# Jack L. Gallant

## Professor

Email Address:
gallant@berkeley.edu
Office: 3115 Tolman Hall
Education:
Ph.D., Yale University
Research Area:
Cognitive Neuroscience
Secondary Research Area:
Behavioral and Systems Neuroscience
Laboratory: Gallant Lab

Research Interests:
Interests: Visual neuroscience, attention

Research Description

The focus of research in my laboratory is on understanding the structure and function of the visual system. Vision is the most important sense for humans, and damage to vision through disease or stroke is a serious problem affecting millions of people. The human visual system is quite complicated, consisting of several dozen distinct modules (visual areas) arranged in a highly interconnected, hierarchical and parallel network. The visual system is also tightly integrated with other sensory subsystems and systems for memory and language. Because of this interconnectivity, and because the brain is build on modular principles, vision research also has important implications for understanding other brain systems.

The goal of the Gallant Lab is to understand the structure and function of the human visual system at a quantitative, computational level, and to build models that accurately predict how the brain will respond during natural vision. Predictive models of brain activity are the gold standard of computational neuroscience, and are critical for the long-term advancement of neuroscience and medicine. Accurate computational models would have many practical applications, in medicine and beyond.

The research program in my lab reflects a tight integration of three distinct approaches: neuroscience experiments involving both classical electrophysiology and functional neuroimaging (fMRI); statistical analysis using methods adapted from nonlinear system identification and nonlinear regression; and theoretical modeling. Much of our research uses modern statistical tools to fit quantitative computational models that describe how visual stimuli elicit brain activity. Statistical tools drawn from classical and Bayesian statistics and machine learning are used to fit appropriate computational models to these data. The resulting models describe how each element of the visual system (e.g., a neuron, a voxel or an entire visual area) encodes information about the visual world. Models are evaluated both by statistical significance and by their ability to predict brain responses under new conditions. This second criterion, accurate prediction, is the gold standard of science and is fairly unique to our approach.

Computational encoding models that accurately predict brain activity have many practical uses. First, they provide a critical foundation for other work aimed at rehabilitation of visual function; after all, one needs to understand how a system functions before one can hope to repair it. Second, these models provide a new tool for neurological evaluation and diagnosis. Third, the models can be inverted in order to decode brain activity, providing a direct and principled way to do brain reading and to build brain-machine interfaces (BMI) and neural prosthetics.

If you would like more information about Jack Gallant's lab at Berkeley, you can check our lab web page.

## Other Graduate Programs at Berkeley

The research program in my laboratory integrates core knowledge from several different fields: neuroscience, statistics, computer science, physics and psychology. For this reason, we take graduate students from many different departments. I am affiliated with several different graduate programs at Berkeley, including Neuroscience, Bioengineering, Biophysics and Vision Science.

## Data Sharing

My lab runs the Neural Prediction Challenge an informal contest meant to further development of quantitative neural models. The site provides data that can be used to fit models, and a procedure for automatic evaluation of model predictions on separate validation data sets. We also release our data under the auspices of a new NSF data sharing initiative, Collaborative Research in Computational Neuroscience. This program is intended to make primary neuroscience data available to theorists and modelers (and to other experimentalists), in order to speed scientific discovery and reduce needless duplication of neuroscience experiments.

## Open Source Software Tools

My lab also helps to develop and maintain the STRFPak system identification software toolbox. This software package can be used to estimate quantitative encoding models for any sensory system, based on data collected using neurophysiology, EEG or fMRI.

Selected Publications

Teaching

Department of Psychology

2121 Berkeley Way
University of California, Berkeley
Berkeley, CA 94720-1650

Berkeley, CA 94720-1650
Phone: 510-642-5292

Fax: 510-642-5293
Email: psychadmin@berkeley.edu

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