Collaboration Key to Research Breakthroughs

**FOCUS:** Vanderbilt Vision Research Center
**RESEARCH:** Visual Perception • Quantum Dot Imaging • G Proteins
**EDUCATION:** Seeing Across Disciplines
**PROFILE:** William B. Snyder, M.D.
Dear Friends,

In previous issues of Vanderbilt Vision, we have introduced you to many of the investigators and projects that take place in the Vanderbilt Eye Institute. We discussed our departmental priority on translational research and our strategic plan to develop treatments for leading causes of blindness based on programs elucidating mechanisms of disease in our research laboratories. It has been exciting to share our success in building a vibrant team of scientists and clinician-investigators in the Department of Ophthalmology and Visual Sciences.

However, the vision research community at Vanderbilt extends well beyond our Department. Vanderbilt’s success as a research institution often has been attributed to its unique community of collaborative and collegial investigators, and our the vision science community could serve as the poster child for this claim. There are funded scientists studying the eye and visual system in the College of Arts and Sciences, Peabody College, the School of Engineering, and the School of Medicine. Even within the School of Medicine, there are numerous vision scientists working outside the Department of Ophthalmology.

Taken together, Vanderbilt houses more than twenty NIH-funded investigators in over a half dozen departments. Although these scientists reside in different buildings on different parts of the campus, there is a true sense of shared interest. The Vanderbilt Vision Research Center (VVRC), headquartered in the Department of Psychology within the College of Arts and Sciences, is the central operating center. The VVRC oversees a group of research support modules across the campus that support the entire community of investigators, as well as overseeing the training of graduate students and postdoctoral fellows, and organizing a world class series of seminars. Although the NIH only provides rankings for overall federal research dollars by department of ophthalmology, Vanderbilt would rank in the top twenty nationally if one measured the number of vision research grants by institution.

I am sure that you will enjoy this edition where we profile our overall vision research community at Vanderbilt that extends beyond the Eye Institute. In particular, I hope you get a feel for the wonderful collaborative energy that fuels vision research here.

Sincerely yours,

Paul Sternberg, Jr., M.D.
G. W. Hale Professor and Chair
Vanderbilt Eye Institute
Editor's Notes

Vanderbilt Vision is a publication of Vanderbilt Eye Institute, a department of Vanderbilt University Medical Center. Vanderbilt Vision provides ophthalmologists with information on current research and state-of-the-art clinical applications.

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Vanderbilt Vision is written for physicians and friends of the VEI and does not provide a complete overview of the topics covered. It should not replace the independent judgment of a physician about the appropriateness or risk of a procedure for a given patient.

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Cover image created by Duje Tadin, Jennifer Jewett and Dan Shima. Courtesy of the Vanderbilt Vision Research Center.
Interdisciplinary research and training in vision have a long and distinguished history at Vanderbilt University. The Vanderbilt Vision Research Center (VVRC), fosters that tradition by bringing together scientists from across the institution – including the College of Arts & Science, Peabody College, the School of Engineering and the School of Medicine – in an exceptionally rich environment for vision research and training. The VVRC originated in 1989, when Vanderbilt received a Core Grant from the National Eye Institute. Jeffrey Schall, the E. Bronson Ingram Professor of Neuroscience, is its current director. The Core grant, renewed in 2004 for five years at $2.5 million, provides technical support for eye and vision research across the campus. This support includes things like access to gene and protein analysis facilities, fabrication of specialized instrumentation, and printing posters for scientific meetings.

Also in 2004, the VVRC was awarded a five-year, $2.8 million Training Grant from NEI that supports pre-doctoral and postdoctoral training in research on the eye and vision. These students and fellows are found in laboratories ranging from psychology to molecular physiology and biophysics. A central component of vision training at Vanderbilt is an interdisciplinary course called The Visual System (see article, page 10). This course, along with regular seminars, fosters intellectual connections among researchers and students who are joined by an interest in vision but separated by their disciplines and majors.

Vanderbilt can compete for these large grants from NEI because individual scientists are funded for diverse eye and vision research projects. “When the VVRC started,” said Dr. Schall, “Vanderbilt had eight NEI grants. Today we have twenty. That is some of the greatest growth in vision research anywhere in the country.” Vanderbilt is currently ranked in the top 20 of U.S. universities for NEI sponsored research. “Our mission to foster trans-institutional research in vision is really paying off,” said Dr. Schall.

“What is impressive about Vanderbilt’s vision research is that the work is not just taking place in ophthalmology and psychology,” said Paul Sternberg, George W. Hale Professor and Chair of Ophthalmology and Visual Sciences. “We have also funded scientists in pharmacology, biomedical engineering, biology, pediatrics, and cell biology - all who are doing work related to the eye and visual system.” Schall adds, “The culture of collegiality at Vanderbilt has resulted in very fruitful collaborations. For example, Rick Haselton from biomedical engineering and Jon Kaas from psychology have received a Vanderbilt Discovery Grant to explore the use of quantum dots to improve tracing connections between the eye and brain. Another important collaboration brings together the talents of Anne Corn in special education at Peabody, a noted expert on low vision, Joe Lappin in psychology, an expert in visual perception, and Jeff Sonsino in
ophthalmology, a skilled optometrist. They are developing tests for how vision improves with training in children with major vision impairments.”

VVRC researchers have been recognized through numerous awards and press coverage. Jon Kaas is a member of the National Academy of Sciences and received the 2006 Karl Spencer Lashley Award from the American Philosophical Society; previous recipients include four Nobel laureates. Randolph Blake was elected to American Academy of Arts and Sciences, and Vivien Casagrande was elected a fellow of the American Association for the Advancement of Science. Frank Tong and Isabel Gauthier have both received Young Investigator Awards from the Cognitive Neuroscience Society. Finally, Schall received the Troland Research Award from the National Academy of Sciences.

Schall notes, “Our trainees have been recognized as well. Ash Jayagopal, a graduate student working with Rick Haselton, was selected among over 1100 nominees to receive an Association for Research in Vision and Ophthalmology Foundation/Retina Research Foundation Travel Grant.”

Vanderbilt Vision Research Center: News

The Brain on the Stand
Vanderbilt professor Owen Jones, who is one of the nation’s few professors of both law and biology, and René Marois, associate professor of psychology and neuroscience, scanned the brains of participants with a highly sensitive technique called functional magnetic resonance imaging, or fMRI. Their goal was to see which parts of the brain were activated when a person was asked to make a decision on crime and punishment.

The researchers said the goal of law is “to inspire positive changes in human behavior”. By bringing in science, they can help see how people make decisions to determine if laws may ultimately need to be altered. Their research was featured in the March 11 cover article of The New York Times Magazine, titled “Neurolaw”.

Improving Vision With Video Games
Just about every kid loves video games, and past studies have shown video games help people develop better peripheral vision. A research study is underway in Oklahoma to see if those games can help students with low vision.

Jeff Nyquist of Vanderbilt University was featured in a recent newscast regarding a multidisciplinary project with Joe Lappin and Anne Corn called PUPIL. This study focuses on testing peripheral vision of kids with low vision. The newscast focuses on the aspect of improving vision with video games and was filmed at the Oklahoma School for the Blind.
Human Visual Perception: Key to Understanding How the Brain Works

Sitting in his office under an array of brightly colored antique pitchers, Randolph Blake is smiling. As a faculty member and researcher in Vanderbilt’s Department of Psychology, he finds himself in the midst of one of the most dynamic vision research collaborations anywhere in the country. His work is supported by several grants from NIH, and he is part of the Vanderbilt Vision Research Center (see article this issue).

Dr. Blake’s research concerns human visual perception. Since 80% of the brain is activated when we see, visual perception provides a key to understanding how the brain works. In recent years, Dr. Blake’s lab has studied visual imagery, visual memory, auditory influences on vision and the role of knowledge in visual perception, with emphasis on binocular vision, motion perception and the role of temporal structure in perceptual organization. Very recently, his work has expanded to include the study of people with a condition called color-graphemic synesthesia. This is a rare neurological condition in which the brain perceives color in letters or numbers that have no actual color. Dr. Blake has determined that these colors have a genuine neural reality and operate just like real colors do for people without synesthesia.

Dr. Blake’s visual perception research takes a three-pronged approach:
1. Perceptual experiments – Using psychophysical lab techniques to study the abilities of people to make judgments about the 3D structure and layout of objects, with an eye toward developing neural models to account for those abilities. The
psychophysical work uses computer-generated animation sequences viewed stereoscopically to simulate 3D objects undergoing transformations associated with motion, including biological motion.

2. Quantitative data – Dr. Blake’s theoretical work relies heavily on existing physiological and neurological data. A major theme running throughout his research is the establishment of “sites” of visual information processing based on perceptual data. In recent years, he and his colleagues have developed several fruitful localization strategies, including ones that utilize binocular rivalry as a neural “reference” for localizing other sites of action. Because an individual’s conscious state is continually in flux while the visual stimulus remains invariant, binocular rivalry might ultimately shed light on the dynamic properties of visual awareness and its underlying neural bases.

3. Brain imaging - The inferential strength of this so-called “psychoanatomical” technique will continue to grow as more is learned about the actual neural conclusions of visual information processing. To supplement this strategy, Dr. Blake’s lab is using functional MRI as a localization technique.

“Vanderbilt’s advantage in vision research is that it is a center for imaging sciences,” said Dr. Blake. “Our collaboration with the Institute of Imaging Science has made many of our advances possible.”

The Vanderbilt University Institute of Imaging Science is a trans-institutional initiative serving physicians, scientists, and students. The VUIIS operates state-of-the-art facilities for imaging research on animals and humans, including a state-of-the-art 7T MRI scanner, near infrared optical topography (NIROT), and event-related potential (ERP) electroencephalography. Equipment is available to provide continuous physiological monitoring of subjects, generate and deliver stimuli, and monitor and record responses during brain function studies. The VUIIS also provides a training environment for postdoctoral fellows, graduate and medical students, and undergraduates.

Dr. Blake received his Ph.D. from Vanderbilt in the mid-70’s and returned to Vanderbilt to chair the Department of Psychology in the late 1980’s. Asked why he has spent so much of his career at Vanderbilt, he responded, “I have a real affection for Vanderbilt and was delighted to come back after a number of years at Northwestern. My years here as a graduate student were pivotal and shaped me in so many ways. I had a wonderful mentor then [Professor Robert Fox] and I try to offer the same experience to my students today.”
John Penn and Rick Haselton couldn’t appear to be more different. But as they talk, Dr. Penn, in his starched white shirt and jacket, and Dr. Haselton, comfortable in cords, light up with a shared vision. The two scientists – a biologist and a biomedical engineer – have worked closely over the years to discover better therapies for retinal neovascular pathologies.

Their most recent project proposes to develop a high resolution, real-time image acquisition system capable of continuous imaging of multiple endothelial progenitor cell (EPC) subpopulations. This quantum dot technology would enable coding and real-time mapping of EPC subpopulations with distinct properties. With a non-invasive view of the retinal circulation, the researchers could assess cell recruitment to neovascular centers.

EPCs circulate in the bloodstream and play a significant role in the vascular pathogenesis of many diseases. They are involved in the disease process because they home to and proliferate at the vascular lesion. In some instances lack of EPCs indicates disease, as in the case of diabetic wound healing.

Current research on EPCs has identified several different subpopulations, based on expression patterns of proteins on the cells’ surface. A better understanding of how they function would enable the development of targeted, highly efficient therapies to either inhibit neovascularization or promote therapeutic angiogenesis. With this in mind, the two colleagues combined their talents to develop and characterize EPC subsets and assess their neovascularization capacities.

Dr. Penn is an expert in the pathogenesis of retinopathy of prematurity (ROP) and in the development of therapeutic interventions for retinal vascular diseases. He has developed a well-characterized rat model of ROP, a retinal pathology characterized by angiogenesis. This model will serve as the venue for the EPC tracking experiments. He has also created methods to purify, isolate and culture distinct EPC subsets.

Dr. Haselton has created a multispectral, real-time quantum dot imaging system to simultaneously image multiple cells and biomolecules in the retinal circulation. This aids in the study of lymphocyte and neutrophil cell trafficking in diabetes. His laboratory also has developed methods to specifically image EPCs. Two graduate students are also actively engaged in this project - Joshua Barnett (in Penn’s lab) and Ashwath Jayagopal (in Haselton’s lab).

The Vanderbilt researchers’ approach applies quantum dot coding to cell subpopulations defined by specific surface protein patterns. Penn and Haselton propose to track the EPCs in the retinal circulation of Penn’s rats using this strategy. Their work creates the first high-throughput template to elucidate EPC function in the context of cell subtypes.
The system includes many unique features. Offering high signal intensity, the technology requires only one excitation source in the visible spectrum. It can noninvasively detect both cells and cell surface markers simultaneously in vivo with high spatial and temporal resolution. Stationary and moving targets can be imaged continuously without fading, enabling the researchers to collect real-time data. It can capture high-velocity cell motility through major vessels as well as the microcirculation.

To their knowledge, no other system currently available has combined all of these features for in vivo imaging applications. With these tools, the two colleagues can elucidate EPC function at high spatial and temporal resolution. They can also screen customized therapies directed against EPC activity in a host of diseases.

Both scientists cite the Vanderbilt Discovery Grant program as one reason why intramural research projects have proliferated at the university. Designed to stimulate the development of new research ideas, Discovery Grants give researchers up to $100,000 for two years to explore ideas that, if further developed, will be competitive for extramural research project funding.

“The collegial atmosphere at Vanderbilt is amazing. That's what brings most of us here, and that's what keeps us here!” - Rick Haselton
Heidi Hamm, Ph.D., wears many hats at Vanderbilt University. Professor, pharmacology chair, researcher, and a leading expert on the G proteins, she sums up her specialization quite simply: “My work is really about trying to understand the fundamental mechanisms of vision and how it works.”

Dr. Hamm has been actively involved in vision research since 1980. She has had a hand in many crucial discoveries — and her lab has solved an elusive puzzle in the activation of G protein-coupled receptor (GPCR) signaling pathways — one of the most physiologically and medically important cell signaling pathways.

In the September 2006 issue of *Nature Structural and Molecular Biology*, Dr. Hamm and her colleagues provided some of the first evidence of the protein shape change that initiates the cellular response to GPCR activation.

G protein coupled receptors are a large class of proteins that weave through the cell membrane. They receive external chemical signals and relay them inside the cell with the help of molecular “switches” called G proteins. Binding an external signal (like a hormone) to its cell surface receptor turns the G protein “on.” The G protein then switches “off”
after passing the signal on to the next protein in the chain.

Activated by a receptor on the cell’s surface, a G protein translates and transmits extracellular signals like light. It does this by exchanging GDP for GTP. But the region of the G protein that touches the receptor is quite distant — on a molecular scale — from the region that holds onto GDP, begging the question, “How does the receptor act at a distance to cause GDP release from the G protein?”

Understanding this switching mechanism has important implications for drug development. All current pharmaceuticals that target this pathway act at the extracellular side of the receptor. But figuring out how 

be answered. These mysteries range from “How does rhodopsin, the G protein-coupled receptor in the rod cells of the retina, cause a G protein to change its shape?” to many questions related to the workings of the retina.

Divided between visual and hormonal signaling studies, Hamm’s Vanderbilt laboratory sets the stage for discovering and understanding many fundamentals of vision research. She works on applications of G protein in the brain, where many transmitting events occur, and applies basic knowledge about visual transduction in the eye to explain how brain synapses operate and how information is processed.

These efforts may in the future create new therapeutics for understanding a variety of pathologies. An important reference for any research related to color vision or night vision, Hamm’s breadth of experience offers insight into genetic disorders like retinitis pigmentosa.

Dr. Hamm feels fortunate to team with a number of talented vision researchers in other Vanderbilt departments and in universities throughout the country. But she heaps the most praise on her colleagues in the Department of Pharmacology. Crystallographer Tina Iverson is attempting to solve the crystal structure of rhodopsin. Seva Gurevich works on how arrestin terminates the signal transduction through rhodopsin, while Bih-hwa Shieh specializes in using the genetically tractable fruit flies as a model system for understanding vision.

“Vanderbilt’s a wonderfully collaborative place,” she said, explaining that the atmosphere makes broad interaction possible. “It provides us with a good core and an enriched environment in which to do our research.”

“My work is really about trying to understand the fundamental mechanisms of vision and how it works”
Understanding vision is the focus of Vanderbilt researchers across campus – at the College of Arts and Science, the School of Medicine, the School of Engineering and Peabody College of Education and Human development. However, seeing one another’s work – and helping their students to do so – is a challenge.

A unique class, “The Visual System,” works to build connections among these researchers and students, who are joined by an interest in vision but separated by their disciplines and majors. Anna Roe is leading the course this semester. “Students learn about the biology and psychology of vision, medical problems of the eye, robots and more.”

Former faculty member Maureen Powers, Professor of Electrical Engineering, Biomedical Engineering and Computer Engineering A.B. Bonds, and Emeritus Professor of Psychology Joseph Lappin created the course 14 years ago.

“The genesis of the course was that we had a large number of people at Vanderbilt who were interested in vision and there wasn’t anything that encompassed the broad interests of all the faculty,” Bonds said.

The course gives students access to what is regarded by many to be one of the premier vision groups in the country. Vanderbilt ranks 18th in extramural funding for vision research from the National Institutes of Health. Research centers and programs on campus studying vision include the Vanderbilt Vision Research Center, the Vanderbilt Eye Institute, PAVE (Providing Access to the Visual Environment), Computer Vision, the Center for Integrative and Cognitive Neuroscience, the Vanderbilt Kennedy Center and the Vanderbilt Brain Institute.

Students and faculty agree that one of the benefits of the course is simply bringing together researchers and students with a shared interest in vision that might not otherwise meet.

“Neuroscience, psychology and engineering students are all rubbing elbows with people they normally wouldn’t interact with,” Schall said.

Roe also believes the benefits of the course extend beyond the classroom. “There are a huge number of vision researchers on campus, and this course helps bring people together and is helpful in forming collaborations. The dream is that ultimately we’ll have a coherent understanding of how our brain processes vision.”
Creating a Legacy in Vision Research

William B. Snyder, M.D., and his wife, Phyllis, have a warm place in their hearts for Vanderbilt. Dr. Snyder graduated from Vanderbilt University School of Medicine in 1957 and Mrs. Snyder was a medical social worker at Vanderbilt University Hospital. They have long been big supporters of Vanderbilt, particularly the Department of Ophthalmology.

Their first gift honored Snyder’s parents with a named lectureship for invited ophthalmology speakers to come to Vanderbilt. Dr. Snyder hopes their most recent gift, the Phyllis G. and William B. Snyder, M.D., Chair in Ophthalmology and Visual Sciences at Vanderbilt, will help advance the field of ophthalmology, aiding in the fight against age-related, hereditary and metabolic disorders of the retina.

“As the population ages, we are seeing an explosion of cases in diabetic retinopathy and macular degeneration,” said Dr. Snyder. “I want to see Vanderbilt’s continued excellence in these areas of molecular and metabolic disorders.”

Dr. Snyder is a founding member of Texas Retina Associates. He taught at Tulane University’s Department of Ophthalmology and the University of Iowa Medical Center in Iowa City, where he served his internship, residency in Ophthalmology and a fellowship in Retina.

“I always felt fortunate to be at Vanderbilt and appreciated the opportunity to learn from the dedicated faculty,” Snyder said.

Paul Sternberg, M.D., chairman of the Department of Ophthalmology and Visual Sciences, recently announced that The Phyllis G. & William B. Snyder, M.D. Chair will be held by John Penn, Ph.D., Director of Research and Vice Chairman of the Department.

The appointment will allow Penn to further grow his research program in retinal angiogenesis. Angiogenesis is the abnormal growth of new blood vessels, which is a critical feature of several leading causes of blindness, including retinopathy of prematurity, diabetic retinopathy and age-related macular degeneration.

Penn: “When you combine all eye conditions in which angiogenesis plays a critical role, the process of abnormal blood vessel growth accounts for a vast majority of irreversible blindness in developed countries.”

Penn is pleased to hold the chair honoring Snyder. “I am particularly proud that our work will be associated with the name of Dr. Snyder, because I have long held him in high regard for his contributions to the ophthalmology community,” he said.

“Dr. Penn is the quintessential translational scientist using his basic science expertise to both understand the mechanisms of vision loss and to develop new and innovative treatments,” said Dr. Sternberg. “The Snyder Chair will allow him to further this research.”

Dr. Snyder: “Dr. Penn’s translational research will provide tremendous benefit to future patients with genetic and molecular disorders of the eye.”
The Vanderbilt Eye Institute is pleased to announce that the following faculty members recently have received 2007 grants or awards for their laboratory research:

**Rachel W. Kuchtey, M.D., Ph.D.**
American Glaucoma Society
Clinician-Scientist Award: “Mechanisms of Regulation of Cornea-Derived Transcript 6 Expression by Transforming Growth Factor Beta in Human Trabecular Meshwork Cells and Tissue”

**David G. Morrison, M.D.**
Knights Templar Eye Foundation
Grant: “IGF-1 and VEGF in Ocular Angiogenesis”

**John S. Penn, Ph.D.**
Pearle Vision Foundation Award: “Targeted Drug Delivery by Endothelial Progenitor Cells”
Dr. Penn has also received new support from Alcon Laboratories, Inc., Celgene Corporation and TaiGen Pharmaceuticals.

**David J. Calkins, Ph.D.**
has received new support from Alcon Laboratories, Inc. and Allergan.

**Wayne Wu, M.D. and Paul Sternberg, Jr., M.D.**
Allergan Horizon Award: “Vitamin C and Proliferative Diabetic Retinopathy”

**In Addition:**
**Sean P. Donahue, M.D., Ph.D.** has had a paper on pediatric strabismus published in the March 8, 2007 edition of *The New England Journal of Medicine.*

**Karen M. Joos, M.D., Ph.D.** was elected to the Board of Directors of the American Society for Lasers in Medicine.

**Anita Agarwal, M.D.** has been chosen by NIH to participate in an NIDDK study section.

**Robert Estes, M.D.** has been honored by the American Association for Pediatric Ophthalmology at their annual meeting for his contributions to pediatric ophthalmology.

**Pears X: June 8 and 9**
Loews Vanderbilt Hotel – Nashville
*A review of current issues for the comprehensive ophthalmologist*

**Guest Faculty:**
**STEVE T. CHARLES, M.D.**
Clinical Professor of Ophthalmology, University of Tennessee Memphis

**JOHNNY L. GAYTON, M.D.**
Adjunct Professor of Ophthalmology, Mercer University; President, Gayton Health Centre – Eye Sight Associates, Warner Robbins, GA

**TERRY KIM, M.D.**
Associate Professor of Ophthalmology, Duke University School of Medicine

**GREGORY S. KOSMORSKY, D.O.**
Chief, Department of Neuro-Ophthalmology, The Cole Eye Institute, The Cleveland Clinic

**PAUL P. LEE, M.D., J.D.**
James Pitzer Gills III, M.D. and Joy Gills Professor of Ophthalmology, Duke University Eye Center

**PAUL R. LICHTER, M.D.**
Professor and Chair, Ophthalmology and Visual Sciences, F. Bruce Fralick Professor of Ophthalmology, University of Michigan School of Medicine

For more information on this event contact Tammy Tankersley at 615-936-0044 or tammy.tankersley@vanderbilteyeinstitute.com
Paul Sternberg, Jr., M.D.  
Chair, Vanderbilt Eye Institute  
RETINA/VITREOUS  
Special interests: age-related macular degeneration and complex retinal detachments.

Anita Agarwal, M.D.  
RETINA/VITREOUS  
Special interests: inflammatory diseases of the retina and diabetic retinopathy.

Jiyang Cai, M.D., Ph. D.  
VISION RESEARCH  
Special interests: mitochondrial oxidative damage and protection in aging and age-related degenerative diseases.

David J. Calkins, Ph.D.  
VISION RESEARCH  
Special interests: degenerative disorders of the visual system and the genetic mechanisms of retinal disease.

Min S. Chang, M.D.  
VISION RESEARCH  
Special interests: growth and maintenance of corneal epithelial cells.

Amy S. Chomsky, M.D.  
COMPREHENSIVE OPHTHALMOLOGY  
Special interests: Veterans Administration Hospital Chief Attending.

Sean P. Donahue, M.D. Ph.D.  
NEURO-OPHTHALMOLOGY/PEDIATRIC OPHTHALMOLOGY  
Special interests: amblyopia, surgical management of complicated strabismus, pediatric neuro-ophthalmology, and visual field testing.

Robert Estes, M.D.  
PEDIATRIC OPHTHALMOLOGY/ADULT STRABISMUS  
Special interests: Childhood and adult strabismus, ophthalmic genetics.

Jin Hui-Shen, Ph.D.  
VISION RESEARCH  
Special interests: laser surgery and the invention of surgical devices.

Karen M. Joos, M.D., Ph.D.  
GLAUCOMA  
Special interests: low-pressure glaucoma and pediatric glaucomas.

Jeffrey A. Kammer, M.D.  
GLAUCOMA  
Special interests: neovascular glaucoma and complicated glaucoma cases.

Brad Kehler, O.D.  
OPTOMETRY  
Special interests: low vision rehabilitation, specialty optics, contact lenses.

Lori Ann F. Kehler, O.D.  
OPTOMETRY  
Special interests: specialty contact lens fitting, both for adults and for children.

John Kuchtey, Ph.D.  
VISION RESEARCH  
Special interests: immunological aspects of anterior chamber pathology in glaucoma.

Rachel W. Kuchtey, M.D., Ph.D.  
GLAUCOMA  
Special interests: cellular and molecular mechanisms of aqueous outflow in glaucoma.

Patrick Lavin, M.D.  
NEURO-OPHTHALMOLOGY  
Special interests: eye movement disorders, nystagmus, neuro-otology, headache and metabolic disorders affecting the visual system.

Jennifer Lindsey, M.D.  
COMPREHENSIVE OPHTHALMOLOGY  
Special interests: Cataracts, eyelid disorders, ocular trauma, diabetic eye disease, and glaucoma.

Louise A. Mawn, M.D.  
NEURO-OPHTHALMOLOGY/OCUPLASTICS  
Special interests: ophthalmic plastic surgery with a particular interest in orbital disease.

Lawrence M. Merin, RBP, FIMI  
OPHTHALMIC IMAGING CENTER  
Special interests: retinal imaging, epidemiology and diabetic eye disease.

David Morrison, M.D.  
PEDIATRIC OPHTHALMOLOGY  
Special interests: strabismus, pediatric cataracts, and retinopathy of prematurity.

Denis, M. O’Day, M.D., F.A.C.S.  
CORNEA and EXTERNAL DISEASE  
Special interests: ocular fungal infections.

John S. Penn, Ph.D.  
VISION RESEARCH  
Special interests: molecular basis of ocular angiogenesis.

Franco Recchia, M.D.  
RETINA/VITREOUS  
Special interests: pediatric retinal disorders and retinal vascular disorders.

Chasidy D. Singleton, M.D.  
COMPREHENSIVE OPHTHALMOLOGY  
Special interests: refractive errors, cornea disorders, cataracts, glaucoma, diabetic eye disease, ocular trauma, and strabismus.

Jeffrey Sonsino, O.D., F.A.A.O.  
OPTOMETRY  
Special interests: complicated and difficult-to-fit contact lenses, and low vision rehabilitation of adults and children.

Uyen L. Tran, M.D.  
CORNEA and EXTERNAL DISEASE/LASER SIGHT  
Special interests: corneal transplantation, cataract surgery, and refractive surgery.

Laura L. Wayman, M.D.  
COMPREHENSIVE OPHTHALMOLOGY  
Special interests: Director of Resident Training and cataracts.
Age-related eye diseases are the leading causes of vision impairment and blindness worldwide. *The Aging Eye*, the theme for the 2007 Association for Research in Vision and Ophthalmology (ARVO) Annual Meeting, will be a major forum for vision researchers and practitioners to explore the vast and varied efforts underway to unlock the mysteries surrounding eye diseases including age-related macular degeneration, glaucoma, cataracts, and diabetic eye disease.

More than 10,000 colleagues from around the world will gather May 6-10 in Fort Lauderdale, Florida, to attend lectures, symposia, workshops and paper and poster presentations on topics related to the aging eye and other problems of vision. Vanderbilt scientists will deliver 58 presentations, a record for the university. This number illustrates Vanderbilt’s significant growth in basic vision research, and its commitment to share its newest findings with the vision research community.

ARVO, founded in 1928 in Washington, D.C. by 73 ophthalmologists, now boasts a membership of more than 11,500 individuals and continues to grow. Some 42% of members reside in over 70 countries outside the U.S. The membership is multidisciplinary and consists of both clinicians and basic researchers.

While many Vanderbilt vision scientists will attend the ARVO conference in Ft. Lauderdale, another group of our researchers will attend the Vision Science Society (VSS) in Sarasota the following week. VSS is a nonprofit membership organization of scientists who are interested in the functional aspects of vision.