Research Experience for Undergraduate (REU) Site: Summer Program on Mind and Brain

June 4-August 3, 2007

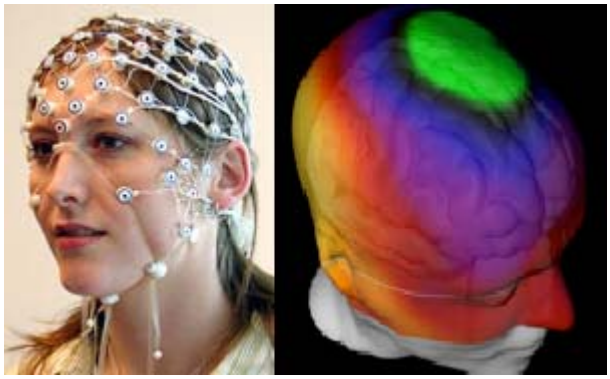
Application Deadline: March 2, 2007

Program Overview

The centerpiece of the summer program is a research experience under the close mentorship of a faculty member. During the nine-week session, students collaborate with their mentor in developing, running, analyzing, and presenting a full experiment. The research problems available to students span a range of topics from the fields of perception, cognition, and cognitive neuroscience, reflecting the research specializations of faculty mentors. To conduct this research, students have access to our state-of-the-art laboratory facilities, which include EEG systems, a driving simulator, an eyetracker, optical systems, and computer-based laboratories. Students also participate in a four-week class on mind and brain, seminars, workshops, and social functions. In addition to full room and board, admitted students are given a $3600 stipend and an allowance of up to $500 for research expenses and $500 for travel expenses.

Detailed Program Description

Mentored Research Experience. The key feature of the program is a research experience under the close mentorship of a faculty member. Participants will be matched with faculty mentors on the basis of their research interests and will conduct research in their mentor's area of expertise. Research projects will be developed in the context of a research team in which participants receive additional assistance from a graduate student in their mentor's lab. During the nine-week session, students will collaborate in developing, running, and presenting the results of a full experiment. Within the context of this research experience, students will: (a) learn how to formulate and test hypotheses; (b) learn how to translate their hypotheses into well-controlled, methodologically sound laboratory experiments; (c) learn the specific skills and techniques needed to run their experiment; (d) learn how to analyze their data; and (e) learn how present their work in the form of a poster comparable to what you would see at a professional conference. The research problems available to students span a range of topics from the fields of perception, cognition, and cognitive neuroscience, reflecting the various research specializations of faculty mentors.



High-density EEG system for research on the electrophysiology of perception and cognition

Course on Mind, Brain, and Behavior. Participants also complete a four-week course on mind and brain in conjunction with the summer research experience. The course will cover the literatures on perception and cognition using behavioral and physiological approaches.

Research-grade driving stimulator for the study of the perception and cognition of driving

Workshops. An important goal of the program is to provide students with experience in the use of state-of-the-art technology for conducting research and give them access to equipment that is not available at their home institutions. Toward this goal, several half-day workshops are planned on the following topics:

- Use of EEG equipment for the study of the electrophysiology of perception and cognition
- Use of an eyetracking device for the study of visual perception and attention
- Use of a driving simulator for the study of the perception and cognition of driving
- Use of transcranial magnetic stimulation for the localization of brain function, with a discussion of the application of the this methodology to neurorehabilitation
- Use of E-prime software for experiment construction
- Use of SPSS for statistical analysis

Site Visit. In partnership with collaborators at the University of Colorado Health Sciences Center, a site visit is planned in which faculty will run workshops on functional magnetic resonance imaging (fMRI) and magnetoencephalography (MEG) in their facility down in Denver. Although the focus of the workshops will be on fMRI and MEG methodology, the faculty will also discuss their use of this equipment to study clinical populations.

Weekly Seminar. A weekly seminar will also be held with a focus on three areas: 1) career and professional development, 2) ethics in research, and 3) interdisciplinary research and applications pertaining to the mind and brain. Planned topics include:

- Running experiments
- Ethics in psychological research
- Oral and poster presentation skills
- Graduate study in psychology
- Career opportunities in psychology
- Brain injury and neurorehabilitation
- Work on mind and brain presented by faculty from the program in Molecular, Cellular, and Integrative Neurosciences, discussed from the perspectives of their own disciplines

Social Activities. Although research and education form the basis of the program, we will include two social activities during the first week of the program. The first social activity will be held on the Sunday before students begin the program. One of the participating faculty members will host an informal barbeque at their residence so that participating students and mentors can meet for the first time in a relaxed setting. The second social activity will occur at the end of the first week of the program and will entail whitewater rafting on the Poudre River, just west of campus. Social interaction will also be facilitated by housing students together in a block of rooms in the same residence hall on campus.

Symposium and Banquet. The capstone experience of the Summer Program will be a research symposium held at the end of the nine-week session. All students in the program will present a poster during a poster session attended by faculty mentors and graduate students. The symposium will also feature a keynote address by a prominent scientist who studies the mind and brain. The session will end with a banquet, during which students will be presented with research awards and certificates of completion.

Mentors for the 2007 Program

Anne Cleary studies human recognition memory, or how it is that people recognize that they have experienced something before. Her particular interest is in when people recognize something based on a feeling of familiarity, such as when you recognize a person's face as familiar, but cannot recall anything specific about the person. She is also interested in relating feelings of familiarity to such experiences as the tip-of-the-tongue phenomenon (when you know that a word is in your memory, about to be recalled, but you momentarily cannot access it), and déjà vu experiences (the feeling of having been someplace or seen something before).

Ben Clegg investigates the general topic of skill acquisition. A core component of this research has been studies of implicit learning—knowledge that can be acquired without any direct intention to learn it, and with limited subsequent awareness of the information that has been learned. These are the type of situations in which you may know how to do something, but cannot necessarily describe it to someone else. The central issues revolve around how you learn things, and what you then know. This work has included the use of a number of basic research paradigms, such as sequence learning in the serial reaction time task, and the Hebb Digits task. Work also includes attempts to apply cognitive psychology to complex real-world tasks like driving, human supervisory control of automated systems, and research within the new field of augmented cognition.

Deana Davalos investigates cognitive processes in clinical populations, time processing, infant neurophysiology, and aspects of cognitive aging. One line of research focuses on understanding the development of time processing abilities from birth to late adulthood. In particular, is there a relationship between one's ability to process time accurately and higher order cognitive skills such as planning, sequencing, and executive functioning? Her research involves behavioral testing, event-related potentials, and neuropsychological testing.

Ed DeLosh is interested in human learning and memory. Why is it that rare or bizarre items may be better remembered than common items? Why is it that presentation format (visual vs. auditory) affects the rate at which people falsely remember information? These questions are addressed by examining how the features of individual items and the organization of a list influence recall. Other research interests pertain to issues of importance in educational settings, such as how study schedules (spaced vs. massed studying) effect memory, and how the act of retrieving information (generating it on your own or being tested on it) effects memory.

Dave McCabe maintains an active research laboratory investigating human memory. He is particularly interested in episodic memory, which is the memory system responsible for recall of specific life events. One issue of interest is the accuracy of episodic memory. He is interested in discovering the factors that lead to memory errors, and in discovering ways to reduce these errors. In order to investigate these issues, a variety of experimental and correlational techniques are employed, including studies examining whether younger and older adults differ in their memory abilities.

Patrick Monnier is interested in how humans perceive the world, and in particular, how colors are perceived. Using psychophysical procedures, Dr. Monnier investigates how the appearance of colors is affected by the spatial layout in which colors are presented, a phenomenon referred to as chromatic induction. Quantitative estimates of color appearance are obtained using well-calibrated computer monitors and by having observers make color-matching judgments. In a separate line of research, he studies how color can be used to guide visual attention. For this purpose, a visual search paradigm is used in which observers are asked to determine the presence or absence of a target presented among a set of distractors. The general aim of this research program is to understand and describe the neural substrates that govern the perception of colors. A practical application of this work is the development of better interfaces where color may be used to code information efficiently while minimizing errors.

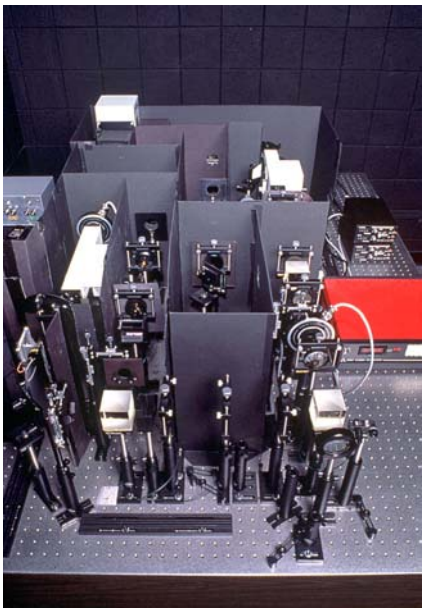
Matt Rhodes studies human memory. One line of work examines memory accuracy and its relation to subjective experience, particularly as it pertains to aging populations. Another line of work investigates recognition memory processes. Still other work examines memory for faces, predictors of individual differences in memory accuracy, and metacognition, both on a basic and applied level.

Carol Seger studies how people learn about patterns present in the world, including concepts, categories, visual patterns, sequences, rules, and skills. She is interested in how patterns are represented in the mind and brain, how they affect our behavior, and how their representations are changed by experience. Much of the current research in her lab examines how the basal ganglia interact with cerebral cortex to subserve learning. In addition to behavioral techniques, her lab utilizes functional magnetic resonance imaging and electroencephalography.

Lucy Troup investigates how the brain processes visual information. She is particularly interested in how low level perceptual representation is linked to high level conscious perception. Recent work includes using event-related potentials to investigate the nature of face perception and expertise in the brain. Other research includes using EEG to investigate how information about the visual image is bound together to form a complete perception. For example, how color

and form information is bound together. In collaboration with colleagues in the Department of Computer Science, Dr Troup is also involved in research evaluating face recognition algorithms, as well as how understanding human vision can help create artificial computer vision systems.

Vicki Volbrecht studies how the visual system enables us to perceive color, particularly how color vision changes across the retina. The center part of vision only has cones mediating perception, but outside this area there are both rods and cones in the retina. Traditionally, it was assumed that rods did not provide any color information. Recent studies demonstrate that this is not the case; rods can alter color perception. It is the influence of rods on color perception that Dr. Volbrecht studies using a Maxwellian-view optical system.



Maxwellian-view optical system for the study of vision

Eligibility and Financial Support

To be eligible for the program, students must have completed an introductory psychology course and a research methods course by the end of the Spring 2007 term, and must have a cumulative grade point average of 3.0 or higher (on a 4.0 scale). Students who will graduate before or by the end of the Spring 2007 term are not eligible. The National Science Foundation also requires that participants be U.S. citizens or permanent residents of the U.S. Admitted students receive a stipend of $3600, a room in a campus dormitory, a full meal plan for use in a campus cafeteria, up to $500 for research expenses, and up to $500 for travel to and from the site.

Application Process

All applications must be submitted on-line as described on the program web pages:

http://www.reu.colostate.edu

Deadline for Receipt of All Materials: March 2, 2007