





Research to Prevent Blindness

360 Lexington Avenue, New York, NY 10017
212-752-4333 or 1-800-621-0026

www.rpbusa.org • inforequest@rpbusa.org
facebook.com/ResearchtoPreventBlindness • twitter.com/RPB_org

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Cover Captions:

(top right) **Ching-Hwa Sung, PhD**, Professor of Cell & Developmental Biology in Ophthalmology at the Weill Cornell Medical College, which holds an RPB Unrestricted Grant, investigates the etiology and progression of age-related macular degeneration.

(bottom right) **Fatema Ghasia, MD**, Assistant Professor of Ophthalmology at the Cleveland Clinic Lerner College of Medicine of Case Western Reserve University, uses her RPB Walt & Lilly Disney Award for Amblyopia Research to study visual function deficits in children with amblyopia.

(bottom left) **J. Patrick Mayo, PhD**, Assistant Professor at the University of Pittsburgh, utilizes the RPB Unrestricted Grant to study the influence of eye movements on the activity of visual neurons in the cerebral cortex.

A Year of Resilience

Dear Friends of Research to Prevent Blindness,

First, a warm “Thank You!”—in a year of unbelievable challenges, we are so grateful for your support, which has enabled us to keep essential vision research not only alive but thriving.

It is no surprise that in 2020 much of the national and international conversation (in the media, in households, and yes, even in funding agencies), was focused on COVID-19. A global pandemic demands global attention. At RPB we turned our attention toward the vision researchers we fund to ask what challenges they encountered. The answers (as reported on page 6) were, at first glance, disheartening.

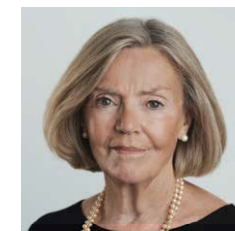
From lab closures that lasted months to social distancing requirements that made the operation of essential scientific equipment impossible, nearly every researcher we queried was impacted in a significant way. Yet we knew that research into vision disorders, which are on the rise in the U.S., due in part to an aging population, could not afford to stand still.

So, it was incredibly gratifying to hear too about the ways that RPB-supported vision researchers were moving forward (page 7). They repurposed their time and reimaged their activities and forged ahead. For this reason, RPB-supported researchers published more than 1,500 new scientific studies in 2020!

That, to us, is great news for a bad-news type of year. But it occurred to us that researchers are always looking for a workaround. Scientific research requires the persistence to find new ways of looking at a problem that many other people have tried to solve. Our researchers are *resilient*. As you'll see in this report, there are so many exciting scientific avenues being pursued by these brilliant minds. And every new piece of knowledge pushes us a step closer to improving the resiliency of the eye—whether slowing or halting vision loss, or reversing it completely.

In short, we are inspired, and we hope you are too. Your support is essential to RPB's success, and therefore to the success of future therapies for vision loss. We are so thankful for friends who do not give up, but rather look forward.

With gratitude,



Diane S. Swift
Diane S. Swift
Chairman



Brian F. Hofland
Brian F. Hofland, PhD
President

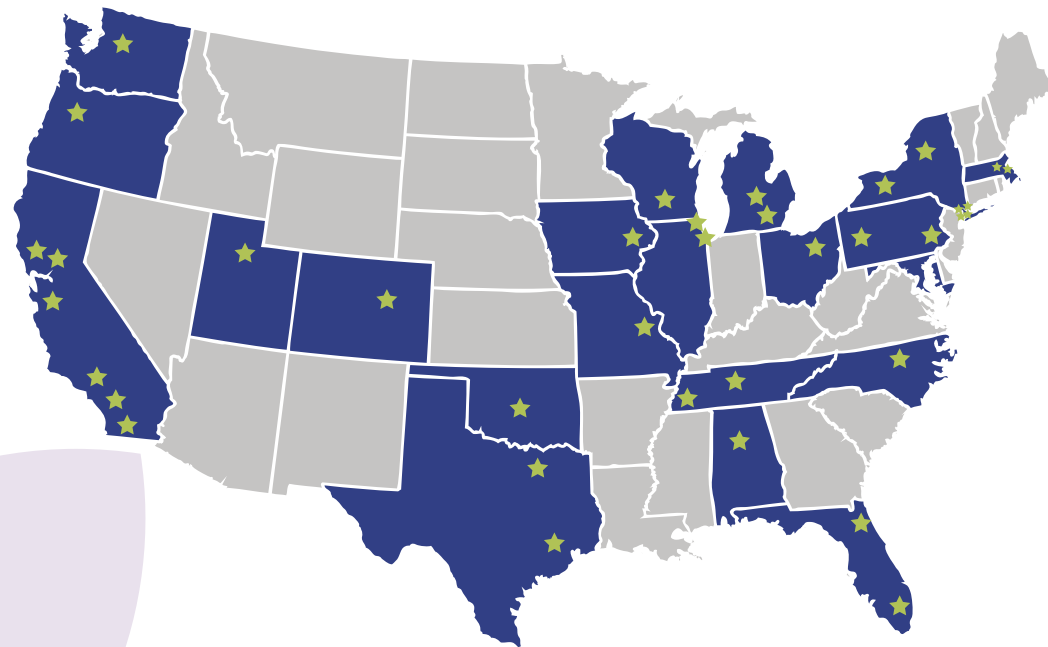


Dedication + Excellence

At Research to Prevent Blindness, our mission has never been more important!

The goal? Supporting research to develop treatments, preventives and cures for all conditions that damage and destroy sight.

An aging U.S. population means that eye diseases are increasing. But so too, is our scientific savvy. RPB-supported researchers at academic medical centers across the country are pushing the boundaries of scientific knowledge in areas such as age-related macular degeneration, glaucoma, diabetic retinopathy, uveal melanoma, retinal degeneration, low vision, amblyopia, and many more.



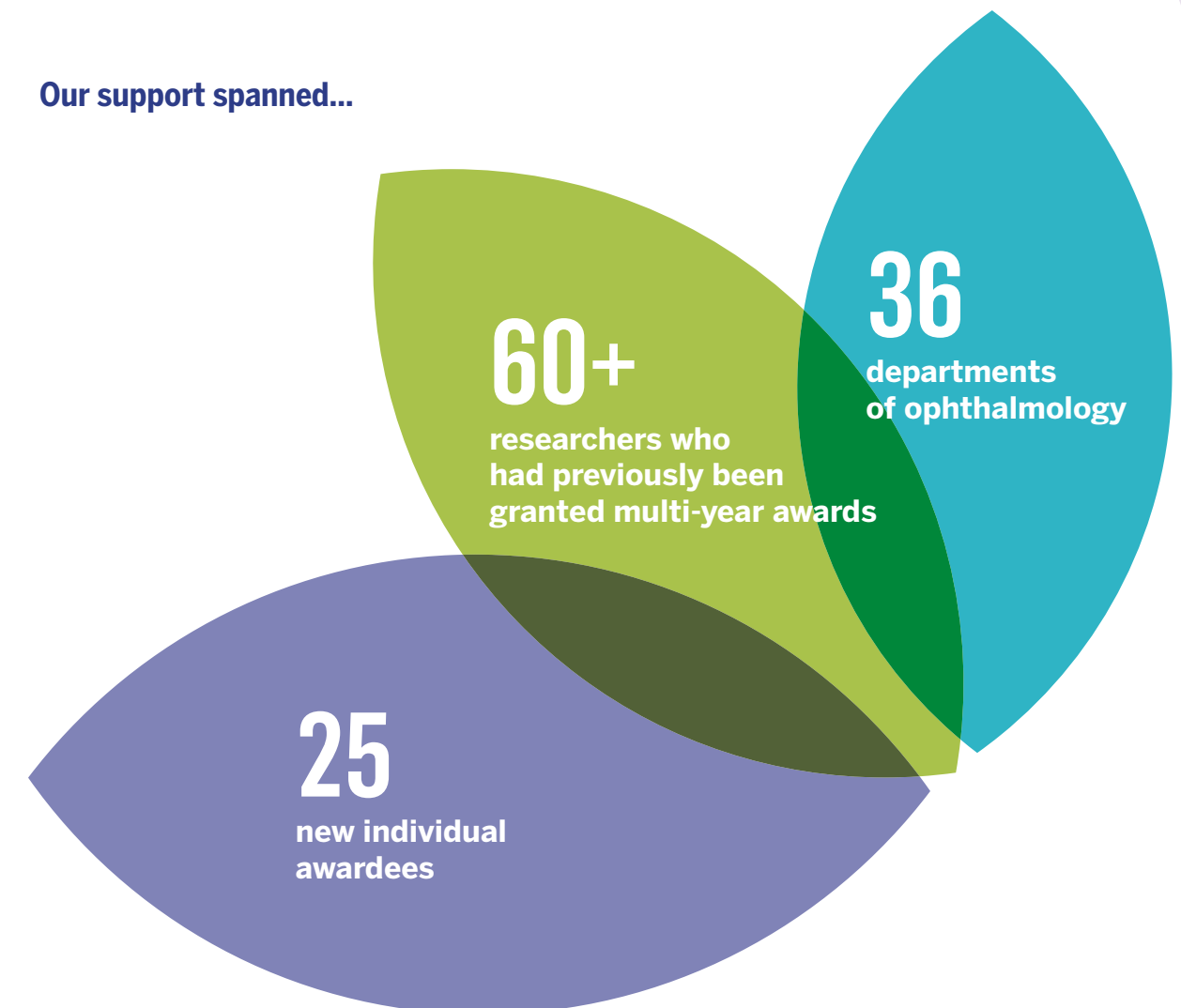
RPB takes a highly strategic approach to research support. It utilizes a two-pronged model to be both flexible and directive in its funding. No matter the grant type, scientific excellence is the priority.

Departmental Grants: RPB provides exceptional departments of ophthalmology (as determined by rigorous peer review) with \$75,000 – \$115,000 a year in unrestricted funding. As one of the few sources of unrestricted funds, RPB grants provide the flexibility that enables true innovation.

Individual Grants: RPB offers a variety of individual grants—from those based on career-stage to those focused on specific diseases. These restricted grants allow researchers to pursue specific proposals that will move the field of vision science forward.

At RPB, we were determined to support vision scientists through the challenges of the COVID-19 pandemic. Despite the temporary shutdown of our office in New York, we ran our full 2020 grants program without interruption, including more than \$6 million to individual investigators for critical research and \$4.5 million in unrestricted support to high-performing departments of ophthalmology.

Our support spanned...



... thereby keeping the pipeline of vision science discoveries flowing

Rising to Meet the Challenge

Despite RPB's ongoing support, the challenges presented by the COVID-19 pandemic intimately and intensely affected researchers.

Many RPB-supported researchers reported:



But scientists are problem-solvers at heart! RPB-supported researchers got creative and focused on activities that would move their research and the field of vision science forward.

Vision Science in Action

We are proud to support the work of exceptional researchers, such as those working in departments of ophthalmology that hold coveted RPB Unrestricted Grants. These scientists are creating the eye disease treatments of tomorrow, bringing us closer to improving the resiliency of the eye.



Christopher E. Starr, MD, Associate Professor of Ophthalmology at Weill Cornell Medical College and Director of the Refractive Surgery Service at Weill Cornell Medicine, leads a multi-disciplinary ophthalmic team in performing and teaching a highly specialized **keratoprosthesis** surgery, which is also an active area of research for Dr. Starr and colleagues.



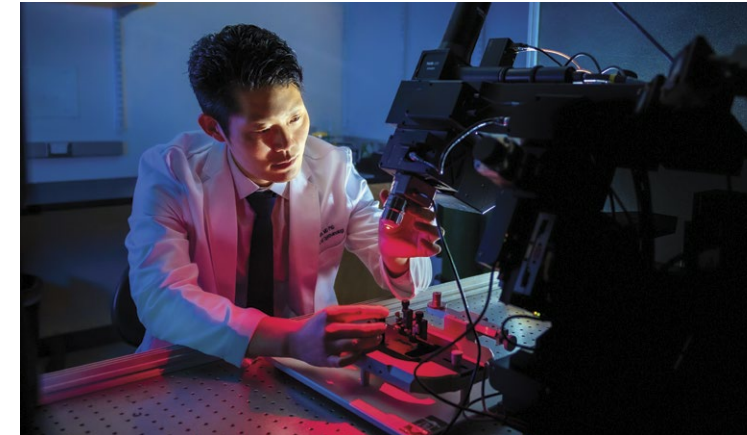
Valeria Canto-Soler, PhD, Associate Professor of Ophthalmology at the University of Colorado School of Medicine, examines retinal organoids grown from stem cells to develop a retinal tissue transplant for possible treatment of **dry age-related macular degeneration**.



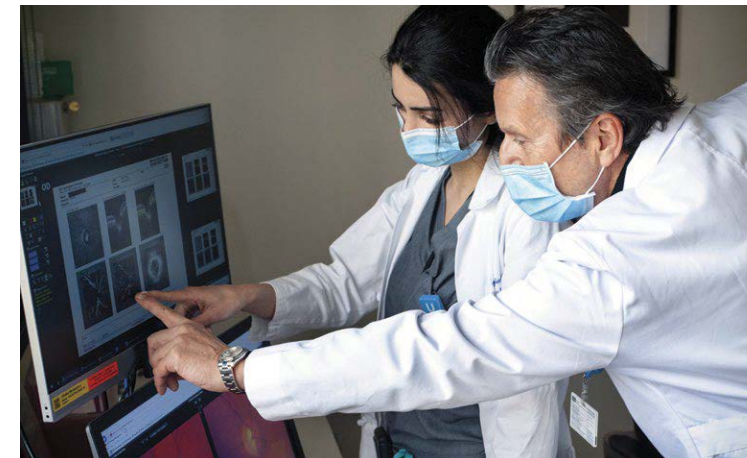
Linda D. Hazlett, PhD, Vice Dean of Research and Graduate Programs; The Robert S. Jampel, MD, PhD, Endowed Chair in Ophthalmology; and Distinguished Professor and Vice Chair in the Department of Ophthalmology, Visual and Anatomical Sciences at Wayne State University School of Medicine, tests the effects of glycyrrhizin to enhance treatment for *Pseudomonas aeruginosa* **keratitis**, inflammation of the cornea caused by this multi-drug resistant bacteria.



Cristhian Ildefonso, PhD, Assistant Scientist in the Department of Ophthalmology at the University of Florida College of Medicine, investigates the role of ocular immunology in diseases such as **uveitis**, **diabetic retinopathy** and **age-related macular degeneration**. He is developing gene therapy vectors to deliver treatments to reduce ocular inflammation.

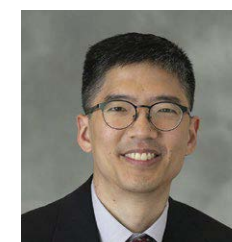


Tyson Kim, MD, PhD, Assistant Professor of Ophthalmology at the University of California, San Francisco, School of Medicine, studies vascular development and dysgenesis in genetic models of disease. His goal is to uncover the mechanisms that drive **abnormal ocular blood vessel growth** to create new therapies.



Joseph Caprioli, MD (right), Professor-in-Residence at the David Geffen School of Medicine at University of California, Los Angeles, along with Fellow **Arpine Barsegian, MD**, and team members, develop innovative approaches for the early diagnosis and individualized treatment of **glaucoma**.

Grantee News



In 2020, **Michael Chiang, MD**, a former RPB Career Development Awardee (CDA) and accomplished clinician-scientist, was named the new Director of the National Eye Institute, joining many other RPB CDAs in leading roles in the field of vision science. We wish him the best of luck in his important new role!

The results of our grantees' dedication and talent is nothing short of incredible!

More than **1,500** new scientific studies citing RPB support were published in 2020.

Topics included:

- creating the world's first pathoconnectome, showing how eye disease alters retinal circuitry
- visualizing the trajectory of a patient's glaucoma progression
- gaining new insight into how night vision can be maintained with retinal degenerative diseases
- evaluating the use of artificial intelligence to screen for retinopathy of prematurity
- predicting proliferative diabetic retinopathy

New studies continue to come out at an astounding pace, showcasing the productivity of RPB's departmental and individual grantees.

New Grants

On the following pages, we're pleased to present the 2020 individual award recipients with brief descriptions of their RPB-supported research projects. These dedicated vision scientists were selected by RPB's esteemed review panels (see page 19 for panel participants) for their innovative ideas and exceptional scientific talent. We eagerly look forward to the important outcomes of these studies in the years to come.



Preethi S. Ganapathy, MD, PhD

RPB Career Development Awards

This award provides \$350,000 over 4 years to early-career MDs, PhDs and MD/PhDs to support their investigations, with mentorship from senior scientists. Their primary appointments must be in ophthalmology and they must show potential for independent research.

Preethi S. Ganapathy, MD, PhD

State University of New York Upstate Medical University

Creating a unique 3D model to study the role of intraocular pressure-initiated strain in retinal ganglion cell death, which is a hallmark of glaucoma, the leading cause of irreversible blindness worldwide.

Sidney M. Gospe III, MD, PhD

Duke University School of Medicine

Testing the hypothesis that light-signaling dysfunction arising from abnormal mitochondrial metabolism—believed to be a factor in age-related macular degeneration and other retinal diseases—is caused by reduced delivery of glucose to photoreceptors by the retinal pigment epithelium.

Thomas V. Johnson III, MD, PhD

The Johns Hopkins University School of Medicine

Studying how human retinal ganglion cells generated from stem cells survive and functionally integrate with a recipient retina, as an important step forward in stem cell transplantation for glaucoma treatment.

Sybil B. Harrington Scholar

Jeremy A. Lavine, MD, PhD

Northwestern University Feinberg School of Medicine

Studying macrophages—immune cells that are involved in inflammatory processes—to identify cell types that either activate or block new, destructive blood vessels in the eye (known as wet age-related macular degeneration).

Aaron Nagiel, MD, PhD

Keck School of Medicine of the University of Southern California

Exploring how synapses, or connections, between retinal neurons become damaged in retinal disease and whether they can be restored using gene and cell-based therapies.

Sophia Wang, MD

Stanford University School of Medicine

Using artificial intelligence techniques to analyze the electronic health records of glaucoma patients to develop algorithms that will predict the likelihood of glaucoma disease progression and glaucoma surgery success.

Thomas J. Wubben, MD, PhD

The Regents of the University of Michigan School of Medicine

Exploring the cellular processes behind proliferative vitreoretinopathy, a negative outcome that can occur during surgical repair of a retinal detachment, leading to irreversible vision loss.

Elizabeth Zuniga-Sanchez, PhD

Baylor College of Medicine

Investigating the molecular mechanisms that enable necessary connections between photoreceptors, the main detectors of light that relay visual information to the brain.



Maria A. Woodward, MD, MS

RPB Career Advancement Awards

This new award, which launched in 2020 in partnership with the Allergan Foundation, supports early- to mid-career researchers with a grant of \$150,000 as they seek new knowledge related to eye diseases. The award is aimed at vision researchers who have already received their first independent federal grant—the National Institutes of Health RO1—and are collecting new data to apply for a second RO1. This time period has been identified by RPB’s Scientific Advisory Panel as a critical gap in the funding pipeline; filling this gap is important for both the field of vision research at large and for advancing the research and careers of individual vision scientists.

Yifan Jian, PhD

Oregon Health & Science University School of Medicine

Developing a new prototype system using the revolutionary imaging technology optical coherence tomography to enable investigation of vascular malformations and nonperfusion in diabetic retinopathy.

Maria A. Woodward, MD, MS

The Regents of the University of Michigan School of Medicine

Creating a decision support tool for clinicians to diagnose keratitis (corneal ulcer) using a data-driven, quantitative empirical approach.

RPB Stein Innovation Awards

This award was developed to uncover and encourage high-risk/high-gain vision research that is innovative and cutting-edge. It provides \$300,000 over 3 years to researchers whose goal is understanding the visual system and the diseases that compromise its function. The proposed research cannot be funded—previously or currently—by others.

David Antonetti, PhD

The Regents of the University of Michigan School of Medicine

Investigating the hypothesis that a novel gene regulates blood vessel growth and maturation and that this process may be unique to the central nervous system, comprised of the retina and brain.

Peter D. Calvert, PhD

SUNY Upstate Medical University

Developing a new imaging modality in the living retina, using high-speed, super-resolution technologies, to better understand the process of segregation, which allows cells to adapt to different light levels or contrast.

Thomas A. Ferguson, PhD

Washington University in St. Louis School of Medicine

Exploring the process of intraocular inflammation, which is linked to many eye diseases, to better understand the interaction between inflammation and disease.

Krzysztof Palczewski, PhD

University of California, Irvine, School of Medicine

Advancing a new generation of CRISPR gene editing technology, referred to as base editing, as a therapeutic approach for Leber congenital amaurosis and retinitis pigmentosa.

Jason Shepherd, PhD

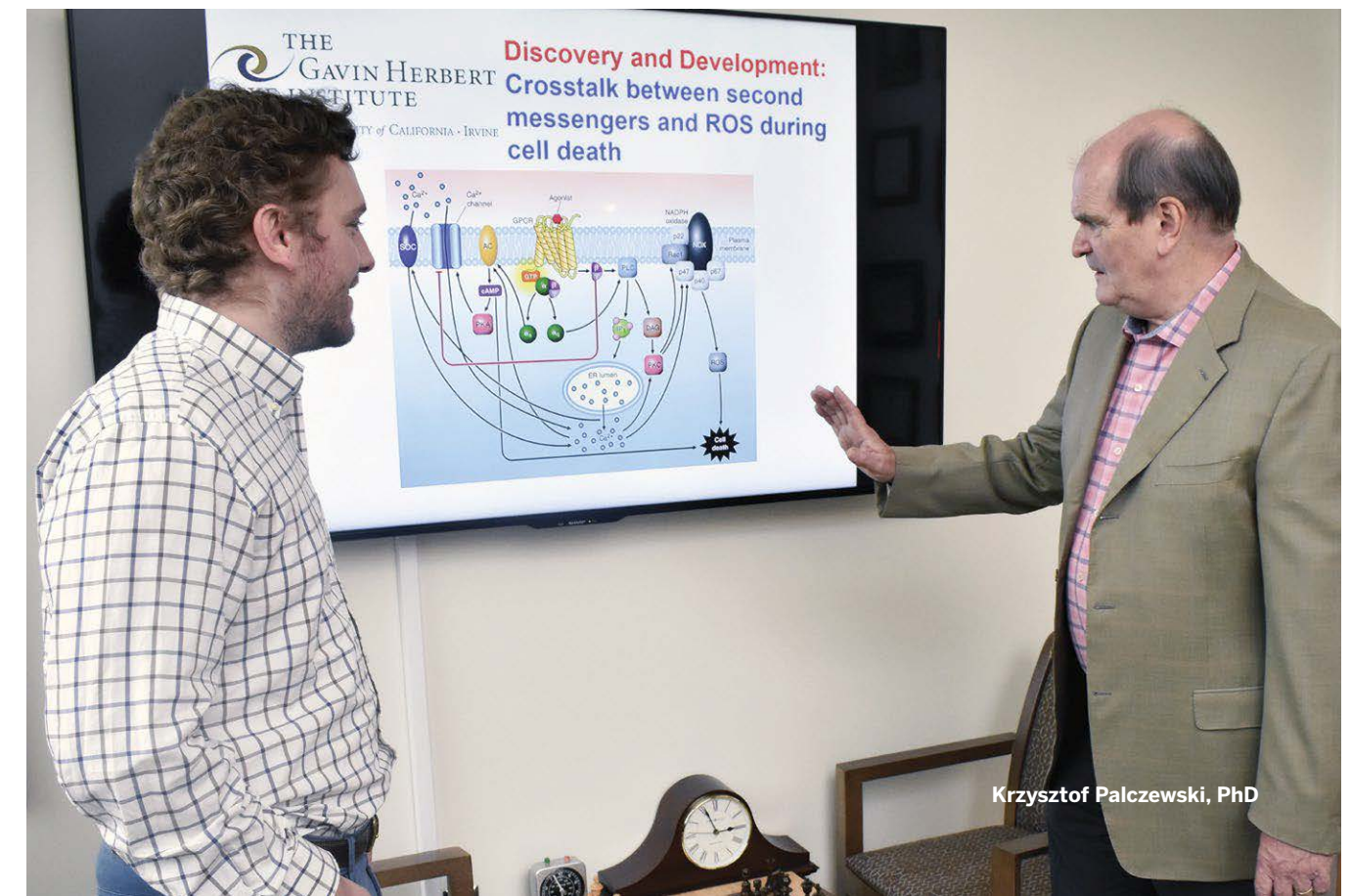
University of Utah Health Sciences Center

Undertaking research to determine how plasticity occurs in the visual cortex, thereby informing knowledge of the basic processes of brain plasticity and revealing new ways to treat amblyopia.

Chao Zhou, PhD

Washington University in St. Louis School of Medicine

Developing and validating a cutting-edge, parallel imaging, hand-held optical coherence tomography (OCT) system, specifically for use in children, who often have trouble staying still and fixating for OCT imaging.



Krzysztof Palczewski, PhD

RPB Physician-Scientist Awards

This 3-year, \$300,000 award strengthens and promotes clinical and/or basic research conducted by MDs or MD/PhDs who are actively engaged in clinical research. Physician-scientists bring a unique perspective and commitment to patient care and to their research activities, enhancing the vision science field.

Lucia Sobrin, MD, MPH

Harvard Medical School/MEEI

Investigating the potential genetic components of glucocorticoid complications.

Akrit Sodhi, MD, PhD

The Johns Hopkins University School of Medicine

Investigating the delicate balance between the protective and pathological roles of hypoxia inducible factor (HIF) and HIF-regulated genes in retinal glial cells in the early stages of diabetic eye disease.

RPB/Lions Clubs International Foundation Low Vision Research Award

Low vision refers to chronic impairment that is not correctable by eyeglasses, medicines or surgery. This \$300,000 award focuses on the damaged visual system and seeks to answer such questions as: How is degraded visual input processed? What are the adaptive strategies in the visual pathway in response to visual impairment? How does the brain re-organize itself in response to visual damage?

Geoffrey K. Aguirre, MD, PhD

University of Pennsylvania School of Medicine

Studying retinal ganglion cell function in individuals with retinitis pigmentosa—a genetic disease that causes blindness—in order to learn about the causes of light sensitivity and visual discomfort in individuals with the disease.



Kinga Bujakowska, PhD

RPB Walt & Lilly Disney Award for Amblyopia Research

This \$100,000 award is available to MDs, PhDs or MD/PhDs conducting research of unusual significance into the diagnosis and treatment of amblyopia (commonly referred to as lazy eye), which develops in up to 4% of children, causing decreased vision without detectable anatomic damage.

Fatema Ghasia, MD

Cleveland Clinic Lerner College of Medicine of Case Western Reserve University

Devising a pediatric-friendly battery of tests that incorporates eye movement measurements to quantify the extent of visual function deficits in children with amblyopia ranging in age from early preschool to third grade.

International Research Collaborators Award

This \$75,000 award promotes international collaborations through which researchers in the U.S. and outside the U.S. gain new knowledge and skills. Under a reciprocal arrangement, a U.S.-based researcher—MD, PhD, or MD/PhD with a primary appointment in a department of ophthalmology or other relevant department—will be funded to develop a new or deeper collaboration with a research lab outside the U.S.

Kinga Bujakowska, PhD

Harvard Medical School/MEEI

Collaborators: Isabelle Audo, MD, PhD, Professor, and Christina Zeitz, PhD, Director of Research, Institut de la Vision, INSERM, Sorbonne University (France)

Improving genetic diagnoses for currently untreated inherited retinal degenerations.

RPB Medical Student Eye Research Fellowships

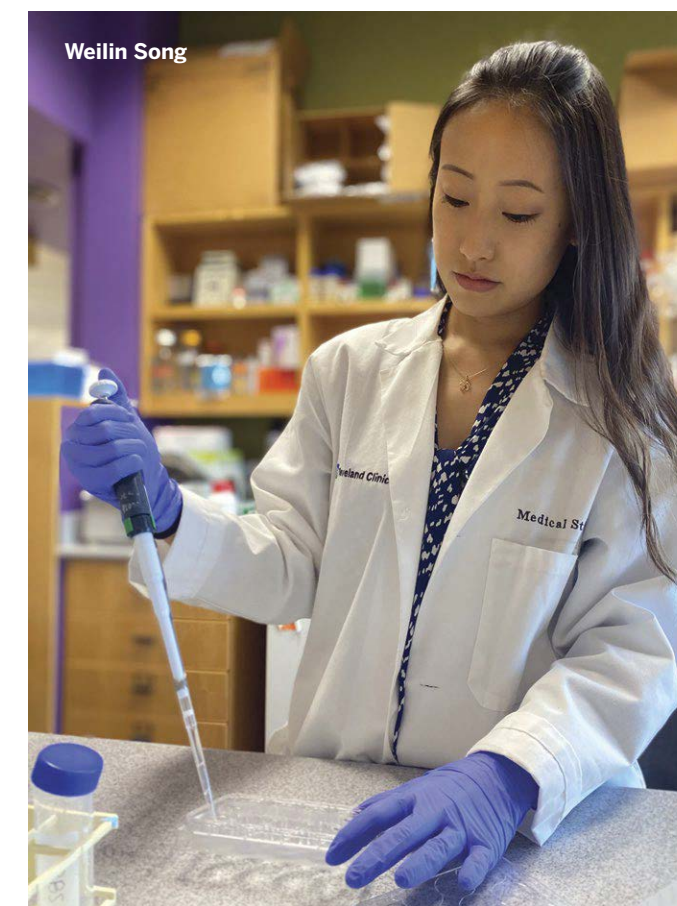
This \$30,000 grant allows outstanding medical students to take a year off from medical school and devote time to a research project in an RPB-supported department of ophthalmology while working closely with a mentor. The fellowship is designed to stimulate students to consider careers in eye research.

Catalina Garzon, conducting research at The Johns Hopkins University School of Medicine
Mentor: Pradeep Y. Ramulu, MD, PhD, Professor

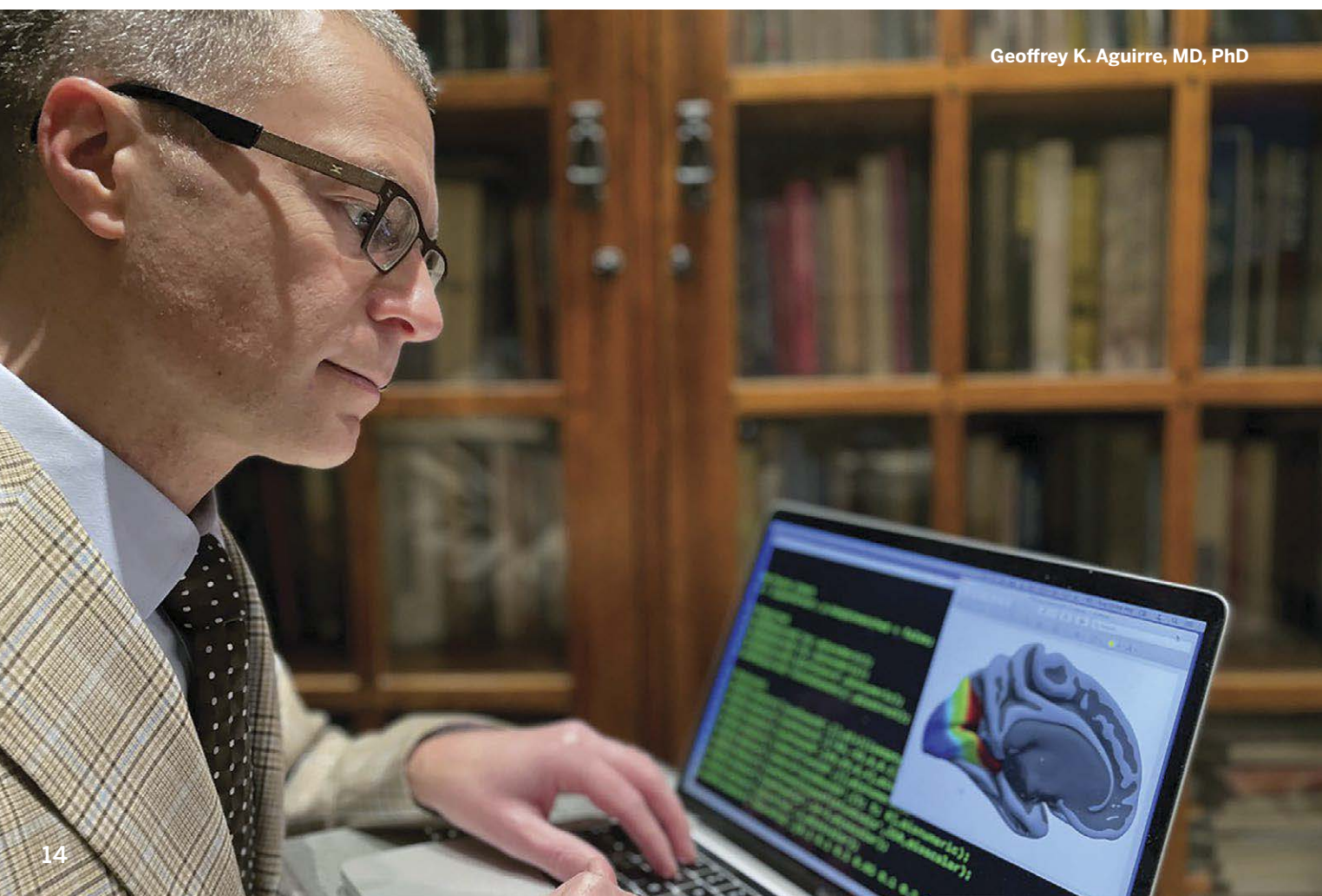
Keke Liu, conducting research at Oregon Health & Science University School of Medicine
Mentor: David Huang, MD, PhD, Professor

Ailin (Irene) Song, conducting research at Duke University School of Medicine
Mentor: Anthony N. Kuo, MD, Assistant Professor

Weilin Song, conducting research at Cleveland Clinic Lerner College of Medicine of Case Western Reserve University
Mentor: Jonathan Sears, MD, Associate Professor



Weilin Song



Geoffrey K. Aguirre, MD, PhD

Special Grants for Partnerships and Collaboration

In 2020, RPB provided grants to several organizations whose missions align closely with that of ours, in order to help advance the entire field of U.S. vision research. We are pleased to work with the following organizations on shared priorities.

Alliance for Eye and Vision Research (AEVR): \$50,000

To enhance AEVR's efforts to educate the public about the value of federally-funded vision research.

In 2020, AEVR nimbly pivoted its in-person educational activities to a virtual format, successfully wrapping up the final year of its Decade of Vision 2010 – 2020 Initiative. In the fall, AEVR hosted the

Sixth Annual Emerging Vision Scientists (EVS) Day which engaged 22 early-stage investigators from across the country. AEVR created videos of each EVS describing their research that were made available to Congressional offices, as well as a video titled "Impact of COVID-19 Lab Closures on the Next Generation of Vision Scientists." The videos are available at

www.eyerresearch.org. AEVR also developed a written summary of the EVS COVID conversation, which has been accepted for publication in *JAMA Ophthalmology*.

Under the auspices of the National Alliance for Eye and Vision Research, each EVS then participated in Advocacy Day phone calls with health staff and Members from Congressional offices, during which they described the importance of federal funding for research.

AEVR also held a well-attended virtual event, the International Age-Related Macular Degeneration (AMD) Awareness Week Congressional Briefing, to educate Congressional Members and staff on the prevalence of AMD, as well as cutting-edge AMD research. The video is available at www.eyerresearch.org/in-action/AMD2020.

Heed Ophthalmic Foundation (HOF): \$34,000

To renew, for two years, RPB's support for HOF Resident Retreats, which provide professional development experiences to talented ophthalmology residents from across the country. The Retreats encourage residents to pursue academic careers.

Association of University Professors of Ophthalmology (AUPO): \$175,000

To further AUPO's mission, which supports academic departments of ophthalmology and their leadership, as well as promotes excellence in ophthalmic education, fosters vision research and promotes ethical practice in eye care.

The grant included \$50,000 to support the RPB David F. Weeks Award for Outstanding Vision Research, which is administered by AUPO. Named after David F. Weeks, former President and Chairman of RPB, the award annually recognizes and celebrates an outstanding ophthalmic vision scientist whose research has made meaningful contributions to the understanding and/or treatment of potentially blinding eye disease.

Congratulations to the 2020 awardee:

Christine Curcio, PhD, White-McKee Endowed Professor in Ophthalmology, University of Alabama at Birmingham School of Medicine

Dr. Curcio was selected for her critical discoveries related to aging in the eye and age-related macular degeneration.

RPB/AAO Awards for IRIS Registry Research

In 2019, AAO received a two-year grant from RPB in support of the RPB/AAO Awards for IRIS Registry Research. These joint awards are administered by AAO and designed to enable researchers to use AAO's IRIS® Registry—the nation's largest specialty clinical database—to conduct population-based studies in ophthalmology and blindness prevention.

In 2020, the previous funding was used to support four new awardees:

Karen Armbrust, MD
Assistant Professor, University of Minnesota Medical School

Prethy Rao, MD
Associate Professor, Emory University School of Medicine

Adam Rothman, MD
Clinical Instructor, University of Miami Miller School of Medicine

Fasika Woreta, MD, MPH
Assistant Professor, The Johns Hopkins University School of Medicine

Congratulations to these researchers!



The participants in AEVR's Sixth Annual Emerging Vision Scientists Day came from departments of ophthalmology and schools/colleges of optometry from around the country.



Fasika Woreta, MD, MPH (left), is using her RPB/AAO Award for IRIS Registry Research to study the application of teleophthalmology in the emergency department for accurate diagnoses of ophthalmic emergencies.

2020 RPB APPROVED GRANTS TOTAL: \$10,934,000*
U.S. medical schools receiving new 2020 departmental and/or individual investigator awards

STATE	RPB GRANTEE INSTITUTIONS	TOTAL GRANTS 2020	TOTAL SUPPORT INCLUDING 2020
ALABAMA	University of Alabama at Birmingham School of Medicine	\$ 115,000	\$5,360,000
CALIFORNIA	David Geffen School of Medicine at UCLA	115,000	9,925,750
	University of California, Irvine, School of Medicine	415,000	1,585,000
	University of California, San Diego, School of Medicine	115,000	4,465,000
	University of California, San Francisco, School of Medicine	115,000	12,134,256
	Keck School of Medicine of the University of Southern California	465,000	6,389,795
	Stanford University School of Medicine	465,000	2,011,450
COLORADO	University of Colorado School of Medicine	115,000	963,000
FLORIDA	University of Miami Miller School of Medicine	115,000	5,597,700
ILLINOIS	University of Illinois at Chicago College of Medicine	115,000	5,611,712
	Northwestern University Feinberg School of Medicine	650,000	4,075,000
IOWA	University of Iowa Carver College of Medicine	115,000	5,582,425
MARYLAND	The Johns Hopkins University School of Medicine	795,000	12,530,140
MASSACHUSETTS	Harvard Medical School	490,000	12,690,315
MICHIGAN	The Regents of the University of Michigan School of Medicine	915,000	10,598,050
	Wayne State University School of Medicine	115,000	4,748,000
MISSOURI	Washington University in Saint Louis School of Medicine	715,000	10,049,981
NEW YORK	Columbia University College of Physicians and Surgeons	115,000	7,033,167
	Weill Cornell Medical College	115,000	5,998,700
	Icahn School of Medicine at Mount Sinai	300,000	4,508,200
	New York University Langone Eye Center	115,000	2,582,250
	University of Rochester School of Medicine & Dentistry	115,000	5,135,250
	SUNY Upstate Medical University	765,000	4,340,000
NORTH CAROLINA	Duke University School of Medicine	495,000	9,735,150
OHIO	Cleveland Clinic Lerner College of Medicine	245,000	4,880,000
OKLAHOMA	University of Oklahoma Health Sciences Center	115,000	6,116,600
OREGON	Oregon Health & Science University School of Medicine	295,000	7,227,150
PENNSYLVANIA	University of Pennsylvania School of Medicine	415,000	7,433,500
	University of Pittsburgh School of Medicine	115,000	6,558,372
TENNESSEE	University of Tennessee Health Science Center	300,000	3,860,000
	Vanderbilt University School of Medicine	115,000	4,750,500
TEXAS	Baylor College of Medicine	465,000	6,109,060
UTAH	University of Utah Health Sciences Center	415,000	6,915,300
WASHINGTON	University of Washington School of Medicine	115,000	5,662,638
WISCONSIN	University of Wisconsin–Madison School of Medicine & Public Health	115,000	6,833,750

*Includes commitments for special grants to the Alliance for Eye and Vision Research, the Association of University Professors of Ophthalmology and the Heed Ophthalmic Foundation.

School that received earlier RPB support but no new grant in 2020: Tufts University School of Medicine.

The RPB grant approval process is highly competitive. A standing Scientific Advisory Panel (SAP) and rotating Ad Hoc Committees convene each spring and fall to review all grant applications. Ad Hoc Committees are comprised of selected ophthalmology department chairs and researchers whose recommendations are forwarded to the SAP for further evaluation. The SAP includes distinguished scientists representing a broad range of scientific disciplines and interests. Their recommendations are presented to the RPB Board of Trustees for final approval.

2020 RPB SCIENTIFIC ADVISORY PANEL

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Deputy Director, NIHR Guy's and St. Thomas' Biomedical Research Centre
Visiting Professor, Kellogg Eye Center, University of Michigan

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Keck School of Medicine, University of Southern California

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Janey L. Wiggs, MD, PhD
Paul Austin Chandler Professor, Department of Ophthalmology
Vice Chair for Clinical Research, Ophthalmology
Co-Director, Glaucoma Center of Excellence
Associate Director, Ocular Genomics Institute
Associate Director, Howe Laboratory, MEEI
Harvard Medical School
Associate Member, Broad Institute, Harvard and MIT

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El – Maghraby Professor of Preventive Ophthalmology
Director of the Dana Center for Preventive Ophthalmology
Wilmer Eye Institute
Johns Hopkins School of Medicine

Robert Eugene Anderson, MD, PhD
Special Consultant to RPB Staff
George Lynn Cross Research Professor
Emeritus of Cell Biology and Ophthalmology
University of Oklahoma College of Medicine

John E. Dowling, PhD
Special Consultant to RPB Staff
Gordon and Llura Gund Research Professor of Neurosciences, EMERITUS
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