T35 Summer 2015 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)
Human night vision is limited by optical and neural components of the visual system. Subjects with corrected myopia, who have otherwise healthy eyes, show reduced acuity compared to those without myopia. The acuity loss in myopia is more evident at low light levels, and Dr. Coletta is examining the possible neural contribution to this effect. A current project involves examination of retinal thickness across subjects with varying refractive errors, using high resolution spectral-domain optical coherence tomography (OCT). Retinal measurements will be related to visual performance in the retinal periphery and in night vision tasks. 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)
My research focuses on myopia study in children. My past and ongoing projects include identifying risk factors for myopia and comparing the effectiveness of myopia intervention methods. Some possible projects for the summer research program are:
1. Meta-analysis of risk factors related to high myopia in different ethnic groups
2. Update meta-analysis on effectiveness of various myopia intervention methods with more focus on under-correction, Ortho-K and atropine.
3. Develop a statistical method for outlier detection by taking the clinical significance or normal variability in measurements into account.

Dr. Anne Fulton (Children’s Hospital, Boston)
A T35 student could join:
1. An m-sequence VEP acuity study in which we are currently working out protocols and analyses on adult controls and then will be moving on to 3-5 year old healthy children, then 6 month old infants; eventually we aim to study amblyopia
2. A fERG study of infants’ cone driven responses
3. A mfERG study in controls and juvenile maculopathy subjects

There is also the possibility of a study using animal psychophysics.

Dr. Jane Gwiazda (NECO)
Studies in my laboratory focus on environmental and genetic risk factors contributing to the development and progression of myopia. Recent work includes risk factors for myopia (e.g., accommodation during near work, timing of near work and outdoor activity) and protective factors against myopia (outdoor activity, light intensity during near work). Depending on student interest and background, new experiments may include measurements of accommodation, axial length, macular and choroidal thickness, and refractive error in myopic and non-myopic individuals under different experimental conditions. Students involved in this research will test subjects, analyze data, present results, and write up key findings.

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. 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, and one that is particularly well-suited because of their rapid post-natal ocular development. My work can be divided into two main areas: first, the involvement of ocular circadian rhythms in the visual regulation of eye growth, and second, the influences on and by the choroid in eye growth control. I am currently 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, and how the rhythm parameters are altered. I am also looking at time-of-day efficacy of intravitreal injections of dopaminergic agonists and muscarinic antagonists in preventing myopia development. These lines of investigation are timely, as they relate to recent findings that suggest that some aspect of the outdoor environment is preventative in the development of myopia in children.

Dr. Eli Peli (Schepens Eye Research Institute, Boston)
This NIH-funded study evaluates the impact of headlight glare and cataract on the driving performance and behavior. The research will be conducted at Schepens/Mass Eye and Ear, Harvard Medical School. A custom-designed validated headlight glare simulator was installed in our state of the art driving simulator. We will be studying the impact of the oncoming headlight glare on drivers with cataract in both eyes one eye or no cataract. This year study as part of the system development will compared simulated cataracts with optical blur (plus lenses) and clear vision. The student will measure subjects’ acuity and contrast sensitivity with cataract simulating filters and will match acuity performance with plus lenses. The performance will then be measured also with the Brightness Acuity Test and with the oculus Straylight Test. Other clinical screening test will be conducted as well including field and fundus photography. Following this evaluation the subjects will be evaluated in the driving simulator with all conditions: clear, cataract simulators and optical blur lenses both with one and both eyes affected. The student will be expected to learn to run all these tests and conduct the full range of experiments as well as participation in data analysis.

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. Needs-based assessment: examining barriers to low vision care access in a pediatric patient population
3. Investigating eye movements when reading with low vision aids
4. 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 and color signals (that arise from longitudinal chromatic aberration) to guide emmetropization. More recently, we have made the important discovery that we can prevent myopic changes in refraction by simply ensuring that there is sufficient blue light in the illuminant. To study these visual signals, week-old chicks are exposed to carefully controlled, flickering, light sources. 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.