2017 TRANS-INSTITUTIONAL PROGRAM
NEW AWARD RECIPIENTS

Adaptive eBooks for Building Children's Language Skills – ViA

Participants:
Peabody College: **Georgene Troseth**, David Dickinson, Amanda Goodwin, Jeannette Mancilla-Martinez, Ann Neely, Molly Collins
School of Medicine (Clinical): Stephen Camarata, Tiffany Woynaroski
School of Engineering: Nilanjan Sarkar

Led by an interdisciplinary team of Vanderbilt faculty with expertise in language, cognitive science, and artificial intelligence, this project will develop an adaptive eBook that represents a groundbreaking approach to foster early language. The ability to comprehend complex text is fundamental to skilled employment, but many students (especially those from low-income homes) fail to acquire foundational reading skills. Limited knowledge of vocabulary and complex syntax, along with weak inferential skills, contribute to these deficiencies. Gaps in language ability linked to social-economic status are apparent by age two, leading to achievement gaps that persist throughout the school years.

The team will create an eBook prototype for use by a child alone or while reading with an adult. As the child enjoys a story, an avatar will teach vocabulary and support comprehension and inferential thinking. The book will adapt content to the child's level, offer parent prompts to guide interaction, and provide games that reinforce learning and assess comprehension. Machine learning algorithms combined with real-time closed-loop feedback will adjust the level of story language and support by utilizing objective measures of child engagement and comprehension.

Addressing the Epidemic of HPV-Associated Cancers – ViA

Participants:
School of Medicine (Clinical): **Ronald Alvarez**, Debra Friedman, Krystle Kuhs, Staci Sudenga, Marie Griffin, Pamela Hull, C. Buddy Creech, Young Kim
School of Engineering: Anita Mahadevan-Jansen
School of Nursing: Shelagh Mulvaney
Peabody College: Brian Heuser

This project will develop supportive infrastructure and educational programs that engage an interdisciplinary team of investigators comprised of faculty and students from across campus to lay the groundwork for a consortium focused on HPV-associated cancers. Faculty and students will conduct pilot projects designed to assess the local burden of HPV-associated cancers, increase HPV vaccination in the general pediatric and adolescent populations, and develop methods for the early detection of non-cervical HPV-associated cancers.

Human papillomavirus (HPV) infection causes more than 600,000 cancer cases annually among men and women worldwide. Vanderbilt is physically located at the epicenter of an epidemic of HPV-associated cancers in the U.S. as HPV vaccination rates in Tennessee are alarmingly low in eligible populations. These HPV-associated cancers are potentially preventable and include cancers of the head and neck, reproductive tract and anus. Vanderbilt is well poised to address critical gaps in prevention and early detection strategies that could significantly reduce the number of individuals who are diagnosed with or succumb to these cancers.

Biomedical Microscopy – Immersion, Innovation, Discovery (BioMIID) at VBC – VRA

Participants:
School of Engineering: **Anita Mahadevan-Jansen**, Duco Jansen, Matthew Lang
College of Arts & Science: Shane Hutson, Carl Johnson, Lauren Buchanan
School of Medicine (Basic Science): Matthew Tyska, Dylan Burnette, Richard Simerly

This project seeks to create a collaborative environment across three schools for biophotonics innovation and biomedical discovery within the Vanderbilt Biophotonics Center. Students, postdocs and faculty from engineering, physical sciences and biomedical sciences will work together to innovate – by building microscopy systems that do not yet exist in the commercial realm – and discover – by using these systems to answer previously unanswerable questions in biomedicine. The goal is to develop a cadre of trainees at all levels who can identify pressing questions in biomedical research and build next generation instruments that exceed the limitations of commercial microscopes.

Development of light microscopy in the 1600s led to great advances in science, specifically the discovery of the basic building block of life – the cell. Over the centuries, improvements in microscopy revealed insights on how cells divide, communicate and coordinate their activities to function in multicellular contexts. Scientists continue to push the limits of microscopy to look deeper, smaller and faster so they can cure cancer, understand how the brain works, and make better bio-inspired materials to improve everyday life. Researchers across Vanderbilt rely on the campus-wide Cell Imaging Shared Resource for access to commercial light microscopes. At the same time, investigators at the Vanderbilt Biophotonics Center (VBC) work to develop novel techniques that push the boundaries of what scientists can observe and measure with light.

Center for Autism and Innovation – ViA

Participants:
College of Arts & Science: **Keivan Stassun**, Frank Tong
School of Medicine (Clinical): Zachary Warren, Julie Taylor
School of Engineering: Maithilee Kunda, Philippe Fauchet
Owen Graduate School of Management: Sal March, Timothy Vogus
Graduate School: Mark Wallace

This project will study the unique capabilities of autistic adults, as well as how to match these capabilities to 21st-century workforce needs and how to develop managers who can leverage the "autism advantage" to fuel innovation in their organizations. This initiative connects Vanderbilt's world-leading researchers in autism-related disorders, psychometrics and managerial science, with Specialisterne, the world-leading recruiter and trainer of autistic individuals for employment with major corporations. With the Vanderbilt Center for Autism & Innovation, Specialisterne is establishing a presence in Nashville, with UBS and HCA as the first major employment partners.

The past decade has documented the challenge of optimizing lifespan outcomes for individuals with increasingly common and impairing neurodevelopmental disorders, such as autism. Traditional research, educational and employment approaches have focused on characterizing symptoms, impairments and documenting challenges related to unemployment, underemployment, psychiatric symptoms and other negative quality-of-life indicators. With these characteristics well-documented, there has emerged a great need and opportunity for creating, understanding and systematizing interventions for individuals with autism. At the same time, the advent of the information age and the data-intensive nature of work in the 21st century economy has opened new avenues for meaningful engagement of individuals with innate talents uniquely well suited to detailed, quantitative, data-immersive employment. Many cities have an unmet demand for talented, highly skilled and capable individuals in the sectors such as technology, finance, cyber-security, healthcare analytics and others. Within this context, a new paradigm has emerged to look beyond the traditional deficit view of autism; to instead understand and harness the unique abilities of neuro-diverse individuals to create systems of mutual benefit in education, research and the private sector. If we can understand and leverage the unique capabilities of autistic individuals to fuel innovation in the 21st century economy, we will have significantly addressed one of the emergent grand challenges of our time.

Data Science Visions – ViA

Participants:
School of Medicine (Clinical): **Yu Shyr**, Jeffrey Blume, Frank Harrell, Tatsuki Koyama, Qi Liu, Bradley Malin, Charles Manning
School of Medicine (Basic Science): Vito Quaranta
School of Engineering: Gautam Biswas, Robert Bodenheimer, Sankaran Mahadevan
Peabody College: Joe Rodgers
College of Arts & Science: **Andreas Berlind**, Tony Capra, Kelly Holley-Bockelmann, John McLean, Thomas Palmeri, Paul Sheldon

Modern society, medicine, business, science, engineering and even the humanities are awash in data. The amount of data being produced is growing so fast that a new interdisciplinary field called *data science* has emerged to process, analyze, visualize and ultimately extract knowledge from the data. This initiative seeks to take the first steps in positioning Vanderbilt to be a leader in this critical new field. The initiative will identify and connect all the disparate islands of data science activity at Vanderbilt to create a unified data science community and spark cross-campus research collaborations. The initiative will also support new educational tracks and establish active partnerships with on-campus research groups and off-campus industry to provide immersive real-world training for students. More ambitiously, this TIPs award hopes to seed a sustainable, visible and internationally impactful activity with the future creation of a trans-institutional data science institute at Vanderbilt.

Enhancing the Research and Educational Missions of the Vanderbilt Brain Institute – VRA

Participants:
School of Medicine (Basic Science): **Ronald Emeson**
School of Engineering: Duco Jansen
Peabody College: Laurie Cutting
College of Arts & Science: Randolph Blake, David Zald

One of Vanderbilt's flagship trans-institutional centers, the Vanderbilt Brain Institute (VBI) is home to the Neuroscience Training Program, the largest of Vanderbilt's biomedical programs, with training faculty spread across 22 departments and five schools within the university and Medical Center. This

funding will enable VBI to run pilot programs, invest in its training programs and establish an External Advisory Board to guide the Institute's director search. In addition, award funding will allow for VBI to continue some of its key initiatives.

More about VBI: The graduate program is complemented by a vibrant undergraduate program in neuroscience that trains some of our most exceptional students, exemplified by the fact that a number of the recent Founder's Medals were awarded to neuroscience majors. These students are admitted to the nation's best medical and graduate schools, and each is required to have an intensive research experience, serving as a model for the undergraduate "immersion" experience which has been articulated as one of the centerpieces of the new academic strategic plan.

Materials Durability and Environmental Research Facilities Hub – VRA

Participants:
School of Engineering: **Florence Sanchez**, David Kosson, George Hornberger, Kane Jennings, Shihong Lin, Scott Guelcher, Sankaran Mahadevan
College of Arts & Science: Steve Goodbred, John McLean, John Ayers
School of Medicine (Clinical): Jeffry Nyman

Vanderbilt's researchers have provided national and international leadership in environmental sustainability and development/assessment of infrastructure materials. The Materials Durability and Environmental Research Facilities Hub will provide core facilities in support of research on the performance and durability of natural and engineered materials and systems exposed to a wide range of environmental conditions. Example applications include development of advanced materials for infrastructure, new techniques for leaching environmental assessment, understanding the transport, fate and biological effects of nutrients and contaminants in natural and built environments, and innovations in water desalination and photovoltaic films.

Collectively, these research programs have been the basis for national and international policies and practices, received more than $110 million in current external research funding, and published more than 200 papers over the past five years. The Materials Hub will provide abilities for trace contaminant measurements, thermodynamics, micromechanical and tribological characterization. The hub will bridge the spatial scales evaluated by the Vanderbilt Institute for Nanoscale Sciences and Engineering (VINSE) and Laboratory for Systems Integrity and Reliability (LASIR), and provide core research facilities for Civil and Environmental Engineering, Earth and Environmental Sciences, Chemical and Biomolecular Engineering, and Chemistry, as well as for Consortium for Risk Evaluation with Stakeholder Participation (CRESP) and the Leaching Environmental Assessment Framework (LEAF) as well as unique analytical services for the whole University. The same facilities also support the educational missions of several programs.

A Reinvestment in Cryo-Electron Microscopy at Vanderbilt – VRA

Participants:
School of Medicine (Basic Science): **Teru Nakagawa**, Tina Iverson, Walter Chazin, Yi Ren
School of Medicine (Clinical): Timothy Cover, Dana Lacy
College of Arts & Science: Brandt Eichman, Lauren Jackson

This project will reinvest in the Center for Structural Biology (CSB) by acquiring a new microscope that will enable the laboratory to remain on the cutting-edge of research. The Titan Krios will replace an aging microscope that is insufficient to support the high-resolution cryo-EM needs of Vanderbilt faculty.

The Titan Krios will enable major scientific discoveries across a broad range of fields in biology and medicine from the inner workings of bacteria to the consequences of disease-associated mutations in essential proteins of DNA repair. It will allow for automated data collection capabilities, enabling researchers at Vanderbilt to fully embrace the current "resolution revolution" that has occurred in the field of structural biology.

Structural biology strives to determine the structural basis for how and why biological molecules interact and how they act together to enable normal cell function and malfunction in disease. New technological developments in the field of cryo-EM have enabled this technique to pass the resolution threshold and tackle problems at scales that cannot be addressed by crystallography and NMR. Vanderbilt has a thriving group of highly productive researchers who share the goal of using molecular structure to understand cellular function, including 22 structural biology faculty experts in the Center for Structural Biology (CSB). These and many other investigators on campus are working on biologically compelling and structurally challenging problems that have become accessible to structural analysis as a result of the revolution in the capabilities of modern cryo-EM instrumentation.

Understanding the Complexity of Life One Cell at a Time – VRA

Participants:
School of Medicine (Basic Science): **Vito Quaranta**, Carlos Lopez, Ken Lau, Gregor Neuert, Jonathan Irish
School of Medicine (Clinical): Qi Liu, Mark Pilkinton, Elizabeth Phillips, Mary Zutter
School of Engineering: Theodore Bapty
College of Arts & Science: John Capra

In living organisms, several single cells interact in non-intuitive ways to support complex functions such as cognition, cardiovascular integrity and immunity. Rare single cells often maintain tissue health or, conversely, drive disease. A current challenge is to understand how large ensembles of single cells accomplish these complex functions. Next generation technologies and computation have spawned the field of Single-Cell Biology (SCB), penetrating the complexity of life originating from the single-cell level. Six centers from across the School of Medicine, the School of Engineering and VUMC have succeeded in introducing S-CB technologies on campus. In order to build upon the success generated by these six centers, this project will support the formation of a S-CB Consortium of Centers that will transform existing S-CB investments into a coherent infrastructure. The consortium will coordinate efforts and investments in S-CB in a bottom-up strategy to support and shepherd technological advances and expand access and education to the whole community. This infrastructure will enhance the already tangible return on current S-CB investment, enable accessibility by interested investigators and position Vanderbilt as a S-CB world leader. The group will capitalize on singular capabilities that exist at Vanderbilt among a cadre of uniquely qualified investigators with expertise in distinct disciplines that share common challenges in S-CB.

Vanderbilt LGBT Policy Lab – ViA

Participants:
College of Arts & Science: **Kitt Carpenter**, Tara McKay, Cindy Kam, Laura Carpenter, Laurel Schneider
School of Medicine (Clinical): Jesse Ehrenfeld, Gilbert Gonzales
Law School: Terry Maroney, Matthew Shaw, Jennifer Shinall
Divinity School: Ellen Armour

The Vanderbilt LGBT Policy Lab will connect interdisciplinary faculty and students to broaden Vanderbilt's international reputation on scholarship surrounding the correlates, causes, and

consequences of LGBT-related public policies. Vanderbilt is currently one of a handful of top universities worldwide with multiple faculty members whose research directly addresses the intersections of LGBT policies and populations. This initiative will leverage unique intellectual resources from interdisciplinary scholars at Vanderbilt, create a course on LGBT Polices and Advocacy that could relate to multiple majors and programs across the university, complement a key component of the university's commitment to equity, diversity, and inclusion and position Vanderbilt as a world leader at the cutting edge of research on LGBT policies and populations.

Lesbian, gay, bisexual and transgender (LGBT) people face immense social, health and economic challenges in the United States and abroad. Because of interpersonal and structural discrimination, LGBT people have worse mental and physical health outcomes compared to their heterosexual and non-transgender peers. They experience barriers to medical care and are frequently victims of hate crimes and direct acts of violence. LGBT individuals also experience higher rates of poverty, lower incomes and more labor market discrimination than non-LGBT individuals. Public policies toward LGBT populations may play important roles in ameliorating or exacerbating these structural factors, but evidence on the determinants and consequences of LGBT-related policies is severely limited and underfunded.

The Vanderbilt Microbiome Initiative – ViA

Participants:
College of Arts & Science: **Seth Bordenstein**
School of Medicine (Clinical): Jane Ferguson, Heidi Silver, Eric Skaar
School of Engineering: Akos Ledeczi

The Vanderbilt Microbiome Initiative (VMI) will provide Vanderbilt the opportunity to become the first university that unifies a major precision medicine initiative with personalized microbiome studies. The VMI will blend Vanderbilt's clinical, basic, translational and educational endeavors into a community of 100+ microbiome scholars who will catalyze development of new microbiome research and education projects. As 21st century health care moves its focus toward precision medicine and self-tracking, microbiome samples that affect health and disease will need to be tracked, databased and integrated with human genome data to develop diagnostic, preventative and therapeutic approaches for improving health.

This project brings together multidisciplinary, but complementary expertise in Biology, Microbiology, Virology, Genetics, Nutrition, Metabolism, Pathology, Computer Engineering and Education to create an infrastructure that unifies the microbiome community at Vanderbilt. The initiative will also catalyze campus-wide research and teaching activities, and deploy state-of-the-art technologies and methods to advance the microbiome sciences.

Vandy Reach: Putting Obesity Science to Work – ViA

Participants:
School of Medicine (Clinical): **Shari Barkin**, Barron Patterson
College of Arts & Science: David Schlundt, Alice Randall
Peabody College: Carol Nixon
Law School: Jennifer Shinall
Owen Graduate School of Management: Kelly Haws

The initiative aims to develop a tool within the EPIC health platform to capture obesity data, catalyze trans-disciplinary conversations with area experts and improve behavioral interventions for dissemination.

Two-thirds of adults in the United States are overweight or obese and almost one in three children are overweight or obese by the time they enter kindergarten. The United States spends approximately $147 billion annually on health issues related to obesity, and its associated chronic disease consequences are the result of complex interactions between individual level factors. The greatest contributor to the burgeoning problem of obesity is related to behavior. Addressing behavioral interventions in the clinic and community setting is paramount to achieve effective prevention and intervention strategies and to improve outcomes. Despite the magnitude of the public health problem resulting from obesity, we lack effective approaches to counteract these trends in order to prevent and treat obesity as well as strategies for disseminating and implementing effective behavioral interventions. Closing these gaps will require innovative, trans-disciplinary approaches to reverse the medical, financial and social consequences of the obesity epidemic.

VUSAT Initiative – ViA

Participants:
School of Engineering: **Amrutur Anilkumar**, Robert Reed, Gabor Karsai, William Emfinger
College of Arts & Science: Steven Wernke, Ralf Bennartz, Keivan Stassun

The VUSAT initiative brings together the advanced resources of Engineering, Anthropology, Earth & Environmental Sciences and Astronomy to design and develop a Space-based platform to study the evolving ecology on earth. The overarching goal is to develop valuable knowledge in climate change-based and man-made ecological effects by interweaving relevant perspectives, features, methods and information from a variety of campus experts. At its core, VUSAT is a student immersion program with undergraduate and graduate students being challenged to plan, design and execute novel science and society based satellite missions. VUSAT also aims to develop a robust infrastructure and technological capability at Vanderbilt, in the area of small satellite design and instrumentation.

ADDITIONAL AWARDS FOR EXISTING TIPS

Making Music City a Magnet for Music Research – ViA

Participants:
School of Medicine (Clinical): **Reyna Gordon**, Roland Eavey, Mark Wallace, Nancy Cox, Miriam Lense
Peabody College: Elisabeth Dykens, Duane Watson
College of Arts & Science: Jay Clayton, David Zald
Blair School of Music: Melissa Rose

This project focuses on connecting faculty and students across campus with an interest in music research – specifically studies on music and the brain with a consortium and funding for pilot projects. Funding will also enable development of a new course. It is difficult to imagine a society of thriving human beings that does not include music. Despite the ubiquity of music and its profound impact on our lives and our health, little is known about how and why it exerts its dramatic effects. To make headway into understanding the biological and societal underpinnings of music, the blending of knowledge and expertise from a diverse set of disciplines is crucial. Vanderbilt's strong interdisciplinary emphasis, coupled with its Nashville location and broad array of interests in music-related research and education,

provides a unique opportunity to become an international leader in music research. Music can be harnessed to answer fundamental questions about the human brain, advance medical research and treatment, improve K-12 education, create trans-institutional immersive student opportunities, and forge stronger bonds with Nashville's vibrant arts community.

Vanderbilt Pre3 Initiative: Preventing Adverse Pregnancy Outcomes and Prematurity – ViA

Participants:
School of Medicine (Clinical): **David Aronoff**, Muktar Aliyu, Katherine Hartmann, Jeff Reese
School of Engineering: Frederick Haselton
Peabody College: Carol Nixon
College of Arts & Science: JuLeigh Petty

The Vanderbilt Pre3 Initiative is an interdisciplinary group of faculty and learners with a shared interest in reducing the burden of preterm birth and other adverse pregnancy outcomes through discovery, innovation, implementation and education. This project seeks to improve maternal-child health by bringing together diverse expertise from across the VU/VUMC landscape. Faculty will focus on catalyzing the creation of new knowledge of how maternal health impacts the entire lifespan, promoting innovation through enhancing trans-institutional collaboration, building a robust environment for cooperative learning and teaching and enhancing philanthropic support for improving maternal-child health.

Despite the central importance of reproduction to all societies, adverse pregnancy outcomes are common. Every day approximately 830 women die from preventable causes related to pregnancy and childbirth, while each year witnesses nearly 2.7 million neonatal deaths and 2.6 million stillbirths. Non-fatal complications of pregnancy are even more common. Tennessee has the 12th highest infant mortality rate in the country (6.9 percent), and the annual prematurity rate among black women in Tennessee is 39 percent higher than the rate among other women. Tennessee currently ranks as 45th worst among all states for disparities in preterm birth.