

Cognitive and Affective Neuroscience Laboratory  
Department of Psychology and Neuroscience  
University of Colorado, Boulder  
Principal investigator: Tor D. Wager

## UP TO FOUR POST-DOCTORAL RESEARCH POSITIONS AVAILABLE

Postdoctoral research positions are now available for independent, mentored work on funded projects combining fMRI imaging, physiology, and behavior at the newly established Cognitive and Affective Neuroscience Lab in Boulder, Colorado. We are recruiting exceptional Ph.D. researchers for up to four positions funded by NIH R01 and RC1 (Challenge) grants and other agencies. Project descriptions are listed below, followed by additional information about the lab, the Boulder environment, and details of how to apply. This posting is independent of other current postings from our lab on other projects.

**fMRI of pain avoidance learning.** This project aims to examine the neurobiological, cognitive, and computational mechanisms that support reinforcement learning from aversive outcomes, and their relation to the pathology of addiction. We combine a computational reinforcement learning approach, which has successfully characterized appetitive learning systems, with an experimental thermal pain model to study aversive expectancies and learning. A unique feature of this project is the study of how learning shapes pain experience and the brain representation of pain. This project is a collaboration with Drs. Daphna Shohamy, Nathaniel Daw, and Martin Lindquist.

**Brain mechanisms of placebo analgesia.** Placebo treatments alter both expectancies and learning processes, and they can influence clinical and physiological outcomes in a variety of disorders. Experimental studies of placebo offer a unique window into ‘top-down’ appraisal processes, their brain mechanisms, and their effects on health-related outcomes. Placebo responses and related endogenous regulatory processes are also substantially under-studied compared with the billions of dollars spent each year studying pharmacological treatments. This project combines fMRI, physiology, and pharmacology to study the neurobiology and neurochemistry of placebo effects.

**Development of biomarkers for pain.** Pain is a central health problem that affects quality of life and productivity for a large segment of the population, but research and clinical care are hampered by the lack of objective, quantitative measures of biological processes that contribute to pain. Pain-processing biomarkers would be useful for both understanding the generation of pain within the brain (and individual differences therein) and for predicting pain when self-reports are unavailable or unreliable. This project combines statistical machine learning techniques with fMRI imaging to develop optimal predictors of pain experience, to study their cortical sources with transcranial magnetic stimulation (TMS), and to study the generalizability of biomarkers to chronic pain. It is a collaboration with a number of investigators, including Holly Lisanby (TMS), Martin Lindquist and David Madigan (machine learning), and Jay P. Mohr and Ralph Wharton (Columbia stroke center).

**Neuroimaging-based biomarkers for emotion.** Two postdoctoral research positions are available to work with Drs. Lisa Feldman Barrett (in Boston) and Tor Wager (in Boulder) and their collaborators on a funded project on the brain bases of emotion. We will use a combination of data amassed in the literature and new fMRI data to develop biomarkers for specific emotional states in the brain, and use them to make predictions about emotional states from patterns of fMRI activity in new individuals. This use of large-scale patterns of activity to differentiate emotional states and compare them to other mental states is a new direction in cognitive neuroscience research. It only in the last several years that the required technology, computational tools, and body of scientific research have become available. Recent advances in our group, which includes a collaborative team of neuroscientists and statisticians, indicates that developing methods for predicting mental states, including emotional states, in individual participants is within reach. The project will include updating several meta-analytic databases, using statistical learning to develop and compare brain-based biomarkers for emotions and other task domains, and the collection and analysis of new fMRI data to examine individual differences in the brain basis of emotion.

**fMRI of post-traumatic stress disorder (PTSD).** This project combines fMRI, behavioral measurements, and physiological measurements to assess fear learning, extinction, and generalization in PTSD patients and matched controls. This project is a collaborative venture with Drs. Yuval Neria and Greg Sullivan at Columbia University, and Mohammed Milad at Massachusetts General Hospital, to examine a large cohort of carefully characterized individuals in the New York area with PTSD. Scanning will be conducted at Columbia University, and data will be analyzed at the University of Colorado, Boulder, under the direction of Dr. Wager. Our work will utilize a variety of lab resources and analysis techniques to characterize patients and to predict treatment outcomes and features of the disorder from multivariate patterns of fMRI activity.

Successful applicants will have a Ph.D. in affective/cognitive neuroscience or a related field (e.g., computational neuroscience or computer science). Strong skills in statistical analysis and manuscript preparation are essential. Candidates will be considered both with a primary interest in cognitive/affective neuroscience (who would be expected to conduct all phases of fMRI studies, from conceptualization to publication) and those interested primarily in the analysis of existing large-sample datasets. A subset of the following skills and interests are preferred (with their relative ranking varying by project and fit):

- Strong conceptual background in pain or affective neuroscience
- Experience with fMRI imaging and analysis (Matlab experience preferred)
- Strong background in machine learning/statistical learning (e.g., penalized regression, reinforcement learning, data decomposition techniques such as ICA, cluster analysis) and/or Bayesian statistics
- Background in psychophysiology and strong interest in brain-peripheral relationships

## **Lab and research environment**

The Cognitive and Affective Neuroscience Lab, renovated in 2010, is located in the Department of Psychology and Neuroscience on the main CU Boulder campus. It includes full facilities to support psychophysiology (ECG, GSR, photoplethysmography, eye tracking and pupillometry), behavioral testing (including a MEDOC Pathways system for hot/cold somatic stimulation), and neuroimaging data analysis, with a dedicated server with a 12 TB storage array, high-performance workstations, and access to the fMRI Data Analysis and Computational Center's high-performance, 200-node Linux parallel processing cluster. fMRI scanning is available at the 3.0T GE scanner at the University of Colorado Brain Imaging Center (BIC) on the Denver campus, 32 miles from the Department of Psychology and Neuroscience. A new 3.0T Siemens Tim Trio fMRI scanner, with a 32-channel head coil and ASL capability, is slated to be installed on the Boulder campus in April, 2011.

The lab currently contains five graduate students, three postdocs, four full-time research technicians and support staff, and other undergraduate and postgraduate research assistants, many of whom are located at Columbia University in New York (P.I. Wager moved from there recently). Weekly lab meetings with the entire group are held over video-conference, and the lab maintains numerous collaborations with other groups at Colorado, Columbia, and elsewhere, providing a rich intellectual environment.

## **Boulder environment and community**

Boulder is a small city of 300,000 residents nestled between the Flatirons, in the foothills of the Rocky Mountains, and Denver, Colorado. Boulder's citizens report the highest quality of life ratings in the United States among mid-sized cities, perhaps because of its balance of intellectual and outdoor recreational capital. Apart from the University of Colorado at Boulder, Colorado's flagship university, Boulder is home to three major scientific National Institutes and numerous high-tech companies, with strengths in aerospace and energy.

Boulder also boasts outstanding outdoor recreational opportunities. It was recently rated the "#1 Sports Town in America" by Outside Magazine. Boulder residents enjoy over 300 sunny days per year and immediate access to climbing, hiking, kayaking, and fishing within walking distance of the city center. World-class outdoor recreation is available in the 30,000 acres of open space parks surrounding Boulder, Rocky Mountain National Park (90 min travel), and 8 outstanding ski resorts (within 2 hours travel).

Boulder citizens possess a unique blend of cultural interests. In addition to its scientific and scholarly strengths, Boulder is home to Tibetan Buddhist-inspired Naropa University and an active community interested in Eastern contemplative practices. Because of its desirability as a place to live, Boulder is also home to a high concentration of novelists and Olympic and other elite athletes. These groups together support over 300 restaurants, more than 30 art galleries, 4 local museums, 32 movie and stage theaters, and many festivals, including the Colorado Shakespeare Festival and the Colorado Music Festival.

## **Position details**

Start date is flexible but preferred before June 1, 2011. The initial position is for one year, with the expectation that it will be renewed for up to an additional four years, contingent on satisfactory performance. Competitive salary and benefits will be commensurate with training and experience.

Review of applications will begin immediately, and will continue until the positions are filled. Please send a cover letter indicating your interest, CV, one-page statement of research, 1 published article, and 3 letters of recommendation to: Tor D. Wager, Department of Psychology and Neuroscience, UCB 345, Boulder, CO 80305, or email documents to [tor.wager@colorado.edu](mailto:tor.wager@colorado.edu).

As an Equal Opportunity/Affirmative Action Employer, the University of Colorado encourages applications from women and minorities who can contribute to the diversity and excellence of the academic community.