CHEN TIANQIAO & CHRISSY INSTITUTE

2025
Annual Report

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“With curiosity as our compass and collaboration as our method, we look forward to the discoveries that lie ahead.”

The Advent of AI Accelerated Scientific Discovery

Dear Friends,

Nearly a decade ago, we created the Tianqiao and Chrissy Chen Institute to advance fundamental brain research. Since then, we've partnered with hundreds of visionary scientists and dozens of world-leading research institutions, supporting pioneering work in scientific discovery, clinical treatment, and human augmentation.

But the world has changed since 2016. Today, artificial intelligence is rewriting the rules of innovation, and opening breathtaking new possibilities for transformation, discovery, and growth.

That's why this year, the Chen Institute embarked on a new chapter. We remain fully committed to supporting groundbreaking brain research but we're also eager to leverage the partnerships and insights we've gained over the past 10 years to shape the future of AI and unlock its transformative potential.

After all, brain research and artificial intelligence have always gone hand-in-hand. Armed with AI, neuroscientists are revealing the brain's secrets in ways that would have been unthinkable just a few years ago. And informed by a deepening understanding of human intelligence, AI innovators are propelling us into a thrilling new era of accelerated discovery, democratized care, and human flourishing.

By bringing these two fields together, we believe it's possible to spark a new era of transformative research and practical innovation—and over the past 12 months,

we've shown how effective this approach can be. At this year's inaugural Chen Institute Symposium for AI Accelerated Science, we unveiled a vision for Discoverative Intelligence—a new kind of AI that, like the brain itself, is designed to explore, question, and learn from the world around us. We awarded the Chen Institute and Science Prize for AI Accelerated Research to celebrate the young researchers who are expanding our horizons. And we launched MiroMind, an open-source platform dedicated to creating powerful new deep-research tools.

We're also proud to continue our support of the Chen Scholars' groundbreaking research at leading hospitals, and of new centers of innovation at Stanford University, Fudan University, and beyond. This has been a year defined by collaboration, discovery, and impact—advancing brain science, empowering physician-scientists, and propelling AI research in thrilling new directions.

We remain, as ever, deeply grateful to the global community of scientists, innovators, and philanthropists who share our vision. With curiosity as our compass and collaboration as our method, we look forward to the discoveries that lie ahead.

Warm regards,

Tianqiao Chen & Chrissy Luo
Founders, Tianqiao and Chrissy Chen Institute

Our Mission, Vision & Priorities

Our Mission

To support transformative research at the intersection of neuroscience, artificial intelligence, and related disciplines, with the goal of advancing human understanding of the brain, improving health, and unlocking human potential.

Our Vision

A world where scientific discovery, powered by both human and artificial intelligence, alleviates suffering, enhances well-being, and empowers people to live more meaningful lives.

Our Priorities

Fundamental Brain Science

Invest in pioneering research that deepens our understanding of the brain and mind.

AI-Accelerated Discovery

Support the development and application of artificial intelligence to transform science and medicine.

Clinical Impact

Empower physician-scientists and medical innovators to translate discoveries into better diagnoses, treatments, and patient outcomes.

Global Collaboration

Build bridges across institutions and countries to spark new ideas and accelerate progress worldwide.

Innovation Platforms

Create spaces, tools, and networks that help researchers move faster from concept to breakthrough.

Chen Institute
Highlights

Building a Community for AI-Enabled Discovery

The Chen Institute Symposium for AI Accelerated Science

In October, over 400 people, from junior researchers to Nobel laureates, gathered in San Francisco for the inaugural **Chen Institute Symposium for AI Accelerated Science** (AIAS), which was organized in partnership with the UC Berkeley College of Computing, Data Science, and Society.

“AIAS is more than just another academic meeting,” said Chen Institute cofounder, Chrissy Luo. “It’s a platform and a community. Scientists, engineers, clinicians, entrepreneurs, investors, and students are all here because we share a belief that AI is transforming scientific discovery.”

The Chen Institute has supported AI research for many years, viewing it as an accelerator for its efforts to spur impactful neuroscience research—but this year, the Chen Institute broadened its mission to promote interdisciplinary collaboration, and steer AI itself in new directions to maximize the benefits to the research community and humanity as a whole.

To support that effort, the Chen Institute partnered with *Science* to create the **Chen Institute and *Science* Prize for AI Accelerated Research**, inspiring young researchers to adopt AI tools. The overwhelming response to the Prize showed the need for a larger effort to connect researchers at all levels, Luo explained.

“We created the Chen Institute Symposium for AI Accelerated Science to identify the people using cutting-edge AI to push back boundaries,” Luo said. “We couldn’t give 100 people the Chen Institute and *Science* Prize for AI Accelerated Research but with the Symposium, we could bring in more people, and let the audience hear from experts in academia and industry.”

Revolutionizing research

To understand the impact of AI-enabled discovery, consider Dr. Omar Yaghi.

In his first public remarks since receiving this year's Nobel Prize for his work in reticular chemistry, the James and Neeltje Tretter Chair and Professor of Chemistry at UC Berkeley told attendees that his graduate students were actively trying to replace him with a chatbot.

Students built an entire research group using ChatGPT agents, Dr. Yaghi explained. "Each agent does something different, from literature searches to planning chemical synthesis to advising—so replacing me in the equation!—or programming a robot to carry out reactions," he said.

The results are impressive: the AI agents rapidly crystallized a notoriously challenging substance, called a covalent organic framework (COF), capable of capturing carbon dioxide from the air. "What would take a human researcher two or three years took this research group just two weeks," Dr. Yaghi said. "This really is a revolution, at least in reticular chemistry."

AI tools can also augment human scientists—surfacing obscure research to support human intuitions, for instance—or accelerate commercialization processes. One water-absorbing material developed by Dr. Yaghi's lab using ChatGPT is already being marketed to produce potable water from atmospheric humidity. "It's transforming the way we make materials," Dr. Yaghi said.

That step-change in scientific output is extraordinary, said Jennifer Chayes, AIAS 2025 co-chair and Dean of the College of Computing, Data Science, and Society at UC Berkeley. "AI is quickly changing the landscape of science," she said. "It's increasing both the scale and speed of discovery."

Importantly, AI methods developed in one area—such as reticular chemistry—often transfer into other fields, underscoring the importance of interdisciplinary gatherings like AIAS. "It's been incredible to see the room alive with ideas and conversation, watching so many brilliant minds exchange thoughts, challenge each other, and explore new directions," Dr. Chayes said.

Sharing data

Of course, challenges remain—including the need for new datasets to power AI insights. "That's the central question right now," said Dr. David Baker, Nobel Laureate in Chemistry and Henrietta Aubrey Davis Endowed Professor of Biochemistry at the University of Washington.

Dr. Baker—best known for using AI to model protein folding—said public data-sources will only get researchers so far. A key challenge will be to combine public and private data, plus experimental data shared across consortia, to shed new light on key biological processes. "One of the challenges in designing therapeutics is that there's a lot of biology we don't understand," Dr. Baker said.

Researchers only truly understand about 40% of the essential genes in even the simplest bacteria, agreed Dr. Jennifer Doudna, who won the Nobel Prize in Chemistry for her work developing CRISPR. "They're essential for life, and yet we don't know what they do—it still blows my mind to think about that," said Dr. Doudna, the Li Ka Shing Chancellor's Chair in Biomedical and Health Sciences and Professor of Biochemistry, Biophysics, and Structural Biology at UC Berkeley.

That means predicting gene functions is out of reach for current AI models. "I do strongly believe that machine learning and AI are going to have a huge impact," Doudna said. "But we have to acknowledge that we're not going to be able to advance these machine learning models fundamentally until we have better and larger sets of data."

The Chen Institute and its partners are striving to solve that problem through data-sharing and collaborative research initiatives. "By sharing the tools, data, and insights—that's how we're going to advance science, and make it more equitable and inclusive," said Angela Pisco, director of data science at the Chan Zuckerberg Initiative. "This problem space is just too large for any one team to solve in isolation."

Forging partnerships

Even with vast amounts of data, researchers can't simply brute-force scientific exploration, said Dr. Animashree Anandkumar, Bren Professor of Computing and Mathematical Sciences at Caltech. Solving complex problems like weather forecasting or drug discovery requires models to work at multiple scales, from the subatomic to the global—and that, in turn, requires structural innovations fusing physical principles, experimental data, and simulations. "The foundation

models for science will require all these ingredients," Dr. Anandkumar said.

New methodologies from frontier AI labs could enable those breakthroughs, said Microsoft Research's AI for Science director, Chris Bishop. Today, researchers understand the equations underpinning physics, chemistry, and biology—but solving them in specific situations remains prohibitively computationally intensive. By training deep-learning networks on synthetic data derived from foundational equations, it's possible to emulate real-world processes far more efficiently. "Over however many thousands, millions, billions of times that we run the trained emulator, we can amortize that cost ever-closer to zero," Bishop said.

Accelerating discovery will require strong bonds between industry and academia. "We have to work with domain experts who really understand the subtleties and complexities of the science," Bishop says. "Those partnerships are going to be really key going forward."

One such partnership saw Dr. Tom Miller move from Caltech to lead Iambic Therapeutics, an AI-driven drug discovery startup. Iambic's AI models conduct experiments using robotic lab tools, with experimental data fed back to continuously refine their algorithms. "We do that for thousands of new molecules each and every

week to try to drive forward the discovery process," Dr. Miller said.

Merging academic expertise and industrial capabilities helps translate AI breakthroughs into real-world impact. Iambic recently began human studies on a potential cancer treatment, and has other promising molecules in development. "Our investors don't care about AI—they care about medicines for patients, and they like that we have a platform that can deliver that," Miller said.

Maximizing impact

The need to optimize for societal impact was front-of-mind when creating Chen Institute Symposium for AI Accelerated Science. "AI is just a tool—it's humans who drive the innovation," said Symposium co-chair Yan Li, the Chen Institute's executive director of scientific programs. "We believe AI will reach its full potential only if it's driven by collaboration across disciplines. That requires building not just tools, but also a community and an ecosystem."

In such a fast-evolving field, researchers—from students to experienced researchers—need to be able to share learnings, ask questions, and hold one another accountable, said AAAS president Theresa Maldonado. "Critical thinking could not be more important," she added. "It's important for us to feel comfortable challenging each other."

Creating such connections now is vital, because the pace of discovery means both challenges and opportunities will snowball in coming years. "What once required a lifetime is now possible in just years or months," said Dr. Chayes.

The key challenge will be to apply AI in ways that not only accelerate discovery, but enrich our lives. “We are at the very beginning of a long journey,” Dr. Chayes said. “Even as AI opens doors, it’s up to us to guide how it’s used, and ensure that the discoveries it enables have a positive impact.”

Preparing for 2026

AIAS 2025 came at a critical moment for researchers, said Symposium co-chair Pietro Perona, the Allen E. Puckett Professor of Electrical Engineering at Caltech.

Until recently, he explained, AI “was a beautiful little academic area where we would dream big and have little impact.” But those days are gone: the rise of ChatGPT sparked a seismic shift, and today everyone wants to know what lies around the next corner.

By bringing together AI specialists and research scientists, the Symposium offered a tantalizing glimpse of what lies ahead—and much-needed opportunities for discussion and reflection. “I view this meeting as a pivotal moment,” Dr. Perona said. “There are people in this room who are seeing each other for the first time, and having those first conversations that will lead to great results in the future.”

Attendees left having forged new relationships, encountered disruptive ideas, and gained important insights. That includes Chen Institute cofounder Chrissy Luo, who said she has plenty of homework on her plate as she begins planning for AIAS 2026.

“We’re already brainstorming for next year, and thinking about new sessions to add,” Luo said. “This Symposium will keep evolving—because the era of AI-accelerated science is only just beginning.”

Chen Institute & *Science*
Prize for
AI Accelerated Research

Honoring the Winners of the 2025 **Chen Institute and *Science* Prize for AI Accelerated Research**

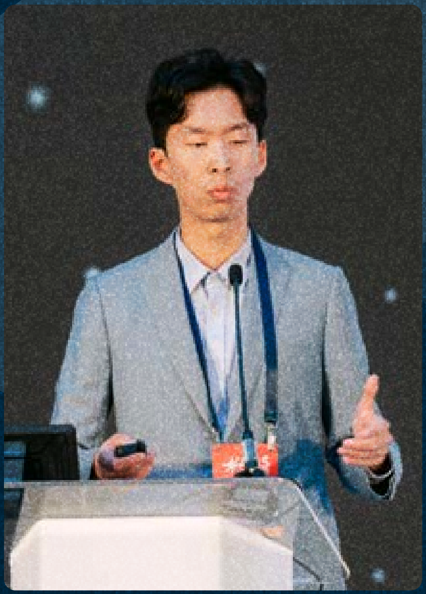
The Chen Institute and Science recognized inspiring early-career researchers.

At AIAS 2025, the Chen Institute and *Science* were delighted to honor the winners of the inaugural **Chen Institute and *Science* Prize for AI Accelerated Research**—a new award recognizing transformative uses of AI by early-career researchers.

Research essays from all corners of the globe, spanning disciplines ranging from telehealth to astrophysics and from quantum computing to civil engineering, were independently judged by *Science* editors. The winner and finalists presented their research at the Symposium, and the winning essays were published in *Science*.

The $30,000 grand prize was won by Caltech alumnus **Dr. Zhuoran Qiao**, founding scientist at Chai Discovery, for creating a generative "computational microscope" that models how proteins fold, change over time, and interact with molecules, opening important new frontiers in drug discovery.

The finalists, receiving $10,000 each, were **Dr. Aditya Nair,** Assistant Professor of Neuroscience and AI at the Lee Kong Chian School of Medicine, Nanyang Technological University, Singapore, for his use of AI to reveal patterns in the brain that encode emotional and mental states; and **Dr. Alizée Roobaert,** of the Vlaams Instituut voor de Zee (Belgium), for applying neural networks to global satellite and ocean data to produce the first high-resolution model of CO_2 absorption in coastal waters.



"We have an opportunity to map out protein interactions on an unprecedented scale. I feel incredibly lucky to have been part of this transformation."

Dr. Zhuoran Qiao

"By fitting AI models to neural activity, we've found a previously undetectable signal in the brain."

Dr. Aditya Nair

"We're using AI to have a real global impact, and that keeps me motivated."

Dr. Alizée Roobaert

Chen Institute & Science Prize for AI Accelerated Research

Read more about their research and watch them explain their work at www.cheninstitute.org/prize

The Dawn of Discoverative Intelligence

Chen Institute founder unveils $1B push to promote discovery at scale.

Speaking at the Chen Institute Symposium for AI Accelerated Science, Chen Institute founder Tianqiao Chen unveiled a new vision for Discoverative Intelligence—a novel framework, backed by over $1 billion in new funding, designed to enable AI to actively pursue and deliver groundbreaking scientific discoveries.

"The ultimate value of AI is discovery: systems that pose new questions, uncover causal structure, and generate knowledge," Chen said.

Most current AI development focuses on what Chen terms the "scaling path," driving innovation by leveraging more parameters, more data, and more compute. That has produced impressive results, but is yielding diminishing returns.

Now, Chen argues, it's time for an alternative "structural path" specifically designed to unlock discoverative capabilities. "Structure is the steering wheel; scale is the engine," Chen said. "If we want AI that discovers, we must engineer time-aware structure, not just add parameters."

To that end, Chen is promoting Structured Temporal Intelligence (STI)—a brain-inspired framework unifying five key capabilities into a closed loop of discoverative intelligence:

- **Neural Dynamics**, featuring sustained, self-organizing activity rather than a static computational graph.
- **Long-Term Memory**, using flexible storage and selective forgetting to build knowledge and form hypotheses.
- **Causal Reasoning**, with inference mechanisms that hold beyond the training distribution.
- **World Modeling**, leveraging an internal, unified simulation to make predictions and test ideas.
- **Metacognition & Intrinsic Motivation**, with uncertainty awareness, attention control, and curiosity-driven exploration.

To support this agenda, Chen announced four major new initiatives:

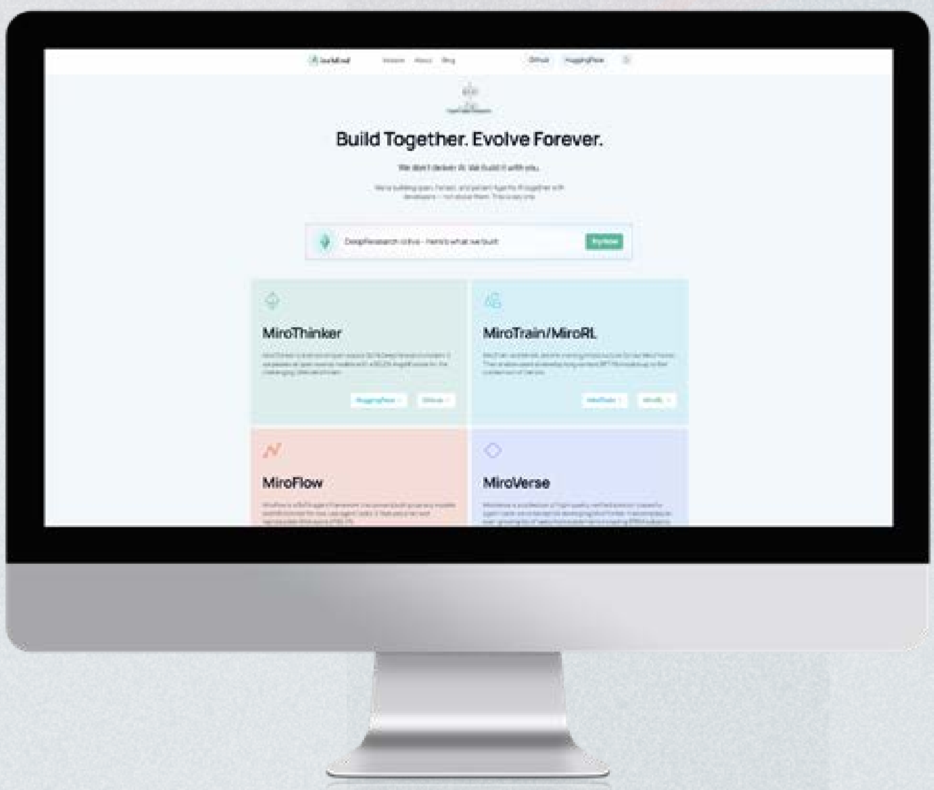
- **A $1 billion commitment** for clusters prioritized for structural experiments in areas such as memory systems, causal architectures, and neurodynamics.
- **Global research hubs** in Silicon Valley, Tokyo, Beijing, Shanghai, Hong Kong, and Singapore, and soon also Toronto and Europe.
- **A new series of STI benchmarks** spanning neural dynamics, memory, causality, world models, and metacognition, with discoverability as the core metric.
- **A PI Incubator** offering independent pathways for PhD students and postdocs to establish named labs, lead teams, and pursue bold ideas.

Chen positioned Discoverative Intelligence as a key opportunity for young researchers to shape the future of scientific discovery. “Scale is the path of giants; structure is the opportunity for the young,” Chen explained. “Tech giants are using compute to push back boundaries, but the young can use structure to redefine intelligence.”

“Discoverative intelligence is the future of science, and will lead to tremendously accelerated discoveries in biomedicine and health, climate and sustainability, and human welfare.” —Prof. Jennifer Chayes, Dean of the College of Computing, Data Science, and Society at UC Berkeley.

Introducing MiroMind

An open-source platform for discoverative intelligence



This summer, Chen Institute founder Tianqiao Chen launched the MiroMind Open Deep Research project—a high-performance, open-source AI research platform dedicated to forging the novel architectures and AI models needed to support Discoverative Intelligence.

MiroMind’s flagship agentic framework, Miroflow, powered by GPT-5, debuted at #6 in the global FutureX benchmark in August 2025—the world’s first real-time test of AI’s ability to predict future events including stock prices, technology trends, and election results.

By September, MiroMind had vaulted to first place in the global ranking, outperforming rival frameworks from leading AI labs including OpenAI, Google, Deepseek, and xAI.

"The first paradigm of AI was about general knowledge and subjectless reasoning. The new paradigm requires subjects—agents with memory, identity, and goals," Chen says. "MiroMind is building large models around long-term memory, so AI can make better predictions and ultimately better decisions. We want an AI that reflects people, not replaces them."

Spiking Intelligence Network

A new research hub advancing brain-inspired AI beyond transformer-based architectures

Spiking Intelligence Lab (SIL) was established on December 13, 2025, by the Tianqiao and Chrissy Chen Institute (TCCI) at the "From BCI to Brain–Computer Symbiosis" Forum. Led by Professor Li Guoqi, SIL is a non-profit research hub dedicated to advancing brain-inspired large models and spiking neural networks (SNNs).

By moving beyond the limitations of transformer-based architectures, SIL aims to unlock new pathways for bidirectional advancement between brain science and artificial intelligence.

The launch of SIL marks a strategic milestone in TCCI's transition to an in-house R&D model and represents a concrete realization of the Institute's vision for Discoverative Intelligence. By moving beyond the limitations of Transformer-based architectures, SIL seeks to unlock new pathways for bidirectional advancement between brain science and artificial intelligence, fostering a next-generation ecosystem for brain-inspired AI research and innovation.

Le Monde

S'abonner

OFFRIR LE MONDE →

LE PRIX DU SAVOIR ÉPISODE 7/7

Le couple Chen ou la philanthropie géopolitique du XXIe siècle

« Le prix du savoir » (7/7). Attaqués en Chine pour avoir financé un projet américain de recherche en neurosciences, les deux milliardaires orientent désormais aussi leurs dons vers la Chine, dans un contexte de concurrence scientifique exacerbée entre Washington et Pékin.

Par Laure Belot
Publié le 25 août 2025 à 18h00, modifié le 27 août 2025 à 15h33
· Lecture 5 min.

Lire plus tard

Article réservé aux abonnés

Geopolitical Philanthropy in the 21st Century

Le Monde celebrates The Chens' continuing mission

In a feature for *Le Monde*, columnist Laure Belot described the Chen Institute as the torchbearer for a new kind of global philanthropy—one that lies at the intersection of science, culture, and geopolitical influence. Founders Tianqiao Chen and Chrissy Luo's ability to bridge between China and the United States—and other global research hubs—has enabled them to foster scientific talent and innovation globally, Belot writes.

"Nothing seems to stop the Chen Institute, which navigates between China and the international scene, multiplying investments, scholarships, and awards to gain recognition, especially among the best talents in artificial intelligence."

Advancing AI and Human Research at Fudan University

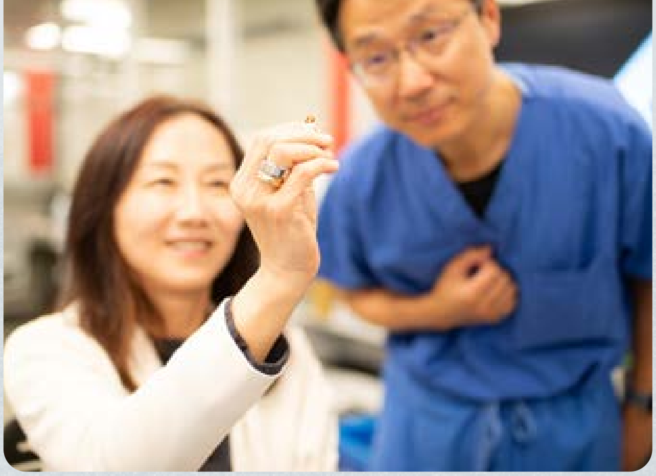
RMB 50 million donation to support long-term memory research

To celebrate the 120th anniversary of Fudan University—Tianqiao Chen's alma mater—the Chen Institute donated RMB 50 million (USD $7 million) to the institution's Engineering Development Fund.

The donation—the largest single gift to the EDF to date—will help the Tianqiao Research Institute, part of Fudan's College of Computer Science and Artificial Intelligence, to advance research at the intersection of AI and human intelligence, with a focus on long-term memory.

"Fudan encourages us to be outstanding and interesting individuals," Chen says. "We will always maintain our curiosity, making 'interesting' an inexhaustible source of innovation and 'excellence' a goal we forever pursue."

Fudan University



"We're grateful to the Chen Institute for making this important expansion possible, and excited to see the space take shape,"

Jennifer Widom
Dean of the Stanford School of Engineering.

The Tianqiao and Chrissy Chen Ideation and Prototyping Laboratory to Support MedTech Innovation

New space accelerates development of new health solutions

March 2025 brought the opening of the Tianqiao and Chrissy Chen Ideation and Prototyping Lab, part of Stanford University's Nanofabrication Facility. Supported by the Chen Institute, the lab will spark medtech innovation by providing engineering expertise, tools, and collaborative space for projects in biosensors, robotics, wearables, and medical devices.

By helping researchers move quickly from concept to prototype, the lab will also accelerate translational research and advance new health solutions powered by deep tech, AI, and data science.

SfN Tianqiao and Chrissy Chen Young Investigator Award

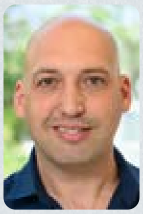
Li Ye wins $25,000 prize for brain-mapping innovations

Dr. Li Ye, a Howard Hughes Medical Institute Investigator and N. Paul Whittier Chair in Chemistry and Chemical Biology at the Scripps Research Institute, received the **Society for Neuroscience (SfN) Tianqiao and Chrissy Chen Young Investigator Award** for his work pioneering transformative brain-mapping technologies.

Dr. Ye's innovations—including CLARITY, CAPTURE, HYBRID, and CATCH—have become new gold standards for linking neural activity, gene expression, and behavior, with broad implications for peripheral and neurological diseases.

The SfN Young Investigator award recognizes early career neuroscientists who demonstrate exceptional independence and innovation with a $25,000 prize and travel to the SfN annual meeting.

Yonatan Stelzer Earns the 2025 ISSCR Outstanding Young Investigator Award



The International Society for Stem Cell Research (ISSCR) honored Yonatan Stelzer, Ph.D. with the 2025 ISSCR Outstanding Young Investigator Award which is supported by the Tianqiao and Chrissy Chen Institute. Dr. Selzer is an associate professor in the Department of Molecular Cell Biology at the Weizmann Institute of Science, Israel. The award recognizes the exceptional achievements of an investigator in the early part of his or her independent career in stem cell research.

Grand Mirror Studio Earns Global Recognition

Chen Institute science communication initiative achieves major milestones

Grand Mirror, a Chen Institute video program using GenAI to advance science communication, now has **over 2 million followers** and **more than 200 million views**, and repeatedly ranked #1 in popularity across social media channels such as Bilibili, WeChat, and Douyin. Several Grand Mirror projects received international acclaim in 2025:

Sebastian im Traum

- **Winner:** "Most Potential AI Short Film," 5th IM Cross-Strait Youth Film Festival
- **Nominee:** 7th FOTOGENIA International Festival of Poetic and Avant-Garde Cinema
- **Nominee:** 2025 FIRST Surprise Film Festival
- **Nominee:** 42nd Tehran International Short Film Festival
- **Nominee:** 12th Silk Road International Film Festival

A Brief History of Life Sciences

- **First Place** and **Best Science Communication Award,** 2025 Beijing Science Communication Competition

TIANQIAO & CHRISSY CHEN INSTITUTE

The Chen **Scholars Program**

Physician-Scientists on the Frontiers of AI and Medicine

Through the Chen Scholars Program, the Chen Institute is empowering a new generation of physician-scientists to reimagine patient care with artificial intelligence. Working at three leading hospitals, these early- and mid-career investigators stand at the intersection of medicine, neuroscience, and computation—using bold ideas and cutting-edge tools to accelerate diagnosis, personalize treatment, and open new frontiers in clinical science.

Their work reflects the program's founding vision: to give extraordinary physician-scientists the freedom to pursue high-risk, high-reward projects with the potential to transform lives.

From detecting consciousness after brain injury to treating the symptoms of Parkinson's, the Chen Scholars aren't just applying AI to medicine—they are inventing the future of care.

Impact at MGH

43 published manuscripts in 2025

$15.8M in new NIH and foundation grants

2 patents filed on AI and bone biology innovations

Mass General

At Mass General Hospital, Chen Scholars are reshaping the way clinicians understand and address some of medicine's most urgent challenges. Neurologist **Brian Edlow** is harnessing AI to detect signs of consciousness in patients with severe brain injuries, offering families and care teams insights that were previously beyond reach. Endocrinologist **Elaine Yu** is probing why osteoporosis outcomes differ so sharply across populations, paving the way for more equitable approaches to fracture prevention. And geneticist **Marc Wein** is uncovering novel pathways in bone biology that could lead to new therapies for rare bone diseases.

Together, their efforts exemplify how Chen Scholars translate laboratory advances into new hope for patients.

Chen Scholar Honored with Presidential Early Career Award

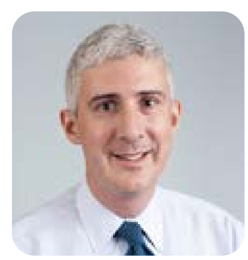
In January, Dr. Marc Wein of Mass General Hospital, an endocrinologist specializing in metabolic bone diseases, received the Presidential Early Career Award for Scientists and Engineers (PECASE), the U.S. government's highest honor for early-career researchers.

Jacqueline Clauss
MD, PhD

Brian L. Edlow
MD

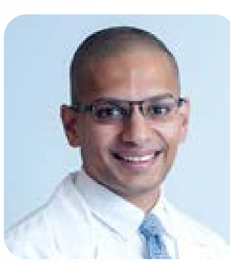
Long Nguyen,
MD, MS

Elaine Yu
MD, MSc



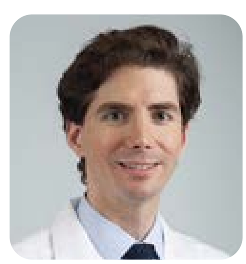
Marc Wein
MD, PhD

Neguine Rezaii
MD

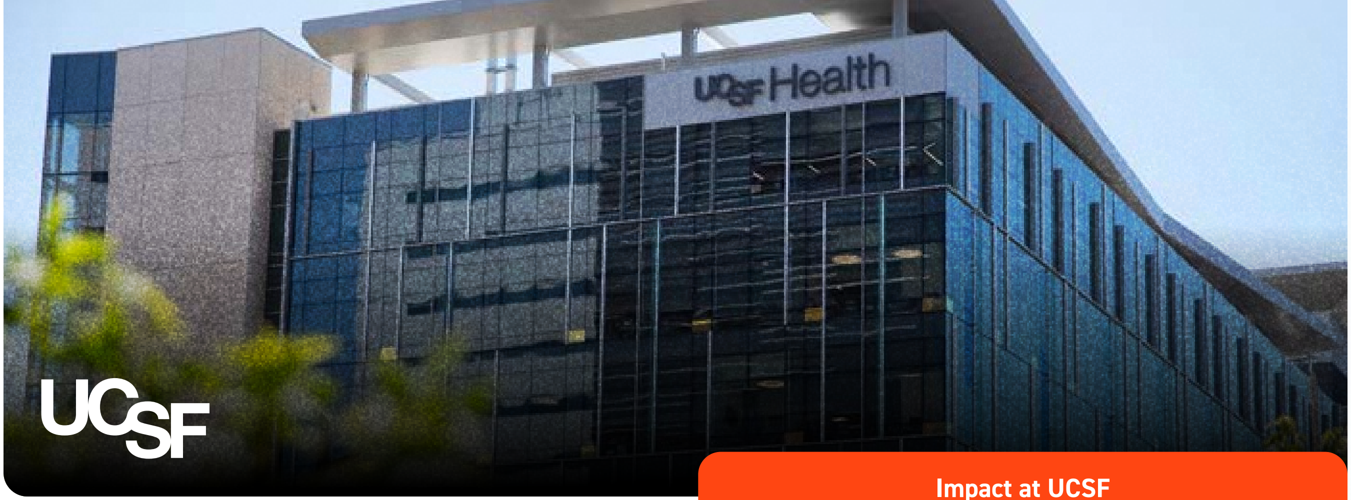


Raghu Chivukula
MD, PhD

Emily Lau
MD, MPH



Michael Young
MD, MPhil



University of California, San Francisco

At UCSF, Chen Scholars are advancing AI applications across multiple specialties. **Joline Fan** is pairing neuroimaging with focused ultrasound to explore new treatments for range of neuropsychiatric disorders. Cardiologist **Rima Arnaout** is creating AI tools to improve prenatal detection of congenital heart disease. **Andreas Rauschecker** is developing AI systems to monitor brain tumors at scale, while ophthalmologist **Jing (Meghan) Shan** is working to ensure equitable access to vision-saving diagnostics. And neurosurgeon **Doris Wang** is refining deep brain stimulation techniques that could restore mobility to patients with Parkinson's disease.

From the heart to the brain to the eye, these projects underscore how AI can illuminate complex biology while directly improving care.

Impact at UCSF

30+ peer-reviewed publications

7 new research hires

15+ national & international invited talks

"The Chen Scholars Program provided crucial support that enabled my team to build robust, clinically motivated models using real patient data from UCSF, bridging research and clinical practice."

Meghan Shan
MD, PhD

Rima Arnaout
MD

Joline Fan
MD, MS

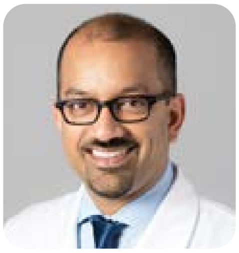
Andreas Rauschecker
MD, PhD

Jing (Meghan) Shan
MD, PhD

Doris Wang
MD, PhD

Kang Wang
MD, PhD

Jon Kleen
MD, PhD



Vikram Rao
MD, PhD

Mayo Clinic

At the Mayo Clinic, Chen Scholars are pushing AI deeper into clinical practice. Neurologist **Farwa Ali** is using AI to predict falls in aging populations, allowing for earlier interventions, while dermatologist **Collin M. Costello** is using machine learning to identify individuals at risk of having poor outcomes to skin cancer. Neurologist **Nathan P. Staff** is using AI to diagnose ALS earlier and more accurately. And **Robert T. Fazzio** is developing new ways to screen for breast cancers using AI-augmented imaging and analysis.

Each of these efforts shares a common thread: using data in new ways to give clinicians sharper tools and patients better outcomes.

Impact at Mayo Clinic

2+ papers published in journals

1 grant received

1 patent filed

"With support from the Chen Institute, I have been able to advance my research by supporting a multidisciplinary team and work toward the aims of the project. I'm incredibly grateful for the support and for the Chen Institute's investment in science and the betterment of humanity."

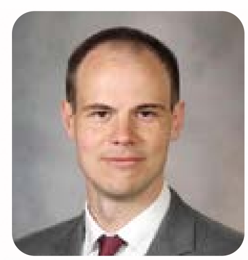
Farwa Ali
M.B.B.S.

Nathan P. Staff
MD, PhD

Robert T. Fazzio
MD, PhD

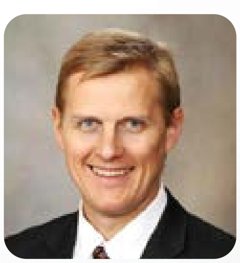
Collin M. Costello
MD

Farwa Ali
MBBS



Nick M. Gregg
MD

Tim J. Poterucha
MD



Kai J. Miller
MD, PhD

Margherita Milone
MD, PhD

Stanford University
AI Scholar

Tatsunori Hashimoto
PhD

Chen Scholars Retreat

All Chen Scholar cohorts gathered in October this year in the beautiful Presidio National Park in San Francisco. These remarkable individuals shared their latest research across a range of scientific areas, bridging the worlds of clinical study and artificial intelligence.

CHEN TIANQIAO & CHRISSY INSTITUTE

Chen Institute **Symposia Series**

FUS Neuromodulation Workshop

Menlo Park, CA — January 9-10

Leading researchers in focused ultrasound (FUS) neuromodulation gathered to share breakthroughs and chart the field's future. FUS neuromodulation is emerging as a transformative tool in brain science, with the potential to treat a wide range of neurological and psychiatric disorders in noninvasive ways.

"Our goal is to make focused ultrasound a technology that reduces suffering on a global scale."—Chrissy Luo

USC-Chen Institute Frontiers Forum

Pasadena, CA — April 30-May 1

In April, the Chen Institute partnered with USC for the second Frontiers Forum, focused on "Sensation and Motivation." The meeting highlighted how brain circuits produce sensation and motivation, and explored emerging connections between neuroscience, deep learning, and AI.

NeuroPSI - Chen Institute Joint Conference on Brain, Behavior & Beyond

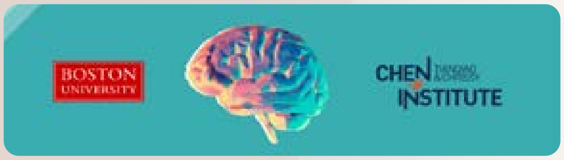
Paris, France — May 19-20

The 2025 NeuroPSI–Chen Institute Joint Conference brought together international experts to explore how social cognition, communication, and decision-making are supported across species, with a focus on advances at the intersection of neuroscience and AI. Experts from Europe, the US, and beyond explored the dynamic interplay between social cognition, emotions, decision making and language systems in humans, primates, rodents, birds, and other species.

Parametric Memory Workshop

Redwood City, CA — May 30-31

The Chen Institute partnered with AGI House to bring together global leaders in AI, neuroscience, and computational science. Experts shared groundbreaking perspectives on parametric memory and AGI architectures, exploring how AI can better mirror human cognition—then joined a hackathon to prototype next-generation intelligent memory.



Neuroscience of the Everyday World Conference 2025

Boston, MA — July 28-29

This year marked the 3rd edition of the Neuroscience of the Everyday World (N.E.W.) Conference, drawing in 191 in-person and 27 virtual attendees from across the United States and all over the world with registrants hailing from 12 different countries; including South Korea, Germany, Brazil, Turkey, India, and more. The two-day, sold-out conference held on Boston University's campus included keynote presentations, speaker symposiums, a neurotechnology panel, poster presentations, and opportunities for networking across fields and disciplines.

2025 Chen Institute and Science Joint Conference on AI & Mental Health

Zurich, Switzerland — September 8-9

Tianqiao and Chrissy Chen Institute and SCIENCE magazine, this year in partnership with ETH Zurich, are focusing on AI and mental health. This year's two-day conference highlighted how AI could be used to benefit individuals and society. Over the course of these two days, leaders gathered to discuss how AI has impacted mental health studies and have recently seen such astonishing progress.

The Chen Institute Symposium for AI Accelerated Science, organized in partnership by the Chen Institute and UC Berkeley College of Computing, Data Science, and Society

San Francisco, CA — October 27-28

This year's program featured presentations from three Nobel Laureates – Jennifer Doudna, David Baker and Omar Yaghi. It also included a wide slate of academic and industry leaders including distinguished academy members. The Chen Institute and Science AI Prize for Accelerated Research Grand Prize Winner, Zhuoran Qiao, and finalists Aditya Nair and Alizée Roobaert also presented their research after receiving their awards. Talks highlighted generative modeling for molecules and materials, AI-driven experimental automation, climate and earth-systems modeling, and next-generation memory and reasoning architectures.

CHEN TIANQIAO & CHRISSY INSTITUTE

Chen Institute
Training Program

Duke & Chen Institute Joint AI Boot Camp

Durham, NC — May 12-16

The Duke & Chen Institute Joint Boot Camp for AI and AI-Accelerated Medical Research featured intensive presentations, hands-on sessions, and lively discussions on the future of medical AI. Highlights included cutting-edge advances in AI-driven diagnostics and data-enabled discovery, along with new opportunities for collaboration at the intersection of computer science, medicine, and engineering.

IRCN-Chen Institute Joint Course on Neuro-inspired Computation

Tokyo — July 2-5

The Chen Institute and the University of Tokyo's World Premier International Research Center for Neurointelligence (WPI-IRCN) co-hosted a four-day course exploring the convergence of natural and artificial intelligence. Sessions covered dynamics, architectures, prediction, plasticity, neuromodulation, and multi-agent learning, highlighting new frontiers at the intersection of neuroscience and AI.

New this year was an entrepreneurship bootcamp, featuring startup founders, panels, and networking opportunities. Speakers included **Eugene Izhikevich** of Brain Corp, **Mackenzie Mathis** of EPFL, and leading faculty from IRCN, Kyoto University, Tsinghua University, and other global institutions.

FENS-CHEN Institute-NeuroLéman Summer School

Geneva, Switzerland — September 1-5

Young neuroscientists and renowned global experts gathered at the University of Geneva to discuss the "Neurobiology of Psychiatric Disorders," and the power of integrating animal models, clinical studies, and advanced technologies to deepen our understanding of psychiatric disorders and develop innovative diagnostic and treatment strategies.

Highlights included **Camilla Bellone**'s compelling overview of animal models of autism spectrum disorder (ASD); **Marie Schaer**'s lecture on the use of magnetic resonance imaging (MRI) and computational modeling to unravel neural mechanisms of ASD; **Stephan Eliez**'s multidisciplinary approach to the deep phenotyping of psychiatric disorders; and **Ileana Hanganu-Opatz**'s discussion of cortical plasticity and the role of early developmental windows in circuit formation.

Participants engaged in roundtable discussions on themes including the value and limitations of animal models; the translatability of findings across species; and the need for transdiagnostic approaches that explore commonalities across disorders.

Supporting the Community

Chen Institute NeuroFrontiers Symposium at NUS

Singapore
January 21-22

In January, the Chen Institute joined with IDG Capital and MIT's McGovern Institute to co-sponsor the inaugural NeuroFrontiers Symposium at the National University of Singapore.

39th Annual AAAI Conference on Artificial Intelligence

Philadelphia, PA
February 25-March 4

This leading international gathering showcased cutting-edge AI research, aligning with the Chen Institute's mission to accelerate science through AI.

International Symposium on Therapeutic Ultrasound

Banff, Canada
June 21-24

The Chen Institute helped convene nearly 500 participants to share advances in ultrasound technologies, fostering innovation in neuroscience and medical research.

The 48th International ACM SIGIR Conference on Research and Development in Information Retrieval

Italy
July 13-18

SIGIR is the international forum for the demonstration of new systems and techniques in information retrieval. The Chen Institute was excited to sponsor at the Platinum level.

The 48th Annual Meeting of the Japan Neuroscience Society

Japan
July 24-27

The annual meeting of the Japan Neuroscience Society included over 6,000 researchers across a wide spectrum of disciplines.

The 63rd Annual Meeting of the Association for Computational Linguistics

Austria
July 27-August 1

ACL 2025 papers may report novel linguistic insights derived using existing computational techniques.

Brain-Computer Interface (BCI) Meeting

Banff, Canada
June 2-5

The Chen Institute sponsored the BCI Meeting's opening keynote and Early Career Awards to foster innovation and support rising researchers.

World Summit AI 2025

San Francisco, CA
June 18-19

The Chen Institute supported the World Summit AI, a global gathering where policymakers, researchers, and industry leaders debated the future of artificial intelligence.

International Society for Stem Cell Research 2025

Hong Kong
June 11-14

The Chen Institute supported the ISSCR's Annual Meeting, convening nearly 4,000 researchers to advance stem cell and regenerative medicine and foster global collaboration in life sciences.

AI and Biology

Seattle, WA
October 9-10

ISSCR produced a unique program that aimed to align data scientists and biologists to collaboratively address the challenges in AI-enabled biology.

Society for Neuroscience

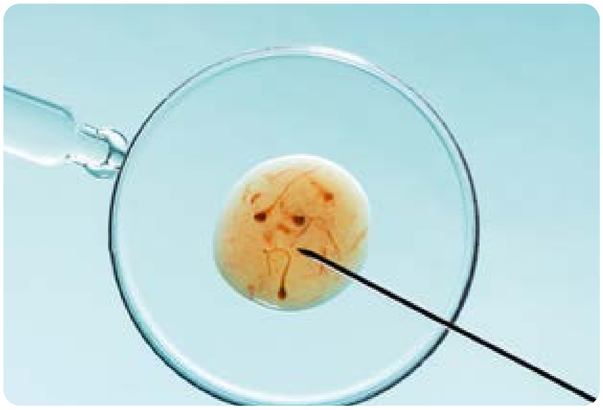
San Diego, CA
November 15-19

The Society for Neuroscience focuses on the understanding of the brain and nervous system by bringing together scientists and all segments of neuroscience.

CHEN TIANQIAO & CHRISSY INSTITUTE

Latest
Research

The Chen Institute's support enabled global research teams spanning a wide range of disciplines to keep pushing back the frontiers of human knowledge in 2025. Here are some of the highlights.



The Earliest Stage of Embryos Show Specialized Asymmetry

As nearly one in six couples experience fertility issues, in-vitro fertilization (IVF) is an increasingly common form of reproductive technology. However, there are still many unanswered scientific questions about the basic biology of embryos, including the factors determining their viability, that, if resolved, could ultimately improve IVF's success rate.

A new study from Caltech examines mouse embryos when they are composed of just two cells, right after undergoing their very first cellular division. This research is the first to show that these two cells differ significantly—with each having distinct levels of certain proteins. Importantly, the research reveals that the cell that retains the site of sperm entry after division will ultimately make up the majority of the developing body, while the other largely contributes to the placenta.

The research, conducted primarily in the laboratory of Magdalena Zernicka-Goetz, Bren Professor of Biology and Biological Engineering, is described in a study appearing in the journal Cell on December 3.

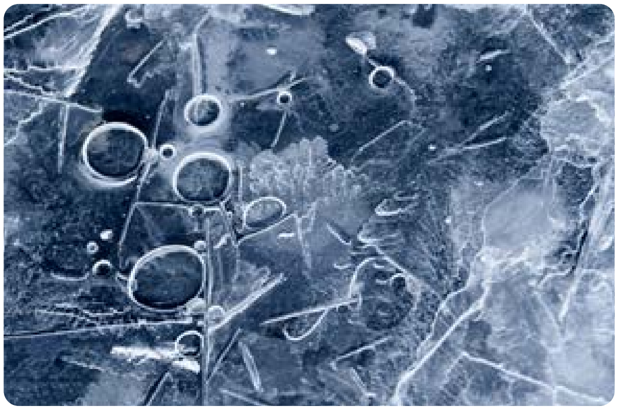
Neural Data Explains How Teams Find Flow

A Caltech-led study in *Nature Scientific Reports* shed new light on how teams achieve "flow"—the deeply focused mental state where time seems to disappear. By recording brain activity as volunteers played a collaborative video game, the team found that individuals with similar neural "fingerprints" were more likely to enter a synchronized flow state.

A New Tool to Detect Viruses in Sequence Data

A new software algorithm developed at Caltech enables researchers to easily search for viruses in RNA sequence data, enabling scientists to detect viruses in samples and study how they impact biological functions.

The research was conducted in the laboratory of Lior Pachte, Bren Professor of Computational Biology and Computing and Mathematical Sciences. A paper describing the research appears on April 22, 2025 in the journal Nature Biotechnology.



Frozen Stem Cells Could Preserve Endangered Bird Species

Caltech researchers have developed a groundbreaking method for culturing, freezing, and later reconstituting avian stem cells—an advance that could one day bring lost bird populations back to life.

"The techniques we're developing will enable reconstituting birds from stored cells of endangered species, even after extinction, creating a permanent repository for species restoration," Dr. Lois says.

Led by Caltech postdoctoral scholar **Xi Chen** in collaboration with **Qi-Long Ying** at USC and Chen Institute-affiliated Caltech biologist **Carlos Lois**, the team's work demonstrates proof of concept in several common bird species and is now being extended to endangered species in partnership with the San Diego Zoo.

Pandemic Linked to Faster Brain Aging in Older Adults

Research from the Chen Institute-supported **Shanghai Aging Study** found that the COVID-19 pandemic may have accelerated cognitive decline and brain aging in older adults.

Following nearly 4,000 Shanghai residents for over a decade, the study compared memory, cognition, and brain imaging before and after the city's 2022 Omicron lockdown. After the pandemic, participants—especially those already at higher risk for Alzheimer's or other health issues—showed faster declines in memory and reasoning, along with greater brain shrinkage.

The results suggest that the biological and social stresses of the pandemic had measurable effects on brain health, highlighting the need to better protect and support older adults during future public health crises.

Stem Cell Embryo Models Reveal Pathways to Fertility

Caltech researchers led by Chen Institute-affiliated biologist **Magdalena Zernicka-Goetz** developed a new method for creating embryo-like structures from stem cells, offering a powerful tool to study fertility.

"This model could revolutionize fertility research—helping us understand why some pregnancies fail and how to support the ones that can succeed,"

Dr. Zernicka-Goetz said.

The team engineered mouse embryo models called iG4-blastoids, which closely mimic natural blastocysts—the stage of development when embryos implant into the uterus. Since most pregnancy losses occur at this implantation stage, including during IVF, these models could help explain why and how factors such as caffeine, nicotine, alcohol, and diet influence reproductive outcomes. The study was published in *Developmental Cell*.

Parkinson's Drug Candidates Show Damaging Side Effects

A new Caltech study raised caution around two experimental Parkinson's disease drugs designed to boost mitophagy, the process by which cells clear away damaged mitochondria. Instead of protecting neurons, the compounds were found to damage cells by making them more vulnerable to mitochondrial stress.

The research, published in *Science Advances*, was led by **William Rosencrans** in collaboration with the labs of Chen Institute affiliates **Tsui-Fen Chou** and **David Chan.** Their findings highlight the need for deeper evaluation of drug mechanisms before advancing potential treatments for neurodegenerative disease.

A Jawless Parasite Reveals the Origins of the Thyroid

The thyroid gland, which regulates metabolism and growth, evolved over 500 million years ago from a primitive organ known as the endostyle—and Caltech researchers have uncovered how this evolutionary leap took place.

Using a lamprey —a jawless vertebrate parasite—as a model, the team discovered that the acquisition of neural crest stem cells was key to transforming the endostyle into the thyroid. This finding sheds light on both developmental biology and the deep evolutionary history of endocrine organs.

The work, led by Chen Institute-affiliated biologist **Marianne Bronner**, was published in *Science Advances*.

Genetic Code Enables Zebrafish to Mend Damaged Organs

Zebrafish have a rare ability: they can regenerate and repair their hearts after injury. New research reveals the genetic circuitry that makes this possible—offering hope that damaged human hearts might someday be repaired after a heart attack or in cases of congenital defects.

The study was led by Chen Institute-affiliated biologist **Marianne Bronner**, in collaboration with developmental biologist **Megan Martik** at UC Berkeley, and published in Proceedings of the *National Academy of Sciences*.

Capturing Molecular Details in a Flash

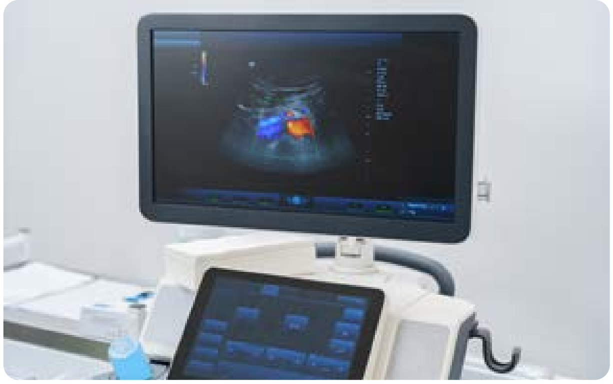
Writing in *Nature Communications,* Caltech researchers unveiled a breakthrough tool for observing ultra-fast molecular events. Led by Chen Institute-affiliated electrical engineer **Lihong Wang**, the team developed Compressed Ultrafast Planar Polarization Anisotropy Imaging (CUP2AI), a technique that makes it possible to capture fleeting molecular processes in real time.

Traditional methods often miss these rapid, nanoscale events. CUP2AI overcomes these limits, successfully imaging carcinogenic chemicals in flames and fluorescent molecules in water. The approach opens new frontiers for studying combustion, drug design, nanoparticle formation, and other fast-moving chemical processes.

A New Tool to Detect Viral 'Dark Matter'

Caltech researchers led by **Lior Pachter** developed a powerful new algorithm allowing scientists to search RNA sequence data for hidden viruses, offering a window into how viruses influence biological systems.

With an estimated 10 million individual viruses for every star in the universe, most remain unstudied—yet some may play roles in conditions like Alzheimer's or Parkinson's disease. The team's work, published in *Nature Biotechnology,* makes it possible to detect viral sequences quickly and accurately, helping to uncover the "viral dark matter" of biology.



Ontology-Guided Machine Learning for Cardiac Ultrasound

In February, UCSF Chen Scholar **Rima Arnout** co-authored a *Nature* paper introducing a powerful new approach to analyzing cardiac ultrasound reports.

These reports contain a mix of structured and free text that vary widely across institutions, making large-scale data mining challenging. By applying ontology-guided machine learning—an approach that integrates domain knowledge with advanced AI—the team outperformed general-purpose foundation models.

Their work shows how tailored machine learning methods can unlock valuable insights from big data, advancing both research and quality improvement in cardiac care.

New Insights into Workings of Active Matter

Caltech researchers co-led by Chen Institute-affiliated computational biologist **Matt Thomson** shed important new light on the workings of active matter—materials that consume energy to move or change.

In a *PNAS* report, researchers presented a new bioengineered coordinate system that allows scientists to track the movement of cellular machinery in unprecedented detail. This breakthrough sheds light on how cells create order out of apparent chaos, from orchestrating embryonic development to the precise movements of chromosomes during cell division.

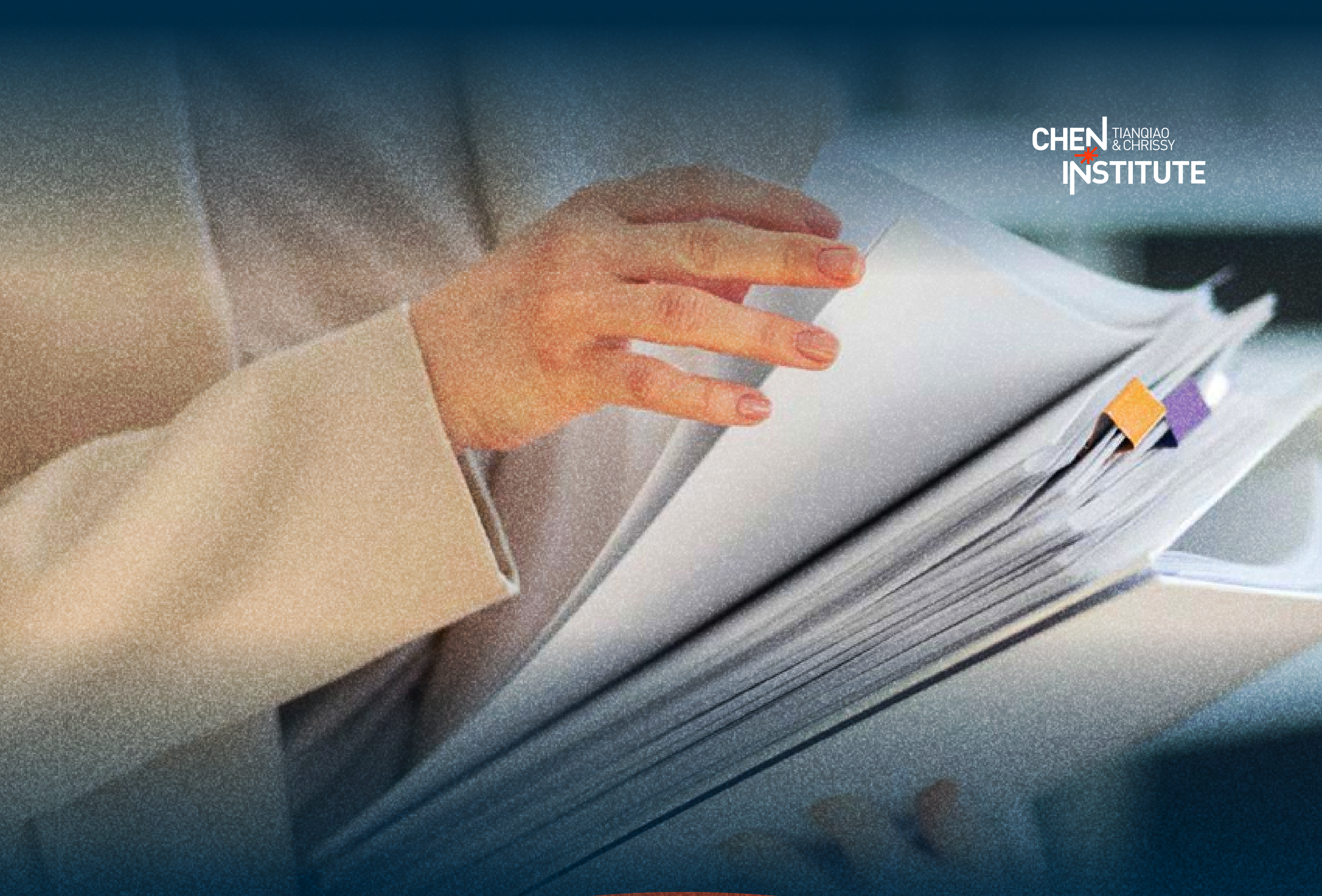
By providing a new way to observe these dynamics, the research opens doors to deeper insights into the fundamental processes that sustain life.

Separately, researchers developed the world's first "programming language" for active matter. Building on earlier work using light to control protein filaments, developing a new framework that enables precise operations in tiny volumes of fluid at the cellular scale.

The breakthrough, published in *Nature Materials*, opens new possibilities for nanotechnology and for studying how cells interact.

AI Models Using F-Wave Responses Predict ALS

Chen Scholar **Nathan P. Staff** of the Mayo Clinic published groundbreaking research in *Brain* using AI to improve ALS diagnostics. Analyzing nerve conduction F-wave responses from more than 46,000 patients, the team trained AI models to distinguish ALS from conditions with overlapping symptoms—supporting earlier diagnosis, better disease management, and improved quality of life for patients.



Chen Institute
Appendix

Impact Report

Prepared for the Tianqiao & Chrissy Chen Institute

October 2025

The Chen Scholars Program

Thank you for your support of the Chen Scholars Program at UCSF. Last year, five outstanding junior and mid-career clinician-scientists had the resources to conduct groundbreaking research in Artificial Intelligence (AI) and the neurosciences, thanks to your generosity. Here are some insights on their work in their own words.

Joline Fan, MD, MS
Assistant Professor, Department of Neurology

My research focuses on identifying and modulating brain network dysfunction in neurological and psychiatric disorders, including epilepsy, mood, and sleep disturbances. Using advanced neuroimaging, electrophysiology, and noninvasive neuromodulation techniques, such as transcranial focused ultrasound (TUS), my work aims to detect aberrant brain states and promote neuroplastic remodeling toward healthier network dynamics.

The Chen Scholars Program has been pivotal in enabling this high-risk, high-reward research by supporting the development and piloting of our TUS paradigms and advancing our understanding of their brain network mechanisms. Ultimately, my work aims to develop personalized, noninvasive, circuit-based interventions for a range of neuropsychiatric disorders.

I am excited to announce that I hired Jack Krolik, a staff research associate, who is helping advance our work. I have also had the opportunity to serve on various UCSF committees over the last year, including the Focused Ultrasound Program Review Committee, Mentorship Committee in Neurology, and Clinical Competency Committee of Neurology Residency.

Publications

Please click here for links to the following publications.

- Thalamic transcranial ultrasound stimulation in treatment resistant depression. *Brain Stimulation*. 2024 Sep-Oct.
- Closed-loop neurostimulation for the treatment of psychiatric disorders. *Neuropsychopharmacology*. 2024 Jan.

National Talks

- “MEG guiding decisions for neuromodulation (VNS, RNS, DBS): Can MEG be useful?”, special interest group invited talk at the American Epilepsy Society (AES) annual conference, Los Angeles, Calif.
- “Toward personalized approaches of focused ultrasound neuromodulation for neuropsychiatric indications”, focused ultrasound neuromodulation workshop at the Chen Institute, Woodside, Calif.

Rima Arnaout, MD
Associate Professor, Department of Medicine

My team and I strive to provide expert-quality imaging to patients and providers worldwide and disrupt traditional paradigms in deep learning to deliver on this goal.

In the past year, we have made exciting progress in developing machine learning for medical imaging and applying these breakthroughs to detecting congenital heart disease from fetal screening ultrasound. We published two articles on self-supervised segmentation in ultrasound. Self-supervised segmentation is the process by which a computer model learns to identify specific parts of an image without the need for human-provided labels or annotations. Our articles show that we can achieve clinical-grade heart chamber segmentations across a full range of patient and disease characteristics without any manual human labels! Self-supervised segmentation stands to disrupt a billion-dollar labeling industry. At the same time, even the latest AI models that claim they can outline any image still perform poorly when it comes to medical images like ultrasounds. We continue to develop this work toward use cases across the lifespan, including our important work in congenital heart disease.

This year, we also received a National Institutes of Health R01 grant renewal with a fourth percentile score and have submitted several follow-on grants and are awaiting further information. In addition to the publications below, my article “From Bytes to Beats: Overcoming Conceptual and Implementation Challenges for AI in Cardiovascular Care” was published. Finally, I am also excited to announce that I joined the faculty of the UCSF-UC Berkeley Computational Precision Health and Bioengineering programs.

I am deeply grateful to the Chen Institute, which has provided invaluable support and a strong scientific community that helps us move our important work forward. Thank you.

Publications

Please click here for links to the following publications.

- Self-supervised learning for label-free segmentation in cardiac ultrasound. *Nature Communications*. 2025 Apr.
- Are AI Foundation Models Efficient for Segmentation of Echocardiograms? *Journal of the American Society of Echocardiography*. 2025 Feb.
- Ontology-guided machine learning outperforms zero-shot foundation models for cardiac ultrasound text reports. *Scientific Reports*. 2025 Feb.
- The MI-CLAIM-GEN checklist for generative artificial intelligence in health. *Nature Medicine*. 2025 Feb.
- Improving Prenatal Detection of Congenital Heart Disease With a Scalable Composite Analysis of 6 Fetal Cardiac Ultrasound Biometrics. *Journal of the American Society of Echocardiography*. 2024 Dec.
- Epistasis regulates genetic control of cardiac hypertrophy. *medRxiv*. 2024 May.

National Talks

- "Combining machine learning with clinical priors to solve problems in medical imaging," Joint Mathematics Meetings, San Francisco, Calif.
- "A Lens to the Future: How Emerging Technology Will Change Cardiovascular Care," American Heart Association Scientific Sessions, Chicago, Ill.
- "How to scale AI for medicine? Can generative AI help?", National Academy of Medicine Emerging Leaders Forum, Washington, DC.

Andreas Rauschecker, MD, PhD
Assistant Professor, Department of Radiology and Biomedical Imaging

Our project, titled "AI-Enabled Quantitative Meningioma Monitoring: Evaluation in Thousands of Patients and Prospective Clinical Deployment" has made steady progress thanks to the generous support from the Chen Scholars Program.

Over the past year, my team and I have extensively refined our automated data processing and data curation techniques; we have used this to curate more than 6,000 meningioma studies, and we have simultaneously refined our AI-powered segmentation tools for these tumors. We have submitted National Institutes of Health R21 and R01 grants based on our preliminary data.

Much of the work in this proposal has been performed by existing lab members, including our data scientist Pierre Nedelec, MS, MTM, and Radhika Bhalerao, MS, a graduate student in the Bakar Joint PhD Program in Computational Precision Health. I also hired a new graduate student in computational precision health, Jinchi Wei, MSE, who has contributed substantially to improving the meningioma segmentation models. I continue to serve as co-director and clinical director of UCSF's Center for Intelligent Imaging (ci^2).

Publications

Please click here for links to the following publications.

- Neurocognitive and brain structure correlates of reading and television habits in early adolescence. *Scientific Reports*. 2025 Feb.
- Automated Lesion and Feature Extraction Pipeline for Brain MRIs with Interpretability. *Neuroinformatics*. 2025 Jan.
- Applications of Artificial Intelligence and Advanced Imaging in Pediatric Diffuse Midline Glioma. *Neuro-oncology*. 2025 Mar.
- Enhancing Large Language Models with Retrieval-Augmented Generation: A Radiology-Specific Approach. *Radiology: Artificial Intelligence*. 2025 May.
- One System to Rule Them All? Task- and Data-specific Considerations for Automated Data Extraction. *Radiology: Artificial Intelligence*. 2025 May.

National and International Talks

- "Brain Anatomy at the Intersection of ADHD and Dyslexia," UCSF-UC Berkeley Schwab Dyslexia & Cognitive Diversity Center Spring Symposium, San Francisco.
- "Using Large Databases in Neuroradiology Research"; American Society of Neuroradiology Luminary Speaker: Socioeconomics, Health Policy and Clinical Practice; Las Vegas.
- "Delineating White Matter Tracts Responsible for Cognitive Deficits in Pediatric Brain Tumor Survivors After Radiation," Society for Pediatric Radiology, Honolulu.
- "AI in Neuroradiology: Bench to Bedside"; American Roentgen Ray Society; San Diego.
- "Applications of Artificial Intelligence in Radiology Workflow Optimization and Efficiencies," American Society of Neuroradiology Luminary Keynote Presentation, Philadelphia.

Awards

- My team and I received an American Society of Neuroradiology Foundation Award for our work.

Jing “Meghan” Shan, MD, PhD
Assistant Professor, Department of Ophthalmology

My team and I continue to develop AI advances for glaucoma detection. These innovations significantly reduce the data volume required for training while improving detection performance, taking important first steps in elevating AI equity and performance for clinically underrepresented populations. Our work directly benefits people at high risk of vision loss from glaucoma — especially patients from regions with limited access to eye care — and promotes equitable AI diagnostics.

The Chen Scholars Program provided crucial support that enabled my team to build robust, clinically motivated models using real patient data from UCSF, bridging research and clinical practice. I'm deeply inspired by the opportunity to address global blindness through AI. I’m driven by the belief that technological innovation should empower access to care for all communities, not just those with abundant data.

In addition, funding from the Tianqiao & Chrissy Chen Institute enabled me to recruit two junior specialists last year — Pulkit Madaan, MSE, and Max Lin Rivera, MA.” I am also pleased to share a list of my publications, national talks, and awards.

Publications

Please click here for links to the following publications.

- Generative Artificial Intelligence Enhancements for Reducing Image-based Training Data Requirements. *Ophthalmology Science*. September – October 2024.

- Utilization of Image-Based Deep Learning in Multimodal Glaucoma Detection Neural Network from a Primary Patient Cohort. *Ophthalmology Science*. May – June 2025.

National Talks

- “Artificial Intelligence: Shaping the Future of Health Care,” Academy of Ophthalmology and the Ophthalmic Business Counsel, San Francisco

Awards

- I was selected for the Young Clinician Scientist Award by the American Glaucoma Society (AGS) but was unable to accept the award because I was not yet an AGS member.

Doris Wang, MD, PhD
Associate Professor, Department of Neurological Surgery

The Chen Scholars Program provides essential support for my lab, which advances our research on the brain circuit pathologies that underlie gait disorders in people with Parkinson's disease.

Using advanced neuromodulation techniques, including gait-phased synchronized closed loop stimulation, our research aims to target gait dysfunctions associated with Parkinson's disease. I am drawn to this area of research because there is a need to develop better treatments to improve Parkinson's disease patients' mobility and gait functions.

In addition to making substantial research progress, our lab recruited two new hires: Seongmi Song, PhD, a postdoctoral scholar from Texas A&M University, and Amanda Sayaseng, a research coordinator.

Below is a list of publications I co-authored, national and international talks I gave, and awards I received in 2024.

Publications

Please click here for links to the following publications.

- Pallidal and motor cortical interactions determine gait initiation dynamics in Parkinson's disease. *medRxiv*. 2024 Dec.
- Human Cervical Epidural Spinal Electrogram Topographically Maps Distinct Volitional Movements. *Journal of Neuroscience*. 2024 Aug.

- Modeling and Optimizing Deep Brain Stimulation to Enhance Gait in Parkinson's Disease: Personalized Treatment with Neurophysiological Insights. *medRxiv*. 2024 Nov.

- A Systematic Review Comparing Radiofrequency versus Focused Ultrasound Pallidotomy in the Treatment of Parkinson's Disease. *Stereotactic Functional Neurosurgery*. 2024 Aug.
- Lesioning the Brain-From Serendipity to Science. *JAMA Neurology*. 2024 Oct.
- At-Home Movement State Classification Using Totally Implantable Bidirectional Cortical-Basal Ganglia Neural Interface. *Research Square*. 2025 Mar.
- Motor learning leverages coordinated low-frequency cortico-basal ganglia activity to optimize motor preparation in humans with Parkinson's disease. *Frontiers in Neuroscience*. 2025 May.

National and International Talks

- “Interhemispheric Synchrony in Gait,” Masters Debate, Paris, France
- “Gait phase triggered adaptive deep brain stimulation improves gait parameters in Parkinson’s disease patients,” American Academy of Neurological Surgeons Meeting, Half Moon Bay, Calif.
- “Deep Brain Stimulation for Parkinson’s disease,” Stereotactic and Functional Neurosurgery Course, Remote
- Symposium Course director, “Impact of chronic recording on DBS for Parkinson’s Disease,” Congress of Neurological Surgeons Meeting, Houston, Texas
- Keynote Speaker, Sixth Annual Glenn Kindt Research Symposium, University of Colorado Anschutz Medical Campus
- “Adaptive deep brain stimulation for Gait,” UCSF Pain and Addiction Research Center (PARC), San Francisco

Honors

- Influential Women in Surgery Honor Roll, Muriel Steele Society UCSF

Massachusetts General Hospital
Founding Member, Mass General Brigham

Annual Report for the Tianqiao and Chrissy Chen Institute

August 2025

Give hope. Build health.

Dear Tianqiao and Chrissy,

I am always glad to have the opportunity to thank you for your continued commitment to Mass General. The impact of your philanthropy will resonate for years to come in service of our patients, their families and our clinicians and scientists.

Enclosed is a report highlighting the incredible work being made possible through your investment in the MGH Research Scholars, Neuroscience Transformative Scholar and the Department of Medicine Transformative Scholar programs. In the following pages, you will read updates from the past year's cohort of Chen Scholars, who are poised to shape the future of healthcare. These bright early- and mid-career scientists are dedicated to advancing medicine, and I know they are all proud to have your backing in such a pivotal stage of their careers.

I would also like to express my sincere gratitude for your generosity to the MGH Fund. Unrestricted support is playing a crucial role in building the future of Mass General Brigham. When our researchers find an unexpected lead or exciting discovery requiring investment, the MGH Fund allows us the flexibility to push ahead and take advantage of critical opportunities as they present themselves. Unrestricted support provides immediate resources to respond to major needs across the system, explore innovative ideas and address our critical needs, whether it's recruiting and retaining top talent, seeding a promising patient support program or enabling our teams to pursue new ideas and make discoveries that will change the face of medicine. Unrestricted gifts are essential to our success, and your investment allows us to drive the future of medicine and reaffirm our commitment to providing accessible, high-quality care for all. Your giving will touch every aspect of our mission, every patient we serve and is a vote of confidence in Mass General that means a great deal — thank you.

I hope you are proud to see what your support has made possible for the Chen Scholars, our patients and the world. From all of us at Mass General, thank you again. I look forward to the next opportunity to see you both.

Best,

David F. M. Brown, MD
President, Academic Medical Centers
Mass General Brigham

Dear Mr. and Mrs. Chen,

Your visionary support of the MGH Research Scholar, Neuroscience Transformative Scholar and Department of Medicine Transformative Scholar programs continues to shape the future of medicine at Mass General. In addition to financial support, the Chen Scholars' awards offer a powerful vote of confidence in the promise and potential of these early-career physician-scientists. For researchers still early in their independent paths, your investment provides not only resources but also the belief that their bold ideas are worth pursuing, and that with the right support, their work could lead to the next major breakthrough in care.

Each of the Chen Scholars is undertaking research that may one day transform our understanding of disease and improve the lives of patients everywhere. Your generosity helps sustain their momentum and inspires them to reach further. In the pages that follow, you'll find updates on their work and accomplishments, which include:

- 10 new research grants, totaling $15,836,121
- 2 new sponsored research agreements, totaling $292,189 to date
- 43 accepted or published manuscripts
- 2 new patents filed
- 21 national talk invitations
- 14 international talk invitations
- 7 new recruitments to their labs

These outcomes reflect both the dedication and talent of the individuals you've supported and the multiplying effect of your philanthropic partnership. As we work to advance the exciting vision for research at Mass General Brigham, we are deeply grateful to the Chen Institute for your vital role in supporting and nurturing the scientists who will help bring that vision to life.

Now more than ever, these awards will ensure our forward progress and allow the advancement of leading science. On behalf of Mass General and Mass General Brigham's research leadership team, we are proud to present this annual report highlighting the remarkable progress and achievements of our exceptional Chen Scholars.

I look forward to seeing you and your team at the Chen Scholars Retreat in October.

With sincere gratitude,

Merit Cudkowicz

Merit E. Cudkowicz, MD, MSc
Executive Director, MGB Neuroscience Institute

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Founding Member, Mass General Brigham

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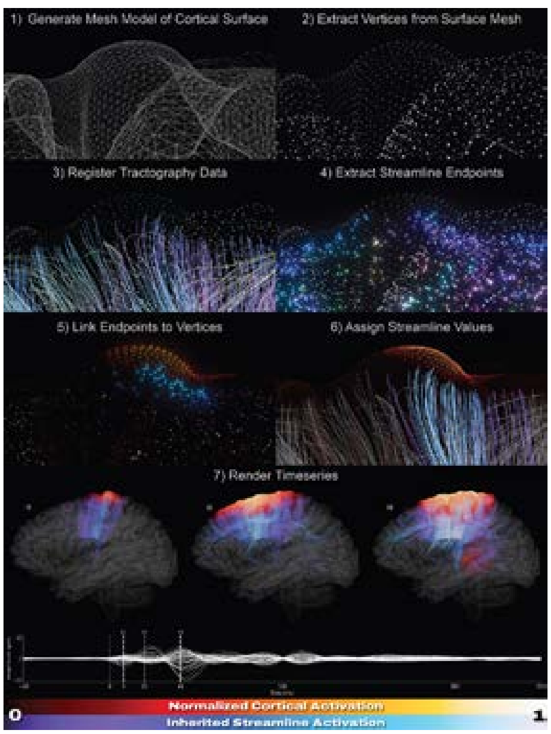
Chen Institute MGH Research Scholar 2023-2028
Neurocritical Care Faculty, Massachusetts General Hospital
Co-Director, Mass General Neuroscience
Associate Director, Center for Neurotechnology and Neurorecovery
Affiliated Faculty, Athinoula A. Martinos Center for Biomedical Imaging
Associate Professor of Neurology, Harvard Medical School

Research Focus

At the Lab for NeuroImaging of Coma and Consciousness (NICC), based in the Center for Neurotechnology and Neurorecovery at Massachusetts General Hospital, I lead a pioneering effort to transform how clinicians detect, predict and promote recovery in patients with traumatic brain injury (TBI). My team's long-term vision is to develop personalized brain connectivity maps that guide targeted therapies — restoring consciousness, communication and cognitive function in both civilian and military populations.



Over the past year, we achieved a major milestone: the successful translation of transcranial magnetic stimulation electroencephalography (TMS-EEG) into the intensive care unit (ICU) — a breakthrough that enables clinicians to detect signs of consciousness in patients with severe brain injuries. This advance, supported by the Chen Institute MGH Research Scholar Award, represents a critical step toward real-time, bedside neurodiagnostics.

Fig. 1: Stepwise visualization of the STREAM-4D pipeline: 1) A cortical surface mesh is generated. 2) Three-dimensional coordinates for each surface vertex are extracted. 3) Streamlines are extracted from a tractography dataset, and 4) represented as directionally independent endpoints. In the visualizations of steps 3 and 4, streamline or endpoint color is determined based on spatial orientation (green: anterior-posterior, red: medial-lateral, blue: superior-inferior). 5) Streamline endpoints are linked to surface vertices using k-d tree spatial indexing. 6) Streamlines inherit the activation intensities of their parent vertices. 7) Streamline and surface activation time series are rendered in four dimensions using Blender. This panel shows snapshots of left premotor stimulation at three EEG latencies (t1, t2, and t3), with a butterfly plot showing each EEG channel's TMS-evoked potential across the stimulation event (t = 0 ms). Streamline and surface activation intensity are indicated by emission color and opacity.

Patient Impact

Our work directly impacts individuals with severe brain injuries — whether in the ICU or long-term care settings — by offering new hope for recovery through advanced neurotechnologies. We recently developed a multimodal data visualization technique, published in *Brain Stimulation*, that provides a dynamic view of how electrophysiologic waves travel through the brain after TMS stimulation. This innovation has the potential to deepen scientific understanding and enhance clinical decision-making.

Key Accomplishments

This past year has been one of remarkable progress for my lab, thanks in large part to the support of the Chen Institute MGH Research Scholar Award. We made a major leap forward by successfully translating TMS-EEG into the intensive care unit — an achievement that brings us closer to real-time, bedside detection of consciousness in patients with severe brain injuries. This work not only advances the science but also has immediate clinical implications for patients and families navigating critical decisions.

In addition to this milestone, I'm proud to share the following accomplishments:

- We developed and published a novel multimodal data visualization technique that illustrates how brainwaves propagate following TMS stimulation, offering new insights into brain connectivity.
- Our team authored or co-authored 25 peer-reviewed manuscripts, contributing to the growing body of knowledge on consciousness and neurorecovery.
- I delivered 16 invited talks — 12 at national venues and 4 internationally — helping to disseminate our findings and foster collaboration.
- We filed two copyright applications to protect and share our innovations.
- I was honored to receive the 2024 Navy SEAL Foundation Scientific Achievement Award.
- I was also recognized as a Quality and Safety Star by the Mass General Department of Neurology.

These achievements reflect the dedication of our team and the transformative impact of flexible philanthropic funding on our ability to innovate and lead in the field of neurocritical care.

Impact of Your MGH Research Scholar Gift

The Chen Institute MGH Research Scholar Award has fundamentally accelerated the pace of our mission. This flexible funding enabled us to collect the preliminary data that led to our NIH R01 grant, and it continues to empower us to bring cutting-edge neurotechnologies into the ICU.

Our NIH-funded research, launched with support from the Chen Institute, is now charting new territory in the detection of consciousness. With each discovery, we are reshaping the landscape of neurocritical care — ensuring that patients and families have access to the most advanced tools available to guide life-altering decisions.

Elaine Yu, MD

Chen Institute MGH Research Scholar, 2023-2028
Physician Investigator, Endocrine Division, Department of Medicine
Associate Professor of Medicine, Harvard Medical School

Research Focus

My research group investigates bone and mineral disorders using multidisciplinary clinical, translational and epidemiologic approaches. Our studies encompass the examination of population outcomes in osteoporosis, and the pathophysiology and treatment of skeletal fragility due to bariatric surgery and diabetes.

My passion is to advance a bone and metabolism research program focused on rigorous scientific principles and team science, and to promote clinical excellence in osteoporosis care. In particular, I was inspired to focus on inconsistent osteoporosis health outcomes for my Research Scholars Award based on my experience both as a clinician and also as a member of the American Society for Bone and Mineral Research (ASBMR) Task Force on Clinical Fracture Algorithms, which highlighted vast knowledge gaps about osteoporosis care among different patient populations.

Patient Impact

Osteoporosis and fragility fractures lead to chronic pain, loss of independence and increased risk of death in older adults. Unfortunately, there are large disparities in the diagnosis, treatment and consequences of osteoporosis among different patient populations within the United States. Our current research focuses on identifying these differences. It is important to ascertain health outcomes among as many patient populations as possible, as the first step to defining clinically important social, environmental and biological factors that influence individual differences in fracture risk and treatment. Ultimately, a better understanding of these important issues will provide direct guidance for clinical care recommendations that are validated and applicable to all populations.

Key Accomplishments

With funding from the Chen Institute MGH Research Scholar award, I have led a collaboration with the Brigham and Women's Hospital Pharmacoepidemiology group to explore disparities in hip fracture outcomes among different patient populations. We have extended our findings from last year which documented varied outcomes in mortality after hip fracture in older adults with Type 2 Diabetes. In particular, we have examined mediators of mortality differences and found that pre-existing comorbidities and socioeconomic status contribute to the higher mortality documented in Black adults after hip fracture. We also found that Black, Hispanic, and Asian adults have lower rates of bone density evaluation and treatment after hip fracture as compared to White adults. These findings are being submitted as a manuscript.

I'm pleased to report that the Doris Duke Foundation will be funding my grant proposal examining osteoporosis disparities in the Kaiser Permanente and FNIH-SABRE datasets. We will be exploring how to improve fracture prediction, and whether anti-fracture efficacy of osteoporosis treatments varies by specific patient population. This project is a natural extension of the goals of my MGH Research Scholar project.

My research team has presented additional data at multiple national and international conferences from our Type 1 Diabetes (T1D) BEACON cohort, documenting high fracture risk and bone structural deficits among older adults with T1D. Several manuscripts have been published, and additional papers are in preparation. We also completed the extension study of our multicenter randomized placebo-controlled trial of denosumab in bariatric surgery recipients; I am presenting our results at a national conference later this year. Finally, we conducted a study examining long-term bone health among young adults who received bariatric surgery during adolescence; our preliminary results are also being presented later this year.

I have published eight manuscripts in the past year. I have been invited to present my research at multiple national and international forums, including Symposia lectures for the American Society of Nephrology, the ASBMR and the American College of Rheumatology.

I was appointed as Co-Chair of the ASBMR Osteoporosis Guidelines Harmonization Working Group, and I continued in my roles as Chair of the ASBMR Professional Practice Committee and as an organizing member of the Endocrine Society Annual Meeting Steering Committee.

Impact of Your MGH Research Scholar Gift

I continue to be incredibly grateful for this philanthropic gift to support my research. Funding from philanthropic sources is more important than ever in the current funding environment. The MGH Research Scholar award has allowed me the flexibility to pursue a new scientific area. In addition to generating important and clinically-impactful findings, this work has led to new scientific collaborations and also played a pivotal role in my successful receipt of a $1.8 million grant from the Doris Duke Foundation. I am also using the MGH Research Scholar award to support postdoctoral and junior faculty, which will not only advance the science but also provide opportunities to train the next generation of researchers. In this way, I'm hopeful that the impact of this generous gift will resonate for years to come.

Marc Wein, MD, PhD

Chen Institute MGH Research Scholar, 2024-2029
Physician Investigator, Endocrine Division, Department of Medicine
Associate Professor of Medicine, Harvard Medical School
Associate Member, Broad Institute

Research Focus

Osteoporosis is a major public health challenge in our aging population, leading to fragility fractures that cause pain, loss of functional independence and increased risk of death. New therapeutic strategies are needed to boost bone formation and cure osteoporosis. In the Wein laboratory, we study the signaling cascades and gene networks that bone cells use during normal skeletal development and remodeling. We aim to understand and exploit normal bone regenerative pathways to develop new treatments for osteoporosis, mineral metabolism, fracture repair and other skeletal diseases. We use a collaborative approach to bring cutting-edge technologies to solve clinically-important problems in musculoskeletal biology and mineral metabolism. To this end, we have identified novel drug targets through detailed examination of the signaling pathways used by mechanical loading and parathyroid hormone.

As a medical student, I saw the impact of osteoporosis and fragility fractures firsthand as my grandmother broke her hip and subsequently lost functional independence. At the same time, my doctoral thesis project unexpectedly turned towards studying mechanisms of bone formation. I became focused on the goal of understanding bone formation to develop new and improved therapies for osteoporosis that build new bone. During my clinical training as an endocrinologist, I focused on osteoporosis and other metabolic bone diseases, a longstanding area of clinical and research strength at Mass General and Mass General Brigham. In 2025, it is incredible what can be done in the laboratory to understand how bone cells function and how bone formation pathways are disrupted in the setting of osteoporosis. At Mass General, we are fortunate to have deep integration between basic and clinical scientists working on this disease. This integration enables us to quickly test hypotheses that emanate from studies in cells and mice in people with osteoporosis. It is an incredibly exciting time in biomedical research, and I am truly inspired and honored to be able to conduct clinically-important research in such a stimulating environment.

Members of the Wein laboratory spending time together.

Patient Impact

Our research is highly relevant for patients with osteoporosis, a common and serious condition in our aging population. In addition to this common skeletal disease, our work on rare bone diseases (osteogenesis imperfecta, fibrous dysplasia, Jansen's metaphyseal chondrodysplasia) has a direct impact on these communities. I am actively engaged in patient and research support groups that focus on these rare skeletal diseases.

Key Accomplishments

This past year, we made a breakthrough in understanding osteogenesis imperfecta. Using a new mouse model, we discovered that the primary defect lies not in osteoblasts, as previously thought, but in osteocytes — the most abundant and least understood bone cell type. This finding opens the door to new therapeutic strategies that target osteocytes and their dendritic networks. Our work was recently published in *Bone Research* and helped launch the career of a talented trainee in my lab, Dr. Jialiang Wang, who is now an Assistant Professor at University of Texas Southwestern Medical.

In addition to this discovery, I am proud to share the following accomplishments:

- Received the Presidential Early Career Award for Scientists and Engineers from the Biden White House in January 2025
- Recruited a new postdoctoral fellow and a visiting doctoral student to the lab
- Filed two patents related to our bone biology research
- Published five peer-reviewed manuscripts
- Delivered three national and two international invited talks
- Initiated a sponsored research agreement with a pharmaceutical company to study new therapeutics for bone and kidney diseases (Jan 2025 – Jan 2026)

Impact of Your MGH Research Scholar Gift

The Chen Institute MGH Research Scholar award has had an enormous impact on my work. Flexible philanthropic funding allows us to take bold risks and pursue new directions in osteocyte biology that would be impossible to fund through traditional funding mechanisms. For example, we have launched a new project exploring the molecular processes involved in osteocyte dendrite development—a topic with direct relevance to aging and osteoporosis. This support enables us to generate the preliminary data needed to secure future grants, to attract talented clinician-researchers to our lab and to develop new therapies that improve lives.

Chen Institute Department of Medicine Transformative Scholars 2023 – 2026

Massachusetts General Hospital
Founding Member, Mass General Brigham

Long Nguyen, MD, MS

Chen Institute Department of Medicine Transformative Scholar 2023-2025
Faculty, Clinical and Translational Epidemiology Unit
Assistant Professor of Medicine, Harvard Medical School

Research Focus

I am a formally trained computational gastroenterologist, an Assistant Professor of Medicine at Harvard Medical School, a Core Member of the Clinical & Translational Epidemiology Unit at Massachusetts General Hospital and an Associate Member of the Broad Institute of MIT & Harvard. As one of two founding gastroenterologists at the Mass General's Center for Cancer Complications, I care for patients with gastrointestinal (GI) and liver-related side effects of cytotoxic chemotherapy and immunotherapy.

My research program focuses on creating strategies to modulate the gut microbiome in gastrointestinal (GI) cancer, as well as developing computational methods to better understand host-associated microbes. My long-term goals are to improve the lives and longevity of patients living with gastrointestinal disease and their cardiometabolic consequences, and to identify and develop personalized disease prevention, risk stratification and therapeutic strategies using artificial intelligence and multi-omic biomarkers.

Patient Impact

Our work spans several disciplines — epidemiology, microbiome, artificial intelligence and deep learning — and patient populations afflicted with some of the most common diseases, including cardiometabolic disorders and gastrointestinal cancers.

Key Accomplishments

I have a sustained track record of productivity as lead or senior author for studies published in high-impact and varied journals, including *Science*, *Cell*, *The Lancet Public Health, BMJ, JAMA Oncology, Gut and Gastroenterology*. Over the past year, I published 15 manuscripts and gave five national and one international invited talks. After being selected to join the American Gastroenterological Association's (AGA) Center for Gut Microbiome Research & Education Scientific Advisory Board in 2024, I was asked to serve on the AGA's inaugural Small Bowel Microbiome Co-Operative in 2025.

My team recently discovered that in people with metabolic dysfunction-associated steatotic liver disease (MASLD), there are noticeable changes in the bacteria and viruses in their gut. These changes also affect how certain biological processes work, what substances are produced, and how accurately we can use this information to identify different subtypes of this increasingly common condition. This work was compiled into a free-to-use resource for the greater scientific community.

Dr. Nguyen's work was recognized during 2025 Digestive Disease Week


Dr. Nguyen with members of his laboratory

We just received a major $5 million grant to create and launch a powerful AI tool that can detect other health issues — like liver and kidney disease — by analyzing standard heart ultrasound images. We're also working quickly with trusted industry partners to bring this technology to market and make it available for use in real-world healthcare settings.

Impact of Your Transformative Scholar Gift

I want to express my sincere gratitude to the Tianqiao and Chrissy Chen Institute and its benefactors. This generous award supported my early scholarly pursuits that have helped me establish my independent research program. Early-stage investigators often have competing interests — financial, personal or otherwise — that may interfere with the establishment of their own program, but at this fragile and critical juncture, this award offered an unmatched opportunity for my career to reach escape velocity, and for my work to extend into unanticipated new directions.

Raghu Chivukula, MD, PhD

Chen Institute Department of Medicine Transformative Scholar 2024-2026
Group Leader, Center for Genomic Medicine
Assistant Professor of Medicine and Surgery, Harvard Medical School

Research Focus

Our lab is grounded in the belief that rare human genetic disorders can illuminate fundamental principles in cell biology and reveal new treatments for common and uncommon diseases alike. We are focused on monogenic disorders of proteostasis and organelle quality control, two key cellular processes that, when disrupted, can contribute to neurodegeneration, organ fibrosis and age-related functional decline. We study rare genetic conditions in people that closely resemble more common diseases involving protein balance and cell structures. Because these rare conditions have a single known cause, they give us a clearer way to study the underlying biology in the lab.

A career as a physician-scientist is a privilege. I feel exceptionally fortunate that my job is to identify and investigate interesting, important problems relevant to human health. As a molecular geneticist, I believe deeply that human genetics will continue to be the most powerful source of insights into human health and disease — particularly as new tools and technologies are developed and improved.

Patient Impact

Our efforts have a meaningful effect on patients and families impacted by genetic disorders involving proteostasis and protein aggregation. More indirectly, our research insights are likely to be of broad relevance both to basic human biology and to the treatment of diseases such as neurodegeneration, pulmonary fibrosis and other important age-related diseases of protein misfolding.

Key Accomplishments

The last year has been a busy and productive time for our laboratory, and the first major project to be completed in the lab has been hugely accelerated by Chen Institute funding and support. We became interested in certain inherited brain diseases that are caused by repeated patterns in DNA, specifically the pattern of guanine, guanine, cytosine, referred to as GGC trinucleotide repeat expansions. These patterns lead to the production of proteins that tend to clump together in the brain — known as polyglycine aggregates — which can cause damage over time. Even though these protein clumps show up in many parts of the body, they only seem to cause problems in the brain, and we wanted to understand why. We discovered that these clumps attract a specific group of enzymes that help process certain RNA molecules. When this process is disrupted, it leads to problems similar to other serious brain diseases. We confirmed this in lab experiments and in brain samples from patients, and we saw that mice missing this enzyme group also developed brain damage and movement issues. This was a big breakthrough for our lab, and we're excited that the work will be published in *Science* soon.

In parallel with this work, we have been making significant progress on another major project in our lab, which focuses on understanding how protein aggregation contributes to a family of genetic lung diseases that cause pulmonary fibrosis, or scarring in the lungs. We have developed new tools to isolate specific parts inside lung cells and have found that some proteins are present in different amounts in these parts when comparing healthy and diseased tissue. We are now working to understand how these changes might help trigger the disease. We have also made significant contributions as collaborators on other projects that explore how these inner parts of cells function.

In the past year, my group's work has been recognized in a number of ways:

- I received the Mark C. Fishman, M.D. Teaching Award in Basic Science Education.
- I am the primary investigator on a new R01 grant submission to the National Institute of Neurological Disorders and Stroke (NINDS).
- Members of my lab and I have published several papers:
    - Yang J, Xu Y, Ziehr DR, Taylor MS, Valenstein ML, Frenkel EM, Bush JR, Rutter K, Stevanovski I, Shi CY, Kesavan M, Mouro Pinto R, Deveson I, Bartel DP, Sabatini DM, Chivukula RR*. Polyglycine-mediated aggregation of FAM98B disrupts tRNA processing in GGC repeat disorders. Science. (article in press)
    - Valenstein ML, Lalgudi PV, Kedir JF, Condon KJ, Platzek A, Freund DG, Taylor MS, Xu Y, Chivukula RR, Sabatini DM. Amino acids and KLHL22 do not activate mTORC1 via DEPDC5 degradation. Nature. Jan;637(8045) (2025)
    - McGarrity S., Ziehr D.R., Austin-Tse C.A., Wein M.N., Chivukula R.R., Oldham W.M. Exercise Intolerance and Low Cardiac Filling Pressures in a Woman With a Novel eNOS Mutation. Circ Genom Precis Med. 17(5):e004741. doi: 10.1161/CIRCGEN.124.004741 (2024)
    - Valenstein M.L.*, Lalgudi P.V.*, Gu X.*, [..] Chivukula R.R., Sabatini D.M. Rag-Ragulator is the central organizer of the physical architecture of the mTORC1 nutrient-sensing pathway. Proc Natl Acad Sci. 121(35):e2322755121. doi: 10.1073/pnas.2322755121 (2024)
- Invited Talks:
    - "Leveraging rare disease genetics to illuminate specialized cell biology." Stanbury Physician-Scientist Program lecture. Massachusetts General Hospital Department of Medicine.
    - "Causes and consequences of tRNA splicing disorders in neurological disease." PSRL Seminar Series. Massachusetts General Hospital Pediatric Surgical Research Laboratories.
    - "Genetic Disorders Associated with Proteostasis." Elucidating the Genetic Basis for Disease Pathogenesis. Mass General Brigham Department of Medicine Research Seminar Series.

Impact of Your Transformative Scholar Gift

Support from the Chen Institute and the Department of Medicine has been absolutely instrumental in helping me launch and grow my laboratory at Mass General. For an early-career physician-scientist like me, the freedom to think deeply and to take risks is a rare and precious gift. Your generosity has allowed me to focus my time on what matters — thinking hard about vexing biomedical problems and crafting new approaches to meet their challenges. Importantly, the work we have undertaken over the past two years would likely have been deemed too ambitious or risky for conventional funding mechanisms. I am confident that the Chen Institute's investment will pay off and am grateful to have had the fortune of this support at such a critical phase of my scientific career.

Chen Institute Neuroscience Transformative Scholars 2023 – 2026

Massachusetts General Hospital
Founding Member, Mass General Brigham

Jacqueline Clauss, MD, PhD

Chen Institute Neuroscience Transformative Scholar 2023-2025
Clinical Investigator, Massachusetts General Hospital
Assistant Professor of Psychiatry, University of Maryland Medical School

Research Focus

The overall goal of my research is to understand how risk and resilience to psychiatric disease develop in the brain, including understanding how different "at-risk" populations go on to develop psychiatric disease and others go on to become resilient. My research employs neuroimaging techniques, clinical research and big data analysis to study risk for psychotic disorders, such as schizophrenia, as they are some of the most impairing mental health conditions. I am interested in using the research insights gained to develop and test novel therapeutic and prevention strategies.

I am motivated by the challenges experienced by my clinical patients and their families. We struggle to predict the long-term outcomes for a child or adolescent who presents for psychiatric treatment. Many of our current treatments are often only partially effective and carry the risk of significant side effects. By understanding the underlying changes in the brain, I hope to be better able to predict and prevent disease.

Patient Impact

The patient populations that benefit from my work are young people who are at risk for serious psychiatric illness and adolescents who are currently struggling with mental health conditions. We hope that by identifying developmental trajectories, we can identify unique factors that put children at risk and prevent the onset or lessen the burden of these illnesses. As a practicing child and adolescent psychiatrist, I see adolescents and young adults who are struggling with impairing symptoms, and my goal is to prevent or alleviate their suffering from these symptoms.

Key Accomplishments

During the second year of funding from the Chen Institute, we have collected symptom data, virtual reality measurement of social functioning and emotion recognition data in 24 participants. We have optimized the MRI scanning protocol and will be collecting MRI data in the coming weeks.

In my work alongside Dr. Joshua Roffman, we have identified that differences in areas of the brain that mature first — the visual cortex and medial posterior cortex — predict later development of psychiatric symptoms. Changes in cortical development during early adolescence tend to happen in areas of the brain that were already active before birth. This might help explain how risks that start before birth can lead to mental health issues later on. We are in the process of completing a manuscript about this work for submission.

I have also completed a meta-analysis of functional neuroimaging studies of nearly 5,000 participants across three different populations of individuals at elevated risk for developing psychiatric disease. The study found that across all at-risk populations, certain brain areas – especially those involved in regulating emotions and detecting salience – do not activate normally. We are finalizing analyses and working towards the submission of this project.

Over the past year, I have also been spending time developing new expertise in utilizing electronic health record data for analyses. My particular interest in this data is to understand how and why children are prescribed certain psychiatric medications and what the long-term outcomes of such prescribing might be.

Finally, I am embarking on a novel neuroimaging study involving weekly MRI scans, continuous behavioral data collection of activity levels during waking hours and sleep and multiple cognitive tasks. Using this study design, we hope to understand how fluctuations in symptoms may contribute to differences in long-term outcomes.

Impact of Your Transformative Scholar Gift

The Chen Institute Neuroscience Transformative Scholar Award has allowed me to conduct high-risk research using cutting-edge brain imaging technology that offers an unmatched view into brain structure and function. It is unlikely that this work would be funded through traditional funding mechanisms, so flexible philanthropic support from the Chen Institute has allowed me to test new hypotheses using novel methods.

Neguine Rezaii, MD

Chen Institute Neuroscience Transformative Scholar 2024-2026
Director, Computational Neuropsychiatry Program, Frontotemporal Disorders Unit
Assistant Professor of Neurology, Harvard Medical School

Research Focus

My research addresses the critical need for early detection and prediction of Alzheimer's Disease (AD) and related dementias (ADRDs). Unfortunately, diagnosis at early and mild stages of these diseases is a persistent challenge, as patients often face difficulty accessing expert clinicians and diagnostic testing — a problem that is amplified in underserved areas. Emerging AD medications are most effective in the early stages of the disease, which underscores the urgency of our research. To address the need for earlier diagnosis, we are using advanced generative Artificial Intelligence (AI) to develop CogniVerse, a fully automated platform that analyzes patient language samples, predicts a patient's likelihood of developing ADs and estimates future disease trajectory.

I have always been fascinated by how we think, process information and rationalize. As measuring these critical capacities is difficult, I have focused on analyzing language as a proxy to study thought processes and have found this approach to be of great value in detecting neurodegenerative disorders.

Patient Impact

My work will impact individuals with dementia — specifically frontotemporal dementia, Alzheimer's disease, posterior cortical atrophy and primary progressive aphasia.

Key Accomplishments

Over the past year, I authored and co-authored five journal publications, submitted six grant applications, gave two talks in the U.S. and one in Canada and engaged in new research collaborations, including with the MIT team of AI in Medicine.

Thanks to the Chen Institute Neuroscience Transformative Scholar Award, I have made significant progress on the CogniVerse project mentioned above. I began by analyzing speech recordings from 197 participants — some with AD and others with memory problems — to automatically identify patterns in how they speak. I then used advanced computer programs, including machine learning and a powerful language model called RoBERTa, to distinguish those who had AD and those who did not. The results are presented in Figure 1.

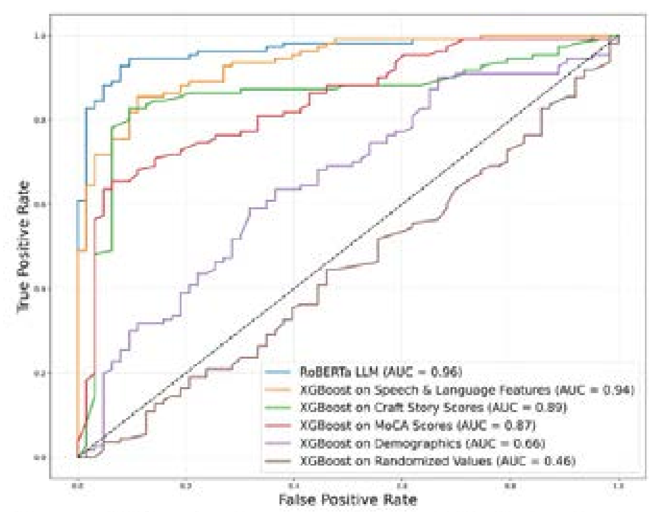


Figure 1. AUCs of various models in classifying AD patients from healthy individuals

To make sure our results were meaningful, we first tested a random variable to set a baseline that performed no better than chance. We then looked to see if grouping participants by demographics like age, sex and education would explain any of the patterns we found, which showed a moderate level of accuracy. Standard cognitive tests showed results that were slightly more accurate, and manually scored memory tests performed slightly better still. But the most accurate results came from the model we built using detailed speech and language patterns. Even more impressive, a specialized computer program we wrote to analyze raw, unedited speech transcripts outperformed all other methods. This innovative approach pushes the boundaries of what is possible in AD detection, offering a powerful new way to identify the disease using everyday language that no traditional detection method has achieved with this level of precision.

I have also been looking at speech patterns linked to a condition called functional neurological disorder (FND), which doctors sometimes consider when diagnosing Alzheimer's. My findings, published in *Movement Disorders* in May 2025, showed that FND affects how speech sounds, while Alzheimer's mostly affects what people say and how they express ideas. I also tested whether the speech features used to detect Alzheimer's in English could work in Persian and found they were surprisingly accurate, with a 90% success rate. This suggests that some signs of Alzheimer's in speech may be similar across different languages. These findings were published in *Annals of Clinical and Translational Neurology* in 2024.

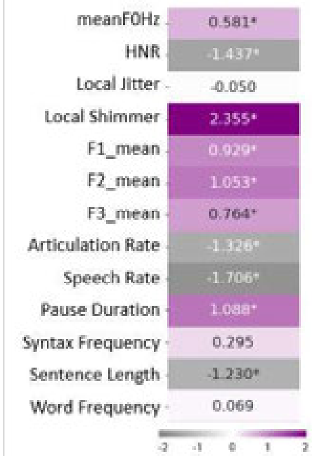


Figure 2. Unlike in AD, acoustic features have higher utility in identifying FND than most lexicosyntactic features, suggesting feature specificity. Cohen's d with * indicating significance after correction for multiple comparisons in differentiating FND from healthy controls.

Impact of Your Transformative Scholar Gift

The Chen Institute Neuroscience Transformative Scholar Award has given me protected time to focus on bold, innovative research ideas that would not typically be funded through conventional research grant funds. With this flexibility, I was able to explore new technologies, test high-risk hypotheses and pursue cross-disciplinary collaborations that have already led to promising discoveries. This kind of support accelerates scientific progress and empowers researchers to think creatively and push boundaries in ways that directly benefit patients and the field.

MGH Fund

Massachusetts General Hospital
Founding Member, Mass General Brigham

The Transformative Power of Unrestricted Support

The MGH Fund plays a crucial role in building the future of Mass General Brigham. Unrestricted support — directed by David F. M. Brown, MD, president, academic medical centers — provides immediate resources to address major needs across the system, whether it's helping to recruit and retain our most talented physician innovators, paying for an important patient support program or allowing our teams to pursue new ideas.

Nurturing Talent and Advancing Innovation

One of the most significant impacts of the MGH Fund — and your support — is its role in helping us to recruit and retain top talent. The MGH Fund enables us to attract the brightest minds from around the world and ensure our exceptional staff have the resources, support and opportunities they need to thrive.

Securing top talent is essential for fostering innovation and excellence in medicine. When a researcher or clinician joins Mass General, they bring fresh ideas and perspectives that help drive scientific breakthroughs and improve patient care. Retention is equally vital; ongoing support allows our experts to deepen their knowledge base, pursue promising new lines of inquiry as they emerge and sustain long-term relationships with patients and collaborators. The MGH Fund supports medical progress from discovery to bedside application by providing the flexibility to offer competitive opportunities, professional development and the stability required for groundbreaking work. For many investigators, this support affirms their vision and gives them the momentum to advance novel therapies or technologies.

Your support is essential to our success, allowing us to invest strategically in talent and reaffirm our commitment to providing accessible, high-quality care — accommodating our community members on their medical journeys, not only at a time of crisis, but throughout their lives.

Transforming Health Outcomes Through Community Collaboration

The MGH Fund stands at the heart of Massachusetts General Hospital's mission to deliver innovative, compassionate care to our communities. By providing the flexible financial resources necessary to launch and sustain forward-thinking programs, the MGH Fund has been the driving force behind initiatives like the satellite clinic of MGH Chelsea HealthCare Center within the Chelsea High School, the pilot program Teaching Kitchen and Food Pantry at MGH Revere, as well as their Youth Zone. These transformative efforts empower children, teens and families with accessible healthcare, mentorship and education — demonstrating the profound impact that philanthropy can have on community wellness and healthy futures.

Equally transformative is the MGH Fund's support for the Patient Navigator Program, which helps break down barriers to care for individuals facing language, developmental or logistical challenges. With nearly 2,000 patient encounters annually in the Emergency Department alone, navigators — supported through the MGH Fund — ensure seamless access to screenings, follow-up care, social services and resources that address both medical and social needs. Your generosity to the MGH Fund has an exponential impact on the initiatives that reflect Mass General's commitment to personalized, holistic care that empowers patients and strengthens community well-being.

We are deeply grateful for your partnership in advancing our mission of excellence.

MAYO CLINIC

TIANQIAO AND CHRISSY CHEN CAREER DEVELOPMENT AWARDS IN TRANSLATIONAL RESEARCH

2025 Progress Report

Dear Mr. Chen and Ms. Luo:

We want to express our deepest gratitude for your extraordinary gift to Mayo Clinic this past year. Your generous support has been instrumental in accelerating our translational research efforts, specifically in the application of artificial intelligence (AI) to revolutionize patient care.

Your philanthropic investments have enabled the launch of the Chen Scholars awards at Mayo Clinic, **providing crucial career development awards for both early-career and established investigators. These projects are leveraging AI and leading to breakthroughs in diagnostics, treatment planning and personalized therapies** — and ultimately, improving the lives of countless patients.

The Chen Scholars awards are particularly exciting because they foster a collaborative environment where scientists from diverse disciplines can come together to share knowledge, exchange ideas and drive meaningful discoveries. This spirit of collaboration aligns perfectly with Mayo Clinic's commitment to teamwork and innovation.

Your dedication to AI-driven research further demonstrates your visionary leadership to improve human health. We are deeply honored to partner with the Tianqiao and Chrissy Chen Institute in this important endeavor.

With sincere appreciation,

Vijay Shah, M.D.

Ronald F. Kinney Executive Dean of Research

Carol M. Gatton Professor of Digestive Diseases Research, Honoring Peter Carryer, M.D.

Consultant, Gastroenterology and Hepatology

Professor of Medicine and Physiology

Heidi L. Dieter

Chair, Research Administration

Mayo Clinic

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CHEN SCHOLAR **HIGHLIGHTS**

The Chen Scholar awardees have achieved remarkable progress in furthering our understanding of diseases and developing AI-based tools for diagnoses and interventions.

We are pleased to share a detailed report from each of the awardees, and here is **a quick glance at their productivity** over the past year.

2
PAPERS PUBLISHED
in high-profile journals.

2
MANUSCRIPTS AND PRESENTATION
abstract submissions underway.

3
ADDITIONAL GRANT APPLICATIONS
submitted based on preliminary data from Chen Scholars.

1
ADDITIONAL GRANT AWARD
received to support work.

1
PATENT APPLICATION
pending.

FARWA ALI, M.B.B.S.

Tianqiao and Chrissy Chen Early-Career Development Award in Translational Research (Neuro)

Neural Mechanisms of Fall Risk in the Aging Population

Using AI and data science to predict incident falls in the aging population, allowing for early intervention and preventive measures

My healthy mom had a fall in her 60s and fractured her arm and leg on one side. Her confidence was so shaken — she quit driving, she quit a lot of her activities. That one fall proved to be so life-changing for her. This situation really motivated me. It hit close to home.

As a movement disorder provider, I am passionate about gait and balance because it affects every single human being as we get older — and all of my patients. Over the age of 65, one in four people experience a fall annually. While such gait and balance concerns may be thought to be part of aging, they can be an early indicator of neurodegenerative disease and give us an opportunity to intervene and prevent falls before they occur.

At this time, there are limited treatments for gait and balance disorders, and falls have one of the biggest healthcare impacts. I am grateful for the support from this award to try to answer these questions: Can we predict falls before they happen? Can we predict what causes them? How can we prevent them?

What are some key findings that have emerged from your research so far?

The support from the Chen Scholars award has enabled me to pursue the question as to how neurodegenerative diseases affect gait and balance. I have been able to partner with the Mayo Clinic Study of Aging to analyze several thousand gait samples and gain a better understanding of how a patient's clinical history and gait performance can predict future falls. We were pleased to publish these results in Nature Communications and are honored to acknowledge support from the Chen Institute in that paper. We reported that those with worse gait performance had higher levels of Alzheimer's disease biomarkers. This indicates that changes in gait can be an early indicator of brain pathology, even before cognitive symptoms appear. We found that these biomarkers are not only useful for assessing cognitive decline, but also potentially for motor decline. This is exciting given the new blood-based tests that are available to assess biomarkers for Alzheimer's disease.

Association of plasma biomarkers of Alzheimer's pathology and neurodegeneration with gait performance in older adults | Communications Medicine

Learn more

How does your research integrate artificial intelligence?

We're aiming to use AI and data science to predict incident falls in the aging population. In our partnership with the Mayo Clinic Study of Aging, we are consuming massive amounts of data to understand if there are clues in a patient's clinical history or gait phenotype that can predict if they will have a fall down the road.

Why is this research important?

The aging population is growing, and falls are increasingly common in this demographic. The healthcare economic burden and the individual and societal impact of falls are high and are projected to increase. The aging population also has a high burden of neurological diseases, such as stroke and Parkinson's, that can cause disability due to both cognitive and motor issues. Identifying people early and instituting preventive strategies for falls could help us limit their impact both for the aging population and those with neurological diseases. Our goal is to understand and develop a tool to predict falls before they happen so we can identify people who are at risk and institute appropriate preventive measures.

How has this award contributed to the advancement of your research?

With support from the Chen Institute, I have been able to advance my research by supporting a multidisciplinary team and work toward the aims of the project. I'm incredibly grateful for the support and for the Chen Institute's investment in science and the betterment of humanity.

COLLIN M. COSTELLO, M.D.

Tianqiao and Chrissy Chen
Early-Career Development Award
in Translational Research (Cancer)

Using Machine Learning to Identify Known Geno-Morphological Changes in BAPomas and Infer Geno-Morphological Changes in Melanoma

Identifying individuals at risk of having poor outcomes to skin cancer

I am a dermatologist, but I also have an interest in oncology, specifically in skin cancers. Melanoma is one of the highest-risk cancers, and **it's important to identify those high-risk patient populations** as they are the most critical group needing targeted screening and intervention.

While melanoma continues to be a high-risk cancer, screening all Americans for the disease is not a feasible strategy. First, there are not enough dermatologists to make this possible, and second, data shows that screening everyone would not lead to overall health benefits at a population level.

As part of the INTERCEPT study — one of the largest multisite studies of universal genetic testing in patients with cancer — we found that 72% of patients with melanoma had an inherited mutation that makes them susceptible to developing melanoma; however, they did not meet current guidelines for screening. Developing a better method for identifying patients who have these underlying mutations would enable strategies for earlier intervention.

What are some key findings that have emerged from your research so far?

We studied a collection of 192 medical images to help identify patients with a specific genetic mutation. We categorized these images into two groups: those from patients with the mutation (germline-positive) and those without it (germline-negative). We used Attention-Based Multiple Instance Learning (ABMIL) to spot patterns in these images that can tell us whether a patient has the mutation. We trained our ABMIL model and found that it performed very well. For example, it was accurate about 79% of the time. More importantly, it correctly identified a significant number of patients with the mutation. We are analyzing these results to identify some characteristic patterns of the mutations, but initial findings suggest that this technology has the potential to greatly improve the way we diagnose and treat this condition. At the end of this two-year award, we are aiming to have an algorithm that has been tested on a large cohort, then validated on part of that dataset. From there, we hope to identify who has the at-risk mutation and those who do not have it.

How does your research integrate artificial intelligence?

Our goal is to use multimodal data input in these algorithms to better predict skin cancers. Thanks to the incredible advances in AI technology in developing models based on image data, we are leveraging this capability for the digitization of whole pathology slides. After the pathology slides are scanned and digitized, we have applied multi-instance learning, which separates the whole slide into tiny pieces. From there, the model can look at those pieces and learn how parts of the tumor will cluster, how parts of the epidermis will cluster, and how the fat will cluster. Then we can tell the model to look at different clusters based on where the morphology is. In addition, we can bring in clinical variables, such as the patient's age, sex and family history of melanoma. These factors can help to improve predictions.

Why is this research important?

As a dermatologist, I think a lot about melanoma, and this work is important to find some of the highest-risk patients. Initially, we hope to find those with melanoma, and this research could possibly extend to colon cancer or breast cancer.

My hope is that individuals with the highest risk will be able to receive enhanced screening and early intervention. If they have cancer, we can identify it at an earlier stage, which improves the chance of survival and mitigates elaborate, expensive treatments. Conversely, if patients test negative for these inherited mutations, they may not need to be tracked quite as closely, and we can provide them reassurance.

How has this award contributed to the advancement of your research?

In short, my research wouldn't be possible otherwise. As a young investigator, it's challenging to receive funding — especially since I am in clinic 80% of the time. This philanthropic gift is powerful, not only because it funds research, but also because it inspires hope and drives progress for patients.

NATHAN P. STAFF, M.D., PH.D.

Tianqiao and Chrissy Chen Established-Investigator Career Development Award in Translational Research (Neuro)

Artificial Intelligence Models of Nerve Conduction F-Wave Responses Predict Diagnosis and Survival in ALS

Diagnosing ALS earlier and more accurately using AI

As a clinician who diagnoses and manages patients with ALS long-term and participates in clinical trials, I saw firsthand the challenges and delays in diagnosis. **That experience made me realize how impactful AI could be** — not just for diagnostics, but also for improving clinical trial design and patient care.

My colleagues and I were also intrigued with the question: What parts of our electromyography (EMG) data could help us advance diagnostics and prognostics? With the volume of second opinions we handle, we knew we had a rich dataset to work with.

Ultimately, our inspiration came from a mix of clinical need, technological opportunity, and a desire to bring something truly useful into practice. We wanted to build a tool that could help clinicians make earlier, more confident diagnoses and improve outcomes for patients living with ALS.

What are some key findings that have emerged from your research so far?

When we started this project, we had one big goal: to help doctors diagnose ALS earlier and more accurately using AI. ALS is a tough disease. It's hard to diagnose, and there's no cure yet. But we believed that by using the data we already collect — like EMG tests that measure how muscles respond — we could train a computer to spot patterns that even experienced doctors might miss.

This tool, built on EMG waveform data and trained using machine learning, is designed to help clinicians identify ALS earlier and more confidently. What's amazing is how well it worked, even in early tests. The AI was able to detect patterns invisible to the human eye, and the results — like a ROC curve with an area under the curve of 0.9 — were incredibly promising. We published the research in Brain, one of the prominent journals in the field of neurology, and we were pleased to acknowledge support from the Chen Institute in the paper.

Artificial intelligence models using F-wave responses predict amyotrophic lateral sclerosis

Learn more

What excites me most is that this isn't just a research project — it's something that could truly change lives. And it's just the beginning. With continued support, we can keep building tools like this to help patients and families facing some of the hardest diagnoses.

How does your research integrate artificial intelligence?

Our AI algorithm analyzes EMG data using machine learning to identify subtle patterns that aren't visible to the human eye. It's like a supercharged calculator that compares muscle response data from patients with confirmed ALS to those without, extracting features that help us assess the likelihood of ALS. The results were surprisingly strong — our model performed with a high degree of accuracy, which was both exciting and validating.

While the tool is still in the research phase, we're designing feasibility trials to integrate it into clinical workflows. Ultimately, this could mean earlier access to trials, better symptom management, and peace of mind for patients and their families.

Why is this research important?

ALS is a devastating disease, and one of the most frustrating aspects for both patients and clinicians is the delay in diagnosis. Symptoms can be vague at first — just weakness — and that often leads to misdiagnosis or long waits for clarity. That delay can mean missed opportunities for clinical trials, delayed symptom management, and prolonged anxiety for patients and their families.

This tool, built on EMG waveform data and trained using machine learning, is designed to help clinicians identify ALS earlier and more confidently. Our vision isn't to replace clinicians but to equip them with another tool — one that nudges the diagnostic needle in the right direction, especially in ambiguous cases. What excites me most is that it has the potential not only to confirm ALS sooner but also to rule it out in cases where the diagnosis is uncertain. That kind of reassurance can be just as powerful.

How has this award contributed to the advancement of your research?

Without that philanthropic support, we wouldn't have had the resources to even begin this work.

Your generous philanthropy empowered us to think differently. It gave us the space to collaborate across disciplines, to test ideas that might have seemed too ambitious otherwise, and to move quickly from concept to clinical feasibility. It's because of that support that we're now designing trials to integrate this tool into real-world practice, with the hope of improving early diagnosis, expanding clinical trial access, and ultimately enhancing quality of life for patients and their families. Thank you, Chen Institute, for your steadfast support of our work.

ROBERT T. FAZZIO, M.D., PH.D.

Tianqiao and Chrissy Chen Established-Investigator Career Development Award in Translational Research (Cancer)

Multimodal Artificial Intelligence for Breast Cancer Screening and Diagnosis

Developing a novel approach for AI-augmented detection of breast cancer

I'm driven by a deep desire to improve the lives of patients facing breast cancer. That's why my research focuses on finding **better, faster ways to diagnose and treat** the disease.

My goal is to improve how we diagnose breast cancer by finding ways to detect and classify tumors without needing a biopsy. This would speed up the process, significantly reduce anxiety for patients, and allow them to begin treatment sooner.

Advanced imaging techniques have made it easier to detect cancer accurately, but these methods can still be slow and require a lot of resources. While there are many AI tools available to help detect cancer, they often aren't advanced enough to speed up the diagnosis or they are difficult to use in a real clinic. We've already created an AI model that can tell the difference between harmless and cancerous growths using mammograms. It works well, but it has some of the same problems as other AI tools on the market. That's why a new, more effective approach is needed — one that truly streamlines the process and improves patient outcomes.

What are some key findings that have emerged from your research so far?

In our experiments, we're using a novel approach to interpreting mammogram images by looking at them in small sections. While using these image "patches" isn't a completely new idea, our unique approach combines it with two important advancements: (1) using advanced computer programs (deep neural networks) to identify and categorize important features in the images; and (2) searching a library of past breast cancer cases to find similar examples.

This combination allows us to analyze mammogram images with more information and understanding. Interestingly, our approach is similar to a new trend in AI that combines creating new information with finding relevant existing information. We call this retrieval-augmented generation (RAG). We believe our approach can greatly improve how accurately and quickly breast cancer can be detected through screening.

How does your research integrate artificial intelligence?

As part of our ongoing work, we utilize and plan to further train or fine-tune deep neural networks for both image and text analysis. Among the models we have already explored are ChexNet — a convolutional neural network originally trained on chest X-ray images — and large foundation models such as ADAM-v2, which are trained using self-supervised learning paradigms.

Building on this foundation, our next phase involves leveraging large language models (LLMs) to extract and characterize relevant information from radiology reports. We are also actively designing a novel AI architecture that can effectively fuse image features and textual insights into a unified representation: the Patient Code. Inspired by the functionality of QR codes in everyday life, the Patient Code is a privacy-preserving, compact computational representation of the patient's imaging and diagnostic data.

This code can be efficiently stored, shared and used to enable rapid processing and streamlined digital consultations across healthcare institutions. It also holds potential for supporting second-opinion workflows, improving diagnostic consistency, and facilitating interoperable AI-driven healthcare services.

The innovative concept of the Patient Code has been formally disclosed to Mayo Clinic Ventures, and a U.S. patent application has been filed to protect the intellectual property.

Why is this research important?

This research is important because it addresses critical challenges in breast cancer diagnosis — accuracy, efficiency and accessibility — by leveraging innovative AI technologies. Breast cancer is the most diagnosed cancer among women worldwide, and early detection is crucial for effective treatment and improved survival rates. However, radiologists face high workloads and variability in interpretation, leading to missed or delayed diagnoses. Our automated system has the potential to significantly reduce diagnostic errors and improve early detection rates through precise, AI-driven lesion analysis and retrieval-based decision support.

If successful, the impact on society could be substantial. For example, even a modest 10%–15% improvement in early detection rates could translate into thousands of lives saved annually and reduced need for aggressive treatments. Furthermore, by enabling faster, standardized second opinions across institutions via the Patient Code, the system could lower unnecessary biopsies and follow-ups, cutting healthcare costs by millions of dollars per year. Ultimately, this research could improve patient outcomes, reduce diagnostic disparities, and increase healthcare system efficiency on a global scale.

How has this award contributed to the advancement of your research?

Philanthropic support plays a vital role in accelerating the advancement of our research by providing flexible funding that enables innovation beyond traditional grant limitations. Unlike traditional research funding, which often focuses on well-established methods and incremental progress, philanthropic contributions allow us to take bold, high-impact risks — such as developing entirely new AI models or creating the novel Patient Code framework for secure, interoperable healthcare data. These resources also help us attract top interdisciplinary talent; and rapidly prototype and test new ideas. Most importantly, philanthropic funding empowers us to maintain patient-centered goals by focusing on real-world implementation and clinical translation, ultimately bringing lifesaving technology to the bedside faster.

I am immensely grateful to have received the Tianqiao and Chrissy Chen Established-Investigator Career Development Award in Translational Research. This generosity will help formulate approaches that **positively impact patients with breast cancer.**

2025 CHEN SCHOLAR AWARDEES

Mayo Clinic is deeply grateful for the continued support from Tianqiao and Chrissy Chen Institute to award the next round of Chen Scholars. We appreciate your close consideration of candidates, and we are pleased to share the new cohort of awardees.

MARGHERITA MILONE, M.D., PH.D.

Tianqiao and Chrissy Chen Established-Investigator Career Development Award in Translational Research **(Cardiovascular)**

KAI J. MILLER, M.D., PH.D.

Tianqiao and Chrissy Chen Established-Investigator Career Development Award in Translational Research **(Neuro)**

TIM J. POTERUCHA, M.D.

Tianqiao and Chrissy Chen Early-Career Development Award in Translational Research **(Cardiovascular)**

NICK M. GREGG, M.D.

Tianqiao and Chrissy Chen Early-Career Development Award in Translational Research **(Neuro)**

THANK YOU

FOR YOUR GENEROUS PHILANTHROPIC SUPPORT.

Your commitment to innovation is instrumental in propelling our AI-driven research forward, enabling us to explore groundbreaking solutions in diagnostics, treatment and patient care. Your vision is directly contributing to advancements that promise to transform healthcare, offering hope and improved outcomes for patients worldwide. **We are profoundly grateful for your partnership in shaping the future of medicine.**

MAYO CLINIC

USC-Chen Institute Frontiers Forum 2025
"Sensation-Motivation and AI"
April 30- May 1, 2025

Opening Remarks

Dr. Li Zhang *(Center for Neural Circuits & Sensory Processing Disorders, Zilkha Neurogenetic Institute, Keck School of Medicine, USC)*

Dr. Li Zhang opened the forum by welcoming attendees to the third USC-Chen Institute Frontiers Forum on Neuroscience and Artificial Intelligence, expressing deep gratitude to the Chen Institute for their continued partnership and support. As the primary organizer, Dr. Zhang emphasized the forum's evolution from its inaugural success, noting how this year's iteration maintains its core focus on understanding how external and internal sensory information drives behavioral responses while expanding to encompass the rapidly growing fields of deep learning and artificial intelligence. He highlighted the forum's mission to serve as a collaborative hub for sharing breakthrough research, identifying fundamental questions and guiding principles, and fostering future scientific partnerships. Dr. Zhang particularly acknowledged the tremendous support from the Chen Institute and thanked the distinguished speakers for taking time from their busy schedules to participate in this interdisciplinary gathering aimed at understanding the fundamental question of how brain circuits produce sensation and motivation.

Dr. Steve Kelly *(Acting Director of Zilkha Neurogenetic Institute)*

Dr. Kelly emphasized that scientific gatherings like this forum have become an essential means of fostering scientific collaboration in the current environment. He highlighted the importance of freely exchanging ideas, cross-mentorship, and collaboration as expressions of resistance against skepticism toward scientific perspectives. He welcomed the continued partnership with the Tianqiao & Chrissy Chen Institute and praised their external validation through philanthropic support of neuroscience research.

Dr. Thomas A. Buchanan, MD *(Vice Dean for Research, School of Medicine, USC)*

Dr. Buchanan expressed gratitude for the three-year partnership and praised the program's quality. He noted that the Tech School of Medicine has identified neuroscience as one of their top priorities, highlighting the Soka Neurogenetics Institute and the Neuro Medicine Program as key initiatives training the next generation of researchers.

Session 1: Sensation and Sensory Behaviors

Dr. Hillel Adesnik, PhD *(UC Berkeley)*

"Neural Basis of Sensory Perception"

Dr. Adesnik presented groundbreaking work on understanding how different patterns of neural activity drive different sensory perceptions. His lab developed innovative "balanced optogenetics" using BiPOLs (bidirectional optogenetic tools) to manipulate spike timing without changing spike rates. Key findings showed that scrambling endogenous spike patterns disrupts behavior, suggesting precise timing of neural activity is crucial for sensory perception. This work challenges the conventional rate-code hypothesis and provides evidence for timing-based neural codes in sensory processing.

Dr. Matthew McGinley, PhD *(Baylor College of Medicine)*

"Sustained Attention and Arousal"

Dr. McGinley's research focused on the intensity of attention rather than selective attention, examining how motivation and arousal modulate sustained attention in mice. Using a novel sustained listening task with reward manipulation, his team demonstrated that optimal performance occurs at intermediate arousal states measured by pupil size. The work revealed that motivation affects both bias and sensitivity in signal detection, with animals spending more time in optimal arousal states when motivated. Neural recordings showed shared dynamics across animals during social behaviors.

Dr. Cris Niell, PhD *(University of Oregon)*
"Active Vision in Freely Moving Mice"

Dr. Niell presented innovative work studying natural visual behaviors in freely moving mice, moving beyond traditional head-fixed paradigms. His lab developed sophisticated tracking systems combining head-mounted cameras with neural recordings to study prey capture, gap crossing, and other natural behaviors. Key findings included the discovery that mice use motion parallax for depth perception and that gaze shifts trigger coarse-to-fine visual processing. The work demonstrates how ecological approaches can reveal visual computations not apparent in laboratory settings.

Dr. Huizhong Whit Tao, PhD *(University of Southern California)*
"Visual-Spatial Navigation Circuits"

Dr. Tao's research revealed how the lateral dorsal thalamic nucleus (LD) encodes visual information for spatial navigation. Her team demonstrated that LD neurons are highly direction-selective, preferentially responding to counter-clockwise turning movements. Through behavioral experiments and optogenetic manipulations, they showed that LD-encoded directional information is crucial for spatial learning and memory formation. This work bridges visual and navigational systems, revealing how visual motion signals are transformed into spatial memory.

Dr. Xiaoke Chen, PhD *(Stanford University)*
"Chronic Pain Circuits"

Dr. Chen presented a comprehensive circuit analysis of chronic pain, revealing a closed-loop system spanning cortex, brainstem, and spinal cord. His team identified mu-opioid receptor-positive neurons in the rostral ventromedial medulla as critical for injury-induced pain sensitization while preserving normal pain sensation. The work revealed parallel thalamic pathways through VPL and PO nuclei, both required for chronic pain. The findings provide new therapeutic targets for treating chronic pain while maintaining protective acute pain responses.

Session 2: Motivation and Social Behaviors

Dr. Zoe Donaldson, PhD *(University of Colorado Boulder)*
"Social Attachment and Pair Bonding"

Dr. Donaldson's research on prairie vole pair bonding revealed how calcium-permeable AMPA receptors organize neuronal ensembles in the nucleus accumbens during bond formation. Using advanced calcium imaging and pharmacological manipulations, her team demonstrated that these receptors are essential for encoding partner preferences through coordinated activity of fast-spiking interneurons. The work provides mechanistic insights into how social experiences are transformed into lasting attachments, with implications for understanding human social bonds.

Dr. Scott Kanoski, PhD *(University of Southern California)*
"Oxytocin and Social Context Effects on Feeding"

Dr. Kanoski presented novel findings showing that oxytocin's effects on food intake depend critically on social context. His team developed a social eating paradigm in rats, demonstrating that oxytocin increases food intake when animals eat with familiar conspecifics—the first evidence of oxytocin increasing rather than decreasing feeding. This work suggests that failed clinical trials of oxytocin for obesity may result from ignoring social context, highlighting the importance of considering social factors in feeding research.

Dr. Dayu Lin, PhD *(New York University)*
"Maternal Aggression Circuits"

Dr. Lin's research revealed a two-phase mechanism controlling maternal aggression in mice. Phase one involves circuit refinement during reproduction, including enhanced synaptic connectivity and cellular excitability in the posterior amygdala to ventromedial hypothalamus pathway. Phase two involves oxytocin-mediated dynamic gating that responds to offspring presence and nursing behavior. This system allows both the establishment of aggressive capacity and flexible expression based on immediate offspring needs.

Dr. Weizhe Hong, PhD *(University of California, Los Angeles)*
"Prosocial Helping Behaviors"

Dr. Hong demonstrated that mice display three distinct forms of prosocial behavior: comforting (addressing emotional distress), targeted helping (assisting with specific goals), and sharing (addressing material needs). Using simultaneous brain recordings from interacting animals, his team revealed shared neural dimensions across brains during social interactions, particularly in GABAergic neurons. The work extends to artificial intelligence, showing that similar shared dynamics emerge in social AI agents.

Dr. Li I. Zhang, PhD *(University of Southern California)*
"Reviving-like Behavior in Mice"

Dr. Zhang presented interesting findings on reviving-like behavior in mice, where conscious animals provide sophisticated assistance to unconscious conspecifics. The behavior includes targeted facial interactions, particularly airway management through tongue manipulation. This innate prosocial behavior is mediated by oxytocin neurons in the paraventricular hypothalamus and represents a novel form of emergency response. The work reveals unexpected complexity in rodent social behavior and has implications for understanding empathy and helping behaviors.

Session 3: AI in Neuroscience

Dr. Brian Lee, MD, PhD *(University of Southern California)*
"Engineering Artificial Sensation"

Dr. Lee presented clinical research on engineering artificial sensation for brain-computer interfaces. His team compared invasive Utah arrays with surface ECoG grids for generating artificial touch sensations. While ECoG couldn't produce naturalistic sensations, patients could use artificial sensations for complex discrimination tasks with high accuracy. The work provides crucial clinical insights for developing sensory feedback systems in brain-computer interfaces, balancing safety and functionality.

Dr. Talmo Pereira, PhD *(Salk Institute for Biological Studies)*
"Computational Models of Biological Motion"

Dr. Pereira presented advances in capturing and modeling biological motion through computer vision. His team developed LEAP and SLEAP for animal pose estimation with minimal labeled data, and DREAM for multi-animal tracking. Moving beyond tracking, they created physics-based virtual animals with neural network controllers that learn from real motion capture data. The Virtual Rodent project aims to bridge behavioral observation with mechanistic understanding of motor control.

Dr. Jonathan Pillow, PhD *(Princeton University)*
"Machine Learning for Animal Training Optimization"

Dr. Pillow addressed the paradox of slow animal learning in laboratory tasks despite assumptions about biological learning efficiency. His team developed PsyTrack to model learning dynamics and discovered that mice use different learning rules than standard reinforcement learning algorithms. They developed machine learning approaches for curriculum optimization, using simulation to show how intelligent stimulus selection could dramatically accelerate training protocols.

Dr. Maryam Shanechi, PhD *((University of Southern California)*
"Dynamical Systems Models for Neural Decoding"

Dr. Shanechi presented advanced dynamical systems models for neural decoding and closed-loop brain control. Her team developed LFADS for nonlinear neural modeling with flexible inference, PSID for joint neural-behavioral modeling, and DPAD for incorporating categorical behaviors. The work enables disentangling intrinsic neural dynamics from input-driven responses, paving the way for AI-based systems that can decode and regulate brain states for therapeutic applications.

Workshop Report: "Sensation-Motivation and AI"

May 1, 2025 - Huntington Library, Los Angeles

The second day of the USC-Chen Institute Frontiers Forum transitioned from formal presentations to an intensive workshop format at the historic Huntington Library in Los Angeles. This one-day discussion session brought together the eleven invited speakers and additional attendees to explore critical challenges and opportunities facing neuroscience, including the transformative impact of new recording technologies, the integration of AI tools in research and education, and strategies for navigating an uncertain funding landscape.

The workshop was structured as two extended discussion sessions spanning morning and afternoon, facilitating deep exploration of four primary areas: sensory information processing and brain-wide signal distribution, integration of AI tools in neuroscience research, teaching and education in the AI era, and funding challenges with strategic responses. The intimate setting of the Huntington Library provided an ideal environment for frank discussions about the field's future directions.

Morning Session: Sensation/Motivation and Brain-Wide Integration

The morning session opened with a provocative observation from Dr. Xiaoke Chen of Stanford University about the surprising ubiquity of sensory signals throughout the brain. Using Neuropixels technology for brain-wide recordings, researchers are discovering that visual and auditory responses extend far beyond traditional sensory cortices, fundamentally challenging our established understanding of brain organization.

One particularly striking example emerged from drug addiction research, where investigators have identified neurons that fire up to 100 seconds before drug-seeking behavior. Rather than finding these "craving cells" localized to a specific nucleus as hypothesized, they appear distributed throughout the brain. This finding parallels observations from human neuroscience, where researchers using Utah arrays have decoded speech signals from parietal regions and discovered robust motor control signals in the hippocampus, particularly in beta frequency bands.

Dr. Talmo Pereira from the Salk Institute raised what became a central theme of the morning: when signals appear everywhere, how do we determine what's computationally relevant? He illustrated this challenge with an elegant example from artificial neural networks, where even completely random networks can decode basic sensory features like distinguishing between apples and acorns. However, these same random networks fail at more complex tasks like counting objects, suggesting that mere presence of decodable information doesn't indicate computational involvement.

This observation sparked intense discussion about new frameworks for understanding distributed processing. The emerging consensus suggested that timing relationships between regions, rather than simple presence of signals, might be key to identifying computational relevance. As one participant noted, it's like "dropping a radioactive tracer and watching its propagation"—the temporal dynamics reveal more about function than static presence.

Expanding Beyond Traditional Models

Dr. Zoe Donaldson from UC Boulder made a compelling case for embracing non-traditional model organisms, drawing from her work with prairie voles to study pair bonding behaviors impossible to investigate in mice. The discussion revealed how new genetic tools like CRISPR and viral vectors are making sophisticated manipulations possible in species chosen for their unique behaviors rather than genetic tractability.

The conversation revealed both tremendous opportunities and practical challenges. Evolution has provided natural experiments in the form of species with exceptional abilities—echolocation in bats, distributed intelligence in octopuses, complex social behaviors in voles. However, developing these models requires significant infrastructure: breeding colonies, brain atlases, species-specific tools, and perhaps most importantly, a critical mass of researchers to form a sustainable community.

A particularly thoughtful discussion emerged around a recent paper showing that oxytocin receptor knockout voles can still form pair bonds, seemingly contradicting decades of pharmacological research. Rather than viewing this as a failure, the group recognized it as revealing the robustness and complexity of biological systems—genetic compensation mechanisms ensure that critical behaviors like bonding have multiple backup pathways.

Human Neuroscience: Possibilities and Constraints

Dr. Brian Lee from USC provided perspective from human neuroscience, carefully distinguishing between "studies" and "experiments" in human subjects. While technological advances allow remarkable recordings through Utah arrays and stereo-EEG, the fundamental inability to perform causal manipulations remains a critical limitation.

The discussion revealed unexpected ethical and legal complexities, particularly around psychiatric applications. California's laws against psychosurgery, written in response to the ice-pick lobotomy era, now complicate even carefully considered interventions like deep brain stimulation for treatment-resistant depression. This highlighted how historical abuses create lasting barriers to potentially beneficial treatments.

Afternoon Session: AI Integration and Future Directions

Transforming Research Workflows

The afternoon session began with a masterclass in using large language models for scientific work that left many participants reconsidering their assumptions about AI capabilities. The demonstration showed sophisticated iterative prompting strategies that go far beyond using ChatGPT as a "smart Google." The presenter walked through writing an NIH grant, systematically building context by feeding the AI relevant documents including funding announcements, previous grants, and recent papers.

What impressed participants most was the strategic use of the phrase "not yet" to prevent premature output while building comprehensive context. The demonstration included creating symbolic references for complex information, allowing commands like "combine insights from PROJECT-A and PROJECT-B" to generate nuanced synthesis. Perhaps most innovative was using AI to simulate NIH study section reviews, generating realistic critiques that identified actual weaknesses later addressed in revision.

Embodiment and Biological Realism

Dr. Talmo Pereira's presentation of embodied fly simulations controlled through PlayStation controllers sparked perhaps the day's most animated debate. The system maps joystick inputs through neural networks trained on actual fly motion capture data, eventually outputting realistic motor commands. The demonstration showed a virtual fly walking with ground reaction forces and realistic biomechanics, all derived from biological data.

This work crystallized a fundamental tension in computational neuroscience: when is biological detail necessary versus distracting? Advocates for embodied approaches argued that biomechanical constraints fundamentally shape behavior—an animal might stop turning not due to cognitive decision but physical limitation. Critics countered that for many questions, particularly in sensory processing, adding 36 degrees of freedom for body mechanics obscures rather than illuminates core computations.

Learning from Failure: The Blue Brain Project

A frank discussion of the Blue Brain Project's failure provided valuable lessons about large-scale neuroscience initiatives. Despite a billion-euro budget and impressive technical achievements in simulating cortical columns, the project failed to produce functional insights. Participants identified key problems: relying on statistical connectivity rather than actual connectome data, lacking clear computational goals, and focusing on biophysical detail without connecting to behavior or function.

This cautionary tale contrasted sharply with more successful approaches like the Microns project, which combined detailed connectivity mapping with functional recordings and behavioral relevance. As one researcher summarized, "detail without function is meaningless"—a principle relevant beyond just large-scale projects.

Education and Transformation in the Age of AI

The education discussion began with a striking example: only few college students attended a recent lecture, with the professor continuing to teach to a nearly empty room. This crystallized broader concerns about education's future in an era of streaming lectures, commercial test prep, and AI assistants.

Different instructors shared contrasting approaches to this challenge. One professor structures courses around the historical development of discoveries, teaching not just facts but how scientific understanding evolves. Another uses rapid-fire questioning every five minutes, forcing active engagement and hypothesis generation. Ironically, this more demanding approach led to even worse attendance, as students feared being called upon.

The discussion revealed that most students and even many instructors use AI tools at a superficial level, missing their potential for deep learning. One computational neuroscience instructor now spends significant course time teaching sophisticated AI workflows, responding to explicit student demand.

Discussion on the Funding Issues

The workshop's final major discussion confronted the challenging situation of potential broader NIH reductions.

Texas emerged as an unexpected model for state-level research funding. Their Cancer Prevention Research Institute has operated successfully for years, and a new Dementia Prevention Research Institute will offer R01-equivalent grants with startup packages double the federal level. However, this model's replicability remains questionable—few states have Texas's oil revenue or government commitment to replace federal funding.

A foundation officer in attendance provided valuable perspective on private funding opportunities. Foundations prefer large, coordinated multi-institutional efforts over scattered individual grants. The most successful approach involves bringing scientists and funders together in workshops to jointly define priorities, similar to how the Brain Initiative developed its RFAs.

Looking Forward

The workshop concluded without formal resolutions but with shared understanding of challenges and opportunities ahead. The path forward requires balancing multiple tensions: embracing technological capabilities while preserving human insight, diversifying funding while maintaining research freedom, and adapting education while preserving core values.

Most importantly, the workshop reaffirmed that neuroscience's future depends not just on technical innovations but on the human elements that no technology can replace: curiosity about nature's mysteries, creativity in designing revealing experiments, wisdom in interpreting complex results, and passion for sharing discoveries.

The success of this third iteration of the Sensation-Motivation and AI workshop demonstrates the value of bringing together researchers across subspecialties to grapple with shared challenges. The Tianqiao & Chrissy Chen Institute's continued support for these dialogues provides a crucial forum for shaping neuroscience's future direction.

Report on the symposium "Innovative ultrasound technologies for understanding brain function"

The symposium 1S06a "*Innovative ultrasound technologies for understanding brain function*" was co-organized and chaired by Dr. Masafumi Shimojo from the National Institutes for Quantum Science and Technology (QST) and Dr. Takahiro Osada from Juntendo University. It was held on the first day (July 24) of the 48th Annual Meeting of the Japan Neuroscience Society.

The symposium addressed the rapidly growing interest in using ultrasound to investigate and modulate brain function. Owing to its high tissue permeability, ultrasound offers a promising, noninvasive means of accessing deep brain regions with high spatiotemporal precision. The session brought together five emerging researchers pioneering ultrasound-based approaches, fostering discussion on the latest findings, technological advances, and future prospects for opening new frontiers in neuroscience and exploring clinical applications.

Dr. Shimojo

The symposium featured the following presentations:

1. **Dr. Hiroshi Kida (Fukuoka University)** addressed the major challenge of delivering drugs across the blood-brain barrier (BBB). He introduced a novel strategy combining ultrafine bubbles (UFBs; < 1 μm in diameter) with low-frequency ultrasound (LoFreqUS). UFBs offer prolonged stability and enhanced tissue penetration. His team developed a method to bypass the BBB by injecting UFBs into the lumbar spinal cavity and applying LoFreqUS to the occipital region, enabling targeted gene delivery to intracranial tissues with minimal thermal damage. This innovative approach holds strong potential for future neuropharmacological applications.

2. **Dr. Yumi Matsushita (QST)** presented fundamental research on the molecular mechanisms of ultrasound neuromodulation. Her team identified the mechanosensitive ion channel TRPC6 as a critical biosensor for ultrasound-induced neuronal responses in the mammalian brain. Using a custom experimental setup for both cultured neurons and *in vivo* mouse brains, they showed that ultrasound elicited rapid neuronal responses, such as intracellular Ca^{2+} influx and action potentials, that were significantly reduced when TRPC6 was pharmacologically inhibited or genetically deleted. These results provide key insights for the future design of ultrasound-based therapies.

3. **Ms. Kaede Yoshida (Kindai University and Hokkaido University)** introduced *sonogenetics*, a technique that combines transcranial ultrasound with targeted expression of mechanosensitive ion channels to achieve noninvasive, cell-type-specific neuromodulation. In her study, overexpression of either the bacterial channel eMscL or the human TRPC6 channel in the mouse cerebral cortex markedly enhanced neural responses to ultrasound, with eMscL also reducing response latency. This technology represents a powerful new tool for developing non-pharmaceutical treatments for drug-resistant brain disorders.

4. **Dr. Keith Murphy (Stanford University and Attune Neurosciences)**, who joined remotely from the United States via Zoom due to family matters, discussed optimizing focused ultrasound parameters to manipulate neural activity and behavior. By coupling focused ultrasound with fiber photometry, his team identified highly distinct parameters for excitation and inhibition, each producing clear, target-specific behavioral effects. These findings are now being translated to human applications using a wearable phased-array ultrasound device, which has already shown promise in regulating pain and obsessive-compulsive disorder (OCD) symptoms across multiple clinical sites.

5. **Dr. Takahiro Osada (Juntendo University)**, co-organizer of the symposium, presented his work on applying transcranial ultrasound stimulation (TUS) in humans. He provided compelling evidence of its neuromodulatory effects, showing that TUS can suppress motor evoked potentials when targeting the motor cortex and impair response inhibition when targeting the anterior putamen of the basal ganglia. By integrating TUS with neuroimaging, his research maps the neural circuits underlying cognitive functions such as response inhibition, highlighting the technology's potential both as a powerful tool for basic human neuroscience and as a therapeutic modality.

The symposium was a remarkable success, attracting a full-capacity audience with some attendees standing at the back, and generating a lively, extended Q&A session. The enthusiastic response highlighted the scientific community's growing excitement about ultrasound neuromodulation and affirmed the leading role of the speakers in advancing this rapidly developing field.


Dr. Kida


Dr. Matsushita


Ms. Yoshida


Organizers, speakers, and supervisors at the post-symposium reception

Chen Institute Science Writers Fellowship

Meeting Report

FENS-CHEN – NeuroLeman Summer School in Geneva (Switzerland)

FENS-CHEN-From September 1st to 5th, 2025, the University of Geneva hosted the FENS–Chen Institute–NeuroLéman Summer School, dedicated to the theme "Neurobiology of Psychiatric Disorders." This edition of the summer school was made possible through the generous support of the Tianqiao & Chrissy Chen Institute, which enabled broad participation and ensured the success of this enriching scientific event. Organized by Camilla Bellone, Alan Carleton, and Christian Lüscher, the event gathered young neuroscientists and renowned experts from around the world to exchange ideas and explore advances in understanding psychiatric conditions. The five-day program provided an interdisciplinary overview of major psychiatric disorders, including schizophrenia, autism spectrum disorder (ASD), and depression, approached through clinical, pre-clinical, and computational perspectives. Lectures delivered by invited speakers covered both fundamental principles and the most recent research findings, from molecular mechanisms and circuit-level alterations to clinical outcomes and therapeutic strategies. In addition, participants were introduced to diverse methodologies, ranging from in vivo and in vitro models to computational tools and applications of artificial intelligence in psychiatry. A distinctive feature of the school was the diversity of its participants, which included clinicians, basic science researchers, and computational neuroscientists. This heterogeneity fostered fruitful discussions and encouraged integration across disciplines, reinforcing the collective goal of better understanding psychiatric disorders and identifying new avenues for treatment. Beyond its scientific value, the summer school also offered well-organized networking opportunities in an informal setting. Shared meals, local cultural experiences, and the chance to enjoy Geneva's landscapes created an inspiring atmosphere for meaningful exchanges among participants.

Highlights of particularly exciting talks and findings:

1. **Camilla Bellone** provided a compelling overview of animal models of autism spectrum disorder (ASD), with particular focus on social behavior as a rewarding process. She highlighted the variety of behavioral assays available to study sociability, moving beyond quantitative measures such as time spent in social interaction to also address qualitative features, including reduced approach, disorganized exchanges, or socially inappropriate behaviors. This broader perspective offered a nuanced understanding of how social deficits manifest differently across psychiatric disorders. Professor Bellone also emphasized dopaminergic regulation as a central mechanism underlying sociability, demonstrating through fiber photometry and chemogenetics that adequate social behavior

depends not on global changes in dopamine release, but on its precise, temporally coordinated modulation. Her group further dissected the neural circuits involved, underscoring the role of the Superior Colliculus–Ventral Tegmental Area (SC–VTA) pathway in orienting behaviors, and introduced advanced machine-learning tools such as LISBET for unbiased analysis of complex social interactions.

2. **Marie Schaer** enriched the program with insights from clinical research in ASD. Her lecture highlighted the use of magnetic resonance imaging (MRI) and computational modeling to unravel neural mechanisms of the disorder, with direct implications for early diagnosis and intervention. In collaboration with Bellone, she presented the *Social Motivation Hypothesis*, proposing that reduced social interest leads to diminished social experiences and, ultimately, impaired cognitive development. Remarkably, her group developed a non-sedated MRI protocol for children, enabling longitudinal data collection. Their findings revealed circuit alterations in autistic children that closely mirror those observed in mouse models, bridging human and animal research. Schaer's team also applied continuous eye-tracking from early childhood, uncovering a progressively divergent gaze pattern in ASD, and pioneered AI-driven digital phenotyping, capable of achieving 80% diagnostic accuracy from video analysis. These advances, combined with intensive early-intervention programs showing promising outcomes, underscored the urgent need for broader access to such treatments despite financial and logistical barriers.
3. **Stephan Eliez** introduced a meta-framework for deep phenotyping of psychiatric disorders, integrating multidisciplinary tools to track developmental trajectories. He highlighted both the scientific value and the logistical challenges of conducting long-term longitudinal studies to follow participants from early life into adulthood.
4. **Ileana Hanganu-Opatz** discussed critical periods of cortical plasticity, emphasizing that early developmental windows are crucial for circuit formation. Her findings demonstrated that hippocampal activity plays a driving, unidirectional role in shaping prefrontal cortex maturation, shedding light on mechanisms that may underlie vulnerability to psychiatric disorders.

Together, these presentations illustrated the power of integrating animal models, clinical studies, and advanced technologies to deepen our understanding of psychiatric disorders and to develop innovative strategies for diagnosis and treatment.

Controversies that were discussed during the Summer School:

Each afternoon, following the lectures, participants engaged in roundtable discussions with the invited speakers. These debates encouraged critical reflection on experimental approaches and conceptual frameworks in psychiatric research. A central theme concerned the value and limitations of animal models. While rodents and other species cannot replicate human psychiatric symptoms, particularly positive symptoms of schizophrenia such as hallucinations or delusions, which rely on verbal reports, they remain indispensable for studying genetic risk factors and early neurodevelopmental mechanisms inaccessible in humans. The discussion highlighted both the utility of behavioral tests that approximate psychiatric phenotypes and the interpretative challenges of linking animal behaviors to subjective human experiences. Another key point was the translatability of findings across species. Given the heterogeneity and environmental sensitivity of psychiatric disorders, speakers acknowledged that no single model can fully capture the complexity of human pathology. Nevertheless, animal models continue to provide valuable insights into circuit-level and molecular dysfunctions, especially when combined with emerging alternatives. Among these, brain organoids were identified as a promising complementary system for dissecting cellular and molecular processes underlying psychiatric conditions. Beyond methodology, the discussions also addressed broader conceptual frameworks. Several participants argued that focusing narrowly on specific diagnoses may obscure the reality of overlapping symptoms and disrupted mechanisms across conditions. This led to strong support for a transdiagnostic approach, which emphasizes commonalities across disorders rather than rigid diagnostic categories. Such a perspective, participants suggested, may offer a more accurate and productive way to investigate psychiatric disorders and to guide the development of effective interventions.

View of future issues that need to be addressed:

Looking toward the future, several themes emerged as priorities for advancing psychiatric research. Computational and artificial intelligence models are expected to play increasingly important roles in providing precise and integrative frameworks, but their use must be accompanied by rigorous validation to avoid bias and ensure translational value. Likewise, organoid models represent a promising avenue for linking cellular mechanisms to clinical findings, though continued refinement and validation remain essential. Another central point was the need to strengthen the connection between basic and clinical research. Bridging laboratory findings with case studies and clinical data will foster a truly bidirectional exchange, ultimately leading to more effective strategies for diagnosis and treatment. This integrative vision highlights the necessity of collaboration across disciplines, bringing together neuroscience, computer science, and clinical psychology. Finally, participants reflected on the ethical and practical challenges of ensuring that advances in medication and therapies are accessible to all who need them. The Summer School concluded with a shared sense of gratitude to the organizing committee, whose dedication made possible not only outstanding scientific discussions but also meaningful networking and personal connections, ensuring an enriching and unforgettable experience.

This meeting report was written by Adriana Souza, Isabel Siew Yin Koh, and Yuri Kim. They wrote this meeting report as part of the Tianqiao and Chrissy Chen Institute Science Writers Fellowship which aims to extend the conversation Beyond the meeting with the hopes of sparking new ideas and collaborations.

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