UNIVERSITY of HOUSTON | OPTOMETRY

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TO:	First year optometry students
FROM:	Laura Frishman, Associate Dean
SUBJECT:	NEI Summer Research Fellowship for Professional Students
	http://www.opt.uh.edu/research/summer-research-program
DATE:	January 24, 2022

The University of Houston, College of Optometry (UHCO) has a summer research program supported by the National Eye Institute (NEI) T35 grant. The purpose of the program is to introduce students in health professional schools to opportunities for a research career. The program is designed to attract professional students into a career that includes clinical and health-related research. Optometry students who participate will receive a Predoctoral Research Fellowship in the amount of $6459 for 12 weeks (May 16 to Aug. 8, 2022). At least 8 fellowship slots are open for 1st year Optometry students who will not be enrolled in Optometry coursework during the summer between 1st and 2nd year. **U.S. citizenship or permanent residence is required**, with special consideration to students from underrepresented minorities.

Faculty mentors are listed below. More detailed descriptions of research projects are on subsequent pages, and will also be included on the webpage http://www.opt.uh.edu/research/summer-research-program. Please include your special research interest and/or particular faculty member that you wish to work with, on the application form, attached in a separate file. It is **strongly** recommended that you contact faculty members whose research interests you. Email addresses are on the UHCO website- http://www.opt.uh.edu/research/research-faculty.

If you are interested in doing vision research this summer, please use the application form attached to this notice, or posted on the UHCO website. Additional information and forms can be obtained by contacting Renee Armacost, the program manager, (rrattelade@uh.edu). Applications are due Friday, **March 11, 2022**. Acceptance announcements will be made by Tuesday, March 29. If you have any questions, please email Dr. Frishman, Renee Armacost or the faculty mentors:

MENTORS	CURRENT RESEARCH INTERESTS
Jan P.G. Bergmanson, OD, PhD	Corneal anatomy and pathology, contact lenses and tears
David A. Berntsen, OD, PhD	Myopia, contact lenses, aberrations of the eye and visual performance
Han Cheng, OD, PhD	Noninvasive evaluation of visual pathways
Dan Coates, PhD	Normal and impaired visual perception; psychophysical testing
Vivien Coulson-Thomas, PhD	Corneal development, wound healing and regeneration, stem cell biology, the ocular surface and aging, Meibomian gland dysfunction and dry eye disease
Luca Della Santina, PharmD, PhD	Retinal connectivity and functionality in animal models of ocular diseases & machine learning approaches for image analysis
Wendy Harrison, OD, PhD	Structure and function relationships in diabetic eye disease
Jason Marsack, PhD	Quantification of optical performance in highly aberrated eyes and development of correction strategies
M Naash,PhD &M Al-Ubaidi,PhD	Mechanisms of retinal degeneration in animal models of human blinding disorders
Lisa Ostrin, OD, PhD	Environmental and behavioral influences on circadian rhythm, myopia, and the choroid
Nimesh Patel, OD, PhD	Optical coherence tomography imaging of the optic nerve head and surrounding tissues
Jason Porter, PhD	High-magnification imaging of the living eye in health, development, and disease
Guoting Qin, PhD	Contact lens-based drug delivery systems
Rachel Redfern, OD, PhD	Toll-like receptors (TLRs) involvement in dry eye inflammation and the risk for ocular surface infection
Christophe P. Ribelayga, PhD	Daily organization of retinal function and visual perception
Eric Ritchey, OD, PhD	Contact lenses, refractive error development, ophthalmic optics
Scott Stevenson, PhD	Eye movements and binocular coordination, visual processing of motion and depth, motion tracking
Geunyoung Yoon, PhD	Optical and neural factors contributing to vision and refractive error development

Summer Research Opportunities by Mentor - 2022

Jan P G Bergmanson, OD, PhD, D.Sc. – Texas Eye Research and Technology Center offers a number of interesting opportunities. We are studying scleral gas permeable contact lens wearers, post-refractive surgery patients and patients with anterior segment pathologies. In addition, we are conducting research in ocular anatomy and pathology at a cellular and subcellular level using light and electron microscopy. In these studies, the research is utilizing human cadaver eyes and corneal buttons from keratoplasty transplant surgery. These specimens will allow the study of normal anatomy, diseases like keratoconus, macular-, granular-, lattice- and Fuchs endothelial- dystrophies, some of which are rare anomalies. You could be part of this team effort.

David A Berntsen, OD, PhD - My research interests include both the development and progression of myopia, the use of multifocal contact lenses to slow the progression of myopia and understanding the effect of these lenses on optical aberrations, image quality, and visual performance. My research involves using biometric data (measurements of the ocular components) and measurements of optical quality to better understand the mechanism responsible for the progression of myopia in children and which children will benefit most from treatment. Current projects in my lab involve using aberrometry to determine the effect of refractive corrections (spectacles and contact lenses) on the central and peripheral optics of the eye and on visual function.

Han Cheng, OD, PhD – This summer's research project is to evaluate a new contrast sensitivity test in healthy adults. Visual function is typically measured with high contrast chart. However, low-contrast vision is often more predictive of the real-world vision and more sensitive in revealing changes in vision. Current contrast sensitivity tests are expensive, not easily portable, or require supervised testing conditions. The SpotChecks is an inexpensive disposable paper chart designed as a take-home test for patients to self-monitor disease progression. Due to the newness of the test, there is currently no normative values or test-retest variability available. The goal of the study is to establish them in healthy adults. The data will be used to set the normative limits for SpotChecks contrast sensitivity so that abnormal vision can be detected; the test-retest variability will provide guidance in using the test for monitoring disease progression.

Daniel Coates, PhD – The broad research focus of my laboratory is visual perception in normal subjects and in the presence of disease, including peripheral vision and reading, binocular vision, eye movements, and color vision, as well as the use of computational and statistical techniques for modeling, diagnosis, and prediction. This summer we will continue the development of a new color perimetry test, validating in normal and diseased eyes.

Vivien Coulson-Thomas, PhD – Research in my lab is focused on corneal development, wound healing and regeneration, stem cell biology, the ocular surface and aging, Meibomian gland dysfunction and dry eye disease. Our main interest involves primarily the extracellular matrix (ECM) and how it regulates development, homeostasis, aging and pathological processes of the ocular surface. Current projects include (1) understanding how the hyaluronan rich limbal stem cell niche maintains limbal stem cells in their "stem cell state", (2) investigating the anti-inflammatory role of the hyaluronan matrix in ocular injury and corneal lymphangiogenesis, (3) understanding the pathology of Meibomian gland dysfunction (MGD) and age related MGD, and develop prevention strategies, and (4) how the ECM affects inflammation in the aging lacrimal gland. A student working on either of these projects would attain hands-on experience in a vast array of cell biology techniques including primary and established cell

line culture, histology, immunofluorescence, protein purification, Western Blotting and high pressure liquid chromatography, as well as working with knock-out mouse models.

Luca Della Santina, PharmD, PhD - My laboratory focuses in identifying the alterations occurring to retinal function and synaptic connectivity. Available wet laboratory projects include: 1) Imaging and quantification of synaptic rearrangement occurring in the retina following to neuronal loss 2) Electrophysiological recording of individual retinal ganglion cell light response properties following to injury. 3) Electrophysiological recording of in-vivo retinal activity using electroretinogram.
In parallel, we directly develop image analysis software for the automatic recognition of synapses and clinical ocular diseases. Available computational projects include: 1) Development of high-performance image analysis algorithm for quantification of large number of synapses 2) Development of deep learning neural network for automating the detection of external ocular diseases from photographs and video streams.

Wendy Harrison, OD, PhD – The goal of our research lab is to better understand what happens in the eye in patients with diabetes. Diabetes is the leading cause of preventable vision loss in working aged Americans. It affects both blood vessels and nerves in the retina as well as the front of the eye. We evaluate local retinal nerve function with a multifocal electroretinogram and nerve and vascular structural changes with an OCT and retinal photographs. Right now one of our goals is to evaluate how these changes match up with local color vision changes in collaboration with the Coates lab.

Jason Marsack, PhD – The research interests of our laboratory center on the development of new optical correction strategies (glasses, contact lenses) for individuals with ocular diseases that cause distorted corneal optics and poor retinal image formation (e.g.: keratoconus). We are interested in three aspects of this problem. 1) Design, manufacture and evaluation of custom contact lenses that contain patient-specific optical corrections: We are currently building and evaluating these 'wavefront-guided' lenses in-house. 2) Evaluation of pseudo-custom corrections: This study is evaluating whether the types of refractive error present in keratoconus have enough commonality across patients to develop corrections that are applicable to not just one keratoconus patient, but to groups of patients, making delivery of these corrections cheaper for the patient, and easier for the clinician. 3) Simulation of the impact of refractive error on visual performance: These experiments focus on developing computer models that simulate real-world optical conditions and neural constraints. These three areas have as a common goal increasing clinical access to care and improving quality of life for individuals that suffer from abnormally high levels of corneal distortion.

Muna Naash, PhD & Muayyad Al-Ubaidi, PhD - The research interests of the joint labs of Drs. Naash and Al-Ubaidi involve primarily the study of the mechanisms of retinal degeneration in animal models of human blinding disorders. Knockin mouse models for mutations that affect humans are generated and subjected to non-invasive functional and structural techniques to assess the rate of degeneration. Then molecular and biochemical analyses are performed on retinal samples obtained from the mouse models. These mouse models are then used to develop nanoparticle based gene therapy to ameliorate the disease phenotype. The animals models used in the labs are for retinitis pigmentosa and Usher syndrome. Another approach that has been recently introduced is the study, using metabolomics, of the metabolic changes that occur prior and during the retinal degenerative process. A student working on any of these projects would attain hands-on experience in electroretinography, optical coherence tomography, fundus imaging, as well as molecular, biochemical, cell biological and histological techniques.

Lisa Ostrin, OD, PhD – My research interests include environmental and behavioral influences on circadian rhythm, myopia, and the choroid. Light exposure has a close link with numerous aspects of human physiology and has been implicated in several different pathological processes including myopia development, circadian rhythm disturbances, mood disorders, cancer, and metabolic disorders. The intrinsically photosensitive retinal ganglion cells (ipRGCs) are an inner retinal photoreceptor that respond directly to short wavelength blue light, and are responsible for non-image forming functions including circadian rhythm entrainment and pupil size. Ongoing projects in the lab include 1) measuring and correlating light exposure with ipRGC activity, circadian rhythm patterns, melatonin level, and refractive error, 2) determining the influence of retinal blur on the choroid, and 3) understanding how behaviors are altered during and after the covid pandemic and if these changes might ultimately contribute to increasing myopia prevalence and progression.

Nimesh Patel, OD, PhD – The research interest of my lab include the accurate quantification of optic nerve head morphology in normal and disease eyes. We use optical coherence tomography (OCT) to image the eye, and develop custom algorithms for analysis, which are then histologically validated. Current projects in this area include; 1) accounting for retinal curvature for OCT based optic nerve head and macula quantification, and 2) determining the retinal ganglion cell density and axonal characteristics in the peripapillary tissue of healthy and glaucomatous eyes.

Jason Porter, PhD – The main goals of our laboratory are to learn more about the causes of retinal and optic nerve head diseases and how the retina develops in normal eyes. In conjunction with the use of conventional clinical tests (such as fundus photography and optical coherence tomography [OCT]), we use a technology called adaptive optics to correct the blur imposed by the eye's optics and examine the structure of single cells in healthy and diseased eyes. Current projects in the lab include (1) measuring changes in the lamina cribrosa, optic nerve head, and retinal vasculature over time in eyes with glaucoma, 2) examining changes in the photoreceptor mosaic in patients with retinal degenerations (such as retinitis pigmentosa) to better understand genotype-phenotype and structure-function relationships in these diseases, as well as 3) examining how the cone photoreceptor mosaic, foveal pit and optic nerve head change during normal development and differ between healthy eyes with different refractive errors. Occasionally, the lab also has projects that examine retinal structure and function in patients following a concussion and/or traumatic brain injury.

Guoting Qin, PhD – One research focus for this summer is to design and develop contact lens-based systems for efficient delivery of anti-inflammatory and anti-myopia drugs. Contact lenses as ocular drug delivery systems have the great potential to provide high ocular drug availability and low drug toxicity while requires less frequent administration, which could provide a more convenient treatment regime and better patient compliance.

Rachel Redfern, OD, PhD – My laboratory is investigating ocular surface inflammation and infection. We hypothesize ocular surface damage stimulates the release of alarmins which activate toll-like receptors (TLR) to perpetuate inflammation through the production of cytokines and conversely protect the ocular surface through the production of antimicrobial peptides. These studies have been investigating using a variety of models including cell culture, animal, and human subjects to examine molecular changes that occur with disease (e.g. dry eye). Currently, we are examining novel therapeutic options that may modulate the risk of inflammation and infection.
Given the prevalence of dry eye expected to double over the next few decades and the lack of definitive treatment regimes, there is a critical need to development of therapeutic regimens that reduce inflammation while not increasing the risk for infection.

Christophe P. Ribelayga, PhD – A major research focus in our lab is to elucidate how the retina processes information and adapts to an environment constantly changing over the course of the day/night cycle. We are particularly interested in understanding the role of gap junctions (or electrical synapses) and that of endogenous circadian (24-hour) clocks in the daily plasticity of retinal circuitry. Our overall goal is to identify the ways through which retinal clocks generate output rhythms in physiology and behavior. We have developed/used a variety of mouse models for that purpose. A student joining our lab would gain hands-on experience in electrophysiological and histological analysis of the retina, and/or analysis of mouse visual behavior.

Eric Ritchey, OD, PhD – My research interests are in the area of 1) contact lenses and 2) refractive error development. Contact lens dropout is a significant issue in clinical practice. My research examines factors related to contact lens comfort and dropout, with a goal of predicting which contact lens product matches the need of the patient. This includes subjecting and objective methods for evaluation of Lid Wiper Epitheliopathy and Meibomian Gland Disease. In refractive error development, my research interest is in contact lens control of myopia progression and the visual performance of these contact lenses. I am interested in the optical profiles of contact lenses, the effect on treatment efficacy, and the quality of life with these devices.

Scott Stevenson, PhD – Eye movements are controlled through a combination of voluntary and reflexive responses to visual input. Research in my laboratory examines the visual processes that support each of these aspects, and the way in which they are combined in the final motor response. For comparison to eye movement responses, we also study visual processing of motion and depth information with psychophysical methods, and we study visual tracking behavior using hand and head movements along with eye movements.

Geunyoung Yoon, PhD – My lab's research interests cover broad areas in physiological optics, vision science, and biomedical engineering. The overarching goal of my laboratory is to improve our understanding of optics of the eye, its impact on neural processing and spatial vision, and underlying mechanisms of eye problems such as keratoconus, presbyopia, and refractive error development/control. We achieve this goal by conducting translational research that involves developing advanced optical imaging modalities, vision correction technology (adaptive optics and wavefront-guided contact lenses), and visual psychophysics paradigms.