

# Alexander J. E. Kell

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Zuckerman Institute  
Columbia University  
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## Research Interests

Computational neuroscience  
Auditory and visual perception – computation, neuroscience, behavior  
Marmoset neurophysiology  
Statistics of natural signals (images and sounds)  
Similarities and differences between sensory modalities (particularly vision and audition)  
Deep learning

## Education and Work Experience

### Columbia University

Postdoctoral Research Fellow at the Zuckerman Institute (2019-present)  
Advisor: Elias Issa

### Massachusetts Institute of Technology

Ph.D. in Neuroscience (2013-2019)  
Advisor: Josh McDermott; Thesis committee: James DiCarlo, Nancy Kanwisher, Shihab Shamma  
Dissertation: "Hierarchy and invariance in auditory cortical computation"

### Lawrence Berkeley National Lab

Visiting researcher in Life Sciences and Computational Research Divisions (Jan-Mar 2017)

### Cold Spring Harbor Laboratory

Computational Neuroscience: Vision (July 2016)

### Massachusetts Institute of Technology

Kanwisher Cognitive Neuroscience Lab Technician (2011-2013)  
Graybiel Macaque Neurophysiology Lab Technician (2010-2011)

### Dartmouth College

A.B. in Neuroscience with High Honors (2006-2010)  
Honors thesis studying executive control with macaque neurophysiology

### Beijing Normal University

Studied written and spoken Mandarin Chinese (2007)

## Funding

2019-2022: NIH F32 National Research Service Award  
2014-2018: Computational Science Graduate Fellowship (Dept. of Energy)

## Honors and Awards

2018: Advances and Perspectives in Auditory Neuroscience (APAN) Travel Award  
2017: International Conference on Auditory Cortex Travel Award  
2017: Cosyne Presenter Award

2015: Vision Sciences Society Best Student Poster Award  
2015: Association for Otolaryngology Travel Award  
2015: Vision Sciences Society Travel Award  
2014: NVIDIA Academic Hardware Donation Program (GPU donation)  
2010: Neuroscience Center at Dartmouth Award for Best Thesis Presentation  
2009: Rufus Choate Scholar  
2008: Citation for Academic Achievement in Advanced Modern Chinese

## Papers

- Kell A.**, Bokor S., Jeon Y., Toosi T., Issa E. Conserved core visual object recognition across simian primates: Marmoset image-by-image behavior mirrors that of humans and macaques. *bioRxiv*. (**Preprint**)
- Kell A.**, McDermott J. Invariance to background noise as a signature of non-primary auditory cortex. *Nature Communications*. 2019.
- Kell A.**, McDermott J. Deep neural network models of sensory systems: Windows onto the role of task constraints. *Current Opinion in Neurobiology*. 2019.
- Kell A.**, Yamins D., Shook E., Norman-Haignere S., McDermott J. A task-optimized neural network replicates human auditory behavior, predicts brain responses, and reveals a cortical processing hierarchy. *Neuron*. 2018.
- Carlile S., Ciccarelli G., Cockburn J., Diedesch A., Finnegan M., Hafter E., Henin S., Kalluri S., **Kell A.**, Ozmeral E., Roark C., and Sagers J. Listening Into 2030 Workshop: An Experiment in Envisioning the Future of Hearing and Communication Science. *Trends in Hearing*. 2017.

## Early Papers (from work before PhD)

- Jouravlev O., **Kell A.**, Mineroff Z., Haskins A., Ayyash D., Kanwisher N., Fedorenko E. Reduced language lateralization in autism and the broader autism phenotype as assessed with robust individual-subjects analyses. *Autism Research*. 2020.
- Cohen M., Dilks D., Koldewyn K., Weigelt S., Feather J., **Kell A.**, Keil B., Fishel B., Zöllei L., Wald L., Saxe R., Kanwisher N. Representational similarity precedes category selective in the developing ventral visual pathway. *NeuroImage*. 2019.

## Conference Abstracts

- Kell A.**, Bokor S., Jeon Y., Toosi T., Issa E. How human-like is marmoset high-level vision? Direct comparison to rat, human, and macaque object recognition behavior. Marmoset Biosciences Symposium, October 2019. (**Selected for "Poster Teaser" presentation**)
- Kell A.**, Bokor S., Jeon Y., Toosi T., Issa E. Conserved core visual object recognition across simian primates: Marmoset image-by-image behavior mirrors that of humans and macaques. Neuromatch 3.0, October 2019.
- Dobs K., **Kell A.**, Martinez J., Cohen M., Kanwisher N. Using task-optimized neural networks to understand why brains have specialized processing for faces. Vision Sciences Society (VSS), June 2020.
- Dobs K., **Kell A.**, Martinez J., Cohen M., Kanwisher N. Using task-optimized neural networks to understand why brains have specialized processing for faces. Denver, CO: Computational and Systems Neuroscience (COSYNE), February 2020.

- Bokor S., **Kell A.**, Jeon Y., Toosi T., Issa E. Core visual object recognition behavior in common marmosets. Chicago, IL: Society for Neuroscience, October 2019.
- Kell A.**, Shook E., McDermott J. Extensive psychophysical and neural comparisons of deep neural networks to human hearing. Chicago, IL: Advances and Perspectives in Auditory Neuroscience (APAN), October, 2019.
- Bokor S., **Kell A.**, Jeon Y., Toosi T., Issa E. Core visual object recognition behavior in common marmosets. Chicago, IL: Marmoset Bioscience Symposium, October 2019.
- Dobs K., **Kell A.**, Palmer I., Cohen M., Kanwisher N. Why Are Face and Object Processing Segregated in the Human Brain? Testing Computational Hypotheses with Deep Convolutional Neural Networks. Berlin, Germany: Cognitive Computational Neuroscience (CCN), September 2019.
- Kell A.**, McDermott J. Task-optimized deep neural networks as models of auditory cortex and behavior. Nyborg, Denmark: International Symposium on Auditory and Audiological Research (ISAAR), August 2019. **(Talk)**
- Kell A.**, Shook E., McDermott J. Comparison of deep networks to biological hearing across many psychophysical and neural experiments. Lisbon, Portugal: Computational and Systems Neuroscience (COSYNE), February 2019.
- Kell A.**, McDermott J. Invariance to real-world background noise as a signature of non-primary auditory cortex. San Diego, CA: Society for Neuroscience, November 2018. **(Talk)**
- Kell A.**, Shook E., McDermott J. Evaluating the generality of deep neural networks as a model of human hearing: Comparison with a large set of psychophysical and neural experiments. San Diego, CA: Advances and Perspectives in Auditory Neuroscience (APAN), November, 2018.
- Kell A.**, Shook E., McDermott J. Robustness to real-world background noise: A physiological signature of non-primary auditory cortex. Denver, CO: Computational and Systems Neuroscience (COSYNE), February 2018.
- Kell A.**, Shook E., McDermott J. Cortical robustness to real-world background noise differentiates primary from non-primary auditory cortex. San Diego, CA: Association for Research in Otolaryngology, February 2018.
- Shook E., **Kell A.**, McDermott J. Exploring speech-trained deep neural networks as models of human auditory behavior. San Diego, CA: Association for Research in Otolaryngology, February 2018.
- Kell A.**, Shook E., McDermott J. Robustness of cortical sound encoding to synthetic and to real-world background noise. Washington, DC: Advances and Perspectives in Auditory Neuroscience (APAN), November, 2017.
- Kell A.**, McDermott J. Exploring the robustness of cortical sound encoding to real-world background noise. Banff, Canada: International Conference on Auditory Cortex, September, 2017.
- Kell A.**, McDermott J. Robustness to real-world background noise increases from primary to non-primary human auditory cortex. Boston, MA: Acoustical Society of America, June 2017.
- Kell A.**, McDermott J. Robustness to real-world background noise increases from primary to non-primary auditory cortex. Salt Lake City, UT: Computational and Systems Neuroscience (COSYNE), February 2017.
- Kell A.**, McDermott J. Robustness to real-world background noise increases between primary and non-primary human auditory cortex. Baltimore, MD: Association for Research in Otolaryngology, February 2017. **(Talk)**

- Kell A.**, Yamins D., Norman-Haignere S., McDermott J. Hierarchical computation in human auditory cortex revealed by deep neural networks. Baltimore, MD: Association for Research in Otolaryngology, February 2017. (**Selected for “Poster Blitz” presentation**)
- Kell A.**, McDermott J. Noise-robustness of cortical responses to natural sounds increases from primary to non-primary auditory cortex. San Diego, CA: Society for Neuroscience, November 2016. (**Talk**)
- Kell A.**, McDermott J. Noise-robustness of cortical responses to natural sounds increases from primary to non-primary auditory cortex. San Diego, CA: Advances and Perspectives in Auditory Neuroscience (APAN), November 2016. (**Selected for “Poster Teaser” presentation**)
- Kell A.**, Yamins D., Norman-Haignere S., McDermott J. Speech-trained neural networks behave like human listeners and reveal a hierarchy in auditory cortex. Salt Lake City, UT: Computational and Systems Neuroscience (COSYNE), February 2016.
- Kell A.**, Yamins D., Norman-Haignere S., McDermott J. Functional organization of auditory cortex revealed by neural networks optimized for auditory tasks. Chicago, IL: Advances and Perspectives in Auditory Neuroscience (APAN), October 2015. (**Selected for “Poster Teaser” presentation**)
- Kell A.**, Yamins D., Norman-Haignere S., McDermott J. Functional organization of auditory cortex revealed by neural networks optimized for auditory tasks. Chicago, IL: Society for Neuroscience, October 2015. (**Talk**)
- Kell A.**, Yamins D., Norman-Haignere S., Seibert D., Hong H., DiCarlo J., McDermott J. Computational similarities between visual and auditory cortex studied with convolutional neural networks, fMRI, and electrophysiology. St. Pete’s Beach, FL: Vision Sciences Society, May 2015. (**Best Student Poster Award**)
- Yamins D., **Kell A.**, Norman-Haignere S., McDermott J. Using speech-optimized convolutional neural networks to understand auditory cortex. Salt Lake City, UT: COSYNE: Computational Systems Neuroscience, March 2015. (**Talk**)
- Kell A.**, Yamins D., Norman-Haignere S., McDermott J. Deep neural networks trained on speech tasks predict auditory cortex responses to natural sounds. Baltimore, MD: Association for Research in Otolaryngology, February 2015.
- Lafer-Sousa R., Conway B., **Kell A.**, Takahashi A., Feather J., Kanwisher N. G. Similar organization of the ventral visual pathway in humans and macaque monkeys: Color regions sandwiched between face and scene regions. Washington, DC: Society for Neuroscience, November 2014.
- Kell A.**, Yamins D., Norman-Haignere S., McDermott J. Similarities between deep neural networks trained on speech tasks and human auditory cortex. Cambridge, MA: Speech and Audio in the Northeast: SANE 2014, October 2014.
- Lafer-Sousa R., **Kell A.**, Takahashi A., Feather J., Conway B., Kanwisher N. G. Parallel processing of colors and faces in human ventral visual stream: functional evidence and technical challenges. St. Pete Beach, FL: Vision Sciences Society, May 2014.
- Kell A.**, Koldewyn K., Kanwisher N. G. The ventral visual pathway in adults with autism. Boston, MA: Boston Autism Consortium, November 2013.
- Kell A.**, Koldewyn K., Kanwisher N. G. The ventral visual pathway in adults with autism. Naples, FL: Vision Sciences Society, May 2013.
- Khan S., **Kell A.**, Klepac K., Levine W., Kralik J. Monitoring the mundane: Rhesus macaque ventromedial prefrontal cortex makes lower quality options more engaging. San Diego, CA: Society for Neuroscience, November 2010.

## Graduate Coursework (GPA: 5.0 out of 5.0)

CS281: **Advanced Machine Learning** (Harvard) – Adams  
6.438: **Algorithms for Inference** – Bresler  
6.860/9.520: **Statistical Learning Theory and Applications** – Poggio, Rosasco  
18.0851: **Computational Science and Engineering** – Strang  
6.338/18.337: **Parallel Programming** – Edelman  
9.660/6.804: **Computational Cognitive Science** – Tenenbaum  
9.S912: **Vision and Learning: Brains and Machines** – Poggio, Ullman  
HST723: **Neural Coding and the Perception of Sound** (MIT/Harvard) – Delgutte, Guinan, Brown  
9.011: **Systems Neuroscience** – Miller, Wilson  
9.012: **Cognitive Science** – Tenenbaum, Sinha, Gibson  
9.S913: **fMRI for Cognitive Neuroscientists** – Kanwisher, Saxe

## Invited Talks

2019:  
International Symposium on Auditory and Audiological Research; Nyborg, Denmark

2018:  
École Normale Supérieure; Paris, France  
Computational Science Graduate Fellowship Program Review; Washington, DC  
Zuckerman Institute, Columbia University; New York, NY  
Johns Hopkins University; Baltimore, MD  
Oregon Health Sciences University; Portland, OR  
Society for Neuroscience; San Diego, CA  
MIT Brain and Cognitive Sciences Department Retreat; Newport, RI

2017:  
Computational Research in Boston and Beyond (CRIBB); Cambridge, MA  
Cosyne Workshops; Snowbird, UT  
Association for Research in Otolaryngology; Baltimore, MD

2016:  
Society for Neuroscience; San Diego CA  
Auditory Cortex Splash Meeting; Cambridge, MA  
Vision Science Society; St. Pete's Beach, FL  
MIT Department of Brain and Cognitive Sciences Cog Lunch; Cambridge, MA

2015:  
Society for Neuroscience; Chicago, IL

2013:  
State Key Laboratory of Cognitive Neuroscience and Learning; Beijing, China

## Teaching Experience

### **GR6055: Neuroscience Survey (Fall 2020)**

Gave a class lecture on marmoset ecology, ethology, and neuroscience to first-year Columbia PhD students.

### **fMRI Methods Short Course at Massachusetts General Hospital (October 2015)**

TA.

### **MIT Center for Brains Minds and Machines Summer School in Woods Hole (Aug-Sept 2015)**

TA at three-week summer school for thirty graduate students. Lectured on linear algebra.

**9.40: Introduction to Neural Computation** (Spring 2015)

TA for Prof. Michale Fee's undergraduate class on biophysics and computational neuroscience. Ran recitations on Poisson processes, spectral analysis, PCA, linear algebra, recurrent neural networks, etc.

**MIT Center for Brains Minds and Machines Summer School in Woods Hole** (June 2014)

TA for cognitive neuroscience at two-week summer school for thirty graduate students.

**Brain Imaging Multimodal Short Course at Massachusetts General Hospital** (June 2013)

TA and programmer.

**fMRI Methods Short Course at Massachusetts General Hospital** (October 2012, March 2013)

TA and programmer.

**PSYC 50: Evolutionary Psychology; Dartmouth College** (Spring 2009, Winter 2010)

TA and study group leader. Gave a class lecture.

### Students Supervised

**Erica Shook:** Center for Brains, Minds, and Machines Undergraduate Researcher (Full-time: Summer 2016, January – December 2017, Summer 2018; UCL Master's thesis: Spring & Summer 2019)

**Divya Gopinath:** MIT UROP (Spring 2018)

**Ariel Herbert-Voss:** Center for Brains, Minds, and Machines Summer Undergraduate Researcher (Full-time: Summer 2015)

### Outreach

**Sheep Brain Dissector** (April 2015, April 2016, August 2016, August 2017, April 2018, August 2018)

Represented Brain and Cognitive Sciences Department at prospective undergraduate expo and pre-orientation; dissected sheep brain and walked through gross neuroanatomy with incoming students.

**Course Organizer and Instructor** (November 2013)

The Meat That Makes You Think: Neuroanatomy and Sheep Brain Dissection  
Organized a neuroanatomy crash course for Boston-area high school students.

### Professional Membership and Service

**Cosyne Workshop: "Understanding neural representations with deep neural networks – progress and limitations"** (2017)

Co-organized two-day workshop at Cosyne (Computational and Systems Neuroscience).

**MIT BCS Seminar Series on Machine Vision and Hearing** (2015)

Organized a seminar series on computer vision and machine hearing, which focused on statistical models of natural images and sounds.

**MIT Cog Lunch:** Organizer (Spring 2015)

**Association for Research in Otolaryngology:** Member (2014-present)

**Society for Neuroscience:** Member (2008-present)

**Vision Sciences Society:** Member (2011-2015)

**Ad Hoc Reviewing:**

*Cognitive Science*, Cognitive Computational Neuroscience, Computational and Systems Neuroscience (Cosyne), *Human Brain Mapping*, *IEEE Access*, *Journal of Neuroscience*, *Nature*, *Nature Communications*, *NeuroImage*

**Early Research Experience****Harvard University**

Marc Hauser's Cognitive Evolution Lab Summer Research Assistant (Summer 2009)

**Caribbean Primate Research Center**

Macaque Field Research Assistant (Summer 2009)

**Pioneer Institute for Public Policy Research**

Summer Research Assistant (Summer 2006, Summer 2007)