

## NSF NRT: Neurodiversity Inspired Science and Engineering (NISE) Program

### List of key researchers:

- Mark Wallace (Graduate School) -- Autism inspired multi-sensory approaches to pattern recognition.
- Frank Tong (Psychological Sciences) -- Novel measures of autistic visuospatial capabilities, data visualization.
- Maithilee Kunda (Computer Science), Keivan Stassun (Initiative for Autism, Innovation & the Workforce), Andreas Berling (Physics & Astronomy; Data Science TIPS) -- Autism-inspired artificial intelligence and data science tools.
- Nilanjan Sarkar (Mechanical Engineering), Zack Warren (Vanderbilt Kennedy Center) -- Novel devices to support social skills development and employment for adults with autism.
- Laurie Cutting (Peabody College; Vanderbilt Kennedy Center) -- Special education with focus on neurodiversity.
- Josh Clinton (Political Science), Tim Vogus (Owen School), Julie Taylor (Vanderbilt Kennedy Center) -- Policy, organizational science, management, and quantitative social science approaches; employer and public attitudes; leveraging neurodiversity in the STEM workforce.
- Elise McMillan (University Center for Excellence in Developmental Disabilities; TennesseeWorks) -- Transitions to adulthood and employment for individuals with autism.

### List of partner organizations:

- Educational partners: Western Kentucky University; Austin Peay State University; Currey Ingram Academy; Benton Hall Academy; Vanderbilt Career Center
- Employment model partners: Specialisterne, USA; The Precisionists, Inc.
- Major employer partners: UBS; HCA; VUMC; Walgreens; Redstone Arsenal; DXC Technology
- Community partners: Autism Tennessee; Tennessee Council on Autism Spectrum Disorders
- Commercialization and internships partners: Vanderbilt CTTC; Vanderbilt Wond'ry

**Estimated budget and duration:** \$3 million over 5 years.

**Project Synopsis:** As autism and other neuro-diverse conditions now affect millions of Americans, a number of groups at Vanderbilt are looking beyond the traditional deficit view of autism to instead seek *innovative advances inspired by neuro-diverse capabilities*. Importantly, much of this work is occurring in STEM, a somewhat non-traditional area for neuro-diversity focused work, which traditionally has been approached from clinical or educational perspectives. However, at present the increasing number of STEM graduate students working in this area are largely disconnected from one another and from the "big picture" of neuro-diversity inspired research. In the NISE program, graduate students in labs across the STEM disciplines at Vanderbilt – including natural and basic sciences; social, behavioral, and economic sciences; and engineering – will participate in a new graduate certificate program that connects them and their work through the interdisciplinary theme of neuro-diversity. The main elements, in addition to core coursework and research within their respective PhD programs, will be a new set of required courses that introduce students to the research literature on neuro-diverse challenges and capabilities, the business case for neuro-diversity in the STEM workforce, and leadership development for managing a neuro-diverse team. A new seminar series will expose students to cross-cutting aspects of their work, including data science approaches; human subjects issues; neuro-diversity in the educational, political, and global contexts; and tech transfer and commercialization opportunities. The program will be homed within the Graduate School, and trainees will come together as a cohort through the new TIPS-funded Initiative for Autism, Innovation & the Workforce (AIW), which connects to regional educational partners, major employers, community advocacy groups, and partners for commercialization, internships, and entrepreneurship. Trainees will have the opportunity to test their neuro-diversity inspired innovations with neuro-diverse and neuro-typical research participants recruited through regional educational partners, deploy their innovations through the AIW employment pipeline program with area employers, explore entrepreneurship opportunities for their innovations through the Center for Technology Transfer & Commercialization, and engage as mentors with Vanderbilt undergraduates participating in immersion or other internship projects through The Wond'ry.

**Transformative potential of the research area:** Diversity and inclusion remain crucially important yet challenging concerns for STEM graduate education. Not only are persons with disabilities (including non-visible disabilities) underrepresented in STEM, neuro-typical individuals in STEM generally receive no exposure or training related to neuro-diversity. A potentially transformative outcome of the NISE program is to transform deficit-based stereotypes of neuro-diversity into a strengths-based approach that engages with—and that leverages—neuro-diversity across STEM.

**Improvements in graduate education and potential impact in STEM workforce:** Research demonstrates that persistence in STEM graduate programs, including especially for under-represented groups, is significantly enhanced when students explicitly see the pro-social impacts of their work. In addition, research shows that while autistic individuals in higher education are overwhelmingly concentrated in STEM disciplines, their eventual unemployment rate is as high as 85%. Not only will the NISE program enhance the effectiveness of all participating graduate students as they enter diverse workforce settings, it will also specifically broaden participation of neuro-diverse individuals in the STEM workforce.

**Disciplinary areas:** Data and computer science; organizational science; physical sciences and engineering; cognitive neuroscience; science education and human resource development

## Abstract

We propose the Neurodiversity Inspired Science and Engineering (NISE) program as a novel, timely, and highly interdisciplinary graduate training program that links research and education across STEM disciplines with an overarching thematic framework of neurodiversity. Students in traditionally disparate disciplines from computer science to political science, from mechanical engineering to psychology, and from neuroscience to economics will engage in disciplinary research projects that have as their common aims: (i) developing a strengths-based understanding of neuro-diversity, (ii) learning how to leverage this understanding to advance discovery and to fuel innovation, and (iii) inventing technologies and approaches that support success for neuro-diverse individuals in the workforce, especially in STEM. For example, students in neuroscience, psychology and computer science may work together to develop new psychometric measures of visuo-spatial and numerical cognition capabilities of autistic individuals; students in astronomy and economics may work together to develop new business intelligence software that applies autistic 'visual thinking' logic to data visualization software used in scientific research; students in mechanical engineering and physics may work together to develop virtual reality devices that promote social skills for success at work and home. Students across the participating programs will undertake, in addition to their regular program requirements, a common core of three new courses and a recurring special seminar that will culminate in a graduate certificate. The programmatic hub of the program will be the new TIPS-funded Vanderbilt Initiative for Autism, Innovation, and the Workforce while the administrative and academic home of the program will be the Graduate School. This proposal responds to the NSF NRT priority areas of The Future of Work at the Human-Technology Frontier (HTF) as well as Harnessing the Data Revolution (HDR), specifically to "understand how constantly evolving technologies are actively shaping the lives of workers", "enable data-driven discovery and decision-making through visualization of data", as well as "the development and evaluation of innovative learning opportunities and educational pathways, grounded in an education research-based understanding of the knowledge and skill-demands needed by a 21st century data-capable workforce".