



## 2016 TRANS-INSTITUTIONAL PROGRAM AWARD RECIPIENTS

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### **Vanderbilt Initiative for Smart-City Operations Research (VISOR)**

#### **Participants:**

School of Engineering: **Gautam Biswas**, Hiba Baroud, Abhishek Dubey, Aniruddha Gokhale, Craig Philip, Douglas Schmidt, Janey Camp

Peabody College: Douglas Clark, Douglas Perkins

College of Arts & Science: Mark Ellingham, Jonathan Gilligan

The rapidly emerging smart city concept aims to enhance the quality and performance of urban services, reduce costs and resource consumption, and provide an infrastructure to engage citizens more effectively. Successful smart city initiatives require coordinated technological, industrial, educational, and policy advances. Creating partnerships where the city, adjoining universities, and industry collaborate to serve local causes and adapt technologies to community needs is critical. We envision that the proposed Vanderbilt Initiative for Smart City Operations Research (VISOR) will yield a trans-institutional center focused on multi-disciplinary research for formulating, developing, and deploying “smart city” applications. Greater Nashville needs such initiatives to deal with its projected growth and corresponding population explosion (82 people move to Nashville every day, and the population is expected to reach 3 million by 2040). This influx and growth in jobs—driven by commerce and entertainment—requires significant research, planning, problem solving, sustainable development of the region's infrastructure, including transportation and utilities to keep the city operating effectively.

The project participants will work with Metro Nashville governmental agencies to develop a technical and policy platform that enables living city labs in which to study, research, and develop solutions to the challenges and problems faced by the city and by extension other cities around the world. By establishing a Vanderbilt presence, this project could set the stage for larger university-city-state-private-public partnerships to address planning and development challenges.

### **Vocations in Racial Justice: Trans-Disciplinary Activist/Practitioner/Scholar (TAPS)**

#### **Participants:**

Divinity School: **Dale P. Andrews**, Gretchen Person

Peabody College: Sandra Barnes

College of Arts & Science: Dennis Dickerson, Frank Dobson, Ifeoma Nwankwo

School of Nursing: Rolanda Johnson

Law School: Daniel Sharfstein

School of Engineering: Matthew Walker, III

Historically, vocations in racial justice have drawn upon lifelong commitments of energized practitioners across several generations, whether in the National Association for the Advancement of Colored People

(NAACP), the National Urban League (NUL), or in innumerable other international, national, or local organizations. Drawing from the intellectual resources from the many schools within the university, a curriculum for training vocational activists and scholars could prepare future leaders with a broad-based competency across otherwise disparate disciplines. These subjects would speak specifically to ongoing and emergent issues important to the goals of racial justice, which in turn could provide models for social justice work more broadly.

The broad objective and goals of this TIPs proposal are to design, develop, and sustain a structured, systematic, and holistic teaching/learning experience from which a Trans-disciplinary Activist/Practitioner/Scholar (TAPS) emerges. As the concept suggests, it is a novel approach to synergistic post-graduate training that can enable participants to successfully negotiate and contribute to an ever-increasing, global, multi-cultural society.

## **Optimizing Health and Well-Being in Adults with Autism Spectrum Disorders**

### **Participants:**

School of Medicine (Clinical): **Beth Malow**, Blythe Corbett, Katherine Gotham, Linda Manning, Tyler Reimschisel, Kevin Sanders, Julie Lounds

College of Arts & Science: Vanessa Beasley, Elisabeth Sandberg

Peabody College: Erik Carter

The steep rise in the prevalence of autism spectrum disorders (ASD) has focused growing attention on this group of individuals at local, state, and federal levels, as well as in policy, legislative, and funding initiatives. Despite this concern there remains a dearth of services, studies and treatments for adults with ASD. All individuals with ASD share common challenges with effective interpersonal communication, relationship skills, and manifestations of restricted/repetitive behavioral patterns. We propose to create a new interdisciplinary collaboration of Vanderbilt faculty to assess, understand, and optimize health and well-being for adults with ASD. This trans-institutional program (TIP) weaves together the strengths of core faculty in three Vanderbilt schools and colleges (Medicine, Peabody, Arts and Sciences) and will serve as a springboard for a new autism research and educational program focused on health and well-being in adults with ASD, a population currently underserved. While multiple Vanderbilt faculty are independently involved in autism research related to adults, we do not have a unifying program. The existence of such a trans-institutional program will position Vanderbilt to successfully compete for grant funding in an emerging area of research that encompasses health services and clinical trials. Additionally, this project will foster the development of innovative educational programs for Vanderbilt undergraduate and graduate students across all disciplines that will serve as models for other institutions worldwide.

## **Establishment of a World-Class Metabolomics Service**

### **Participants:**

School of Medicine (Basic Sciences): **Kevin Schey**

School of Medicine (Clinical): Jeff Rathmell

School of Engineering: Jamey Young

Despite the critically important information that metabolomics analysis provides and despite the world renowned strengths in mass spectrometry that Vanderbilt possesses, our University does not provide a dedicated metabolomics service. Vanderbilt investigators currently send samples to other institutions, e.g. University of Michigan Metabolomics Center, or commercial services, e.g. Metabolon, for metabolomics analysis. These services, however, specialize in discovery metabolomics. We are seeking institutional support via the Vanderbilt Initiative Award (VIA) program to establish a new state-of-the-art

metabolomics service in the Mass Spectrometry Core of the Mass Spectrometry Research Center (MSRC). We propose to develop an LC-MS/MS-based metabolomics service that will leverage the combined expertise of the organizers and the MS Core staff to provide this much-needed new service for Vanderbilt investigators. Investigators across the university would have the opportunity to perform discovery non-targeted metabolomics, where large numbers of metabolites are identified for metabolic pathway-based analyses, or targeted and accurate quantitative measurements of specific metabolites of interest or of a panel of ~200 metabolites representing 25 major metabolic pathways. The specific workflows to be included in the proposed service will establish a widely used, strong foundation for future expansion into other pathways and additional metabolomics methods, including metabolic flux. The metabolomics core facility will be key enabler for new discoveries to advance health care and medicine.

### **Africa at a Crossroads: Challenges and Prospects**

#### **Participants:**

College of Arts & Science: **Moses Ochonu**, Dianna Bell, Amanda Clayton, Frank Dobson, Jane Landers, Clive Mentzel, Kristin Michelitch, Frank Robinson, Tara McKay, Frank Dobson

School of Medicine (Clinical): Muktar Aliyu

Blair School of Music: Gregory Barz

Peabody College: Carolyn Heinrich

This project seeks to build – for the first time at Vanderbilt – an interdisciplinary community of Africanists to explore the topic “Africa at a Crossroads.” Working from this broad theme we will explore the widespread notion that contemporary socio-economic, cultural, and political indicators demonstrate that Africa now stands at a pivotal point – marked by both infinite possibilities and lingering challenges. Those who engage the region from scholarly, policy, or mercantile perspectives are compelled to reckon with a plethora of positive trends – growing economies, slowing rates of HIV infections, declining infant mortality rates, a rising middle class, democratic consolidation, entrepreneurial innovations in the physical and virtual worlds, and the reverse migration of Africa’s best brains.

This project draws from multiple disciplinary perspectives, including history, medicine, sociology, ethnomusicology, economics, political science, and anthropology, to analyze the extent to which the current state of affairs indicates that Africa stands at a crossroads ripe with challenges and prospects. This collaboration will also provide opportunities for graduate and undergraduate students to study Africa through immersive experiences.

### **Understanding Digital Dominance in Teaching and Learning: An Interdisciplinary Approach**

#### **Participants:**

Peabody College: **Amanda Goodwin**, Sun-Joo Cho

School of Engineering: Doug Fisher

College of Arts & Science: Haerin Shin

Vanderbilt Institute of Digital Learning: Gayathri Narasimham

Digital media has become the dominant mode of communication and interaction of our time. Digital tools are constantly changing the way we teach and learn, yet our understanding of these tools is lagging behind. Some students and teachers continue to employ traditional learning tools such as printed text and pen whereas others enlist digital tools such as MOOCs, online discussion spaces, interactive digital textbooks, video lectures and/or some combination thereof to facilitate learning. These choices are related to the affordances of the tools. Indeed, one of these forms -- the interactive digital textbook -- can play host to a wealth of tools, including text and images, simulations and

animations, video coverage of selected material (e.g., “lectures”), embedded formative and summative assessments, discussion forums, mapping and GIS tools, embedded (or links to) collaborative writing environments akin to Google Docs and Wikimedia, as well as “hidden” intelligent software to personalize the learning experience. The long-term goals of our project are to better understand our move to the digital by investigating how we best coordinate learning tools within interactive, online, digital textbooks in ways that facilitate teaching and learning for different learners in varying educational domains and settings. In this proposed seed study, we will limit our investigation to the pros and cons of using selected digital tools that can be embedded within digital textbooks.

This study could help identify best digital teaching and learning practices with interactive digital textbooks, such that students can autonomously learn and comprehend material based (i.e., build content knowledge) even without intense instructor participation.

## **Vanderbilt Initiative for Intelligent Resilient Infrastructure Systems (IRIS)**

### **Participants:**

School of Engineering: **Caglar Oskay**, Mark Abkowitz, Hiba Baroud, Craig Philip  
College of Arts & Science: Ralf Bennartz, Jennifer Trueblood

A perfect storm is brewing involving civil infrastructure protection. On one hand, infrastructure protection systems are exposed to more natural disturbances (e.g., hurricanes, tsunamis, drought-flood cycles) with ever increasing severity, as a consequence of climate change. On the other, the nation’s civil infrastructure is aging and in poor health, with increasingly restricted budgets allocated to maintain, repair and restore them. The consequences of inaction are severe as demonstrated very recently during Superstorm Sandy in 2012 and Hurricane Katrina in 2005, and across the nation and around the world.

In the proposed initiative, the core team, which includes faculty from A&S and Engineering with complementary and cross-disciplinary expertise, will build a hub for intelligent resilient infrastructure system for research and education innovation. The project will develop a prototype test-bed and “experimentation ground” that could become a “core facility” for implementing and validating new ideas by Vanderbilt researchers.

## **Engineering Immunity**

### **Participants:**

School of Medicine (Clinical): **Jeffrey Rathmell**, Sebastian Joyce, Charles Caskey  
School of Engineering: Todd Giorgio, John Wilson, William Grissom

From cancer to diabetes, and to chronic infections, our immune system plays an important role in nearly every disease. Accordingly, harnessing the power and exquisite specificity of the immune system has enormous – and still largely untapped – potential to improve human health and wellbeing. The mission of ‘Engineering Immunity’ is to integrate the fields of immunology and engineering at Vanderbilt to address challenges in tumor immunology and advance discovery and empower clinically relevant cancer interventions. This TIPs proposal will integrate medicine, engineering, and the basic sciences by leveraging existing trans-institutional investments in immunobiology, nanotechnology, and imaging (Figure 1B). Engineering Immunity will bring together synergistic expertise in bioengineering, advanced materials, medical imaging, and immunology to understand, modulate, and visualize immunology and anti-tumor immunity in ways not previously possible. Interest in tumor immunology is rapidly growing at institutions across the world, including research sponsors and pharmaceutical companies. This initiative in Engineering Immunity will provide Vanderbilt unique capabilities in the field that will make Vanderbilt

a world leader in cancer immunology to develop innovative technologies with the potential to revolutionize cancer therapy.

### **Towards a Trans-disciplinary Program on Data Science Policy**

#### **Participants:**

School of Medicine (Clinical): **Bradley Malin**, Ellen Wright Clayton, Nancy Cox, Joshua Denny, Mark Frisse, Frank Harrell, Laurie Novak, Dan Roden

School of Engineering: Yevgeniy Vorobeychik

College of Arts & Science: Sarah Igo, Lijun Song, Myrna Wooders

Owen Graduate School of Management: Eric Johnson

Law School: Chris Slobogin

Society is increasingly entranced by and concerned about big data and data science. Big data is often described as massive growth in the “four V’s” of data: variety, velocity, veracity, and volume. Yet critical policy issues must be addressed in order to understand the implications of the collection and analysis of such vast quantities of data, and how policies can best be designed to uphold rights and responsibilities. Many Vanderbilt faculty conduct research and educate on data-related technology and policy issues. However, efforts are fragmented in ways that impede larger efforts. In an effort to create a more effective and cohesive approach, we propose to establish a trans-disciplinary program in Data Science Policy (DASPY) at Vanderbilt to provide the evidence base and advice needed for developing appropriate policy in this complex domain.

This project will develop data science policy, with an initial focus on genomic data sharing, a “big data” challenge that will serve broader Vanderbilt priorities in precision medicine.

### **Advancing the Development of Brain-Based Measures of Treatment Outcomes in Clinical Trials across the Lifespan**

#### **Participants:**

Peabody College: **Elisabeth Dykens**, Amy Needham

School of Medicine (Clinical): Alexandra Key, Blythe Corbett, Paul Newhouse, Zach Warren

This VRA application aims to advance the development of functional, cost-effective, and easy-to-administer brain-based measures of treatment outcomes for use in human clinical trials across the lifespan. Success in translating basic science discoveries to effective treatments or interventions in diverse patient groups depends, in part, on the ability to accurately detect and document the outcomes of clinical trials. The lack of sensitive outcome measures has been recognized as a major barrier to the progress of translational research, especially in vulnerable populations. Another challenge for clinical trials is often the ability to recruit sufficient number of participants, especially for studies involving individuals with rare diseases or with multiple disabilities. The proposed VRA investment into new EEG amplifiers and data processing software will allow the Vanderbilt Kennedy Center (VKC) Psychophysiology Core to address both of these constraints related to human clinical trials across the lifespan.

### **Vanderbilt Program for Next Generation Vaccines-Integrating Structural Biology with Big Data**

#### **Participants:**

College of Arts & Science: **Jens Meiler**

School of Medicine (Basic Sciences): Walter Chazin, Melanie Ohi, Benjamin Spiller, Kevin Schey

School of Medicine (Clinical): James Crowe, Daniel Fabbri, James Slaughter, Ivelin Georgiev  
School of Engineering: Yevgeniy Vorobeychik

The Vanderbilt Program for Next Generation Vaccines brings together scientists from the School of Medicine, the College of Arts & Science, and the School of Engineering who create a complex pipeline that integrates structural biology with big data for the discovery of novel antibodies that will spur the development of next-generation vaccines. The program reinvests into two of Vanderbilt's core strengths that resulted from past investments – the Vanderbilt Vaccine Center (VVC) and the Center for Structural Biology (CSB) – in a new and innovative way. Evidence for Vanderbilt University leadership in this research area is listed as a prerequisite for VRA funding. This evidence is given by the NIH designating Vanderbilt University as one of only four “Modeling Immunity for Biodefense” centers in 2015. The grant “Structure-based design of antibodies and vaccines” provides \$10 million over the coming five years to the PIs Jens Meiler and James Crowe and their collaborators at the Scripps Research Institute. Jens Meiler and James Crowe are also engaged in a NIH contract “Genetic and structural basis for virus neutralization” and completed a grant from Defense Threat Reduction Agency (DTRA) “Molecular and structural basis for fine specificity of antiviral antibodies”. A series of impactful publications documents Vanderbilt's leadership in this area of research<sup>1-15</sup>. This VRA proposal builds on this foundation but transforms it substantially, expands scope, and shifts focus to the next frontier: the integration of big data and structural biology into vaccine design. It adds a comprehensive training program, eight mostly early/mid-career faculty, and a series innovative technologies to form the Vanderbilt Program for Next Generation Vaccines. We embrace a comprehensive vision for educating at the interface of big data, structural biology, and vaccine development at all levels – undergraduate, graduate, and post-graduate. Through reinvestment we can implement a two-pronged approach: as an institution, VU becomes the leader in an emerging, highly dynamic and translational research field and we simultaneously educate the next generation of scientific leaders, creating a multiplier effect where trainees from VU continue to shape this emerging field.

This proposal integrates structural biology with big data for the discovery of novel antibodies that will spur the development of next-generation vaccines--- the Vanderbilt Vaccine Center is already very well recognized and this project will likely lead to path breaking advances.

### **VINSE I<sup>3</sup>: Increasing Immersion and Innovation in Interdisciplinary Nanoscience Research and Education**

#### **Participants:**

School of Engineering: **Sharon Weiss**, Peter Cummings, Paul Laibinis, Jason Valentine, Greg Walker  
College of Arts & Science: Sandra Rosenthal, David Cliffler, Richard Haglund

The objective of the VINSE TIPS proposal is to launch new initiatives related to (1) **immersion** experiences for Vanderbilt students and (2) **innovation** in trans-institutional research activities and education, including entrepreneurial endeavors that would benefit from accessibility to a “nano-maker” space. TIPS funding will allow VINSE to be among the elite schools in making cutting-edge nanoscience facilities accessible to undergraduates to promote a highly skilled workforce and foster increased appreciation of the basic R&D underlying most modern technology. We seek to 1) increase enrollment in courses involving VINSE facilities; 2) develop Commons Seminars to increase scientific literacy; 3) develop an intensive 2-week summer course that would broadly introduce and train participants on VINSE instrumentation; 4) provide seed funding for undergraduate research and entrepreneurial projects requiring VINSE core facilities; and 5) equip the soft lithography bay of the new VINSE cleanroom in the Engineering and Science Building (ESB) to support coursework, maker, and research activities.

This project will provide immersion experiences at VINSE for undergraduate research that could spur entrepreneurial activities around maker and nano technologies.

## **The Vanderbilt International Public Opinion Project**

### **Participants:**

College of Arts & Science: **Elizabeth Zechmeister**, Edward Fischer, Mitchell Seligson, Cecilia Mo

School of Medicine (Clinical): Troy Moon

School of Law: Michael Vandenberg

Peabody College: Carolyn Heinrich, Brian Heuser

The proposed Vanderbilt Reinvestment Award (VRA) supports the expansion of the Latin American Public Opinion Project (LAPOP) at Vanderbilt and globally. This dual-pronged strategy – tied to increasing Vanderbilt faculty and student connections to the center and to extending its international reach – will be encapsulated in a rebranding of the institute as the Vanderbilt International Public Opinion Project (VIPOP), within which LAPOP will continue to operate as a functioning unit. VIPOP's mission is to advance research on the interface between ordinary individuals and global challenges related to governance, security, and development. The proposed VRA deepens the center's on-campus value by generating greater opportunities for Vanderbilt faculty and student involvement in its core project (the Americas Barometer) and by increasing opportunities for collaboration in projects located outside of the Americas. Through this dual-pronged strategy, the creation of the campus-wide VIPOP expands the scope of activities related to Vanderbilt student immersion, while facilitating new trans-institutional research discoveries on our campus that address critical issues facing the world today.

LAPOP has a track record of impressive successes. This VRA project brings a cohesive approach to advancing research and education that allows expansion in scope and scale and rebranding as the Vanderbilt International Public Opinion Project (VIPOP).