Unpacking the “Black Box”

The Science of Learning Institute
5 Year Anniversary

January 2018
Dear SLI Community

The Science of Learning Institute (SLI) began with a single big idea – to unpack the “black box” of learning. Learning occurs every day throughout the lifetime – from infancy to adulthood, across formal and informal environments. Yet we still do not understand the fundamental processes by which it occurs. In order to achieve truly new insights about the nature of learning, we began by building bridges among the sciences, and closing the gap between science and practice. As we reflect over the last 5 years and begin our future journey, we are proud to have launched the beginning of a wave of exciting collaborations, connections, and community-building -- all of which represent new bridges among researchers and practitioners across the divisions and departments of Johns Hopkins and beyond. From basic brain and cognitive science research to machine learning, translation of science to practice, and dissemination, the Science of Learning Institute has delivered on its founding strategic goals. We are pleased to share our key accomplishments and future vision for the SLI in this book.

It takes many hands to build a bridge and we are grateful for the generosity of spirit, insight, and guidance from the JHU administration, our magnificent steering committee, and our dedicated team. It also takes resources and an unwavering belief in the potential of our work to move us forward. Thank you for being a part of our journey.
in the promise of science to change the world. We are honored to have generous philanthropists, who, from the beginning, have understood that creating new ways of doing science and forging new pathways between science and practice are essential to moving the field forward.

With gratitude and pride,

Barbara Landau
Director Dick and Lydia Todd Professor of Cognitive Science

Kelly Fisher
Executive Director
Science of Learning Institute
In an era driven by globalization and rapidly advancing technology, our ability to learn has become the most essential part of our human capital. Learning allows us to adapt to changing situations, collaborate with others, solve complex problems, and participate in activities that bring us much joy. It underlies our capacity to function in an ever-evolving society, and it offers us the chance to change ourselves, and the world around us. Our prosperity, as individuals and as a nation, is inherently tied to our capacity to become proficient lifelong learners.

In order to maximize our power to learn over our lifetime, we must first unpack the “black box” of learning to understand how it works. Learning is a complex process that spans interdependent biological, psychological, sociocultural, and technological systems. We have already made enormous strides in understanding the brain and mind, and have made discoveries about how genetics, brain chemistry, cognitive predispositions, the environment, and other influences foster or inhibit learning. But we are only now beginning to possess the knowledge and tools to better understand how it occurs within and across these systems. Only by building bridges within the scientific community, and between science and practice, will we truly be able to unravel the complexities of learning and meet the lifelong learning needs of the 21st century.

To foster the growth of the field, in 2013 the Johns Hopkins University launched an ambitious, interdisciplinary Institute that operates at the nexus of synergistic research and practice in learning. In just five years, the Science of Learning Institute has cultivated a large and growing community of scientists, engineers, and practitioners who work together to generate truly novel discoveries about learning, train the next generation of scientists, and facilitate the translation of research into practice. Since our inception, the Institute has become an innovator in the science of learning, a nationally and internationally recognized organization that works as a catalyst for discovery and educational growth.
Unlocking the Complexities of Learning

Three strategic goals

1. Fostering cutting-edge science of learning research
   Our grant program supports new scientific discoveries across the lifespan through interdisciplinary collaborations spanning basic and applied sciences.

2. Training future leaders in the science of learning research
   We mentor emerging scientists and foster their ability to think broadly about learning, generate innovative perspectives and research on how we learn, and build meaningful connections between research, practice, and policy.

3. Connecting science to practice
   We collaborate with educators, practitioners, and policymakers to advance the understanding of science of learning research and translate research into evidence-based practices, programs, and policies.
The Science of Learning Institute (SLI) has reached a number of significant milestones over the last 5 years. These achievements position SLI for future growth and development at Hopkins and beyond. Among its accomplishments, SLI has:

- Produced 86 outreach initiatives to disseminate research to the broad science of learning community
- Developed novel community-building initiatives to generate interdisciplinary research and bridge research and practice
- Fueled 164 new collaborations across 6 divisions and 34 departments at Johns Hopkins University
Funded 41 innovative science of learning research and fellowship projects

Engaged in 13 community partnerships to develop educational programming and teacher professional development

Generated over $17m in new funding for research and community partnership projects

Developed a new fellowship training program
Goal 1

Fostering Cutting-Edge Science of Learning Research
13 Events
70 + presenters
370 + guests spanning 10 divisions and institutes
Promoting opportunities for dialog and interaction across the divisions of Johns Hopkins University was critical to fostering new synergies and sparking new ideas for interdisciplinary research and effective practice. We hosted several community-building events per year where faculty, research scientists, postdoctoral fellows, and graduate students from across the university were invited to present their research and mingle in a casual, conversational atmosphere. The locations of these events varied across Johns Hopkins campuses in order to promote greater diversity in participation and showcase the breadth of expertise and interest in the science of learning at Johns Hopkins University. Presentations covered a range of topics, including the anatomical biomarkers of learning, early adversity and cognitive development, brain aging, role of memory systems in learning, tools for mapping neural circuits, and STEM learning in Baltimore schools. These events were very popular, well-attended, and became a launching pad for new collaborative partnerships and innovative research.
This collaborative project represents a new direction for all of us, and wouldn’t have happened without the Institute’s support. We are excited to be devising new AI technology in the service of education, and are looking forward to having a kind of impact we have not had before, both through our own foreign language learning technology, and also by potentially inspiring others in our research communities to use AI in similar ways to support education in other subjects.

– Philipp Koehn
Department of Computer Science

Seed Grant Program Fuels New Connections

SLI’s competitive seed grant program was designed to generate novel, interdisciplinary scientific discoveries that address lifelong learning inquiries. Over the last five years, thirty-three projects were awarded across five funding cycles. Projects ranged in topics, and drew on theories and methods from neuroscience, cognitive science, computer science, applied mathematics, psychology, cognitive science, robotics, biomedical engineering, medicine, rehabilitation, public health, and education.

Based on their seed grants, grantees generated over 12 million dollars return on investment through NSF, NIH, and other funding sources to build upon their funded work.
New Collaborations Across the University and Beyond

Across Schools
- BSPH
- SOE
- WSE
- SOM
- KSAS
- KKI

Within Schools
- KSAS
- SOM
- WSE
- SOE
- BSPH

Outside JHU
- China
- Canada
- Italy
- Germany

The Science of Learning Institute
The SLI grant was a catalyst for my research. It enabled me to get the required preliminary data for my R01, gave me status and credentials as a funded researcher to NIH and the scientific community, enabled new collaborations, fostered new ideas and established my line of research. I would not have been able to apply for my R01 as a New Investigator without the data I collected through the SLI grant. I will always be extremely grateful for this opportunity. I believe that the seed funding provided by the SLI grant is extremely essential especially for young investigators because there are not that many other sources for seed funding. Speaking especially as a SOM researcher where even seed funding is usually granted to established researchers, it was particularly impactful to be able to get funding for a daring new idea without having an established lab at the time. I hope that SLI will continue and expand its mission in fostering new innovative research.

– Kyrana Tsapkini, Department of Neurology

Nurturing Young Careers

Our grant from the Science of Learning Institute has allowed us, four junior faculty with complementary interests but no history of working together, to catalyze an exciting new collaboration. We anticipate that this will launch many years of fruitful collaborations together at Johns Hopkins.

– Daniel O’Connor, Department of Neuroscience
Over $12 million in new funding

Seed Grant Program Impact

167 Products

29 News & Presentations for General Audience
38 Scientific Publications
12 New Tools and Methods
88 Scientific Presentations

84 Grantees
33 Funded Projects

Private Foundations $203,700
Other Sources $155,855
Federal $12,245,733
Spotlight: Seed Grant Research Projects

From left to right. **Row 1:** Jonathan Flombaum, Leila Barmaki, Howard Egeth, Kyrana Tsapkini, Marshall Hussain Shuler, Jin Kang  **Row 2:** Johnathon Ehsani, Sridevi Sarma, Michael McCloskey, Gregory Hager, Rebecca Haberman **Row 3:** Kevin Yu, Joseph Monaco, Noah Cowan, Anand Malpani, Lisa Feigenson, Shreesh Mysore, Bonnie Nozari, Chaz Firestone, Brenda Rapp **Row 4:** Kechen Zhang, Lieny Jeon, Dwight Bergles, Philipp Koehn, James Pekar, Richard Huganir. For complete list of grantees, see "Research Seed Grants" section.
How does growing up blind shape brain and behavior?

Marina Bedny, Department of Psychological and Brain Sciences, Krieger School of Arts & Sciences
Akira Omaki, Department of Cognitive Science, Krieger School of Arts & Sciences
Pablo Ariel Celnik, Department of Physical Medicine and Rehabilitation, School of Medicine

This research will lay the groundwork for optimizing brain function, inform future brain stimulation techniques that guide neuroplasticity in cases of stroke and disease, and inform decisions about sight restoration in blind individuals.

Can we establish new methods for monitoring the activity of astrocyte networks in vivo and use this approach to define their role in learning-induced changes in the brain?

Dwight Bergles, Department of Neuroscience, School of Medicine
Marshall Hussain Shuler, Department of Neuroscience, School of Medicine
Jin Kang, Department of Electrical and Computer Engineering, Whiting School of Engineering

This work found astrocytes in cortical networks were reliably engaged by stimuli that increased arousal/attention, such as sleep-wake transitions, by appetitive stimuli and during exploration of novel objects. Our findings raise the possibility that astrocytes participate in the modification of neural circuits during learning.

What is the current state of research on mindfulness related to learning?

Erica Sibinga, Department of General Pediatrics and Adolescent Medicine, School of Medicine
Tamar Mendelson, Department of Mental Health, Bloomberg School of Public Health

This workshop aimed to share current research on the state of mindfulness and learning from the standpoint of brain imaging, cognitive science, and the learners’ experiences. It provided an opportunity for researchers and practitioners to share ideas and learn from each other, and develop networks and new collaborations.

What kinds of inference and learning support visual perception?

Jonathan Flombaum, Department of Psychological and Brain Sciences, Krieger School of Arts & Sciences
Bruno Jedynak, Department of Applied Mathematics and Statistics, Whiting School of Engineering
Lisa Feigenson, Department of Psychological and Brain Sciences, Krieger School of Arts & Sciences

This research has multifaceted implications. It can guide computer scientists in terms of how to design algorithms for computer assisted visual search (for example, in radiology or airport security). It also suggests that algorithm selection and learning may be a way to understand and target interventions in a variety of cognitive impairments. Lastly, in the case of visuospatial intervention, this work highlights specific deficits that emerge in early childhood.
Can we develop automated methods to assess surgical technical skill and provide individualized feedback to surgical trainees?

Gregory Hager, Department of Computer Science, Whiting School of Engineering
Gyusung Lee, Department of Surgery, School of Medicine

Training to become a surgeon involves the acquisition of a family of technical skills. In current practice, trainees acquire surgical skills by practicing in the laboratory and simulators, or by operating on patients under a senior surgeon’s supervision. The current approach to train surgeons in technical skills is “proximate,” i.e., it requires the presence of a teacher. Although trainees may practice on their own, appropriate feedback is essential to acquire the specific skills needed to perform the task like an expert. We envision that our discoveries will inform the development of efficient and individualized programs to train surgeons on how to provide safe and effective patient care. It will also inform future interdisciplinary research to understand the acquisition, retention, and attrition of surgical skills.

Can diagnosis and treatment of reading disorders be improved through an interdisciplinary approach combining cognitive science, neuroscience, educational, and computer science methods?

Michael McCloskey, Department of Cognitive Science, Krieger School of Arts & Sciences
Brenda Rapp, Department of Cognitive Science, Krieger School of Arts & Sciences
Argye Hillis, Department of Neurology, School of Medicine
Kerry Ledoux, Department of Neurology, School of Medicine
Mariale Hardiman, School of Education
Gregory Hager, Department of Computer Science, Whiting School of Engineering

This research will lead to improved methods for diagnosing and treating reading disorders in children learning to read, and in adults with neurological conditions.
Goal 2

Training Future Leaders in the Science of Learning
Preparing for the Future

We launched the Distinguished Science of Learning Fellowship Program in 2015 for pre- and post-doctoral scientists.

Eight fellows completed 2-year interdisciplinary research projects, with joint mentoring by two faculty from different divisions at Johns Hopkins University. Each fellow and his or her mentors followed a mentoring plan designed to promote the cross pollination of ideas and methods during the course of the project.

In addition, fellows completed a “Science for Public Consumption” workshop series during their first year, developed and led by Drs. Kelly Fisher and Kristin Gagnier. During the workshop series, fellows:

- learned about the importance of communicating science to the public and ways to address common “issues of translation”
- developed communication skills to meet the needs and interests of specific target audiences
- developed a dissemination plan for their own research

In the second year, fellows implemented their dissemination plans, which included activities to inspire high school students to pursue science careers, dispel common learning myths held by the public, promote awareness of science of learning tools and techniques, and more.
The interdisciplinary training that I participated in as an SLI fellow was critical in teaching me how to communicate with a diverse group of scientists as well as non-scientists. Working in military human performance research now, I am part of a team of individuals that includes psychologists, physiologists, toxicologists, engineers, and others. To solve the diverse and ever-changing problems that face military personnel, it is vital that our team be able to work together and communicate each of our areas of expertise. My experience as an SLI fellow motivated me to pursue an applied research career and it prepared me for working in this dynamic interdisciplinary setting. – Kara Blacker

The fellowship program taught us 'what's at stake' and why dissemination and translation are important, why it is so challenging, what we can do about it, and different ways we can go about it. It’s already helped me improve my writing for non-scientific audiences and I’m hoping that the dissemination plan will become something that really strengthens my CV. And finally -- it’s an enjoyable and rewarding thing to do!

– Anonymous Fellow
I am incredibly grateful for the opportunity to develop my work into a new area. The focus of the fellowship on interdisciplinary research especially pushed me to broaden my research to new lines of inquiry – in my case, into the field of educational research... I feel I have gained a solid background in educational research that will make me a stronger and more well-rounded researcher in my career. I also love the translational nature of my project and am excited to be continuing this type of work, which has important and clear-cut practical applications. Having experience in translational research will make me a more competitive researcher and is also personally fulfilling. Overall, I don’t think I would have pursued this type of innovative and interdisciplinary research had it not been for the SLI fellowship; but I am extremely glad I did, as it has made me a better scientist.

– Emily Coderre

I am incredibly grateful to the SLI for the opportunity to pursue a unique interdisciplinary research project, and for the invaluable training in dissemination, translation, and communication. Scientists and engineers have increasingly been participating in outreach through several channels. I felt that the fellowship training absolutely prepared me for these styles of engagement with both the academic and non-academic communities.

– Eleanor Chodroff
Fellowship Impact

- **8** Awarded Fellowships
- **16** Mentors spanning 5 divisions
- **30** Scientific Presentations
- **3** News and Presentations for General Audiences
- **3** New Tools and Methods
- **11** Scientific Publications

**Dissemination Projects**
- Reaching K-12 students, K-12 teachers, general public, and patient populations

**47 Products**
Learned interesting things that impacted what I would like to study in the future.
– Western High School Student

Linguistics is a field of study I’ve never seriously considered but after the activities, I’ve changed my stance.
– Western High School Student

I realized that I can’t listen to music while doing my work.
– Western High School Student
Spotlight:
Fellowship Dissemination Project

Inspiring young women’s interest in science in Baltimore City

For their dissemination projects, three fellows produced a science outreach event designed to spark young women’s interest in the science of learning. Kara Blacker, Emily Coderre, and Eleanor Chodroff visited Western High-School, an all-girls school in Baltimore City, to illustrate how scientists study aspects of learning. During the visit, the fellows conducted hands-on demonstrations of cognitive science and neuroscience research, including demonstrations of how divided attention hurts your ability to remember information, how voice recognition software - such as Apple’s Siri - learns to recognize individual voices, and how scientists measure brain activity using an EEG (electroencephalography) cap.
Goal 3

Connecting
Science to Practice
Connecting the Pieces, Places, and People

To advance the understanding and utilization of science of learning research in practice, we forged new connections between scientists and the broader community of teachers, practitioners, policymakers, and the general public through a range of innovative initiatives.

- We increased the Institute’s visibility as a resource and partner through website and social media
- We produced events to highlight research findings that may inform educational needs on the ground
- We invested in deep, “translational” partnerships to develop and evaluate new educational programming for early care providers and K-16 educators and school leaders that are informed by science of learning research

23 Partnerships

- 4 JHU Faculty Development Organizations
- 3 JHU Graduate Student Training
- 2 JHU Scientific Community
- 6 City and Nonprofit Organizations
- 1 JHU Policy Organizations
- 7 External K-12 and Higher Education Organizations
Impact in the Community and Beyond

70,000 visitors
Over the past 5 years, our website has attracted a growing number of visitors, and has led to new partnerships and long-term collaborations in the community.

Over $1.5 million
secured for dissemination and translational science partnerships

86 dissemination activities
reaching over 3000 viewers

- 29 Presentations for Non-Scientific Audiences
- 49 Requests for Consulting Services to Translate Research into Practice
- 2 Biennial Symposia
- 6 Educator-Practitioner Workshops

Over $1.5 million
secured for dissemination and translational science partnerships
Spotlight: Translational Partnership
The science of teaching and learning academy

Understanding how students learn has the potential to change educational practice, yet educators are often unaware of current research on learning and its implications. In 2016, the Center for Transformative Teaching and Learning (CTTL) partnered with SLI’s Kelly Fisher and Kristin Gagnier to develop and evaluate an innovative, high-quality professional development training program for PreK-12 teachers and school leaders about science of learning research and its application to educational practice.

CTTL hosted the inaugural Science of Teaching and School Leadership Academy in 2017, which aimed to help educators and school leaders (1) learn about research findings, (2) identify ways in which research may inform educational practice, and (3) develop action research projects to implement and evaluate research-informed techniques in classrooms. Educators from public and private schools traveled from many places within the United States, as well as Africa and the United Kingdom, to attend the 5 day Academy.

During the Academy, over 150 educators descended on JHU’s Homewood campus to visit the labs of 17 scientists to learn more about how they study learning. They also attended workshops with thoughtful discussions on how research can be translated to practice.

Impact
The Academy was influential. It not only fostered educators’ understanding of how science of learning research may inform education, but it also provided scientists with a new lens through which they view their own research.

The success of the inaugural Academy is undeniable. Plans for two additional Academies in Maryland are on the horizon, and new partnerships have blossomed between CTTL, SLI, and other schools to bring science of learning research to practice across the world.
The Science in Action day re-energized me by opening my eyes to new ideas and questions that are driven by the needs of the practitioner. The opportunity to talk with the teachers and see how they are thinking about the problems was a game-changer. I have as much to learn from the teachers as they do from me, and the result is that my own thinking is enriched in ways that can only be good for the research.

– Amy Shelton, JHU Scientist

“By co-developing this opportunity with the CTTL, the Science of Learning Institute has created a model that should become part of the public purpose of all universities that want to help teachers and schools bridge the gap between research and classroom practice.

– Glenn Whitman, CTTL Director

“
Connecting with Johns Hopkins University Science of Learning Institute during our time at the CTTL Academy was pivotal for Breck School. From initial conversations, we are moving forward to design a use-inspired research collaboration between SLI and key PK-12 faculty to explore a way of teaching that deeply and positively affect student learning. Through this collaboration we are also able to inspire a level of reflective practice and professional development unheard of in most school settings. Our work with SLI has the potential to boost both our students and our faculty, and will bring us into the national conversation about bridging research and practice in independent school settings.

– Daisy Pellant, Director Peter Clark Center for Mind, Brain, and Education at the Breck School
Tw o Science of Learning biennial symposia showcased research within and outside of JHU. We welcomed over 1,300 attendees to the university, with attendees from 29 states and 39 countries across the world. Attendees represented a variety of professions, including those in research, K-12 education, health services, industry, and state and federal governance.

**Countries include**
- Argentina
- Algeria
- Australia
- Barbados
- Belarus
- Belgium
- Brazil
- Canada
- Chile
- Colombia
- Czech Republic
- Denmark
- Finland
- France
- Guinea
- Guatemala
- Honduras
- Iraq
- Italy
- Japan
- Myanmar
- Maldives
- Mexico
- Malaysia
- Mozambique
- Norway
- Netherlands
- Panama
- Puerto Rico
- Qatar
- Romania
- Saudi Arabia
- Senegal
- Spain
- Thailand
- Turkey
- Trinidad and Tobago
- Taiwan
- United Kingdom

**States include**
- Alabama
- Arizona
- California
- Colorado
- Connecticut
- Florida
- Georgia
- Idaho
- Illinois
- Indiana
- Indiana
- Iowa
- Kansas
- Massachusetts
- Maryland
- Michigan
- Missouri
- North Carolina
- New Hampshire
- New Jersey
- New York
- Ohio
- Oregon
- Pennsylvania
- South Carolina
- Texas
- Utah
- Virginia
- Wisconsin
Spotlight: Singapore Partnership

Singapore has long been known for its outstanding education at all academic levels as well as their firm dedication to high-quality, continuous improvement in their educational systems. As part of their plan to root these improvements in the science of learning, a delegation visited JHU’s Science of Learning Institute in 2014 to learn how we developed an intensely interdisciplinary forum for advancing the field and practice at JHU. Several years later, JHU faculty participated in several joint workshops with the Nanyang Technological University’s (NTU) Center for Research and Development in Learning to explore common interests and research opportunities in the science of learning. The workshops led to JHU and NTU faculty launching several collaborative research lines to explore how Singaporean children learn to speak and read several languages at the same time in their intense multilingual culture.
Looking Forward

It would be easy to say we will simply continue what we have started, but this is not enough to meet the goal of advancing the science of learning field at JHU and beyond – where learning happens at home, in schools, and in our communities.

Our first five years have been learning years for us, too. We have learned how to foster a synergistic, interdisciplinary environment to stimulate innovative discoveries in learning - bridging departments, divisions, and eco-systems. We have created and refined a novel training program for the next generation of scientists who have the skills to conduct interdisciplinary research, and connect science to society. We have also listened carefully to teachers, administrators, clinicians, and other critical partners to gain insight about what the real needs are in learning communities across the life span. Working together, we translated research to inform their work on the ground. These lessons are the foundation that SLI’s team brings forward as we chart the next five years.

To continue our work, we plan to:

1. Expand the vision of our grant program to form larger teams across the university that will produce a better, more unified understanding of the complexities of learning.
2. Build our training program for students and faculty across the university so that our scientists will be able to continue to build bridges on their own.
3. Intensify our efforts in disseminating science of learning research to the broader community.
4. Develop strategic, long-term translation partnerships around the world that have a broad reach, such as our partnership with the Center for Transformative Teaching and Learning, resulting in a multiplier effect on the ground.
5. Partner with colleagues working at the intersection of research and policy, to help facilitate ways to translate science into policy-relevant actions.

The Science of Learning Institute has made significant advances in unpacking the "black box" of learning. The interdisciplinary synergies across sciences and the marriage of science and practice will move discoveries farther and faster than ever before. The next generation of exploration and impact in the science of learning has arrived.
Gratitude and Thanks

The Institute would not be possible without the passion and dedication of our staff, steering committee, oversight committee, and university leadership. We would like to express our deep gratitude and thanks for the time, talent, and commitment of our partners, colleagues, and friends.

Barbara Landau
Kelly Fisher
Kristin Gagnier
Mike Alexander
Steven Holochwost
Susan Magsamen

Institute Leadership and Staff

Barbara Landau
Director
Kelly Fisher
Executive Director
Kristin Gagnier
Outreach and Evaluation Specialist

Mike Alexander
Program Coordinator
Steven Holochwost
Senior Advisor, Evaluation
Susan Magsamen
Senior Advisor, Community Partnerships

Mike Alexander not pictured
# Steering Committee

**Ed Connor**  
Director, Mind Brain Institute; Professor of Neuroscience

**Barry Gordon**  
Director, Cognitive Neurology/Neuropsychology Division; Professor of Neurology and Cognitive Neuroscience

**Richard Huganir**  
Director and Professor of The Solomon H. Snyder Department of Neuroscience; Director of the Kavli Neuroscience Discovery Institute; Co-Director of the Johns Hopkins Medicine Brain Science Institute

**Patricia Janak**  
Bloomberg Distinguished Professor of Psychological and Brain Sciences and Neuroscience

**Sanjeev Khudanpur**  
Director, Human Language Technology Center of Excellence; Associate Professor of Electrical and Computer Engineering, and Computer Science; Center for Language and Speech Processing

**Barbara Landau (Steering Chair)**  
Director of the Science of Learning Institute; Dick and Lydia Todd Professor of Cognitive Science

**Michael Miller**  
Director and Massey Professor of Biomedical Engineering; Director of the Center for Imaging Science; Co-Director of the Kavli Neuroscience Discovery Institute

**Timothy Moran**  
Paul R. McHugh Professor of Motivated Behaviors; Professor of Psychiatry and Behavioral Sciences

**Amy Shelton**  
Associate Dean of Research and Professor of Education; Director of Research, Center for Talented Youth

**Michael Wolmetz**  
Senior Scientist of the Applied Physics Laboratory

**Alan Yuille**  
Bloomberg Distinguished Professor of Cognitive Science and Computer Science
Oversight Committee

Fred Bronstein
Dean of the Peabody Institute

Patricia Davidson
Dean of School of Nursing

Gail Geller
Director of Educational Initiatives,
Berman Institute of Bioethics

Elaine Hansen
Executive Director of the Center for Talented Youth

Landon King
Executive Vice Dean of School of Medicine

Jerry Krill
Assistant Director for Science and Technology, Chief
Technology Officer of the Applied Physics Laboratory

Sunil Kumar (Oversight Chair)
Provost & Senior Vice President for Academic Affairs

Ellen Mackenzie
Dean of Bloomberg School of Public Health

Chris Morpew
Dean of School of Education

Marie Nolan
Executive Vice Dean of Academic Affairs,
School of Nursing

Paul Rothman
Dean of the Medical Faculty, Vice President for
Medicine, and CEO of Johns Hopkins Medicine

T. Ed Schlesinger
Dean, Whiting School of Engineering

Ralph Semmel
Director of Applied Physics Laboratory

D. Winston Tabb
Dean of University Libraries and Museums

John Toscano
Vice Dean of Natural Sciences

Beverly Wendland
Dean of Krieger School of Arts and Sciences

University Leadership

Ronald Daniels
President

Sunil Kumar
Provost & Senior Vice President for Academic Affairs

Denis Wirtz
Vice Provost for Research

Sue Porterfield
Associate Vice Provost for Research

Phillip Spector
Vice President for Strategic Initiatives

Fritz Schroeder
Vice President for Development and Alumni Relations

Andrew Rentschler
Associate Vice President and Executive Director of Development

Kristin Blanchfield
Associate Vice President for Principal Gifts

Mary Louise Healy
Director of Research Administration
Research Seed Grants

Can a machine accurately predict how adults articulate words? Can machine feedback help adults learn how to correctly pronounce sounds in a novel language?

Project Team:
Raman Arora, Whiting School of Engineering
Bonnie Nozari, School of Medicine

What are the molecular changes that promote preservation of learning and memory during aging?

Project Team:
Jay Baraban, School of Medicine
Michela Gallagher, Krieger School of Arts and Sciences
Rebecca Haberman, Krieger School of Arts and Sciences

How does growing up blind shape brain and behavior?

Project Team:
Marina Bedny, Krieger School of Arts and Sciences
Akira Omaki, Krieger School of Arts and Sciences
Pablo Ariel Celnik, School of Medicine

Can we develop new methods for monitoring the activity of astrocyte networks in vivo and use this approach to define their role in learning-induced changes in the brain?

Project Team:
Dwight Bergles, School of Medicine
Marshall Hussain Shuler, School of Medicine
Jin Kang, Whiting School of Engineering

What are the neural bases of auditory perceptual learning in the adult human brain?

Project Team:
Dana Boatman, School of Medicine
Colin Wilson, Krieger School of Arts and Sciences
Anna Korzeniewska, School of Medicine
Xiaoqin Wang, School of Medicine

What changes in gene expression underlie learning and memory?

Project Team:
Solange Brown, School of Medicine
Loyal Goff, School of Medicine

How does bariatric surgery cause obese individuals to relearn their taste preferences and their desire to consume high-calorie foods? How does this relearning lead to reduced calorie intake and weight loss?

Project Team:
Susan Carnell, School of Medicine
Kimberley Eden Steele, School of Medicine
Brian Caffo, Bloomberg School of Public Health
Dean Foster Wong, School of Medicine
Tim Moran, School of Medicine

How does the brain control the processing of different kinds of information that sometimes need to cooperate and sometimes need to compete, such as sensory information from the outside world versus abstract ideas and relationships?

Project Team:
Susan Courtney, Krieger School of Arts and Sciences
Joshua Vogelstein, Whiting School of Engineering
James Pekar, Kennedy Krieger Institute

Is there evidence that the late gestation fetus can learn?

Project Team:
Janet DiPietro, Bloomberg School of Public Health
Kellie Tamashiro, School of Medicine

Are there neurophysiological differences (i.e., differences in skin conductance, heart rate, neural activity) between inexperienced and experienced teenage drivers as they experience driving hazards?

Project Team:
Johnathon Ehsani, Bloomberg School of Public Health
John Desmond, School of Medicine
Karen Seymour, School of Medicine
Neale Kinnear, Transport Research Laboratory, UK

How do we learn to ignore irrelevant information?

Project Team:
Joshua Ewen, School of Medicine
Howard Egeth, Krieger School of Arts and Sciences
Ana Arenivas, School of Medicine
Research Seed Grants, Continued

How ‘rational’ is the learning process?

**Project Team:**
- Chaz Firestone, Krieger School of Arts and Sciences
- Steven Gross, Krieger School of Arts and Sciences

What kinds of inference and learning support visual perception?

**Project Team:**
- Jonathan Flombaum, Krieger School of Arts and Sciences
- Bruno Jedynak, Krieger School of Arts and Sciences
- Lisa Feigenson, Krieger School of Arts and Sciences

Does the brain learn to provide increased blood flow to regions where and when neural activity is anticipated?

**Project Team:**
- David Linden, School of Medicine
- Mikhail Pletnikov, School of Medicine

Can we develop automated methods to assess surgical technical skill and to provide individualized feedback to surgical trainees?

**Project Team:**
- Gregory Hager, Whiting School of Engineering
- Gyusung Lee, School of Medicine

Can technology enable effective and efficient learning of skilled tasks, e.g., surgical technical skills?

**Project Team:**
- Gregory Hager, Whiting School of Engineering
- Anand Malpani, Whiting School of Engineering
- Gina Adrales, School of Medicine
- Swaroop Vedula, Whiting School of Engineering
- Bethany Sacks, School of Medicine
- Christina Harnett, School of Education
- Linda Tsantis, School of Education

How is learning motivated?

**Project Team:**
- Marshall Hussain Shuler, School of Medicine
- Gerald Nestadt, School of Medicine

Do teachers’ and children’s cognitive and emotional executive functioning influence each other in early care and education settings in ways that could shape teaching and learning?

**Project Team:**
- Lieny Jeon, School of Education
- Sara Johnson, School of Medicine

How does the sleep/wake cycle (circadian rhythm) regulate the neural plasticity mechanisms that impact learning?

**Project Team:**
- Alfredo Kirkwood, Krieger School of Arts and Sciences
- Samer Hattar, Krieger School of Arts and Sciences

How does the brain learn information presented sequentially and protect memories of events that occurred close in time from interference with each other?

**Project Team:**
- James Knierim, School of Medicine
- Noah Cowan, Whiting School of Engineering

Do technology-driven personalized learning experiences using macaronic language improve students’ learning of a foreign language?

**Project Team:**
- Philipp Koehn, Krieger School of Arts and Sciences
- Jason Eisner, Whiting School of Engineering
- Chadia Abras, School of Education

What is the current state of research on mindfulness related to learning?

**Project Team:**
- Nettie Legters, School of Education
- Tamar Mendelson, Bloomberg School of Public Health
- Erica Sibinga, School of Medicine

How does the hippocampus support the creation of memories?

**Project Team:**
- David Foster, School of Medicine
- William Anderson, School of Medicine
Can diagnosis and treatment of reading disorders be improved through an interdisciplinary approach combining cognitive science, neuroscience, educational, and computer science methods?

**Project Team:**
Michael McCloskey, Krieger School of Arts and Sciences
Brenda Rapp, Krieger School of Arts and Sciences
Argye Hillis, School of Medicine
Mariale Hardiman, School of Education
Gregory Hager, Whiting School of Engineering
Kerry Ledoux, School of Medicine

Can augmented reality help medical school students learn human anatomy?

**Project Team:**
Nassir Navab, Whiting School of Engineering
Gregory Hager, Whiting School of Engineering
Greg Osgood, School of Medicine
Leila Barmaki, Whiting School of Engineering

How does learning impact neural networks in the primary visual cortex?

**Project Team:**
Kristina Nielsen, School of Medicine
Joshua Vogelstein, Whiting School of Engineering

What is the best way to help individuals learn new words or re-learn words they have lost after brain damage? Does training a target along with similar words help or hurt learning?

**Project Team:**
Bonnie Nozari, School of Medicine
Chadia Abras, School of Education

How can we characterize individual differences in learning behaviors as a function of motivation and attention; and how can we identify the underlying neural mechanisms?

**Project Team:**
Sridevi Sarma, Whiting School of Engineering
Susan Courtney, Krieger School of Arts and Sciences

Why does brain stimulation combined with adaptive working memory training lead to improved cognition?

**Project Team:**
Tracy Vannorsdall, School of Medicine
Susan Courtney, Krieger School of Arts and Sciences
Arun Venkatesan, School of Medicine

Learning new skills depend on changes in the underlying neural activity, and in many cases, are improved by active engagement of the learner. What large-scale changes in cortical encoding underlie perceptual learning?

**Project Team:**
Daniel O’Connor, School of Medicine
Solange Brown, School of Medicine
Shreesh Mysore, Krieger School of Arts and Sciences
Jeremiah Cohen, School of Medicine

How does the protein Kibra confer better memory to some people?

**Project Team:**
Mengnan Tian, School of Medicine
Richard Huganir, School of Medicine
Michela Gallagher, Krieger School of Arts and Sciences
Anand Mattay, School of Medicine

Can transcranial direct current stimulation (tDCS) augment the effects of re-learning language (and in particular spelling) in primary progressive aphasia (PPA), an early neurodegenerative disease?

**Project Team:**
Kyrana Tsapkini, School of Medicine
Argye Hillis, School of Medicine
Peter Barker, School of Medicine
Brenda Rapp, Krieger School of Arts and Sciences
Richard Edden, School of Medicine
Martin Lindquist, Bloomberg School of Public Health
John Desmond, School of Medicine
Constantine Frangakis, Bloomberg School of Public Health

How do neuronal networks of the hippocampus learn to generate sequences of spatial activity that help animals find their way in a changing world?

**Project Team:**
Kechen Zhang, School of Medicine
David Foster, School of Medicine
Joseph Monaco, School of Medicine
Distinguished Science of Learning Fellowships

How does working memory training improve cognitive ability?

Fellow: Kara Blacker
Mentors: Susan Courtney, Krieger School of Arts & Sciences and Joshua Ewen, School of Medicine

Can brain stimulation improve reading comprehension in individuals with autism?

Fellow: Emily Coderre
Mentors: Barry Gordon, School of Medicine and Nancy Madden, School of Education

How does the cerebellum update our movements following an error?

Fellow: David Herzfeld
Mentors: Reza Shadmehr, School of Medicine and Xiaoqin Wang, School of Medicine

How do people learn words that express relationships between different types of objects?

Fellow: Aaron Steven White
Mentors: Kyle Rawlins, Krieger School of Arts and Sciences and Benjamin Van Durme, Whiting School of Engineering

How do listeners adapt to speaker-specific acoustic variation in speech?

Fellow: Eleanor Chodroff
Mentors: Sanjeev Khudanpur, Whiting School of Engineering and Colin Wilson, Krieger School of Arts and Sciences

How do learned dietary associations influence attention?

Fellow: Corbin Cunningham
Mentors: Howard Egeth, Krieger School of Arts & Sciences and Lawrence Cheskin, Bloomberg School of Public Health

Can we use reinforcement motor learning to improve specific symptoms of cerebellar ataxia?

Fellow: Amanda Therrien
Mentors: Amy Bastian, School of Medicine and Vikram Chib, School of Medicine

Is the learning of letters affected by the modality of training experience?

Fellow: Bob Wiley
Mentors: Brenda Rapp, Krieger School of Arts and Sciences and Karin Sandmel, School of Education

For more details on funded projects, please visit the Science of Learning Institute's website: scienceoflearning.jhu.edu