New England College of Optometry
T35 Summer 2016 Research Laboratory Activities

Dr. Peter Bex (Northeastern University, Boston)
Peter Bex's lab is studying several visual deficits and there are projects available for students in each area. We use a combination of techniques including eye tracking and dichoptic/binocular stimulus control to study the effects of pathological and simulated visual impairment. In our age–related macular degeneration research, projects are available to study eye movement training methods to help people who have lost their fovea to acquire and use a non-foveal preferred retinal locus in their peripheral visual field. In our blur and myopia research, projects are available to study how differences in the shapes of myopic eyes affect perception across the visual field. In our amblyopia research, projects are available to study how the visual system integrates or suppresses information from each eye and how strabismus affects binocular eye movements.

Dr. Alex Bowers (Schepens Eye Research Institute, Boston)
My lab is part of the Mobility and Vision Rehabilitation Center at Schepens Eye Research Institute, Massachusetts Eye and Ear, in downtown Boston. Our research focuses on understanding more about how vision impairment affects activities of daily living (walking, driving, social interactions) and evaluating the benefits of optical devices and new training techniques to assist visually impaired people. We use a wide range of tests to quantify the effects of vision impairment on task performance and to evaluate whether devices or training improve performance, including: clinical vision measures; laboratory-based tests of vision and attention presented on computer screens; real world tasks (e.g. walking outdoors); and simulated "real-world" tasks in the controlled conditions of a virtual shopping mall walking simulator and a high-fidelity driving simulator. There are at least two possibilities for summer projects: (1) A study evaluating new clinical tests of visual attention that we are developing to determine how well they predict performance of visually impaired people on more complex mobility tasks (such as driving in the simulator), and (2) A study evaluating hazard detection by people with moderately reduced visual acuity when using bioptic telescopes (small spectacle-mounted telescopes) in the driving simulator. Students will be involved in all aspects of the research process including data collection, data analysis and presentation of results.

Dr. Nancy Coletta (NECO)
Subjects with corrected myopia, who have otherwise healthy eyes, show reduced acuity compared to those without myopia. This acuity reduction is associated with retinal stretching that occurs with axial expansion of the eye. A current project involves examination of retinal thickness across subjects with varying refractive errors, using high resolution spectral-domain optical coherence tomography (OCT). Retinal thickness in various retinal regions, and in different retinal layers, will be compared to visual performance in the corresponding retinal areas. Other current projects examine how peripheral retinal thickness is related to eye shape in myopia. The experiments employ psychophysical techniques to measure visual thresholds of human subjects, and clinical methods such as aberrometry, corneal topography, ocular biometry, anterior segment imaging and retinal OCT imaging.

Dr. Li Deng (NECO)
Outliers could significantly alter the final conclusion of studies when inappropriate statistical methods are employed and the sample size is small. However, most classical parametric statistical tests or models are not robust in the presence of outliers. In practice, outliers are usually removed before data analyses. Identifying outliers is not always straightforward. Often they are detected by visual examinations and thus are susceptible to subjective bias. In this project, we are going to compare several strategies of identifying outliers for both cross-sectional and longitudinal datasets. In addition, we will incorporate statistical as well as clinical relevance in the criteria to illustrate the importance of both in identifying outliers. The comparison will be done via simulations.
Background requirement: programming experience in R, Splus, Matlab, SAS or other simulation software.

Dr. Anne Fulton (Children's Hospital, Boston)
A T35 student could join our studies of the central retina (macula) in control subjects and those with juvenile macular disorders. Paired with clinical assessments, mfERG responses are recorded and retinal imaging is performed using conventional OCT and also adaptive optics imaging. Our aim is to learn about the effect of the macular disease on the retinal cells as step toward further improved management.

Dr. Jane Gwiazda (NECO)
Studies in my laboratory have focused on environmental risk factors contributing to the development and progression of myopia. Recent projects have examined factors that may be protective against myopia (e.g., outdoor activity, special lighting during near work). Depending on student interest and background, new experiments may investigate changes in accommodation, ocular components (e.g., axial length), and choroidal thickness in response to different lighting and near work experimental conditions.

Dr. Gang Luo (Schepens Eye Research Institute, Boston)
The Luo lab at Schepens Eye Research Institute, Harvard Medical School, is interested in developing mobile device-based technologies for vision care. Potential T35 students are welcome to participate in evaluation studies of two mobile phone apps they have developed. The first is a telescopic app for people with central vision loss. An image stabilization function has been implemented to address the image shaking problem when the phone camera is used for distance viewing in way-finding tasks. The second app captures snapshots of patients and quickly measures strabismus using a computerized Hirschberg algorithm. The app is designed as an easy-to-use tool, which can be particularly useful for hard-to-measure populations using cover test, such as young children and older adults with head trauma due to stroke or head injuries. The T35 students will be mentored by Gang Luo, PhD and Kevin Houston, OD MSc.

Dr. Glen McCormack (NECO)
We are studying the relationships between ocular accommodation, convergence, and visual clarity in 3D Displays. Other researchers have found that 3D movies and TV may induce blur, double vision, and visual discomfort for some viewers. The first two studies conducted in our laboratory indicate that clinical measures of blur induction by ocular convergence differ quantitatively and qualitatively from analogous measurements made in 3D display environments. Two additional studies found that visual motion reduces the effect of convergence on clarity. We are presently studying how these motion effects occur, because motion is ubiquitous in movies and television, and must be considered when evaluating the visual response to 3D displays.

Dr. Debora Nickla (NECO)
The goal of my research is to elucidate the cellular and molecular mechanisms underlying the development of myopia. My animal model is the chicken, the most well-studied model for work on emmetropization. I am studying the effect of exposing eyes to different visual stimuli at different times of day, to determine if there is a phase-dependency to their efficacy at inhibiting growth, and then to determine how the rhythm parameters in choroidal thickness and axial length are differentially altered. I am also looking at the possibility that there is a time-of-day difference in the efficacy at growth inhibition of 2 drug classes in preventing myopia. Experiments will involve intravitreal injection of a drug at 3 different times of day to see if one time is more effective, and then looking at the rhythms (using ultrasound measurements at 6-hour intervals) to determine how they are differentially expressed. These lines of investigation are timely, as they relate to recent findings showing that some aspect (timing of light exposure?) of the outdoors is preventative for myopia development in children; these may impact on circadian rhythms.

Dr. Thanasis Panorgias (NECO)
Color vision relies on three cone photoreceptors with peak spectral sensitivities at different parts of the visible spectrum dictated by inherited cone opsin-genes. There are, however, cone opsin-genes that differ from the cone opsin-genes that give us ‘normal’ trichromatic color vision. People that inherit these not-normal opsin-genes have a different color perception than normal trichromats and their color vision is called colloquially as deficient. The degree of color vision deficiency depends on how different the cone sensitivities are when compared to the normal cone sensitivities. Clinically common tests screen for color vision deficiencies without being able to give any information about the altered peak sensitivities of the cone photoreceptors. A more advanced test (the anomaloscope) that can offer a color vision deficiency diagnosis is difficult to administer and is also expensive for a clinic to afford. The objective of this project will be to develop a psychophysical task on a computer screen that will be able to screen for and diagnose color vision deficiencies in a conceptually easy and straightforward manner.

Dr. Eli Peli (Schepens Eye Research Institute, Boston)
In my lab we have numerous projects covering various aspects of low vision and binocular vision. Project includes:

- Novel prism treatment for tunnel vision, including use of virtual reality for performance evaluation
- Headlight glare impact on driving with cataract and following cataract surgery, including use of driving simulator
- Confocal imaging for retinal prostheses, including training of blind people in use of a vision substitution device
- Hemianopia and strabismus; evaluation of the possible benefit of eye deviation for field expansion
- Stereo virtual reality displays and motion sickness
- Augmented reality system for tripping obstacle detection and avoidance for partial sight

Dr. Nicole Ross (NECO)

The projects in my laboratory in which a student can participate include:

1. Studying outcome measures for a low vision population - measuring impact of a mobile van low vision clinic utilizing the activity inventory

2. Investigating eye movements in patients with central vision loss

3. A new look on the PRL: does image enhancement improve visual performance at the PRL?

Dr. Frances Rucker (NECO)
We are investigating the environmental signals that drive the development of myopia. Our ultimate goal is to develop clinical treatments that slow myopia progression. We have shown that the eye uses both luminance (brightness) and color signals (that arise from longitudinal chromatic aberration) to guide emmetropization. We have shown that we can slow eye growth during emmetropization by stimulating the eye with rapidly changing stimuli and the goal of our current research is to optimize these stimuli for clinical use. To study these visual signals, week-old chicks are exposed to carefully controlled visual stimuli. Complete biometric measurements are made using Lenstar, a high precision instrument, that utilizes low-coherence, optical reflectometry. Refraction measurements are made using a Hartinger Refractometer.