Chris Holdgraf, Ph.D.

Data Science Fellow, Berkeley Institute for Data Science

Researcher, Helen Wills Neuroscience Institute, UC Berkeley

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Professional and Research Interests

How information is represented hierarchically in the brain; how different levels of representation interact with one another

The role of expectation, learning, and prediction in sensory processing in the brain; brains as "prediction engines"

Machine learning and predictive modeling approaches to the analysis of neural data; statistical computational modeling

Communication and teaching of science and computational methods; advancement of science understanding through open-source technology and information systems

Research Experience

University of California at Berkeley

Data Science Fellow 2016-present

Berkeley Institute for Data Science

- Half-time post-doctoral appointment to assist in creating tools and improving the use of Data Science and Open Science tools in the scientific community.
- Work with an interdisciplinary team of researchers and industry interested in Data Science.

Post-Doctoral Fellow 2017-present

Head Advisor: Robert T. Knight, M.D.

- Focus on data-driven methods in electrocorticography analysis, as well as extending graduate research in predictive modeling and top-down auditory processing.

Graduate Student Researcher 2011-2017

Head Advisor: Robert T. Knight, M.D.

- Using predictive models of the brain to investigate encoding models of speech perception
- Emphasis on computational modeling and data mining

Lab Manager 2010-2011

Project Investigator: Tom Griffiths, Ph.D.

- Lab coordination, event planning, and subject recruitment

- Conduct research on Computational Inferential Decision Making in humans

Tulane University

Master's Student Research 2008 - 2011

Advisor: Edward Golob, Ph.D.

- Master's thesis on Inhibition of Return and Auditory Perception.
- Designed and conducted multiple studies on attention, perception, and working memory

Research Assistant (LSU Health Sciences Center) 2009-2010

Advisor: Alberto E. Musto, M.D., Ph.D.

- Performed data acquisition and analysis of in-vivo local field potentials using implanted silicon probes

Publications and Proceedings

Holdgraf, C., Culich, A., Rokem, A., Deniz, F., Alegro, A., Ushizima, D. Portable learning environments for hands-on computational instruction: Using container- and cloud-based technology to teach data science. Proceedings of: Practice and Experience in Advanced Research Computing. New Orleans, LA. 2017.

Holdgraf, C. R., de Heer, W., Pasley, B., Rieger, J., Crone, N., Lin, J.J., Knight, R.T., Theunissen, F.E. Rapid tuning shifts in human auditory cortex enhance speech intelligibility. *Nature Communications*. **7,** 13654 (2016).

Martin, S., Brunner, P., **Holdgraf, C.**, Heinze, H.J., Crone, N.E., Rieger, J., Schalk, G., Knight, R.T., Pasley, B.N. (2014). Decoding spectrotemporal features of overt and covert speech from the human cortex. *Frontiers in Neuroengineering*. 7(14). DOI: 10.3389/fneng.2014.00014

Sfondouris, J.L., Quebedeaux, T.M., **Holdgraf, C.**, Musto, A. (2012). Combined Process Automation for Large-Scale EEG Analysis. *Computers in Biology and Medicine*. 42(1) 129-134.

Holdgraf, C.R., Ward, K.O., & Golob, E.J. (in preparation). An event-related potential study of exogenous attentional cueing and auditory objects. *Psychophysiology*.

Shi, L., **Holdgraf, C.,** & Griffiths, T.L. (in preparation). Neural Implementation of Bayesian Inference by Importance Sampling.

Holdgraf, C.R. (2010). An event-related potential study of exogenous attentional cueing, inhibition of return, and auditory objects. (Master's Thesis)

Hill, K. & **Holdgraf, C**. "Trickle Down Education: University-Public School Partnerships." *10 Ideas for Education*. 1(2009):10-11. *The Roosevelt Institute.*

Data Science, Open Science, and Other Projects

Berkeley Institute for Data Science

The Docathon 2016-present

- Co-creator of a week-long coding sprint to improve documentation in the open-source community
- Continuing work on the role and perceptions of documentation in open-source science

Data Science 8 Course Infrastructure Team 2015-2017

Project Lead: Cathryn Carson, Ph.D.
github.com/data-8/connector-instructors

- Assist instructors in creating/executing "connector" courses for the undergraduate course introduction to data science.
- Assist with creating materials, teaching how to use infrastructure, and managing student assistants

UC Berkeley Data Science Mapping Project 2015-2016

Project Lead: Cathryn Carson, Ph.D., AnnaLee Saxinian, Ph.D.

- Conduct surveys and collect data to assess the state of Data Science research across the UC Berkeley campus.
- Determine strengths, weaknesses, and needs for improving Data Science training of undergraduate and graduate students.

BIDS Collaborative - UC Berkeley Sourcing Data Science Project 2015

Project Lead: Myself and Andrew Clark, UC Berkeley Sourcing
github.com/BIDS-collaborative/purchasing

- Managed a team of 4 undergraduates and graduate students in gaining insights about UC Berkeley purchasing and sourcing using historical data from the UC system.
- Oversaw the data mining process from planning, to feature extraction, to analysis, to visualization.

UC Berkeley General

The Berkeley Science Review - Editor and Web Director 2010 – Present

- Writing, editing, and teaching for covering a wide range of scientific disciplines
- Focus on making scientific information understandable, readable, and interesting

Software Carpentry – Bootcamp Lecturer 2013 – Present

- Give lectures on computer programming for scientists
- Build materials and tutorials on scientific programming

Beyond Academia - Administrative Team and Fundraiser 2013-2014

- Plan conference aimed at connecting Berkeley graduate students with local businesses
- Financial planning and fundraising for all conference activities

Graduate Student Peer-Mentor Program Co-Creator 2015-present

- Created a peer mentor program for incoming graduate students in the Helen Wills Neuroscience Institute graduate program
- Created infrastructure and set up the foundations for a program that helps students acclimate to life in graduate school in the sciences

PLOS Labs

Communication and social media contractor 2014-2015

Project Lead: Jonathan Dugan and Elizabeth Seiver

- Organized a social media and outreach strategy for the PLOS Labs project
- Assisted with research of open-access and open-science topics, and developed a communication plan around discussing and promoting these issues.

Selected Open Source Repositories

MNE-Python – MEG and EEG Analysis and Visualization
github.com/mne-tools/mne-python

Ecogtools – A collection of tools for data analysis and machine learning for electrocorticography
github.com/choldgraf/ecogtools

Teaching, workshops, and invited lectures

Rigor and Reproducibility in Research 2017

- Invited lecture series on computational analysis and reproducible workflows in science

Data-driven Neuroscience Bootcamp 2017

- Day-long workshop on machine learning and data analysis for neuroimaging
- Interactive, cloud-based course infrastructure for collaborative learning

L&S 88 – Data Science in Cognitive Neuroscience 2016

- Co-creator of undergraduate course on data analysis in the cognitive neurosciences
- Focus on python, data visualization, and machine learning practices

NEUROS299 – Applied Statistics in Neuroscience (Course co-creator and instructor) 2013-2014

- Co-creator of graduate-organized and run course in applied statistics for neuroscience
- Organizer and leader for initial course offering

Software Carpentry Workshops (Instructor and assistant) 2014-present

- Series of workshops on scientific computing, reproducible computational science, and computer programming.

PSYC101 - Research and Data Analysis in Psychology (Graduate Student Instructor) 2012

- Focus on statistics and significance testing for psychologists

NSCI638 – Cognitive Neuroscience Lab (Teaching Assistant) 2010

- Focus on experimental design and scientific project management

Awards and Grants

Berkeley Institute for Data Science Fellow (2 years of funding) 2016
Outstanding Graduate Student Instructor Award 2015
National Defense Science and Engineering Fellowship (NDSEG, 3 years of funding) 2012
Summer Undergraduate Neuroscience Grant - LSU Health Sciences Center 2009
Summer Research in Neuroscience Program Grant – Tulane University 2009
Phi Beta Kappa National Academic Fraternity 2009
Karleim Riess Memorial Award Winner 2009
"Given to one new PBK member that has demonstrated a breadth of experience in the liberal arts and sciences"
William Wallace Peery Society 2009
"Awarded to the top 15 students among the ranks of all undergraduates who have earned the highest cumulative grade point averages over the course of their undergraduate careers"
The Newcomb-Tulane College Dean's Grant - Tulane University 2008

Conference proceedings and talks

Portable learning environments for hands-on computational instruction: Using container- and cloud-based technology to teach data science

A Whirlwind Tour of ECoG and Language. **Holdgraf, C.,** Knight, R.T. Society for Music Perception and Cognition conference. San Francisco, CA. 2016.

Human Auditory Cortical Response to Low-Level Acoustic Features Shifts During Perceptual Enhancement. **Holdgraf, C.,** De Heer, W., Rieger, J., Pasley, B., Knight, R.T., Theunissen, F. Society for Neuroscience Conference. Chicago, IL. 2015.

Evidence for predictive coding in human auditory cortex. **Holdgraf, C.,** De Heer, W., Rieger, J., Pasley, B., Knight, R.T., Theunissen, F. International Conference on Cognitive Neuroscience (ICON-XII). Brisbane, Australia. 2014.

Decoding speech with ECoG – Computational challenges. **Holdgraf, C.** Minisymposium: SIAM Conference in Computational Science and Engineering. Boston, MA. 2013.

The Relationship between Auditory Objects, Task Demands and Inhibition of Return: An Event-Related Potential Study. **Holdgraf, C.R.** & Golob, E.J. AAAS Annual Meeting Student Poster Competition. San Diego, CA. 2010.

Hippocampal epileptiform activity is counteracted by the novel mediator Neuroprotectin D1. Musto, A.E., Canavier, C.C., Quebedeaux, T.M., **Holdgraf, C.R.**, and Bazan, N.G. Louisiana NCRR/IDeA 2010 Biomedical Research Symposium. New Orleans, Louisiana. 2010.

Impairment of hippocampal oscillatory activity in early epileptogenesis. Musto, A.E., Quebedeaux T.M., **Holdgraf, C.**, Canavier, C., and Bazan, N.G.. Southeast IDeA Regional Meeting. Charleston, SC. 2009

Neuroprotectin D1 (NPD1) induces hippocampal neuroprotection in experimental epilepsy. Quebedeaux, T. M., **Holdgraf, C.**, Musto, A.E., and Bazan, N.G. *23rd ANNUAL REASEARCH DAY*. School of Graduate Studies, LSU Health Sciences Center. New Orleans, LA. 2009

Education

University of California at Berkeley 2011 – 2017
PhD, Neuroscience

Tulane University - New Orleans, LA
Master of Science, Neuroscience - GPA: 4.0 2010
Bachelor of Science, Neuroscience - GPA: 4.0 2009

Relevant Coursework

Berkeley
AY250 – Python Computing for Data Science
MCB261 - Advanced Cellular Neurobiology
STATS200a – Probability and Statistics
STAT215b – Applied Statistics
VS265 – Neural Computation
PSYC128 – Probabilistic Models of Cognition

Tulane
NSCI604 - Trends in Neuroscience
NSCI711 - Graduate Neuroscience
NSCI600 - Methods in Neuroscience
NSCI657 – Cognitive Neuroscience

Non-Science Projects

Tulane University

Radio host and webmaster 2006 – 2010
WTUL College Radio

- Host a 2-hour long radio show broadcasting to the New Orleans Metro Area

Eagle Scout 1998
Boy Scouts of America