BIOGRAPHICAL SKETCH

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NAME: Andrew Boal

eRA COMMONS USER NAME (credential, e.g., agency login): A.BOAL

POSITION TITLE: Heed Fellowship

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Start Date MM/YYYY	Completion Date MM/YYYY	FIELD OF STUDY
Vanderbilt University, Nashville, TN	BA	08/2013	05/2017	Neuroscience, Spanish
Vanderbilt University, Nashville, TN	MD, PhD	06/2017	05/2024	Medicine, Neuroscience
University of Michigan, Ann Arbor, MI	Internship	06/2024	06/2025	Internal Medicine
University of Michigan, Ann Arbor, MI	Residency	07/2025	06/2028 (expected)	Ophthalmology

A. Personal Statement

I plan to channel my passion for the visual system and diseases that threaten sight into a career as a clinician-scientist, where I can leverage my training background combining a strong foundation in basic and translational science with rigorous clinical and surgical training to drive advances in patient care. My interest in the visual system was sparked by early exposure to the field in my undergraduate neuroscience coursework. Building upon this experience, I joined the lab of Vivien Casagrande to pursue directed research and later an honors thesis. In Dr. Casagrande's lab, I had my first exposure to academic research, studying the connections between the pulvinar thalamic nucleus and early visual cortex in a nonhuman primate model. My time in the lab gave me valuable opportunities to learn to think critically and analytically, experience failure, and communicate findings to a broad audience. I was also introduced to the career path of a physician-scientist, combining research and clinical training to study human disease. After matriculating to the Vanderbilt Medical Scientist Training Program (MSTP), rotations in ophthalmology during early clinical years of training gave me insight into the realities of diagnosing and treating diseases that affect the visual system. I determined early that ophthalmology, for me, was a field that could offer a fulfilling career where I could combine scientific intrigue with impactful patient care. For my PhD training, I chose to join the lab of David Calkins to broaden my scientific skillset and mature as a scientific thinker, working to understand stress responses of retinal ganglion cells and retinal astrocytes in early glaucoma. With each experiment, I tried to contextualize how my results may inform our understanding of the progression and treatment of glaucoma in patients. I gained independence as a scientist and developed expertise in key methods including developing transgenic mice, single cell electrophysiology, immunohistochemistry, and computational analysis of large data sets. My work was well-funded by both a T32 training grant through the Vanderbilt MSTP as well as an individually awarded F30 Fellowship from the National Eye Institute. My time in graduate school was productive, resulting in numerous peer-reviewed publications and presentations at national and international scientific meetings. I also grew as a leader and a mentor during this time, holding leadership positions in the Neuroscience Graduate Program and the MSTP. Following defense of my PhD dissertation and completion of medical school, I was proud to match into ophthalmology residency at the Kellogg Eye Center at the University of Michigan, a program with a long history of training leaders in academic ophthalmology. I have received outstanding clinical and surgical training thus far and grown more confident as a young ophthalmologist. I am also continuing to

hone my skills as a researcher, working with Dr. David Antonetti to analyze RNA sequencing data from a mouse model of diabetic retinopathy to explore how alterations to the blood-retinal barrier in diabetes impact neuron-glia interactions in the retina. I plan to use my dedicated research time later in residency to carry out targeted *in vivo* and *in vitro* experiments informed by these findings. I am confident that my training in residency and subsequent fellowship training will prepare me well for a career as an academic ophthalmologist-scientist, combining my passions for visual neuroscience and patient care into an impactful lifelong pursuit. Participation in the Heed Resident Retreat would support these goals by offering timely advice, access to mentorship, and fostering a like-minded community to support my transition to independence.

B. Positions, Scientific Appointments and Honors

Positions and Employment

2015 - 2017	Undergraduate Directed Study/Honors Research, Vivien Casagrande Lab, Vanderbilt University, Nashville, TN
2015 - 2017	Undergraduate Research Technician, Kathleen Gould Lab, Vanderbilt University, Nashville, TN
2019 - 2023	Graduate Student, David Calkins Lab, Vanderbilt University, Nashville, TN
2021	Teaching Assistant, Neurobiology of Disease Graduate Course, Vanderbilt University, Nashville, TN
2024 - 2025	Internship (Internal Medicine), University of Michigan, Ann Arbor, MI
2025 -	Residency (Ophthalmology), University of Michigan, Ann Arbor, MI

Memberships

2019 - 2023	Member-in-Training, Association for Vision Research and Ophthalmology (ARVO)
2022 - 2023	Early Career Researcher, International Society for Eye Research (ISER)

Awards and Honors

2013 - 2017	Joanne Fleming Hayes Scholarship Recipient
2013 - 2017	Dean's List, Vanderbilt University
2017	*Magna Cum Laude*, Vanderbilt University
2017	Undergraduate Honors in Neuroscience, Vanderbilt University
2019 - 2020	T32 Training Grant Recipient, Vanderbilt MSTP (T32GM007347)
2021	Travel Fellowship, Association for Research in Vision and Ophthalmology (ARVO) Meeting
2021	Member-in-training Outstanding Poster Award, ARVO Annual Meeting
2022	Travel Fellowship, ISER/Brightfocus Glaucoma Symposium
2022 - 2024	F30 Individual Predoctoral Fellowship, National Eye Institute (F30EY033627-01A1)
2023	Travel Fellowship, ISER Biennial Meeting, Gold Coast, Australia
2023	Travel Fellowship, ARVO Annual Meeting, New Orleans, LA
2023	Journal Cover Image, *Trans. Vis. Sci. Tech,* Volume 12, Issue 4
2024	Making a Difference Award, Michigan Medicine, University of Michigan
2025	Good Catch Award, Michigan Medicine, University of Michigan

C. Contributions to Science

1. **Undergraduate Research: The connections between lateral pulvinar and early visual cortex**
   I became interested in vision research early in college and decided to join Vivien Casagrande's lab at the end of my sophomore year. My project was focused on studying the connections between the lateral pulvinar nucleus of the thalamus and early visual cortical areas, determining the origins of the two retinotopic maps in the pulvinar. The experiments were done in a galago/bush baby nonhuman primate model and involved *in vivo* electrophysiologic recordings and fluorescent tracer injections. During my time in lab I assisted in surgical procedures, sectioned and labeled brain tissue, and performed fluorescent and electron microscopy. In Dr. Casagrande's lab I developed my scientific thinking, writing, and presentation skills, and solidified my desire for a career in academic research.
   - Moore, B., Li, K., Kaas, J.H., Liao, C.C., **Boal, A.M**., Mavity-Hudson, J., & Casagrande, V. (2019). Cortical projections to the two retinotopic maps of primate pulvinar are distinct. *The Journal of comparative neurology*, 527(3), 577–588.

2. **Graduate Research: The role of retinal astrocytes and their gap junctional networks in glaucoma**
One of the areas of focus of my graduate work involved investigating the contributions of gap junctional coupling of retinal and optic nerve astrocytes in glaucomatous neurodegeneration. For this work I used a mouse model with an astrocyte-specific conditional knockout of the gap junction protein connexin-43 and an inducible model of glaucoma to determine the neuroprotective and pro-degenerative influences of these networks. Further projects also investigated how these networks may mediate long-distance impacts of stress or medication delivery through the optic nerves. Additional projects in collaboration with lab members investigated the fine morphology and novel electrophysiologic properties of retinal astrocytes to further delineate their relationship to retinal vasculature, neurons, and Müller glia in homeostatic and degenerative states.
    - **Boal, A.M.**, McGrady, N.R., Holden, J.M., Risner, M.L., & Calkins, D.J. (2021). Astrocyte Gap Junction Protein Cx43 Modulates the Light Response of Mouse Retinal Ganglion Cells. *Investigative Ophthalmology & Visual Science*.
    - **Boal A.M.**, Risner M.L., Cooper, M.L., Wareham, L.K., & Calkins D.J. (2021). Astrocyte networks as therapeutic targets in glaucomatous neurodegeneration. *Cells*.
    - Holden, J.M., Al Hussein Al Awamlh, S., Croteau, L.-P., **Boal, A.M**., Rex, T.S., Risner, M.L., Calkins, D.J., & Wareham, L.K. (2022). Dysfunctional cGMP Signaling Leads to Age-Related Retinal Vascular Alterations and Astrocyte Remodeling in Mice. *Int. J. Mol. Sci.*
    - McGrady, N.R., Holden, J.M., Ribeiro, M., **Boal, A.M.**, Risner, M.L., & Calkins, D.J. (2022). Axon hyperexcitability in the contralateral projection following unilateral optic nerve crush in mice. *Brain communications.*
    - McGrady, N.R., **Boal, A.M**., Risner, M.L., Taiel, M., Sahel, J.A., & Calkins, D.J. (2023). Ocular stress enhances contralateral transfer of lenadogene nolparvovec gene therapy through astrocyte networks., *Mol. Therapy*.
    - Holden, J.M, **Boal, A.M.**, Wareham, L.K., & Calkins, D.J. (2025). Potassium-Dependent Coupling of Retinal Astrocyte Light Response to Müller Glia. *Glia*.

3. **Graduate Research: Retinal ganglion cell excitability and adaptation to ionic stress in glaucoma**
A central focus of my graduate work was focused on understanding and modeling the physiologic changes sustained by retinal ganglion cells in early stages of glaucomatous degeneration. I used single cell electrophysiologic recordings and an inducible mouse model of glaucoma to evaluate the relationship between disruptions in extracellular ion homeostasis, neuronal hyperexcitability, and intrinsic factors that may underlie retinal ganglion cell susceptibility to degeneration.
    - **Boal, A.M**., McGrady, N.R., Risner, M.L., & Calkins, D.J. (2022). Sensitivity to extracellular potassium underlies type-intrinsic differences in retinal ganglion cell excitability. *Frontiers in cellular neuroscience*.
    - **Boal, A.M.**, McGrady, N.R., Chamling, X., Zack, D.J., Calkins, D.J., & Risner, M.L. (2023). Microfluidic platforms promote polarization of human derived retinal ganglion cells that model axonopathy. *Trans. Vis. Sci. Tech.*
    - **Boal, A.M.**, McGrady, N.R., Holden, J.M., Risner, M.L., & Calkins, D.J. (2023). Retinal ganglion cells adapt to ionic stress in experimental glaucoma. *Frontiers in Neuroscience*.