistics of the Mind (5/2016), NAVIGO (3/2016).

2015: Columbia Department of Psychology (10/2015). Center for Neural Engineering and Computation, Columbia University (10/2015), NeuroTheory Center (6/2015), National Academy of Engineering, Symposium on Engineering in Medicine (4/2015), Columbia Neurosurgery Department Grand Rounds (2/2015).

2014: Single-neuron studies of the human brain (11/2014), NeuroFutures Summit (6/2014), Harvard University's Department of Psychology (1/2014).

2013: Fifth International Workshop on Advances in Electrocorticography (11/2013), Brandeis University (9/2013), Space in the Brain, Royal Society, UK (5/2013), Massachusetts Institute of Technology, Department of Brain and Cognitive Science (1/2013).

2012: U. Penn Center for Cognitive Neuroscience (9/2012), Drexel Chronobiology and Sleep Symposium (9/2012).

2011: University of Wisconsin, Milwaukee (12/2011), University of Pennsylvania Department of Psychiatry (10/2011), Montreal Neurological Institute (6/2011), Drexel Human Cognition Enhancement Program (5/2011), Drexel University Neurobiology Department (5/2011), Princeton University Department of Psychology (3/2011), Hahnemann Hospital (3/2011).

Reviewing for USA Federal Funding Agencies

- National Institute of Health, BRAIN Initiative ZMH1-ERB-E(02) (October, 2023).
- National Science Foundation, ad-hoc reviewer (October, 2023).
- National Science Foundation, invited review panelist (April 12–13, 2023).
- National Institutes of Health, NIMH Pathway to Independence Awards (K99/R00). Meeting Dates: 03/23/2023. ZMH1 ERB-M 03 S.
- National Institutes of Health, BRAIN Initiative, ZNS1 SRB-P(09) (January, 2023).
- National Institutes of Health, Human Complex Mental Function (HCMF) Study Section (October, 2021).
- National Institutes of Health, Learning and Memory (LAM) Study Section (October, 2020).
- National Institutes of Health, Molecular, Cellular, and Behavior Neuroscience, F30, F31, & F32 Fellowship Study Section, ZRG1 F02C-A(20) (July, 2020).
- National Institutes of Health, Cognition and Perception (CP) Study Section (June, 2020).
- National Institutes of Health, BRAIN Initiative, U19 study section, ZNS1 SRB-N-21 (March, 2020).
- National Science Foundation, ad-hoc reviewer (November, 2019).
- National Science Foundation, invited review panelist (May, 2019).
- National Institutes of Health, BRAIN Initiative, U19 review panel, ZNS1 SRB-N-18 (March, 2019).
- Air Force Office of Scientific Research, Cognitive & Computational Neuroscience program (February, 2019).
- National Institutes of Health, Cognition and Perception study section (October, 2018).
- National Institutes of Health, BRAIN Initiative, U19 review panel, ZNS1 SRB-N-16 (April, 2018).
- National Science Foundation, invited review panelist (April, 2018).
- National Science Foundation, invited review panelist (October, 2017).
- National Institutes of Health, Special Emphasis Panel ZRG1 IFCN-B-55 (June, 2017).
- National Science Foundation, ad-hoc reviewer (March, 2017).
- National Institutes of Health: Special Emphasis Panel ZRG1 IFCN-T-55 (October, 2016).

Reviewing for Other Organizations

- Irving Institute for Clinical and Translational Research (May, 2023).
- Keck Foundation (August, 2022).
- French National Research Agency (May, 2022).
- Columbia University internal Competition for Johnson & Johnson WiSTEM2D Scholars Program (September, 2020; September, 2021).
- Columbia University Department of Psychiatry, Smither Pilot Program. (January 2020).
- Columbia University Research Initiatives in Science & Engineering. (November, 2020; March, 2019; February, 2018; October, 2016).
- Czech Science Foundation, Department of Medical and Biological Sciences (June, 2018).
- Wellcome Trust (February, 2018).
- Grant reviewer for the Irving Institute for Clinical and Translational Research (April, 2017).
- European Union Grid-Map research program, on-site reviewer, Trondheim, Norway (November 30, 2015).
- European Union Grid-Map research program, on-site reviewer, Brussels, (March 26–30, 2014).
- Poland National Science Center (March, 2014).
- Army Research Office (June, 2010).

Contributions to Diversity, Equity, and Inclusion

- Mentor for underrepresented Rutgers University medical student Omar Elfanagely. (August 2015–May 2016.) Supported by supplement to NIH grant MH104606.
- Member of the admissions committee for Columbia University's *Bridge to the Ph.D. Program in STEM*. (1/2020–present).
- Mentored high school students in my lab Claire Padilla, Max Rathmuth (6/2021–8/2021).
- Mentor for Milan Ndjiki in Columbia University's BRAINYAC program (6/2022–8/2022).
- Sponsored by NSF CAREER grant for doing Neuroscience outreach education in local NYC high schools.
- Columbia University Psychology Department Panel "Getting the most out of mentorship: Best practices for mentors and mentees" (April 24, 2020).
- Lecturer in the International Youth Fellowship program (August, 2018).
- Lecturer in the Columbia University Science Honors, a weekend program for talented NYC high school students. (April, 2017).

Academic Service at Columbia University

- Founding organizer of the Columbia Hippocampus Club (a University-wide discussion group for researchers studying the hippocampus, funded by the MBBI). (2018–present).
- Columbia Department of Biomedical Engineering (DBME) Graduate Student Evaluation Committee (2015–present).
- Department of Biomedical Engineering representative on the Columbia Translational Neuroscience Initiative (2015–present).
- Department of Biomedical Engineering Hiring Committee: Magnetic Resonance Imaging (2015–2016).
- Department of Biomedical Engineering Hiring Committee: open-rank position (2021–2022).

General Academic Service

- Member of the organizing board of iNav, the Interdisciplinary Navigation Symposium (2019–present).
- Editorial board member: *Royal Society: Open Science.* 2015–2017.

- Peer reviewing (roughly two reviews per month): Cell, Current Biology, Human Brain Mapping, NeuroImage, 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, Journal of Neurophysiology, European Union Grant Office, Psychological Reports, Journal of Neuroscience Methods, Royal Society: Open Science, Poland National Science Center, Wellcome Trust, Nature Communications, Nature Human Behavior, Proceedings of the National Academy of Sciences, Cell Research, eLife, Current Opinion in Behavioral Sciences, eNeuro, Scientific Data, and others.

Current Mentoring (selected)

- Serra Favila (12/2019–present). Postdoctoral research fellow. *National Institutes of Health F99/K00 award ($294,192, 9/30/2019–9/29/2023).* Incoming Assistant Professor at Brown University in June 2024. Project title: "Oscillatory synchrony between hippocampus and cortex."
- Thomas Donoghue (3/2021–present). Postdoctoral research fellow. Project title: "Single-neuron correlates of spatial memory and location."
- Anup Das (8/2020–present). Postdoctoral research fellow. Project title: "Role of traveling waves in human spatial memory."
- Luka Kolibius (5/2023–present) Postdoctoral research fellow.
- Tamara Gedankien (8/2017–present). Ph.D. student and postdoctoral fellow.
- Erfan Zabeh (9/2019–present). Ph.D. student.
- Cameron Holman (9/2020–present). Ph.D. student.
- Weijia Zhang (9/2022–present). Ph.D. student.
- Sandra Pereira (1/2022–present). Ph.D. student.
- Claire Han (1/2022–present). Ph.D. student.
- Sai Vaddi (4/2022–present). Lab staff.

Past Mentoring (selected)

- Lukas Kunz (3/2021-2/2023). Postdoctoral research fellow. Project: Analysis of "anchor cells" in the human medial temporal lobe. Current position: Assistant Professor at the University of Bonn, Germany.
- Shachar Maidenbaum, Ph.D. Postdoctoral research fellow in my lab, 3/2017–8/2020. Received an NIH F32 NRSA training grant. Current position: Assistant Professor at Ben Gurion University.
- Molly Hermiller (8/2020–present). Postdoctoral research fellow. Project: *Theta-burst stimulation for enhancement of human spatial memory.* Current position: Assistant Professor at Florida State University.
- Salman Qasim. Graduate student and post-doc in my lab, 9/2015–10/2021, supported by an NSF GRFP fellowship. Current Position: Postdoctoral fellow at Mount Sinai School of Medicine.
- Melina Tsitsiklis. Graduate Student in my lab, 9/2015–5/2021. Current position: Clinical Data Scientist at DeepHealth.
- Uma Mohan (1/2016–present). Columbia University graduate student in Biomedical Engineering. Project title: "Cross-frequency phase coupling in the human hippocampus." Current position: Postdoc at the National Institute of Health.
- Ida Momennejad, Ph.D. Postdoctoral research fellow in my lab, 5/2019–6/2020. Current position: Research Scientist at Microsoft Research.
- Jonathan Miller. Graduate student and post-doc in my lab, 9/2011–6/2019. Current position: Data analyst at Commonwealth Computer Research.
- Andrew Watrous, Ph.D. Postdoctoral research fellow in my lab, 6/2015–6/2018. Current position: Assistant Professor at Baylor College of Medicine.
- Honghui Zhang. Ph.D. and Postdoc in my lab, 12/2010–12/2019. Current position: Software Engineer at Amazon.
- Abhinav Goyal. Research assistant in my lab, 5/2017–6/2018. Current position: MD/Ph.D. student at Mayo Clinic, Rochester, MN.

- Simon Khuvis, MD/PhD intern in my lab, 1/16–3/2019. Current status: fellow at NYU Medical School.
- Tora Bonnevie. mentee 1/1/2016–12/31/2018. Associate Professor, Norwegian University of Science and Technologie.

Teaching

- 2023 (Spring), 2021 (Spring), 2020 (Spring), 2018 (Spring), 2017 (Spring) *Electrophysiology of Human Navigation and Memory*, Columbia University (BMEN-E4050). Average rating: 4.7 out of 5.0.
- 2023 (Fall), 2021 (Fall), 2020 (Fall), 2018 (Fall), 2016 (Fall), *Biostatistics for Engineers*, Columbia University (BMEN-E4110). Average rating: 4.2 out of 5.0.
- 2019 (Fall), 2019 (Spring), 2017 (Fall), *Computational Modeling of Physiological Systems*, Columbia University (BMEN-E6003). Average rating: 4.0 out of 5.0
- 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).

Society memberships

- Society for Neuroscience (2003–present).
- Cognitive Neuroscience Society (2004–present).
- Psychonomic Society (2005–present).
- Memory Disorders Research Society (2019–present).

Collaborators at Columbia University (selected)

- Jacqueline Gottlieb (Neuroscience, Columbia University), joint graduate student Erfan Zabeh.
- Mariam Aly (Psychology, Columbia University), joint post-doc Serra Favila.
- Lila Davachi (Psychology, Columbia University), joint post-doc Molly Hermiller.
- Catherine Schevon, Guy McKhann, Brett Youngerman & Charles Schroeder (Epilepsy Center, Columbia University).

Collaborators outside Columbia University (selected)

- Sameer Sheth (Baylor College of Medicine)
- 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).

Media coverage (selected)

- Press related to outreach regarding scientific integrity.

- *The Atlantic*, "When evidence says no but doctors say yes,", Feburary, 2017. https://www.theatlantic.com/health/archive/2017/02/when-evidence-says-no-but-doctors-say-yes/517368/

- Press related to "Phase Precession in the human hippocampus and entorhinal cortex" in *Cell (2021)*:
  - *Wired*, "A New Way to Understand the Brain's Intricate Rhythm," June, 2021. https://www.wired.com/story/a-new-way-to-understand-the-brains-intricate-rhythm/.
  - *Quanta*, "Neurons Unexpectedly Encode Information in the Timing of Their Firing", July, 2021. https://www.quantamagazine.org/a-new-kind-of-information-coding-seen-in-the-human-brain-20210707/.

- Press related to my paper "Memory retrieval modulates spatial tuning of single neurons in the human entorhinal cortex in *Nature Neuroscience (2019)*:
  - *Medical Science News*, "Study sheds new light on the brain's spatial map,", November, 2019. https://www.news-medical.net/news/20191111/Study-sheds-new-light-on-the-brains-spatial-map.aspx
  - *Science Daily*, "Specific neurons that map memories now identified in the human brain,", November, 2019. https://www.sciencedaily.com/releases/2019/11/191112095740.htm
  - *Cosmos*, "The tour guide in our brain: Researchers find specific neurons that map memories,", November, 2019. https://cosmosmagazine.com/biology/the-tour-guide-in-our-brain

- Press related to my paper "Theta and alpha oscillations are traveling waves in the human neocortex" in *Neuron (2018).*
  - *Scientific American*: Makin, S. "Traveling brain waves may be critical for cognition." June 28, 2018. https://www.scientificamerican.com/article/traveling-brain-waves-may-be-critical-for-cognition/

- Press related to my paper "Direct electrical stimulation of human entorhinal cortex impairs memory" in *Neuron (2017).*
  - *Nature* News & Views: Young N. & Deisseroth, K., "Cognitive neuroscience: In search of lost time" (2017). 542, 173—174.
  - *Wall Street Journal*, "Deep Brain Stimulation Fails to Improve Memory in New Study," December 13, 2016. https://www.wsj.com/articles/deep-brain-stimulation-fails-to-improve-memory-in-new-study-1481130000.
  - *Time*, "Why Scientists are Still Flummoxed by Alzheimer's," December 7, 2016. http://time.com/4592564/why-scientists-are-still-flummoxed-by-alzheimers/.
  - *Neurology Today*, "Deep Brain Stimulation Impairs Memory, Researchers Report," January 19, 2017. http://mobile.journals.lww.com/neurotodayonline/Pages/articleviewer.aspx?year=2017&issue=01190&article=00003&type=Fulltext

- Selected press related to my paper "Direct recordings of grid cells in human spatial navigation" (2013) in *Nature Neuroscience:*
  - Whalley, K. (2013), Humans are on the grid. *Nature Reviews Neuroscience*, 14, 667.
  - Navigational Cells Located in Human Brains. *New York Times*. August 4, 2013. http://www.nytimes.com/2013/08/06/science/navigational-cell-systems-located-in-human-brains.html
  - Grid Cells help rats, humans with navigation, researchers say. *Fox News.* August 5, 2013. http://www.foxnews.com/science/2013/08/05/grid-cells-help-humans-navigate.html
  - Sense of Direction comes from Grid Cells in Brain, Researchers Find. *Huffington Post,* August 5, 2013. http://www.huffingtonpost.com/2013/08/05/sense-of-direction-grid-cells-brain-_n_3708972.html.
  - *Live Science*. Human Brains Have Internal GPS. Tanya Lewis, August 8, 2013, http://www.livescience.com/38772-human-gps-neurons-found.html

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