T35 Summer 2019 Laboratory Research Activities

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 normal aging and vision impairment affect activities of daily living (walking, driving, social interactions) as well as evaluating the benefits of optical devices, new training techniques and advanced driver assistance systems for people with vision impairment. Many of our studies involve the use of a high-fidelity driving simulator. Possibilities for summer projects in 2019 include: the effects of central vision loss (e.g. AMD) and distraction (e.g. using a cell phone) on hazard detection in simulated driving; the effects of advanced driver assistance systems on hazard detection in simulated driving; and a survey addressing the use of advanced driver assistance systems by drivers with vision impairment. Students will be involved in all aspects of the research process including data collection, data analysis and presentation of results.

Dr. Rhea Eskew (Northeastern University, Boston)
With Dr. Frances Rucker at NECO, we are studying the relationship between myopia and chromatic sensitivity. It is known that the difference in focus for different wavelengths of light (longitudinal chromatic aberration or LCA) can be a stimulus for accommodation (focusing) of the eye, and perhaps can serve as a cue for regulating eye growth during development. If so, it may be that some children are less sensitive to the regulatory influence of LCA, and that may contribute to the development of myopia. This difference would most likely manifest itself as a relative lack of sensitivity to S cone stimulation, since short-wavelength light has the largest LCA. If the chromatic sensitivity difference persists into adulthood, we should find a correlation between S cone sensitivity and degree of myopia in adults. We are currently exploring this idea in two experiments. In one, we measure the ability to detect Gaussian blob stimuli (fuzzy spots) that are only visible to the S cones, and compare that to stimuli visible to the other cone types. In the other experiment, we measure the effects of LCA using high spatial frequency gratings. Gratings seen via S cones can be made visible to the other cone types due to the effects of LCA, and myopes may be less sensitive to this effect.

Dr. Haiyan Gong (Boston University Medical School, Boston)
Dr. Gong’s lab seeks to understand the mechanism of aqueous humor outflow resistance in the normal eye, how it is modulated, and causes of increased outflow resistance in open angle glaucoma (POAG), a disease which is the second leading cause of blindness worldwide. The research in Dr. Gong’s laboratory is to develop new therapeutic strategies to lower IOP in glaucoma. Her lab has developed a novel fluorophore-guided method of studying the structure and function of the aqueous outflow system. This unique method uses the effective filtration area as a new parameter in examining the structural changes responsible for the reduced outflow in glaucomatous eyes. They are currently using this new method to investigate both the mechanisms of potential new drugs, as well as novel micro-invasive surgical devices in the treatment of glaucoma. Dr. Gong’s laboratory is also developing a new approach to investigate how cellular connections of the inner wall endothelial cells of Schlemm’s canal play a role in giant vacuole and pore formation using serial block-face scanning electron microscopy in combination with 3D-reconstruction.
Dr. Gang Luo (Schepens Eye Research Institute, Boston)
Dr. Luo’s lab has developed a suite of smartphone apps for measuring visual acuity, inter-pupil distance, angle Kappa, eye deviation (including tropia and phoria), refractive error, and also for binocular vision therapy. These apps have shown great potential in tele-medicine and mass vision screening in preliminary studies. Motivated students are welcome to participate in our clinical studies to evaluate these technologies for vision diagnosis and treatment. The students will be supervised by Gang Luo, PhD and Kevin Houston, OD, MS.

Dr. Sangeetha Metlapally (NECO)
Research in the laboratory is broadly centered on understanding the influence of optical aberrations on binocular vision and accommodation. Our recent focus has been on understanding the effects of abnormally increased high-order aberrations (HOAs) and aniseikonia (differences in perceived retinal image sizes between two eyes) on the worsening of binocular three-dimensional depth perception. Such effects are relevant in patients with keratoconus or those with a history of refractive surgery, as they experience increased magnitudes of HOAs and mismatched optics between the two eyes. Tools used in the research include, but are not limited to, optical wavefront analyses, psychophysics, data analyses with Matlab/SPSS and computational modeling. Previous experience with these tools is not required. The research will inform clinical management strategies or lead to strategies that alleviate visual discomfort and improve binocular visual quality in patients with these conditions.

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 studied model for work on emmetropization. I am studying the effects on eye growth of exposing chicks to blue light at the transition times of dawn and dusk (times of greatest sensitivity of the circadian system), and to determine how the rhythm parameters in choroidal thickness and axial length are differentially altered. I am also interested in determining if the rhythm in choroidal thickness is endogenous; i.e. driven by clocks in choroidal cells, and in identifying these cells. These lines of investigation are timely, as they relate to recent findings showing that some aspect of the outdoors inhibits myopia development in children; these may impact on circadian rhythms.

Dr. Eli Peli (Schepens Eye Research Institute, Boston)
In my lab we have numerous projects covering various aspects of low vision and binocular vision. Projects include:
• 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 a 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 from different service models including telehealth
2. Investigating eye movements in patients with central vision loss
3. Image enhancement and head mounted displays in low vision
4. Examining blur tolerance in low vision patients

Dr. Magali Saint-Geniez, (Schepens Eye Research Institute, Boston)
Student positions are available in my laboratory to characterize and target novel molecular pathways involved in common retinal degenerative diseases. In particular, my group is i) investigating the underlying pathogenic roles of metabolic dysfunction and oxidative damage in photoreceptors and retinal pigment epithelium, and ii) evaluating the therapeutic benefits of novel metabolic regulators using multidisciplinary approaches, including molecular and metabolic biology on cellular and animal models. Our research is predominantly centered on Macular Degeneration and Retinal Detachment for which we have established in vitro and in vivo models and have access to clinical samples/data. Students will assist in the exploration of a novel pathogenic process promoting mitochondrial and metabolic defect in retinal cells. Prior research experience is not required, but we are looking for highly motivated individuals. Basic laboratory skills and cell culture experience are a plus.

Dr. Christopher Taylor (NECO)
My lab is studying how differences in the eye, such as refractive error and axial length, can affect behavior. We use optical coherence tomography to measure the ocular biometry of the eye alongside psychophysical visual tasks. Two projects are available. The first project aims to address if the use of head-mounted displays for virtual reality affects the structures at the back of the eye, particularly the thickness of the choroid. The second project aims to address whether the changes in the eye that result from reading text of different colors (e.g., black/white text versus black/white background) can influence visual performance.

Dr. Fuensanta Vera-Diaz (NECO)
(1) Accommodation, aberrations and myopia in children, in collaboration with Dr. Bex (Northeastern University)
We will study the interaction between high positive spherical aberration and large lags of accommodation, a combination that could degrade retinal image quality enough to pose a risk for myopia development. We will measure dynamic accommodation with a variety of stimuli and optical quality across the retina for both accommodated and un-accommodated eyes in children.
(2) Sensory dominance in binocular refraction, in collaboration with Dr. Gaiser (NECO)
We will evaluate three ocular dominance tests used in clinical settings and compare their results with those using our custom-designed electronic dichoptic shutter glasses. The results will aid understanding of how eye preference is related to subjective refraction.
(3) Myopia calculator tool, in collaboration with Dr. Russo (NECO), Dr. Kerber (NECO) and Dr. Kochik (UC Berkeley Optometry)
This study will create a normative database to help clinicians determine whether a myopia control treatment is working for an individual patient. We will compile and analyze large myopia datasets to generate a user-friendly tool for clinicians to enter patient data (DOB, onset of myopia, amount of myopia, gender, race, parental myopia, near work and outdoor activities) to see where they fall in terms of expected myopia progression.