THEC Neuroscience Center of Excellence

Annual Report to the
Tennessee Higher Education Commission (THEC)
Fiscal Year 2023 (7/1/2022-6/30/2023)
I. MISSION STATEMENT

The Neuroscience Institute (NI) at the University of Tennessee Health Science Center (UTHSC) is supported by the Neuroscience Center of Excellence, one of several Centers of Excellence established by the Tennessee Higher Education Commission in 1985. Our mission is to develop and support multidisciplinary research and training in neuroscience. We feature basic science and clinical members spanning 13 departments and three colleges, and foster neuroscience research through support of neuroscience track graduate students and postdocs, the NI Imaging Center and Behavioral Core, a robust seminar series, and start-up packages for new faculty. The brain is the final frontier of biology. Scientific inquiry has produced remarkably detailed knowledge of the physical world and much of the life sciences, including details of the human genome. However, our knowledge of the brain is far from complete. The nature and mechanisms of consciousness, thought, perception, learning, memory and many diseases of the nervous system are poorly understood. Neuroscience is now at an exciting threshold of discovery and unprecedented growth. The resulting explosion of information is rapidly increasing our understanding of the basic mechanisms of brain structure and function. This emerging knowledge is helping us discover effective treatments and even cures for some neurological diseases. More information concerning the NI is available at: https://www.uthsc.edu/neuroscience-institute/
II. EXECUTIVE SUMMARY

In FY 2023 the NI/Center of Excellence continued the start-up fund support of (1) Dr. Tauheed Ishrat, an R01-funded associate professor and stroke/Alzheimer’s neurobiologist recruited into the Anatomy & Neurobiology Department in 2017; (2) Dr. Il Hwan Kim, an R01-funded assistant professor and social behavior neurobiologist recruited from Duke University into the Anatomy and Neurobiology Department in 2019; and (3) Dr. Jianyang Du, an R01-funded associate professor and social behavior neurobiologist in the Anatomy & Neurobiology Department in January 2020. We provided stipend support to 4 graduate students and had 16 students in the Neuroscience Track of the Biomedical Sciences Ph.D. program, after accepting 3 new students. We supported 2 postdocs in the Departments of Ophthalmology and Pharmaceutical Sciences. We further promoted neuroscience research by: (1) providing the Neuroscience Seminar series, mixing outside speakers with UTHSC and affiliated faculty; and (2) continuing the undergraduate summer Neuroscience Merit Fellowship program supported two students from Rhodes College. We supported the NI Imaging Center, a cost-recovery facility providing the only transmission electron microscope (JEOL 2000) on campus, a Zeiss 800 Aryscan laser-line confocal microscope and a Neurolucida 3-dimensional reconstruction workstation, and the Neuroscience Behavioral Core. We purchased a Leica Cryostat and a new computer workstation for the JEOL electron microscope. We supplemented the service contracts of these instruments and software to keep user fees low. We supported the Imaging Center’s Technical Director, Esther Marquez Wilkins, Ph.D. Matthew Ennis, Ph.D., Chair of the Department of Anatomy & Neurobiology, continued as Interim Director since August 2020. The College of Medicine has recruited Lynn Dobrunz, Ph.D., a prominent neuroscientist from the University of Alabama/Birmingham, to be the new Chair of the Department of Anatomy & Neurobiology and the new Neuroscience Institute Director. She will begin these positions October 1, 2023.
### III. TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. MISSION STATEMENT</td>
<td>2</td>
</tr>
<tr>
<td>II. EXECUTIVE SUMMARY</td>
<td>3</td>
</tr>
<tr>
<td>III. TABLE OF CONTENT</td>
<td>4</td>
</tr>
<tr>
<td>IV. ADMINISTRATIVE STRUCTURE</td>
<td>5</td>
</tr>
<tr>
<td>V. FACULTY OF THE NEUROSCIENCE INSTITUTE</td>
<td>6-9</td>
</tr>
<tr>
<td>VI. GRADUATE STUDENTS AND POSTDOCTORAL STUDENTS</td>
<td>10</td>
</tr>
<tr>
<td>VII. PROGRAM OVERVIEW AND ACCOMPLISHMENTS</td>
<td>11-16</td>
</tr>
<tr>
<td>VIII. GOALS AND FUTURE PLANS</td>
<td>16-17</td>
</tr>
<tr>
<td>IX. BUDGET</td>
<td>17-20</td>
</tr>
<tr>
<td>X. FACULTY PUBLICATIONS</td>
<td>21</td>
</tr>
<tr>
<td>XI. FACULTY EXTRAMURAL SUPPORT</td>
<td>21</td>
</tr>
<tr>
<td>APPENDIX 1: Faculty Funding FY 2023</td>
<td>21-23</td>
</tr>
<tr>
<td>APPENDIX 2: Faculty Publications FY 2023</td>
<td>24-37</td>
</tr>
<tr>
<td>APPENDIX 3: Neuroscience Seminar Speakers FY 2023</td>
<td>38-44</td>
</tr>
<tr>
<td>APPENDIX 4: Neuroscience News, Events and Graduate Flyer FY 2023</td>
<td>45-61</td>
</tr>
</tbody>
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IV. ADMINISTRATIVE STRUCTURE

Interim Director: Matthew Ennis, Ph.D., Department of Anatomy & Neurobiology
Co-Director: John Boughter, Ph.D., Department of Anatomy & Neurobiology
Administrative Specialist: Mistie Brewer
Program Coordinator/IT Specialist: Brandy Fleming, M.S.

Center Address: University of Tennessee Health Science Center
875 Monroe Ave., Suite 426, Wittenborg Building, Memphis TN 38163
(901) 448-5960  https://www.uthsc.edu/neuroscience-institute/

Neuroscience Executive Committee:
John Boughter, Ph.D., Professor and NI Co-Director, Department of Anatomy and Neurobiology
Matthew Ennis, Ph.D., Professor and Chair, Department of Anatomy and Neurobiology
TJ Hollingsworth, Ph.D., Assistant Professor, Department of Ophthalmology
Jon Jaggar, Ph.D., Professor, Department of Physiology
Shalini Narayana, Ph.D., Associate Professor, Pediatric Neurology, Le Bonheur Hospital/UTHSC
Jeff Steketee, Ph.D., Professor, Department of Pharmacology
Steven Tavalin Ph.D., Associate Professor, Department of Pharmacology
Jim Wheless, M.D., Professor, Chief of Pediatric Neurology and LeBonheur Chair, Le Bonheur Hospital/UTHSC

The executive meets at least twice a year to (1) review the budget and make budget recommendations, (2) vote on faculty who wish to become NI members or addition of new Executive Committee members, (3) reviews and determines awardees for the NI Postdoctoral Support and Pilot Project programs.

NI Organizational Chart
V. FACULTY OF THE NEUROSCIENCE INSTITUTE

In FY2023, the Neuroscience Institute was comprised of 68 faculty members in 13 different departments on the UTHSC campus, including those with primary appointments at St. Jude Children’s Research Hospital and one faculty member at UT Knoxville. Faculty are listed by department; those with primary appointments outside UTHSC or UTK are so indicated. We added one new member (*), and 3 members left UTHSC as indicated, this past FY.

Department of Anatomy and Neurobiology
William E. Armstrong, Ph.D., Professor Emeritus
Alessandra d’Azzo, Ph.D., Affiliated Professor (St. Jude)
Jay Bickoff, Ph.D., Affiliated Assistant Professor (St. Jude)
John D. Boughter, Jr., Ph.D. Professor and NI Co-Director
Joseph C. Callaway, Ph.D., Associate Professor
Viktor Chizhikov, Ph.D., Associate Professor
Jianyang Du, Ph.D., Associate Professor
Robert C. Foehring, Ph.D., Professor Emeritus
Kristin Hamre, Ph.D., Associate Professor
Detlef Heck, Ph.D., Professor (departed UTHSC 4/2023)
Marcia G. Honig, Ph.D., Professor Emeritus
Tauheed Ishrat, Ph.D., Associate Professor
Il Hwan Kim, Ph.D., Assistant Professor
Hitoshi Kita, Ph.D., Professor Emeritus
Peter J. McKinnon, Ph.D., Affiliated Professor (St. Jude)
James I. Morgan, Ph.D., Affiliated Professor (St. Jude)
Anton J. Reiner, Ph.D., Professor Emeritus
Lindsay Schwarz, Ph.D., Affiliated Assistant Professor (St. Jude)
J. Paul Taylor, M.D., Ph.D., Affiliated Professor (St. Jude)
Robert S. Waters, Ph.D., Professor
Stanislav Zahkarenko, Ph.D. Affiliated Professor (St. Jude)

Department of Biochemistry and Cellular and Molecular Biology, UT Knoxville
Rebecca A. Prosser, Ph.D., Professor
Department of Genetics, Genomics and Informatics
Robert W. Williams, Ph.D., UT-Oak Ridge National Laboratory Governor's Chair in Computational Genomics, Professor and Chair; Director, Center for Integrative and Translational Genomics
Byron Jones, Ph.D., Professor
Lu Lu, Ph.D., Professor
Megan Mulligan, Ph.D., Assistant Professor
Burt Sharp, M.D., Van Fleet Professor

Department of Medicine/Cardiology
Syamal Bhattacharya, Ph.D., Professor

Department of Psychiatry
Ronald Cowan, M.D., Ph.D., Professor and Chair

Department of Neurology
Michael McDonald, Ph.D., Professor
Mohammad Khan, Ph.D., Assistant Professor
Thaddeus S. Nowak, Ph.D., Professor
Lawrence T. Reiter, Ph.D., Professor

Department of Neurosurgery
Frederick Boop, M.D., Professor and Chair

Department of Ophthalmology
Rajashekhar Gangaraju, Ph.D., Assistant Professor
TJ Hollingsworth, Ph.D., Assistant Professor
Monica M. Jablonski, Ph.D., Professor
Nawajes Mandal, Ph.D., Professor
Siamak Yousefi, Ph.D., Assistant Professor

Department of Pediatrics, Pediatric Neurology and LeBonheur Children’s Hospital
Shalini Narayana, Ph.D., Associate Professor, Pediatric Neurology, Le Bonheur
Massroor Pourcyrous, M.D., Professor, Pediatrics
James W. Wheless, M.D., Professor and Chief of Pediatric Neurology, Le Bonheur
Department of Pharmaceutical Sciences
Duane D. Miller, Ph.D., Van Fleet Professor and Chair
Bob Moore, Ph.D., Professor
Jianxiong Jiang, Ph.D., Associate Professor

Department of Pharmacology
Alex M. Dopico, M.D., Ph.D., Professor and Chair
Suleiman W. Bahouth, Ph.D., Professor (deceased)
Anna Bukiya, Ph.D. Professor
Hao Chen, Ph.D., Associate Professor
Chang Hoon Jee, Ph.D., Assistant Professor
Dean Kirson, Ph.D., Assistant Professor
Francesca-Fang Liao, Ph.D., Professor
Kafait U. Malik, Ph.D., Professor
Kazuko Sakata, Ph.D., Associate Professor
Jeffery Steketee, Ph.D., Professor
Steven J. Tavalin, Ph.D., Associate Professor
Brendan Turnstall, Ph.D., Assistant Professor
Thirumalini Vaithianathan, Ph.D., Assistant Professor
Fu-Ming Zhou, M.D., Ph.D., Professor

Department of Physiology
Julio Cordero-Morales, Ph.D., Associate Professor
Ioannis Dragatsis, Ph.D., Professor
Jonathan Jaggar, Ph.D., Maury Bronstein Professor
*Djamel Lebeche, Ph.D., Professor
Helena Parfenova, Ph.D., Professor
Valeria Vásquez, Ph.D., Associate Professor
Paula Dietrich, Ph.D., Assistant Professor

Department of Preventive Medicine
Khyobeni Mozhui, Ph.D., Associate Professor

College of Nursing
Ansley Stanfill, Ph.D., Associate Professor

**St. Jude Children’s Hospital** (see Departments Above for Affiliated Appointments)

Jay Bickoff, Ph.D., Assistant Professor
Michael Dyer, Ph.D., Professor
Alessandra D’Azzo, Ph.D., Professor
Peter McKinnon, Ph.D., Professor
James Morgan, Ph.D., Professor
Lindsay Schwarz, Ph.D., Assistant Professor
J. Paul Taylor, M.D., Ph.D., Professor
Stanislav Zakharenko, Ph.D., Professor
VI. GRADUATE STUDENTS & POSTDOCTORAL STUDENTS

Graduate Students: The NI supports the Neuroscience Graduate Program, which is a division of the Biomedical Sciences Program at UTHSC. A description of the Neuroscience program can be found at: https://www.uthsc.edu/anatomy-neurobiology/neuroscience_graduate_program.php. This program is directed by NI members Dr. Max Fletcher (Track Director) and Dr. Matthew Ennis (Program head and Chair of Anatomy and Neurobiology). Students in this track take Functional Neuroanatomy, and 2 of 3 additional Core courses (Cellular Neuroscience, Behavioral Neuroscience, Developmental and Molecular Neuroscience), in addition to Statistics and Research Ethics. In addition, all graduate students must take the Neuroscience Seminar/Journal Club Class each year until they pass their qualifying exam, and all students participate in the student Neuroscience Symposium class every year, where they present their research. Both the Seminar and Symposium courses are coordinated and supported by NI. All students in good standing in the program are awarded matching stipends for at least 2 years (typically, years 3 and 4) of their Ph.D. research phase with the exception of students working at St. Jude Children’s Hospital, which provides their complete stipend. The program had 16 students in FY 2023, including 4 who graduated. Two students were at St. Jude’s (faculty mentors have affiliate faculty appointments in Anatomy & Neurobiology) while the other students were placed with faculty mentors at UTHSC in Anatomy & Neurobiology, Pediatrics (Division of Neurology), Neurology, Pharmacology and the College of Nursing.

In the last 8 years, four NI supported students have been awarded nationally competitive NIH F31 predoctoral fellowships during their graduate tenure: Sarah Neuner, Jordan Ross, Jessica Baker and Angela Taylor. Drs. Neuner and Ross graduated and left for postdocs several years ago, and Jessica Baker and Angela Taylor graduated in FY2021. These are the only UTHSC students from the larger Biomedical Sciences Program to have F31 fellowships.

Postdoctoral Fellows: The NI supports matching postdoctoral fellowships to some extent every calendar year, and successful postdocs can receive support for a maximum of 2 years. In November 2022, we solicited applications for postdoctoral fellow support (see Appendix 4). Seven applications were reviewed by the Neuroscience Executive Committee based on productivity and promise in neuroscience research and awards were made on a competitive basis to the following two candidates with Neuroscience Institute faculty mentors: Yu Chen (Pharmaceutical Sciences; Dr. Jiang) and Xiaoqin Huang (Ophthalmology, Dr. Yousefi). We also continued (and completed) support of 7 postdoctoral fellow awards made in FY22. Further information on postdoctoral awards is available at https://www.uthsc.edu/neuroscience-institute/education/postdoc-awards.php
VII. PROGRAM OVERVIEW AND ACCOMPLISHMENTS

OVERVIEW

Organizational Structure: The Tennessee Higher Education Commission Neuroscience Center of Excellence comprises the administrative core and financial engine of the Neuroscience Institute (NI), which is located within UTHSC’s College of Medicine in Memphis. Dr. Matthew Ennis is the Interim Director, and Dr. John Boughter is the Co-Director. The Director reports to the Executive Dean of the UTHSC College of Medicine, Scott Strome, M.D., and the UTHSC Vice Chancellor of Research, Wes Byerly, Ph.D. Physically the NI is housed within 13 different departments in 3 colleges (Medicine, Pharmacy, Nursing) with an administrative suite in Rm 426 Wittenborg Building at UTHSC. Affiliated members reside at UT Knoxville, St. Jude Children's Hospital, and LeBonheur Children’s Hospital.

Dr. Ennis supervises Ms. Brandy Fleming, M.S., our Program Coordinator and also functions as our IT specialist. Ms. Fleming and Dr. Ennis supervise our administrative assistant, Mistie Brewer. With Ms. Fleming’s help, the administrative assistant organizes the seminar series including all travel arrangements, assists in ordering and billing, and handles NI official correspondence. The Neuroscience Imaging Center is managed by Dr. Esther Marquez Wilkins, Ph.D., who reports directly to NI Director Ennis.

History: The Neuroscience Center of Excellence at UTHSC was established in 1985 and designated an accomplished Center of Excellence by the Tennessee Higher Education Commission in 1988. In 1998, the Neuroscience Center of Excellence was designated as the University of Tennessee Neuroscience Institute, with dedicated space in the Wittenborg, Link and Johnson buildings. The Neuroscience Center of Excellence award was designed to support graduate and postdoctoral research training and education, to recruit and provide initial support to new neuroscience faculty, to renovate laboratory facilities, to purchase research equipment, to host symposia, a weekly seminar series, and to support community outreach programs such as those associated with Brain Awareness Week. The Director from 1985-2002 was Dr. Steven T. Kitai (retired, 2002; deceased 2019). Dr. David Smith was named director from 2002-2006 (deceased, Sept. 2006). Dr. William Armstrong was director from 2006-2020. Dr. Matthew Ennis, Chair of the Department of Anatomy and Neurobiology, was selected as NI Interim Director by UTHSC administration in 2020 upon Dr. Armstrong’s retirement.

The program brings together neuroscience faculty members from the Departments of Anatomy and Neurobiology, Genomics, Medicine, Neurology, Neurosurgery, Nursing, Ophthalmology, Pediatrics, Pharmaceutical Sciences, Pharmacology, Physiology, Preventive Medicine, Psychiatry, and the Department of Biochemistry and Cellular and Molecular Biology at the University of Tennessee, Knoxville. Strong affiliations exist with Methodist University Hospital, Le Bonheur Children’s Hospital, St. Jude’s Children Hospital, the University of Memphis, Rhodes College, and Christian Brother’s University. The interdepartmental nature of the program and the collaborations it fosters provide the cross-disciplinary environment necessary for high quality neuroscience research.

Neuroscience Administrative Suite and Conference Rooms: The NI maintains an administrative suite with offices for the Director, Program Coordinator, and Administrative Assistant in the Wittenborg Building, 4th floor (Room 426). This suite also contains 2 conference rooms, one large room for classes, lab meetings, and large committee meetings,
and a smaller room for small meetings. We also maintain a breakroom for the NI staff, graduate students, postdocs as well as for staff from the animal vivarium located in the basement of the Wittenborg building, which houses animals for Anatomy and Neurology, Physiology, and Neurology faculty.

**Neuroscience Imaging Core:** The NI maintains a full-service Imaging Center (https://www.uthsc.edu/neuroscience-institute/facilities/imaging-center.php) housing confocal and electron microscopes, 3-dimensional reconstruction workstations, microtomy facility and lab and office space for the Director of the Imaging Core, Dr. Esther Marquez Wilkins, located on the 3rd floor of the Link Building. This is a cost recovery facility that NI supports in order to keep costs low. Scheduling is on-line.

**Neuroscience Behavioral Core:** This core is located on the 3rd floor of Wittenborg building (https://www.uthsc.edu/neuroscience-institute/facilities/behavioral-core.php), and is managed by Dr. Mike McDonald of Neurology. NI helped recruit Dr. McDonald. Dr. McDonald personally trains users in the great variety of testing equipment available in this core; nearly all equipment in the core was generously donated by NI faculty. This core is free of use to any UTHSC faculty, but NI occasionally supplies equipment and software on an as-needs basis. Scheduling is on-line.

**Neuroscience Institute Web Site:** Our Program Coordinator, Ms. Brandy Fleming, maintains the NI website with assistance from IT at UTHSC (https://www.uthsc.edu/neuroscience-institute/). This site contains information about our cores, the graduate and postdoctoral support programs, undergraduate fellowships, conference room and core on-line scheduling, faculty funding, spotlights on new faculty, seminars and symposia, and a full list of participating departments and NI faculty members. Ms. Fleming maintains 2 servers for NI members. One server is for file exchange for users of the Imaging Center. All images are digitally acquired from our confocal and electron microscopes, and these can be uploaded to this site by users, stored for a month, and downloaded at their convenience during that period. We also maintain a second server for archiving all NI business.

### Areas of Neuroscience Research

**Neurological and Neurodegenerative Disorders**

Neurological diseases include disorders of the nervous system arising from nervous system malfunction or degeneration. Current areas of focus within NI include: cellular and network physiology of basal ganglia in the context of Parkinson’s disease, traumatic brain and eye injury, stroke, seizures/epilepsy, neuronal dysfunction and death in Huntington’s disease, the molecular biology of synaptogenesis in dystonia, and animal models of Alzheimer’s disease.

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Excitable Properties of Neurons

Behavior, mentation and physiological homeostasis are all a function of neuronal activity in the nervous system. This activity can be encoded by membrane polarity or in the rates and patterns of neuronal action potentials. Information is passed among neurons through synaptic transmission.

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Sensory Information Processing

Sensory systems extract information from the environment and provide the nervous system an interface with the outside world. Understanding the way in which this information is represented in neuronal activity is the focus of this research group, which includes the study of olfaction, taste, pain, and vision.

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Vision and Retina

Understanding the normal function of the eye and the way this process is affected by disease is the primary interest of this group. Researchers are addressing the normal development of the eye as well as the genetic basis of function and disease.

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<td>N. Mandal</td>
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<td>TJ. Hollingworth</td>
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**Neurogenetics and Development**

This group is interested in gaining a deeper understanding of the origins of the impressive structural and functional complexity, diversity, and plasticity of the nervous system. Experimental and technical expertise of this group is broad, ranging from genetic and molecular analysis of the early stages of central and peripheral nervous system development to sophisticated functional assays of neuronal plasticity in response to environmental manipulations.

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<tr>
<td>B. Jones</td>
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**Mental and Addictive Disorders**

Mental and addictive disorders are due to changes in normal brain function. This research group collaboratively explores changes in brain function that might explain mental disorders, such as depression, schizophrenia, ADHD, anxiety, post-traumatic stress disorder and addiction, and drug-induced changes in brain function that may be responsible for relieving mental disorders or producing addiction.

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<td>J. Du</td>
<td>Anatomy &amp; Neurobiology</td>
<td>R. Cowan</td>
<td>Psychiatry</td>
</tr>
</tbody>
</table>

**ACCOMPLISHMENTS**

**Faculty support and recruitment:** NI is currently disseminating start-up funds to 3 faculty. (1) Dr. Tauheed Ishrat, awarded $150,000 to be spent over 5 years. Dr. Ishrat was recruited in 2017 into Anatomy & Neurobiology as an associate professor with an R01. He is a stroke neurobiologist and is interested in factors that mitigate or exacerbate stroke susceptibility in a focal ischemia model. (2) Dr. Il Hwan Kim, $150,000 to be spent over 5 years. Dr. Kim was recruited in 2019 into Anatomy & Neurobiology as an assistant professor; his R01 funded research area is social behavior and schizophrenia. He received a second R01 in September 2022. (3) Dr. Jianyang Du, $100,000 to be spent over 5 years. Dr. Du was recruited in 2020 into Anatomy & Neurobiology as associate professor; his R01-funded research investigates social behavior and autism and he is working towards a second R01 in this area.

**Acquisition of Equipment for Cores:** In the past, NI has contributed matching funds for multi-user pieces of...
equipment, including those obtained from NIH for an electron microscope, for two confocal microscopes and a computerized light microscope for three-dimensional neuronal reconstructions. In addition, NI partnered with UTHSC Research to obtain a high resolution digital camera attachment for the electron microscope and to upgrade the Zeiss 710 to a Zeiss 800 Airyscan confocal microscope. A separate post-image acquisition Zen workstation is available for off-line image analysis. The workstation is also equipped with Imaris software suite: (1) the Tracking XT Package which provides interactive processing, visualization and analysis software for 3D and 4D microscopic images; and (2) the ClearView Deconvolution 9.5 module for confocal image deconvolution. All are located in the Neuroscience Imaging Core and are maintained and supervised by a dedicated Technical Manager (Dr. Esther Marquez Wilkins) supported by the NI. This past year we renewed our service agreements for this imaging equipment. Additionally, we purchased a new Leica Cryostat as the previous one no longer worked and a new computer for the JEOL as the software on the existing computer could no longer be upgraded due to hardware incompatibility. The web site for the Imaging Center is: (https://www.uthsc.edu/neuroscience-institute/facilities/imaging-center.php) and features on-line scheduling for equipment use.

**Research Support-Pilot Project Awards**: Every several years, NI has supported pilot project research awards to NI faculty members. This program is intended to facilitate collaborative research by awarding research funds for the collection of pilot data or for the purchase of small equipment items to support multi-PI grant applications. Applications are reviewed by the Executive Committee and awarded on a competitive basis. This year, due to major equipment purchases the previous year, we did not request Pilot Project applications. We continued support to the Pilot Projects Awards made in the previous fiscal year to Drs. Chizhikov (Anatomy & Neurobiology), Fletcher (Anatomy & Neurobiology, and Zhou (Pharmacology). (See Appendix X)

**Graduate Student Support and Recruiting**: Our interdisciplinary Graduate Neuroscience Track attracts outstanding applicants from around the country, with an emphasis on those in the Mid-South. The NI pays 50% of their stipend for 2 years (years 3 and 4), the remainder is paid by their mentor. For FY23 we spent $59,508 on matching stipends for 4 students and another $1,500 on travel support. During FY23 we had 16 Neuroscience students, including 3 new students who entered in the Fall 2022. In Fall 2023 we recruited 3 new graduate students. Our recruiting flyer can be found at the end of Appendix 4.

**Postdoctoral Research Awards**. The NI provided matching funds on a competitive basis for 7 postdoctoral fellows or research associates for FY23 (this includes 5 awarded in the previous calendar year) and 2 new awards. These awards range from $10,000-$15,000 each and totaled $34,261. The 2 postdocs newly awarded in FY23, and their NI faculty mentors and departments, are listed above under item VI.

**NI Neuroscience Seminar Series and Symposia**: This series is a major mechanism for interaction among
neuroscience faculty, staff and students and brings outstanding neuroscientists from around the world to the UTHSC campus. During the 2022-2023 academic year, the NI sponsored the weekly Neuroscience Seminar Series, hosted 22 speakers, from outside UTHSC. The NI seminar series serves as the basis for a graduate course, Neuroscience Seminar (ANAT 821), which is attended by all neuroscience track IBS graduate students and within which they read papers by and meet with the visiting scientists (course director: Dr. Iskusnykh, Anatomy & Neurobiology). This seminar program is vital to the Neuroscience Track of the Graduate Program and to the entire UT neuroscience community, serving to keep our faculty and students abreast of recent developments and, perhaps even more important, to showcase our strengths to national and international leaders in neuroscience research visiting our campus. NI also coordinates the Spring Student Seminar course (course director: Dr. Fletcher, Anatomy & Neurobiology), where students give seminars and receive critical feedback from their colleagues. A complete list of the seminar speakers and their topics are provided in Appendix 3.

Undergraduate Neuroscience Merit Scholarships: These are given to outstanding undergraduates at Rhodes College and Christian Brothers University (CBU); typically awards are made to those undergraduate students with a Neuroscience or Psychology major. The Rhodes and CBU scholars work on independent projects for their undergraduate thesis. We spent $6,644 supporting 2 scholarships in the summer of 2022 (after July 1, 2022, so part of FY2023). We are currently supporting two new students in summer 2023.

VIII. GOALS AND FUTURE PLANS

Faculty Support and Recruitment: From time to time the Executive Dean of the College of Medicine asks NI to partner on start-up funds for neuroscience faculty recruits. The most recent recruits are listed above under Faculty support. NI will continue to partner on neuroscience faculty recruitments in consultation with UTHSC administration.

Core Support: NI will continue to support the Imaging Center (including the microtomy facility), and Behavioral Core. This requires collecting and processing user fees, paying service contracts, and repairing/replacing equipment. Our confocal microscope and electron microscope/camera are very old and experiencing recurring problems; we will need to replace the confocal microscope (~$870,000) and the electron microscope camera (~$50,000). Further Details are found in the budget for FY24 below.

Graduate Student Support and Recruiting: We expect to recruit 3 new students into the Neuroscience Track for Fall 2023. We will support matching stipends of 3 students during the next fiscal year beginning July 1, 2023. Dr. Fletcher will run the Neuroscience Student Symposium class with Drs. Ennis and Boughter assisting, and Dr. Iskusnykh will run the Neuroscience Seminar Series class for graduate students. The NI offers travel stipends ($500 per trip) to any Neuroscience student or supported postdoc for a national meeting if they are the first or presenting author of a talk or poster.
**Postdoctoral Research Awards.** We will continue ongoing support to 2 postdocs. Depending on budgetary issues (allocation of NI start up funds to the recruit of a new Director, replacement of core equipment), we may continue to support new Postdoctoral Awards in FY24. These applications are competitive and ranked by the NI Executive Committee. See Budget for FY23 for further details.

**NI Neuroscience Seminar Series:** We will continue to run the Neuroscience Seminar Series, which will be held in person or on-line by Zoom with the preference up to the individual speaker.

**Undergraduate Research Fellows:** We will support ~2 undergraduate research fellows from Rhodes College or Christian Brothers University.

IX. BUDGET (see Schedule 7, page 21)

A. FY2023 The FY23 THEC appropriated budget for the NI was $667,652. We carried forward $324,782 from the previous year for a total budget of $992,434. This carryover reflects amounts encumbered but unspent for Graduate Stipends that were picked up previously by NI and are now picked up by UTHSC for the student’s first 18 months, monies encumbered to support our new faculty hires for whom we provided startup packages (Drs. Ishrat, Du, and Kim) and any unspent funds from research award accounts. Additionally, the carry forward reflects funds for seminar arrangements (travel, per diem, hotel and honorarium) that were not expended due to Covid.

This past FY, we expended $441,103 total personnel costs (including salaries and fringe). Personnel costs include administrative supplements for the NI Director (who also directs the NI Imaging Center), the NI Co-Director, a full-time Program Coordinator/IT specialist, a ¾ time Administrative Specialist, and a full time Technical Manager of Imaging Center as well as the students and postdocs mentioned below.

**Students:** We awarded matching or partial funds for 4 graduate stipends to NI faculty mentors with Neuroscience track graduate students for a total $59,508. The mentors were located in the departments of Anatomy and Neurobiology, Neurology, Pediatrics and in the College of Nursing.

**Postdoctoral Support:** We provided matching funds for 7 postdoctoral fellows for a total $34,261. The NI faculty mentors and departments are listed above under item VI.

**Neuroscience Imaging Center:** Currently the NI Imaging Center is run by Dr. Esther Marquez Wilkins. We supplement our cost-recovery program to keep user fees low, helping to pay the service contracts on our JEOL 2000 Electron Microscope, the Zeiss 710/800 confocal microscope, the Microbrightfield Neurolucida workstation, and the Imaris software suite (including the new modules purchased this past year as noted above). This year our cost-recovery
program took in $21,423 which was used against the fees needed to pay the service contracts on the Zeiss 710/Airyscan ($19,662) and the JEOL 2000 ($17,300). The cost recovery this FY was much less than previous years due to the restricted research operations during Covid-19. As noted above, to replace non-functional equipment, we purchased (1) a Leica Cryostat (CM3050, $54,508) and (2) a computer workstation ($7,850) for the JEOL as the software on the existing computer could no longer be upgraded due to hardware incompatibility. The equipment available for use can be viewed at: https://www.uthsc.edu/neuroscience-institute/facilities/imaging-center.php.

Neuroscience Behavioral Core: The procedures for use and available equipment can be viewed at: https://www.uthsc.edu/neuroscience-institute/facilities/behavioral-core.php. Due to the generally low cost of maintenance (Dr. McDonald generously trains new users at no charge and faculty provide their own research personnel to use the equipment), NI has not yet instituted fees for services in this facility.

Seminars and Symposia: We spent $15,983 on travel and entertainment for the seminar speakers. We did pay honoraria ($3200) for the Neuroscience Seminar series (see Appendix 3).

Research Project Support: We provided startup funds for Drs. Ishrat, Du, and Kim, who were awarded $150,000, $100,000 and $150,000, respectively (see details above under Accomplishments – Faculty Support and Recruitment). We continued support for 3 Pilot Projects awarded in FY22 ($15,000 each). Those receiving the awards were: Drs. Chizhikov (Anatomy & Neurobiology), Fletcher (Anatomy & Neurobiology, and Zhou (Pharmacology).

Undergraduate Fellowships: We spent $6,945 supporting these and 2 scholarships in the summer of 2022 (after July 1, 2022, so part of FY23) and 2 students who began research in summer 2023.

Travel Awards: As national and international research meetings have resumed with the cessation of Covid our expenditures in this area were back to normal levels. $3,000 in travel awards for graduate students and postdoctoral fellows were awarded.

B. FY2024. We will carryover $286,004 to the coming fiscal year and have been appropriated $691,114 for a total of $977,118. In addition to providing support for all the NI staff (Program Coordinator, Administrative Assistant, and Imaging Center Manager), here is a breakdown of the major anticipated projects for FY2024.

Students: For the coming year, we have awarded matching, or partial support, funds for 3 graduate stipends to NI faculty mentors with Neuroscience track graduate students. Mentors are located in Anatomy & Neurobiology and Neurology. The NI match is ~$14,500 each for 3 of these making an expected total of ~$43,500.
Postdoctoral Support: We continued to provide funds for 2 postdoctoral fellows awards made in FY22 ($10,000-15,000 each for a total of ~$30,000). Some can be given to awardees from last year assuming good progress, with a maximum of 2 year’s support.

Neuroscience Imaging Center: We will pay/renew the service contracts on the: (1) JEOL 2000 ($17,300), (2) Zeiss 710/800 Confocal ($19,662), (3) Imaris software suite ($4,346), (4) Leica Glass Knife Maker ($585), and (7) Leica Ultramicrotome ($5,876). We will replace the confocal microscope (~$870,000 with partnering funds from the Department of Anatomy & Neurobiology) and the electron microscope camera (~$50,000).

Neuroscience Behavioral Core: We will continue to support the Behavioral Core in FY2024, but expenditures are expected to be nil. However, should a need arise for additional equipment, or for a part-time assistant to help run behavioral studies, NI would consider additional funding assuming a fee for service program were approved and initiated.

NI Faculty: We will provide administrative supplements to Dr. Ennis (until September 30, 2023, when Dr. Dobrunz becomes the NI Director), Dr. Dobrunz (beginning October 1, 2023) and Dr. Boughter. We are currently providing start-up funds as to 3 faculty as detailed above: (1) $150,000 to Dr. Ishrat over 3-5 years to (2/01/2018-1/31/2023); (2) $150,000 to Dr. Kim over 3-5 years (to ~2024), and (3) $100,000 to Dr. Du over 3-5 years (to 2025). We limit NI expenditures for each faculty at no more than $50,000/year, and request that they use at least $30,000 per year should they wish to extend the full five years.

Research Projects and Bridge Funding: We can provide small amounts of bridge fund assistance, but this will be limited by our ongoing commitments to start-up fund packages noted above for Drs. Ishrat, Kim, and Du.

Seminar and Undergraduate Neuroscience Merit Fellowships. We will offer the Neuroscience Seminar series, currently offered in person or virtually on-line and featuring national and international speakers (on-line only). We will continue to fund summer Undergraduate Neuroscience Merit Fellowships to Rhodes and Christian Brothers University students who are doing research projects in Neuroscience towards fulfilling their degree requirements (from 2-3 awards, depending on qualifications).
### Schedule 7
**CENTERS OF EXCELLENCE ACTUAL, PROPOSED, AND REQUESTED BUDGET**

<table>
<thead>
<tr>
<th>Expenditures</th>
<th>FY 2022-23 Actual</th>
<th>FY 2023-24 Proposed</th>
<th>FY 2024-25 Requested</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Matching</td>
<td>Appropriations</td>
<td>Total</td>
</tr>
<tr>
<td><strong>Salaries</strong></td>
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<td>Assistantships</td>
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<td><strong>Total Salaries (exclude Longevity)</strong></td>
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<td>Longevity (Excluded from Salaries)</td>
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<td><strong>Total Personnel</strong></td>
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<td>$460,540</td>
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<td>Professional Serv &amp; Memberships</td>
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<td>$0</td>
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<td>Direct Cost Sharing</td>
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<td><strong>Total Non-Personnel</strong></td>
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<td>New State Appropriation</td>
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<td>$667,652</td>
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<td>Carryover State Appropriation</td>
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<td>New Matching Funds</td>
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<td>Carryover from Previous Matching Funds</td>
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<td>$0</td>
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<td><strong>Total Revenue</strong></td>
<td>$982,200</td>
<td>$992,434</td>
<td>$1,974,633</td>
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</table>
X. FACULTY PUBLICATIONS

The Neuroscience faculty at UTHSC is consistently productive, both in terms of peer-reviewed publications and participation in the national neuroscience community. Lists of peer-reviewed journal publications during the last academic year, as cited in PubMed are presented in Appendix 2. These PubMed-cited publications do not include the many chapters, reviews and other articles written by NI faculty. NI faculty members are indicated in bold in Appendix 2. NI members published 246 papers.

XI. EXTRAMURAL FUNDING OF NEUROSCIENCE FACULTY

The total annual grant dollars (total costs) currently held by UTHSC NI faculty (i.e., excluding affiliate members, such as St. Jude, and excluding grants in no cost extensions) is $20,579,980, up from $19,632,057 reported last year. The research grants (current year total costs) currently held by individual NI faculty are listed by Principal Investigator in Appendix 1. These values are reported to us by Research Administration at UTHSC. Appendix 4 includes some highlights of publications and grants recently awarded to NI faculty.

APPENDIX 1
External Funding of Neuroscience Institute Faculty
FY 2022-2023
<table>
<thead>
<tr>
<th>Lead PI</th>
<th>Department</th>
<th>Project Title</th>
<th>Sponsor</th>
<th>Award Number</th>
<th>Begin Date</th>
<th>End Date</th>
<th>Total Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boughter, John</td>
<td>Anatomy and Neurobiology</td>
<td>The Neural Organization of Taste Neophobia</td>
<td>HHS - NIH - NIDCD - National Institute on Drug Abuse</td>
<td>A23-0259-001</td>
<td>8/2/2022</td>
<td>7/31/2023</td>
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<td>Buliya, Anna</td>
<td>Pharmacology</td>
<td>Fetal alcohol exposure and cerebrovascular development</td>
<td>University of South Florida (USF)</td>
<td>A22-0351-006</td>
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<td>Buliya, Anna</td>
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<td>Buliya, Anna</td>
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<td>A22-1017-008</td>
<td>2/1/2023</td>
<td>1/31/2024</td>
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<td>Chen, Hsiu</td>
<td>Pharmacology</td>
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<td>HHS - NIH - NIDA - National Institute on Drug Abuse</td>
<td>A19-0991-014</td>
<td>7/1/2023</td>
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<td>Chishkov, Viktor</td>
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<td>NMDA-dependent regulation of neuronal scaling in the developing cerebellum</td>
<td>HHS - NIH - NINDS - National Institute of Neurological Disorders and Stroke</td>
<td>A22-1364-008</td>
<td>6/1/2023</td>
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<td>Cordero-Morales, Julio</td>
<td>Physiology</td>
<td>The Role of Sensory Receptors in Angelman Syndrome</td>
<td>HHS - NIH - NINDS - National Institute of Neurological Disorders and Stroke</td>
<td>A23-0828-001</td>
<td>2/15/2023</td>
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<td>Sensory Ion Channel Modulation by Bioactive Lipids</td>
<td>HHS - NIH - NINDS - National Institute of General Medical Sciences</td>
<td>A23-1069-001</td>
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<td>3/1/2024</td>
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<td>Ohio State University (OSU)</td>
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<td>Du, Jinyang</td>
<td>Anatomy and Neurobiology</td>
<td>CFTR activators regulate emotional behaviors</td>
<td>Cystic Fibrosis Foundation</td>
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<td>Du, Jinyang</td>
<td>Anatomy and Neurobiology</td>
<td>The mechanism of cell size regulation by polydipsins</td>
<td>University of Toledo (UT)</td>
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<td>A15-0771-028</td>
<td>6/1/2022</td>
<td>5/31/2024</td>
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<td>Gangaraju, Raja Shekhar</td>
<td>Ophthalmology</td>
<td>Regulation of Mesenchymal Stem Cell Secretome for Treatment of Microglia Damage in Traumatic Brain Injury</td>
<td>HHS - NIH - NINDS - National Institute of Neurological Disorders and Stroke</td>
<td>A23-0256-001</td>
<td>8/2/2022</td>
<td>7/31/2023</td>
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<td>Gangaraju, Raja Shekhar</td>
<td>Ophthalmology</td>
<td>Novel engineered extracellular vesicles for blast injury to the retina:</td>
<td>University of Illinois Board of Trustees (BOT UI)</td>
<td>A23-0899-001</td>
<td>9/1/2022</td>
<td>5/31/2022</td>
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<td>Gallen, Anna</td>
<td>Ophthalmology</td>
<td>TSg6 Exosomes for Treatment of Visual Dysfunction as Related to Military-Relevant Trauma</td>
<td>DOD - Department of Defense</td>
<td>A22-0304-001</td>
<td>7/15/2022</td>
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<td>Hollingsworth, TJ</td>
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<td>Suppression of Chronic Retinal Inflammation to Maintain Visual Function in a Spontaneous Polygenetic Mouse Model of Early Onset Inherited Retinal Dystrophy</td>
<td>Knights Templar Eye Foundation</td>
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<td>7/1/2023</td>
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<td>Jablonski, Monica</td>
<td>Ophthalmology</td>
<td>Novel Atrophic AMD therapy, delivery platform and preclinical models</td>
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<td>7/1/2023</td>
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<td>Jaggar, Jonathan</td>
<td>Physiology</td>
<td>SIK3 channel trafficking in endothelial cells</td>
<td>HHS - NIH - NHLBI - National Heart, Lung, and Blood Institute</td>
<td>A22-0106-009</td>
<td>5/1/2023</td>
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<td>Jiangxiong, Jian</td>
<td>Pharmaceutical Sciences</td>
<td>Targeting TRPC3 Channels for Epileptic Seizures</td>
<td>HHS - NIH - NINDS - National Institute of Neurological Disorders and Stroke</td>
<td>A22-0630-007</td>
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<td>Genetics, Genomics &amp; Informatics</td>
<td>Genetics of epigenetic response to high circulating glucocorticoids and organophosphorus compounds</td>
<td>HHS - NH - NIEHS - National Institute of Environmental Health Sciences</td>
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<td>Khan, Mohammad Masahid</td>
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<td>LucRNA Malat1 as a potential therapeutic target for Alzheimer’s Disease</td>
<td>University of Texas - Rio Grande Valley (UTRGV)</td>
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<td>Novel DNA damage-Based Mechanisms and Therapeutics for Parkinson’s disease</td>
<td>HHS - NH - NINDS - National Institute of Neurological Disorders and Stroke</td>
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<td>Oligonucleotide-based therapy for Frontotemporal Degeneration</td>
<td>DOD - Department of Defense</td>
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<td>1/1/2023</td>
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<td>Kim, Ji Hwan</td>
<td>Anatomy and Neurobiology</td>
<td>Sunroad agreement to Virginia Tech</td>
<td>Virginia Tech (VT)</td>
<td>$369,998</td>
<td>9/1/2023</td>
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<td>Kirsh, Dean</td>
<td>Pharmacology</td>
<td>Hypothalamic oxytocin influence on extended amygdala CRF neurons in alcohol dependence</td>
<td>HHS - NH - NIAAA - National Institute on Alcohol Abuse and Alcoholism</td>
<td>$240,000</td>
<td>9/1/2023</td>
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<td>Moshari, Khlyobien</td>
<td>Preventive medicine</td>
<td>Functional genetic analysis of epigenetic age acceleration and the regulatory landscape of the mthyline</td>
<td>HHS - NH - NIA - National Institute on Aging</td>
<td>$315,415</td>
<td>9/1/2023</td>
<td>8/31/2023</td>
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<td>Narayana, Shalini</td>
<td>Pediatrics-Neurology</td>
<td>A National Consortium of Pediatric TMS Centers: Creating Infrastructure to Improve Language Mapping and Support Neurosurgical Decision Making</td>
<td>Pediatric Epilepsy Research Foundation (PERF)</td>
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<td>9/1/2023</td>
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<td>North, Kelary</td>
<td>Pharmacology</td>
<td>Pregabalin constricts cerebral vascular arteries through the direct modulation of BK ion channels</td>
<td>HHS - NH - NHLBI - National Heart, Lung, and Blood Institute</td>
<td>$46,752</td>
<td>8/1/2023</td>
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<td>Paragon, Elena</td>
<td>Physiology</td>
<td>Endothelial Vasoprotection by Hypothemia</td>
<td>HHS - NH - NINDS - National Institute of Neurological Disorders and Stroke</td>
<td>$424,069</td>
<td>7/1/2023</td>
<td>6/30/2023</td>
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<td>Proser, Rebecca</td>
<td>Biochem-cell &amp; mole biology</td>
<td>Does dantrolene attenuate the initial toxicity of Alzheimer’s Disease peptides in young, old and Alzheimer’s mouse model brain tissue?</td>
<td>University of Tennessee Medical Center (UTMC)</td>
<td>$25,000</td>
<td>5/31/2023</td>
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<td>A22-1289-001</td>
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<td>Reber, Lawrence</td>
<td>Neurology</td>
<td>Development of an Assay for Circadian Rhythm Defects in Prader-Willi Syndrome</td>
<td>Foundation for Prader-Willi Research</td>
<td>$150,000</td>
<td>2/1/2024</td>
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<td>Reber, Lawrence</td>
<td>Neurology</td>
<td>The role of UBE3A in gliopathic seizures.</td>
<td>HHS - NH - NINDS - National Institute of Neurological Disorders and Stroke</td>
<td>$404,130</td>
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<td>Genetics, Genomics &amp; Informatics</td>
<td>Genetics of oxycodone intake in a hybrid rat diversity panel</td>
<td>HHS - NH - NIDA - National Institute on Drug Abuse</td>
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<td>Sharp, Burt</td>
<td>Genetics, Genomics &amp; Informatics</td>
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<td>Stanfield, Andrey</td>
<td>Nursing-Research Programs</td>
<td>The utility of the Neuro-Qol. measures to trigger neuropsychological assessment post-aneurysmal subarachnoid hemorrhage: A pilot study</td>
<td>National Academy of Neuropsychology (NAN)</td>
<td>$7,500</td>
<td>10/1/2023</td>
<td>9/30/2023</td>
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<td>Tavullia, Steven</td>
<td>Pharmacology</td>
<td>Actions of proline at receptors and synapses</td>
<td>HHS - NH - NIMH - National Institute of Mental Health</td>
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<td>8/1/2023</td>
<td>7/31/2023</td>
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<td>Valthanathan, Thumralini</td>
<td>Pharmacology</td>
<td>Dynamics of calcium signals control neurotransmitter release in retinal ribbon synapses</td>
<td>HHS - NH - NIE - National Eye Institute</td>
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<td>1/1/2023</td>
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<td>Regulation of mechanosensitive ion channels by membrane lipids.</td>
<td>HHS - NH - NICHS - National Institute of General Medical Sciences</td>
<td>$526,800</td>
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<td>Vasquez, Valeria</td>
<td>Physiology</td>
<td>Studding prorlonged nociceptor sensitization by TRPV1 combining a spider toxin and C. elegans</td>
<td>US-Israel Binational Science Foundation</td>
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<td>Genetics, Genomics &amp; Informatics</td>
<td>Imaging Gene of Brain Structure and Cognitive Aging in Murine Models of Alzheimer’s Disease</td>
<td>HHS - NH - NIA - National Institute on Aging</td>
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<td>2/1/2023</td>
<td>1/31/2024</td>
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<td>$2,231,314</td>
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<td>Yousef, Siamak</td>
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<td>Improved Glaucoma Monitoring Using Artificial-Intelligence Enabled Dashboard</td>
<td>HHS - NH - NIE - National Eye Institute</td>
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<td>9/1/2023</td>
<td>8/31/2023</td>
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**TOTAL** $20,579,890
APPENDIX 2
Faculty Publications (PubMed)
FY 2022-2023
Peer-reviewed publications for 2022-2023 (cited in PubMed):


SARDs for the Treatment of Enzalutamide-Resistant Prostate Cancer. *J Med Chem*, 64(15), 11045-11062. doi:10.1021/acs.jmedchem.1c00439


decreases discriminative stimulus-controlled relapse to cocaine seeking in rats. 
*Neuropsychopharmacology, 46*(11), 1969-1980. doi:10.1038/s41386-021-01067-6


rat HXB/BXH family identifies Tti2 as a pleiotropic quantitative trait gene for adult hippocampal neurogenesis and serum glucose. *PLoS Genet*, 18(4), e1009638. doi:10.1371/journal.pgen.1009638


APPENDIX 3

Neuroscience Seminar Speakers

FY 2022-2023
NEUROSCIENCE SEMINAR SERIES SCHEDULE

Fall 2022

Kumar Vivek, Ph.D                         August 30, 2022
Associate Professor
Addiction Biology
Jackson Laboratory
Host: Students
Title: “Advanced Mouse Phenotyping with Computer Vision and Machine Learning”

Jeremy McIntyre, Ph.D.                 September 20, 2022
Assistant Professor
Neuroscience
University of Florida
Host: Dr. Max Fletcher
Title: “The role of neuronal cilia as modulatory signaling centers”

Corinde E. Weirs, Ph.D.     Zoom        September 27, 2022
Assistant Professor
Psychiatry and Radiology
University of Pennsylvania
Host: Brendan Tunstall
Title: "Nutritional ketosis as a potential treatment of alcohol use disorder"

Keith Hengen, Ph.D.                October 4, 2022
Assistant Professor
Department of Biology
University of Wisconsin-Madison
Host: Dr. Detlef Heck
Title: “Does sleep restore an optimal computational regime in the brain? Network dynamics in long-term recordings point to an answer”

Jenna McHenry, Ph.D.  
Assistant Professor  
Department of Psychological and Neuroscience  
Duke University  
Host: Dr. Jianyang Du

Title: “Illuminating social state dynamics in neural circuits for motivated behavior ”

Un Jung Kang, M.D.  
Professor  
Neurology  
NYU Grossman School of Medicine  
Host: Fu-ming Zhou

Title: “Aberrant plasticity in PD therapy”

Matthew Campbell, Ph.D.  
Smurfit Institute of Genetics  
Trinity College Dublin, Ireland  
Host: Raja Gangaraju

Title: “Regulation of the blood-barrier in health and disease”

Nabil J. Alkayed, M.D., Ph.D.  
Professor and Director of Research  
Knight Cardiovascular Institute  
Oregon Health and Science University  
Host: Tauheed Ishrat

Title: “Novel Therapeutic Targets for Vascular Cognitive Impairment and Dementia”

Weizhe Hong, Ph.D.  
Associate Professor  
Neurobiology
UCLA  
Host: Jianyang Du  
Title: “Understanding the Social Brain”  

Seonil Kim, Ph.D.  
Assistant Professor  
Biomedical Sciences  
Colorado State University  
Host: Il Hwan Kim  

Title: “The Autism-Associated delta-Catenin Mutation Induces Social Deficits in Mice”  

Theanne Griffith, Ph.D.  
Assistant Professor  
Physiology and Membrane Biology  
UC Davis  
Host: Valeria Vasquez  

Title: “Illuminating new roles for Nav1.1 in somatosensory signaling and behavior”
NEUROSCIENCE SEMINAR SERIES
SCHEDULE
Spring 2023

Qian-Quan Sun, Ph.D.
Professor
Zoology and Physiology
University of Wyoming
Host: Dr. Jianxiong Jiang
Title: “Interneuropathy in the thalamocortical network links epilepsy with psychiatric disorders”
February 7, 2023

Veronica Flores, Ph.D.
Assistant Professor
Psychology
Furman University
Host: Dr. Max Fletcher
Title: “Cortical Taste Processing Evolves through Benign Taste Exposures”
February 28, 2023

Rajtarun Madangopal, Ph.D.
Scientist
National Institute of Drug Abuse
National Institute of Health
Host: Brendan Tunstall
Title: "Fos and Calcium Ensembles in Learned Behaviors"
March 7, 2023

Robert Smith, M.D., Ph.D.
Professor, Chair
Neurosciences
March 14, 2023
University of Toledo  
Host: Dr. Jianyang Du

Title: “Assessment of Protein kinase signaling networks in complex biological substrates”

Thyagarajan Subramanian, M.D., Ph.D.  
Professor  
Neurology  
University of Toledo  
Host: Dr. Fu-ming Zhou

Title: “Maladaptive neuroplasticity in Parkinson’s disease: basic science to therapeutic testing”

Christoph Kellendonk, Ph.D.  
Associate Professor  
Psychiatry  
Columbia University  
Host: Fu-ming Zhou

Title: “Dopamine D2 receptors and striatal circuit function”

Udai Bhan Pandey, Ph.D.  
Associate Professor  
Human Genetics  
University of Pittsburgh  
Host: Mohammad Moshahid Khan

Title: “Identifying hidden GEM’s in neurological diseases”

Jungsu Kim, Ph.D.  
Professor  
Medical and Molecular Genetics  
Indiana University  
Host: Mohammad Moshahid Khan

Title: “Targeting Astrocytes and Microglia for Alzheimer’s disease”
Jason Yi, Ph.D.                  April 25, 2023
Assistant Professor
Neuroscience
Washington University of St. Louis
Host: Larry Reiter

Title: “A functional genetic approach to Angelman Syndrome”

Charles Cox, M.D.                    May 2, 2023
Professor
Institute of Molecular Medicine for Prevention of Human Diseases
University of Texas School of Medicine
Host: Rajashekhar Gangaraju

Title: “Cellular Therapies for Neurological Injuries”

Longjun Wu, Ph.D.                    May 9, 2023
Professor
Neurology
Mayo Clinic
Host: Jianxiong Jiang

Title: “Neuroimmune Interaction in Health and Disease”
APPENDIX 4
Neuroscience News, Events and Graduate Training Flyer
FY 2022-2023
Neuroscience Institute (NI) Postdoctoral/Research Associate Support

Purpose and Eligibility: The NI solicits proposals for supplementary funds for postdoctoral fellows whose UTHSC mentors are active tenured or tenure-track faculty members of NI. Mentors should be currently funded or working on a no-cost extension of a competitively renewable grant. Those working with faculty currently on NI seed support are ineligible for this award. Research associates may apply, but their applications will be considered only if there are insufficient meritorious applications from postdoctoral fellows.

Although we try to rotate funding to new applicants, currently funded postdocs (or research associates) with no more than one year of previous NI matching support can apply for a one year, competitive renewal.

Support: The NI provides $10,000-15,000 in matching funds to NI mentors, to be used toward the salary/fringe of each awarded applicant. The award amount and number of postdocs funded will be determined during evaluation, and will depend on the number of quality applicants we receive.

Application:

1. New Applicants: The applicant should provide a cover letter requesting support with a brief overview of the proposed research project, a 3-page research proposal, a current CV, and two letters of reference (reference letters can also be emailed directly to NI), one of which must come from the mentor. These documents should be submitted electronically as PDF files. Mentors should provide an updated, brief, NIH-style biosketch attached to their support letter.

2. Renewal applicants: The applicant should submit a 2-page progress report covering the past year’s publications, presentations, and research progress. Support letters for renewals are only needed from the mentor, and must comment on the candidate’s progress.

Review Process and Criteria: The NI Executive Committee will review applications. Criteria include evidence of productivity in neuroscience research, with particular value attached to first author publications.


Submission: Please send all materials electronically to:
Brandy Fleming, Program Coordinator
Neuroscience Institute
bfleming3@uthsc.edu.
Phone: 448-1286
UTHSC Team Receives $2.16 Million To Test Potential New Alzheimer-Fighting Compound

Written by Lee Ferguson | July 14, 2022

The National Institute on Aging recently awarded $2.16 million to a team of investigators from the University of Tennessee Health Science Center (UTHSC) testing a new way to combat the root cause of neurodegenerative disorders such as Alzheimer's Disease.

Francesca-Fang Liao, PhD, professor of Pharmacology, Addiction Science and Toxicology in the College of Medicine, is the NIH contact principal investigator on the project. Wei Li, PhD, distinguished professor in the Department of Pharmaceutical Sciences in the College of Pharmacy, is a multiple principal investigator.

A number of progressive neurodegenerative diseases, such as Alzheimer's, involve the abnormal accumulation of a key protein, tau, in the brain. In healthy neurons, tau binds to and stabilizes internal support structures called microtubules, which help guide nutrients and molecules from one part of the nerve cell to another. In diseased patients, stressful signals in the brain alter tau, causing it to misfold and detach from microtubules, forming neurofibrillary tangles which are toxic to neurons.
A breakdown in the signaling pathways that can rid cells of misfolded tau and prevent its accumulation is the focus of Dr. Liao's project. Her team is examining new mechanisms that might cause these breakdowns, zeroing in on the link between oxidative stress and the activity of a particular enzymatic molecule, otulin. In previous studies, Dr. Liao has found that inhibiting otulin prevented the accumulation of tau. She hypothesizes that oxidative stress activates otulin, which increases tau aggregation and neurotoxicity. Her project aims to investigate both the mechanisms that regulate tau accumulation, and the mechanisms affected by oxidative stress during otulin-induced tauopathies. It will also test a new otulin-inhibiting drug developed by Dr. Li for its effectiveness in promoting tau clearance and reducing tau's cellular toxicity.

"We are extremely excited to work together as a team to further validate a potential use of this compound in translation," Dr. Liao said.

UTHSC Team Receives $2.13 Million National Award to Study Early-Stage Development of the Cerebellum

Written by Lee Ferguson | September 2, 2022

The National Institute of Neurological Disorders and Stroke has awarded $2.13 million to a University of Tennessee Health Science Center (UTHSC) team studying how neural cells that build a functional brain are generated during embryonic and neonatal life. Viktor Chizhikov, PhD, associate professor in the Department of Anatomy and Neurobiology, is the principal investigator. Igor Iskusnykh, PhD, instructor in the same department, contributed significantly to the project.

During brain development, different types of neurons must be produced in appropriate proportions in order for healthy neural circuits to be formed. Research suggests that disorders such as autism may be caused by these scaling processes gone awry. But little is known about the machinery that scales the number of functionally related neurons in the brain.

In this study, Dr. Chizhikov’s team aims to define the molecular mechanisms that regulate early neuron development, using the cerebellum in an animal model. The team will work to answer questions such as, what genes coordinate the growth and movement of neuron progenitors? How are these genes regulated during normal brain development? What signaling pathways are involved in neural cell growth and production? How does the machinery that controls neuronal growth get disrupted in patients with brain overgrowth disorders?

Answering these questions may help future research pinpoint where and when neural scaling goes off course, which will have a large impact on understanding autism and other developmental brain disorders, and our ability to develop new treatments.

Tags: Department of Anatomy and Neurobiology, National Institute of Neurological Disorders and Stroke, UTHSC Office of Research
Little is known about the underlying neural circuits involved in taste neophobia. In this project, Dr. Boughter, Dr. Fletcher and their team will work to understand how information regarding the newness or familiarity of tastes are encoded within brain circuits. They hypothesize that neophobia is driven by enhanced responses from forebrain inputs. Findings from the study will increase understanding of taste learning and the mechanics within sensory regions that process new sensations.

"Food neophobia is an important behavior for most animals," Dr. Boughter said. "It is important to understand its neural organization in order to gain new insights into how feeding behaviors are controlled by the brain."

Tags: Department of Anatomy and Neurobiology, National Institute of Deafness and Other Communication Disorders, UTHSC Office of Research
UTHSC Researcher Co-Leads Study of Genes that Modulate Aging, Lifespan

Written by Lee Ferguson | October 5, 2022

Scientists led by the University of Tennessee Health Science Center (UTHSC) and the École Polytechnique Fédérale de Lausanne (EPFL) in Switzerland are exploring the elaborate interplay between genes, sex, growth, and age and how they influence variation in longevity. Their findings, which are being published in the peer-reviewed journal Science, are an important step in understanding why some people live longer than others and provide a basis for future studies to improve healthspan.

Robert Williams, PhD, chair of the Department of Genetics and Genomics in UTHSC’s College of Medicine, along with Johan Auwerx, MD, PhD, professor and director of the Laboratory for Integrated and Systems Physiology at EPFL, started a program in 2016 to define genetic factors underlying aging and lifespan. "Finding common molecular pathways that control differences in rate of aging is critical to our understanding of how individuals differ in their health and lifespan," Dr. Williams said. "Such insights may help us work out ways to intervene rationally.”

Drs. Williams and Auwerx worked with colleagues at the National Institute on Aging’s Interventions Testing Program (ITP), which donated DNA of over 12,000 mice to the project. ITP mice are genetically heterogeneous. Each of the 27,574 mice studied is a full sibling, sharing half its genetic inheritance with each other mouse in the program, and each has a known lifespan, making them an ideal system to study.

EPFL and UTHSC researchers measured the genetic makeup of more than 3,000 mice, all of them genetic brothers or sisters. The mice were then genotyped and allowed to live until their natural death. The researchers then explored the relationship between DNA difference and differences in the lifespan of each mouse. This genetic mapping allowed the teams to define stretches of DNA in genomes that affect longevity. The results show the DNA segments, or loci, associated with longevity are largely specific to sex, with females having a region in chromosome 3 that affects lifespan. When the males who died early due to non-aging-related reasons were removed from the analysis, additional genetic signals started to emerge, suggesting some genetic variations only affect lifespan after a certain age.

In addition to finding genetic determinants of longevity, the researchers explored other contributors. In general, bigger mice die younger. The researchers found that some, but not all, of the genetic effects on longevity are through effects on growth. One of the non-genetic effects may be how early access to food affects growth. They observed that mice from smaller litters tended to be heavier adults and live shorter lives. Mice from larger litters that had to share their mother's milk with more siblings, grew more slowly and lived longer on average. The researchers corroborated these trends of early growth versus longevity in large human datasets with hundreds of thousands of participants.

Beyond characterizing how longevity is affected, the researchers worked to find genes most likely to play a role in longevity determination. They measured the effect of DNA variation on how genes are expressed and compared their analyses with multiple human and non-human databases. From this they nominated a few genes likely to modulate aging rates. They then tested the effects of manipulating these genes in roundworms and found that a subset of gene perturbations did in fact affect the lifespan. The results of this study will be a rich resource of aging genes that will hopefully guide the design of therapies that not only extend lifespan, but also healthspan.

Funding for the project was provided by the NIA, EPFL, the European Research Council, the Swiss National Science Foundation, and the Glenn Foundation for Medical Research. The paper, titled "Sex- and age-dependent genetics of longevity in a heterogeneous mouse population" ([https://www.science.org/doi/10.1126/science.abo3191](https://www.science.org/doi/10.1126/science.abo3191))，“is in the October 2022 issue of Science.

Dopico Awarded $2.6 Million for Project to Understand and Treat Alcohol-Induced Blackouts

Written by Lee Ferguson | November 16, 2022

The National Institute on Alcohol Abuse and Alcoholism has awarded $2.6 million to Alex M. Dopico, MD, PhD, Van Vleet Chair of Excellence and professor in the Department of Pharmacology, Addiction Science, and Toxicology (PHAST) at the University of Tennessee Health Science Center, to study cerebrovascular dysfunction that could contribute to alcohol-induced blackouts.

Alcohol-induced blackouts are a form of amnesia caused when a person drinks heavily enough to temporarily block the transfer of memories from short- to long-term storage — known as memory consolidation — in the brain’s hippocampus. These blackouts can occur in anyone who heavily drinks within a short period, regardless of age, education, socioeconomic status, drinking history, sex, or sexual orientation. A serious consequence of alcohol misuse, alcohol-induced blackouts drastically increase the risk for dangerous behaviors, injuries, and other harms.

Previous studies have sought the cellular basis of alcohol-induced blackouts, focusing primarily on neuronal or glial elements. Dr. Dopico’s study departs from all previous research by focusing instead on blood perfusion of this brain region. His project builds on his years of research and his discovery of a molecular site in BK channel protein receptors where alcohol is recognized and interacts to make cerebral arteries contract.

Dr. Dopico’s team, including Anna Bukiya, PhD, and Brendan Tunstall, PhD, both faculty in the PHAST department, will explore how, at concentrations reached in the brain during alcohol-induced blackouts, these amino acids cause artery constriction, regional hippocampal ischemia, and ultimately, blackouts. The team will use a wide array of methodologies, from computational models of alcohol-BK receptor interaction to behavioral testing in animal models. They aim to fully characterize the vascular target for alcohol, the first step in designing drugs to counteract alcohol-induced blackouts. They will examine whether there is a difference between the biological sexes in how the target responds to alcohol action. Finally, they will test the effectiveness of their newly discovered vasomodulator as a possible treatment.

“As recently done in other fields within the neurosciences, such as neurodegeneration, cognition deficits, and dementia, we are bringing a vascular component(s) as central to the pathophysiology of substance use disorders, alcohol-induced blackouts in particular,” Dr. Dopico said.

Tags: alcohol-induced blackouts, Alex M. Dopico, PHAST, Research
Repeated traumatic brain injuries (TBI) in soldiers and military personnel can cause behavioral, neurologic, and cognitive effects and lead to dementia. There is currently no treatment for that type of dementia, but a $308,000 grant from the United States Department of Defense aims to help researchers at the University of Tennessee Health Science Center find one.
TBI can lead to the development of frontotemporal degeneration (FTD), a progressive process marked by atrophy of the frontal and temporal lobes. FTD is one of the most common causes of dementia in people under the age of 65.

Principal investigator Mohammad Moshahid Khan, PhD, associate professor in the Department of Neurology (https://www.uthsc.edu/neurology/), and co-investigator Tayebeh Pourmotabbed, PhD, professor in the Department of Microbiology, Immunology, and Biochemistry (https://www.uthsc.edu/medicine/molecular-sciences/index.php), are working on a project to find the first therapeutic intervention to prevent frontotemporal dementia or slow its progression in a mouse model linked with the condition.

The team is aiming to use a novel gene therapy called DNAzymes to target pathologic al tau aggregates, which cause frontotemporal dementia and its resulting cognitive impairment and progressive neuropathological symptoms. The team is examining the effective dose, frequency, and duration of treatment as well as its potential in reducing neurodegeneration and behavioral deficits in mice.

“Our preliminary data suggest that DNAzyme is a novel therapeutic approach and has a great potential for preventing the accumulation of pathological tau,” Dr. Khan said. “The results of this proposal would be foundational for future studies examining the clinical use of DNAzyme for other neurological diseases associated with traumatic brain injury and other tauopathies.”
Newly Funded Study Focuses on HIV-Induced Aging, Alzheimer’s Disease

Written by Lee Ferguson | March 9, 2023

HIV in the United States has become a manageable disease, thanks to the free and wide accessibility of antiretroviral therapy. Antiretrovirals work by preventing the virus from making copies of itself by blocking stages of its life cycle. But these drugs have poor permeability in the brain. HIV replication persists in brain cells, causing HIV-associated neurocognitive disorders. Additionally, the HIV population is aging. More than 50% of the HIV population in the U.S. will soon reach their 60s, the prime decade when Alzheimer’s disease symptoms begin to manifest. The coupling of these factors have made it critically important to examine the relationship between HIV-induced aging and Alzheimer’s disease.

A team at the University of Tennessee Health Science Center has taken on this challenge, with the help of a $423,500 grant from the National Institute on Aging. Santosh Kumar, PhD, professor in the Department of Pharmaceutical Sciences, and Tauheed Ishrat, PhD, professor in the Department of Anatomy and Neurobiology, are working to define the underlying mechanisms contributing to Alzheimer’s disease-associated neurodegeneration and memory impairment in the HIV population. Their project involves developing a new drug delivery system and regimens to facilitate drug permeability to the brain. Increased HIV suppression in the brain will subsequently decrease HIV-associated neurocognitive disorder, aging, and Alzheimer’s disease-related pathology.

“Our research goal is to better manage cognitive decline and Alzheimer’s disease pathologies in HIV/AIDS populations who are aging,” Dr. Kumar said.

The specific research will focus on how novel extracellular vesicles carry specific molecules, including viral proteins, from HIV-infected brain cells and deliver them to neuronal cells. The team hypothesizes that delivery of these vesicles causes a cascade of cellular events that ultimately bring about neuroinflammation and neurodegeneration. The team will also use these extracellular vesicles to carry antiretroviral drugs permeable to brain to suppress brain HIV.
Collaboration Researching Angelman Syndrome Publishes Findings, Receives $2.4 Million Award

Written by Lee Ferguson | April 10, 2023

A three-way research collaboration at the University of Tennessee Health Science Center (UTHSC) is achieving crucial advances in finding a new target for Angelman syndrome, a rare neurogenetic disorder characterized by intellectual disability, balance issues, motor impairment, and debilitating seizures.

Julio Cordero-Morales, PhD, and Valeria Vásquez, PhD, both associate professors of Physiology in the UTHSC College of Medicine, have spent years studying the cellular processes of mechanosensation, the conversion of mechanical stimuli into neuronal signals. These complex processes allow us to interpret and navigate the physical world, enabling us to sense our position in space, maintain our balance, and perform coordinated movements like walking.

The mechanosensitive ion channel PIEZO2 is expressed in sensory neurons. It mediates proprioception (the sense that allows us to know where our bodies are in space) and balance. Mice and humans lacking PIEZO2 expression have an unsteady gait, irregular stride and step length, and unstable posture. This phenotype is shared by individuals suffering from Angelman syndrome, which is caused by the loss of UBE3A gene expression in neurons.

The investigators suspected that there could be a connection and teamed up with Lawrence Reiter, PhD, professor in the Department of Neurology. Dr. Reiter has over 20 years of experience in the Angelman syndrome field. The research was led by a graduate student, Luis Romero, and an instructor, Rebeca Caires Mugarra, PhD.

“Together, we provided several lines of evidence demonstrating that PIEZO2 currents are reduced in Ube3a-deficient mouse neurons and stem cell-derived neurons from individuals with Angelman syndrome,” Dr. Cordero-Morales, lead investigator, said. “Our results demonstrate that PIEZO2 is a potential therapeutic target.”

The team used a dietary fatty acid (linoleic acid) to increase PIEZO2 activity, mechanoexcitability, and improve gait in a mouse model of Angelman syndrome. Moreover, the investigators demonstrated that linoleic acid supplementation increased PIEZO2 activity in dental pulp stem cell-derived neurons from multiple individuals with Angelman syndrome, part of a patient repository developed by Dr. Reiter.

“Our work represents the first example in which a dietary fatty acid intervention has been used to enhance the function of a mechanosensitive sensory ion channel,” Cordero-Morales said. “We revealed that PIEZO2 function is compromised in Angelman syndrome and that PIEZO2 is a potential pharmacological target for the rescue of ataxia in this neurogenetic disorder.”
The project is gaining national recognition and support. The study findings were published in the article “Linoleic acid improves PIEZO2 dysfunction in a mouse model of Angelman Syndrome” in the March 2023 issue of the journal Nature Communications (https://www.nature.com/articles/s41467-023-36818-0), and the investigators were recently awarded $2.4 million by the National Institute of Neurological Disorders and Stroke.

An MRI scan with record-breaking resolution merged with light sheet microscopy allows researchers to visualize brain cells in unprecedented detail and to map connections between parts of the brain.

After nearly 40 years of research, a team including two researchers from the University of Tennessee Health Science Center has published a process for improving magnetic resonance imaging (MRI) capabilities, allowing the researchers to capture brain images at a higher resolution than ever before.

As a result of the study, scientists can now create images that show unprecedented details of cell types and connections between parts of a mouse’s brain. The researchers believe this can have broad applications in studies of aging and neurogenerative diseases, including Alzheimer’s disease, in humans.

“The primary goal was to make sure we have the technology that allows us to do preclinical research more efficiently and at higher resolution, and we’re there now,” said Robert W. Williams, PhD, professor in the UTHSC College of Medicine’s Department of Genetics, Genomics, and Informatics (https://www.uthsc.edu/genetics/).

More than 20 years ago, Dr. Williams joined forces with G. Allan Johnson, PhD, the leader of Duke University’s Center for In Vivo Microscopy, which started the research project more than a decade earlier. Dr. Williams and his UTHSC colleague David Ashbrook, PhD, were tasked with providing possible applications for Dr. Johnson’s work to devise higher resolution and higher throughput methods to image the brain in the
areas of aging and neurodegenerative disease genetics. The study also included six other colleagues from Duke and one each from the University of Pennsylvania, University of Pittsburgh, Indiana University, and LifeCanvas Technologies.

In an article published recently in Proceedings of the National Academy of Sciences (https://www.pnas.org/doi/10.1073/pnas.2218617120), Dr. Johnson, the lead author, describes the two-step process for obtaining such clear brain images. High-computing pipelines merge the improved MR scans, which allow scientists to map the circuits of the brain, with light sheet microscopy, which allows scientists to label groups of brain cells. Combining the complementary techniques is a groundbreaking method that provides a vivid view into what is going on inside the brain.

"By jacking up the resolution, as we have in both the MR and the light sheet, we're getting closer to where everything is happening in the brain," Dr. Johnson said. "We are not encumbered by having all of the rest of the population of the human brain to keep us from coning our focus down close to the operational units, whatever they happen to be, of the animal model of interest."

Not only does the process allow for clearer images, but it also allows the researchers to have a much higher throughput. According to Dr. Williams, "If you tried to do this 10 years ago, it would have been one case a week. Dr. Johnson can process two cases a day, and that's enough to do some serious, serious science."

While the technology won't be used to treat patients with neurodegenerative diseases, it is already being used to study those illnesses. Dr. Williams has created mouse models of Alzheimer's disease that meaningfully replicate the disease in humans. Using the models, the team is investigating whether dietary changes could extend the part of a
person’s life in which cognition is intact. With the new imaging techniques, the disease can be studied in the mice in a way Dr. Johnson described as “gloriously simple, but gloriously robust.”

“If you do that study in a clinical population, you’re talking about tens to hundreds of millions of dollars,” he said. “We can now examine these diseases in a much more controlled environment, at orders of magnitude lower cost, and with orders of magnitude higher fidelity.”

The team’s success in improving brain imaging has opened the door for more advanced studying of neurogenetics and of “diseases that are important to all of us,” Dr. Williams said. It is the culmination of decades of work of people from multiple organizations and multiple disciplines — biomedical technology and neurogenetics.

“When you have two completely different areas of research, the sum is considerably more than the parts,” Dr. Johnson said. “The fact that we have two completely different views of the world, two completely different areas of research, but we’ve been able to merge them together, it gives us some capacity that others don’t have.”

The Neuroscience Graduate Program is a multidisciplinary, interdepartmental Ph.D. program at the University of Tennessee Health Science Center (UTHSC) and supported by the Neuroscience Institute. Established in 1985, the Neuroscience Institute comprises over 90 faculty from multiple departments and colleges, including Anatomy and Neurobiology, Medicine, Molecular Sciences, Neurology, Neurosurgery, Ophthalmology, Pathology, Pediatrics, Pharmaceutical Sciences, Pharmacology, Physiology, and Surgery. Some faculty hold primary appointments at the world-renowned St. Jude Children’s Research Hospital (SJCRH) a short distance away. Our program provides broad training in neurophysiology, neuropharmacology, neuroanatomy, molecular and cellular neuroscience, developmental neurobiology, and behavioral neuroscience.

Basic and clinical Neuroscience research at UTHSC focus on intracellular signaling pathways, neuronal excitability, synaptic transmission, sensory processing and retinal biology, neurological and neurodegenerative disorders, brain tumors, neurogenetics and neural development, and mental and addictive disorders. UTHSC is one of the world’s leading centers exploiting novel genetic approaches to explore brain development, function and behavior, and psychiatric and neurodegenerative diseases. Neuroscientists at SJCRH are studying diverse pediatric tumors and diseases in the CNS using cutting-edge molecular, genomic and genetic methods.

Memphis is a culturally diverse metropolitan area of over 2.5 million residents, with the rich traditions of a city on the banks of the Mississippi River. Memphis has more sunny days than Miami, and combines southern heritage and hospitality with contemporary charm. You’ll enjoy great dining (world famous barbecue), art galleries and an exciting nightlife. Memphis is a must for those wanting to visit the birthplace of blues, soul, and rock and roll. Sun Studio, The Rock ‘N’ Soul Museum, Gibson Guitar Factory and Beale Street entertainment district are just a few blocks from campus, as is the Mississippi River, and downtown. The city is runner and bike friendly, with a new “greenline” extending to the city center from a 3200 acre urban park (Shelby Farms) that also provides fishing and horseback riding. Memphis is home to FedEx, to the NBA’s Memphis Grizzlies, and to the Memphis Zoo, ranked one of the top zoos in the US and home to over 3500 animals on 76 beautifully landscaped acres.

To apply to the Neuroscience Track of our Graduate Program, please go to the Integrated Biomedical Science Program website: http://www.uthsc.edu/grad/IBS

To find out more about Neuroscience and our program, please visit our website: http://www.uthsc.edu/neuroscience