CHEN TIANQIAO & CHRISSY INSTITUTE

2022

ANNUAL REPORT

A letter from Tianqiao Chen and Chrissy Luo

In many ways, we think of 2022 as the "come back year." With the strain of the pandemic easing in many parts of the world, things in the scientific world started to return to normal and the regular business of science began to shift from "Herculean" back to business as usual.

We were excited to reach some important milestones during this time. For example, we have now supported over 200 neuroscience meetings around the world and our momentum continues to grow. We held the inaugural Chen Brain and Mind Lecture at the California Academy of Sciences and in China, we were able to organize new ZNext and Brain Talk seminars.

Adjacent to these meetings, we launched the Chen Science Writers program which awards young scientists grants to attend neuroscience meetings and report on what is discussed, new trends and controversial discussions. In China, we started NextQuestion media which does much the same thing, reporting out not only on meetings, but also emerging research in the broader field. Finally, we were able to hold a second seminar in partnership with Science Magazine.

In addition to our continuing support for over 100 scientists and a number of universities, we made great progress with the Chen Frontier Lab in Shanghai which has several projects in the works. Academic papers and seminars focused both on applied neurotechnology and AI and mental health, have been warmly received by the scientific community.

As we look forward to 2023, we are thankful for the continued openness and spirit of partnership we feel from the global scientific community. The willingness to explore new directions and models of engagement is what will ultimately help propel us forward to unlock the mysteries of the human brain.

Sincerely,

Tianqiao Chen Chrissy Luo

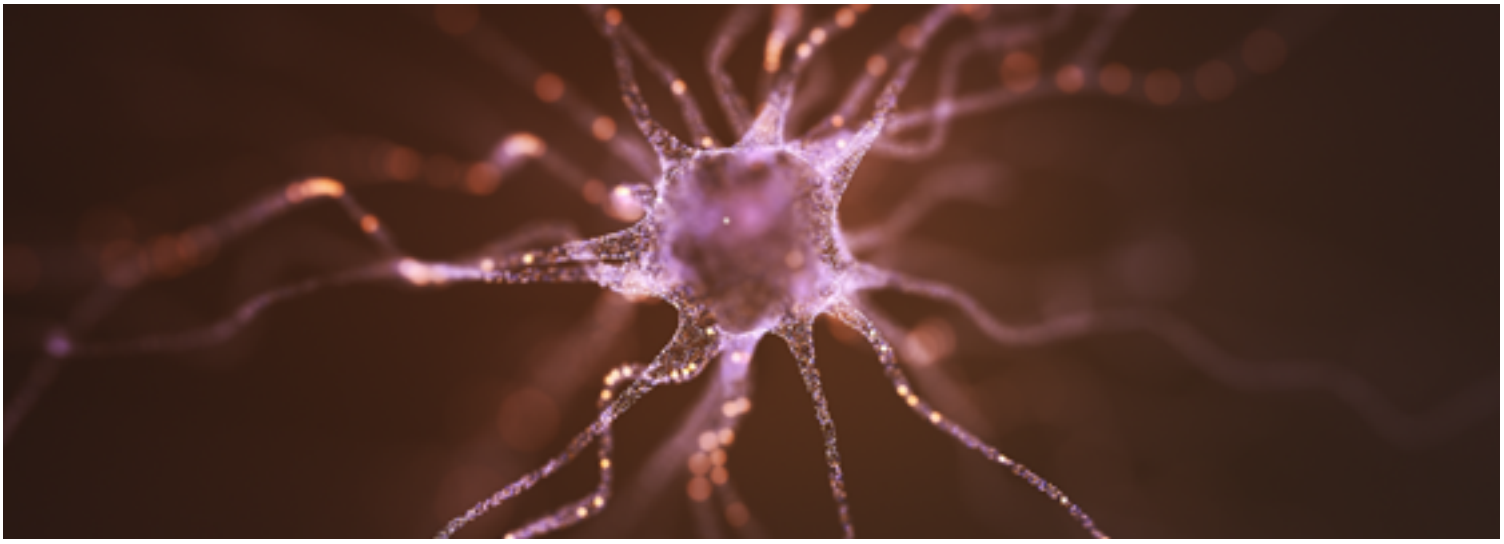
Our Vision

Improving the human experience by understanding how our brains perceive, learn and interact with the world.

Supporting brain research focused on:

- Understanding the sensation-perception mechanisms and related systems of memory, attention, learning and expectations.
- Advancing discoveries and applications that minimize the negative and enhance the positive impact of perceptions.

The ability to shape and refine perception will help us better understand our world, be it through more targeted therapies to alleviate negative psychological states such as depression or seamless brain-machine interfaces to enhance the utilization of mental capacity and capabilities.



Focus

Driving fundamental research into brain function and how perceptions are formed

We are committed to bringing together the world's most talented researchers across biology, chemistry, engineering, mathematics, physics, the humanities and the social sciences to investigate the complex interactions governing sensation, perception and cognition. We have three core areas of interest: brain discovery, brain treatment and brain development.

Brain discovery

Our primary focus is interdisciplinary research in basic sciences to understand fundamental brain at the level of the individual neuron and synapse. We support research that will deepen understanding of how the brain gathers, organizes and retains information, and translates perceptions into thoughts, emotions, decisions, actions and memories. Currently, limited understanding of these processes is a bottleneck for new discoveries in both brain treatment and development.

Brain treatment

We seek to translate improved understanding of brain mechanisms and processes into breakthroughs in the treatment of physical and psychological suffering. In particular, we will focus on two severe areas:

- The first area is mental disorders, which can seriously impair cognitive abilities and affect one's ability to cope with life. Such disorders include anxiety issues, mood disorders, chronic pain, schizophrenia and other psychotic problems.
- The second is neurodegenerative diseases such as dementia, Parkinson's and Lou Gehrig's diseases, which are often debilitating and remain largely incurable due to inadequate knowledge of etiology and progression.

Brain development

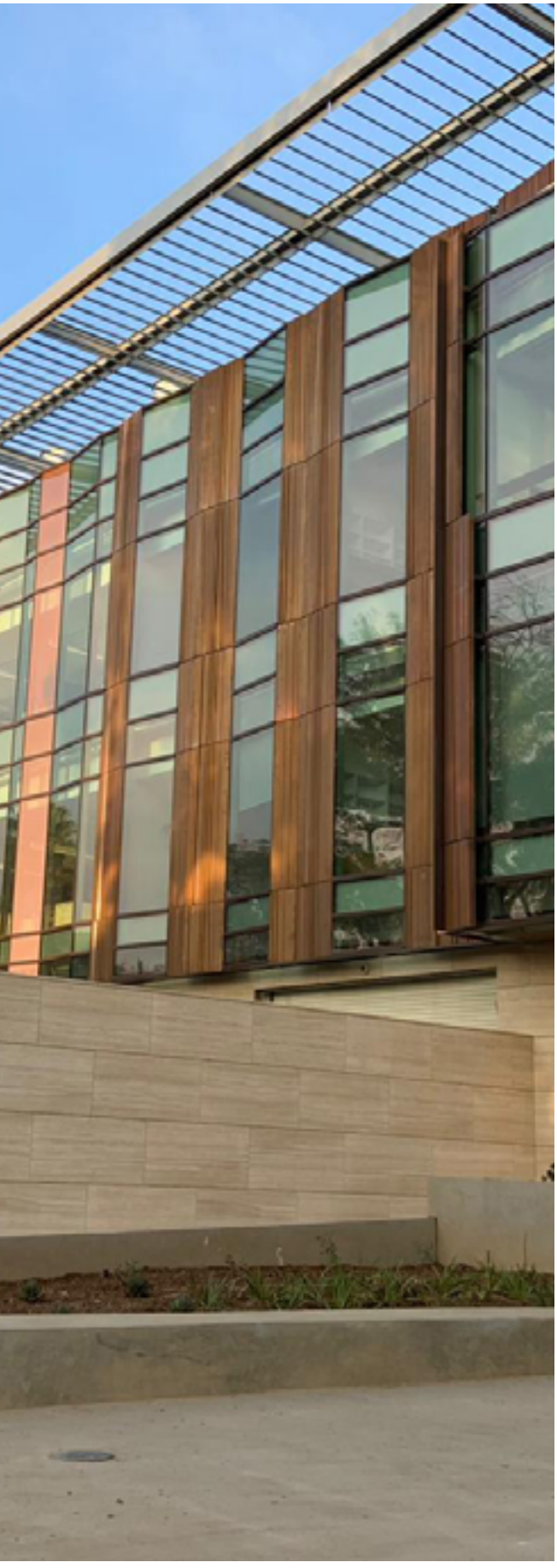
An acute understanding of fundamental brain processes offers multiple windows of opportunity to leverage and enhance brain capacity, with three areas of focus:

- First, we are committed to studying the relationship and interaction between the brain and machine. We are interested in perfecting a two-way neural communications via seamless, real-time brain machine interfaces that can record and decode intentions from neural patterns, with no side effects.
- Second, neural interfaces that can augment human capabilities. Together with technologies such as AR or VR, brain machine interfaces can enhance neurorehabilitation, create virtual sensation and push the boundaries of brain performance in areas such as learning, memory and concentration.
- Third, research in neural mechanisms, cognition architectures and brain machine interfaces can lead to new insights in artificial intelligence, helping us design novel learning models that mimic the layers of neuronal activity within our brains, training machines and robots to be more intelligent.

Cornerstone Partnerships

We partner with the world's leading institutions to accelerate brain research.

We forge long-term cornerstone partnerships with leading universities and institutions by providing bespoke programmatic support such as endowed institutes, professorships or topic-specific programs. Each partnership is a platform for discovery that brings together great minds in the brain science ecosystem.



Tianqiao and Chrissy Chen Institute for Neuroscience at Caltech

The Tianqiao and Chrissy Chen Institute for Neuroscience at Caltech, founded in 2016, brings together a cross-disciplinary team of scientists and engineers to investigate one of today's greatest challenges and opportunities: understanding the brain and how it works. Together, these researchers are probing the most sophisticated biological and chemical computing machine and advancing the most promising ideas from that work.

Visit the Caltech Website

Endurance, Change and Vision: The Caltech Chen Neuroscience Research Building

Copper and LEED certification help this intelligent neuroscience research building foster cross-disciplinary collaboration.

Recognition

Four TCCI-affiliated Caltech Researchers among Five to Receive NIH High-Risk, High-Reward Awards

Four TCCI-affiliated faculty members were awarded grants from the High-Risk, High-Reward Research (HRHR) Program of the National Institutes of Health (NIH).

Viviana Gradinaru Among Caltech Faculty Members Named as AAAS Fellows

Viviana Gradinaru, Professor of neuroscience and biological engineering and director, Center for Molecular and Cellular Neuroscience at Caltech was named a fellow of the American Association for the Advancement of Science (AAAS) for "extraordinary achievements in bioengineering and neuroscience.

Magdalena Zernicka-Goetz Receives Prestigious Developmental Biology Honors – Caltech

The Society for Developmental Biology awarded its 2022 Edwin G. Conklin Medal to Magdalena Zernicka-Goetz, Bren Professor of Biology and Biological Engineering and TCCI-affiliated faculty member.

Tianqiao and Chrissy Chen Institute for Translational Research

The Tianqiao and Chrissy Chen Institute for Translational Research was established in April 2018 in partnership with the Shanghai Zhou Liangfu Medical Development Foundation and Fudan University-affiliated Huashan Hospital. Shanghai Mental Health Center then joined the alliance which focuses on brain disease research and strengthening translational research between clinical and fundamental research. In October 2019, the center released a three by four strategy: three verticals (brain-machine interface, digital medicine and sleep) and four dimensions of breakthroughs (scientific research; standards formulation; integration of production, study and research; talent development.)

TCCI Investigator Tiger Tao and Jintai Yu listed as Highly Cited Chinese Researchers

In mid-2022, Elsevier, the academic publishing company, announced their 2021 list of Highly Cited Chinese Researchers. Two TCCI investigators, Tiger Tao and Jintai Yu, made it on the list.

Tiger Tao wins 2021 Young Scientist of the Year Award from Chinese Academy of Sciences

In early 2022, the Chinese Academy of Sciences announced that Tiger Tao, Investigator of the Shanghai Institute of Microsystem and Information Technology, TCCI Investigator, and founder of brain computer interface start-up, NeuroXess, was named 2021 Young Scientist of the Year.

Chen Frontier Labs

Chen Frontier Labs are unique interdisciplinary R&D laboratories that form a central component of the philanthropic activities of the Tianqiao and Chrissy Chen Institute. Each Chen Frontier Lab operates with a distinct topical focus but they are united by a vision to improve humanity by solving important problems of the brain and mind.

Vision

To enrich people's lives with brain- and mind-related technology.

Mission

To build the world's first laboratory focused on identifying, validating, and incubating neuroscience research.

Tianqiao & Chrissy Chen Investigators

Tianqiao & Chrissy Chen Investigators are accomplished academic experts who help to advance the Chen Frontier Labs' exciting mission by contributing their leadership and expertise. Chosen by an international selection committee, these are successful mid-career engineers or scientists (typically at the Associate Professor level) who have substantial technical expertise related to the Chen Frontier Lab's core areas of focus.

Chen Investigators will oversee and participate in technology validation efforts that can lead to commercial incubation. At the end of their tenure, Chen investigators will typically return to their home institution, although staying on to help with incubation is possible if mutually desired.

World Artificial Intelligence Conference Holds First Brain Computer Interface Forum

In September 2022, TCCI worked with Shanghai Institute of Microsystem and Information Technology, NeuroXess, Chinese Neuroscience Society and Shanghai Society for Neuroscience to host a first-of-its-kind forum called "BCIs Usher in A New Future for Human Brain."

Forum: Neurotechnologies that Connect Music with the Brain

TCCI and the Shanghai Conservatory of Music co-hosted an international Forum on "Neurotechnologies that Connect Music with the Brain" in November 2022. Leading scientists and musicians from China, United States, Germany, Britain, and Ireland shared their views.

Webinar: Neurotechnology for Mass Populations

In September 2022, TCCI hosted the International Forum on "Neurotechnology for Mass Populations" featuring five renowned scientists from China, the United States, Germany, the Netherlands and Singapore who shared their insights and perspectives on the topic.

Supporting Scientists

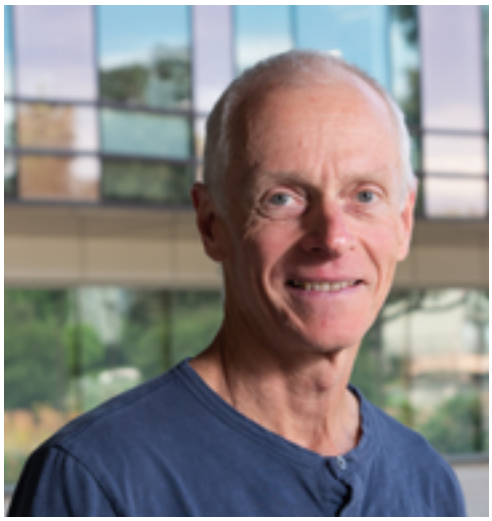
Principal Investigators

David Anderson

Director of the Tianqiao and Chrissy Chen Institute for Neuroscience at Caltech

Richard Andersen

Director of the T&C Chen Brain-Machine Interface Center



Ralph Adolphs

Director of the Caltech Brain Imaging Center

Colin Camerer

Director of the T&C Chen Center for Social and Decision Neuroscience

Viviana Gradinaru

Director of the Center for Molecular and Cellular Neuroscience

Ying Mao

President of Huashan Hospital, Director of the Tianqiao and Chrissy Chen Institute for Translational Research

Carlos Lois

Director of the Chen Center for Neuroscience Education

Liangfu Zhou

Vice Chairman of Translational Research, Academician of Chinese Academy of Engineering, Director of Neurosurgery Department of Huashan Hospital

Tiger H. Tao

Vice President of Shanghai Institute of Microsystems and Information Technology (SIMIT), Founder of NeuroXess

Chunbo Li

Vice President, Shanghai Mental Health Center; Vice President, Institute of Psychology and Behavioral Science, Shanghai Jiao Tong University

Zhili Huang

Director of Department of Pharmacology of Shanghai Medical School, Fudan University, President of Chinese Sleep Research Society

Yanyan Huang

Professor, Director of General Medicine, Deputy Director of Geriatric Department, Huashan Hospital

Wei Zhu

Professor, Deputy Director of Neurosurgery Department, Huashan Hospital

Jintai Yu

Professor, Deputy Director of Neurology Department, Huashan Hospital

Zhi Yang

Professor, Shanghai Mental Health Center; Professor, Institute of Psychological and Behavioral Sciences, Shanghai Jiao Tong University

Liang Chen

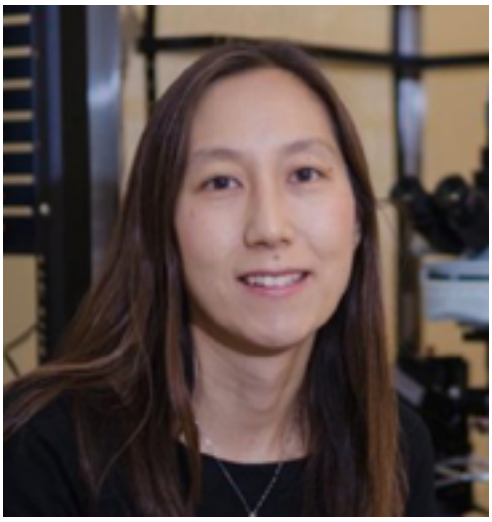
Professor, Deputy Director of Neurosurgery Department, Huashan Hospital

Tifei Yuan

Executive Director of Brain Health Institute, Shanghai Mental Health Center (SMHC)

Huan Yu

Associate Professor of Neurology Department at Huashan Hospital, Fudan University; Director of Sleep and Wake Disorders Center at Fudan University



Elizabeth J. Hong

Clare Boothe Luce Assistant Professor of Neuroscience

Supporting Scientists

Chen Scholars

Joseph Parker

Assistant Professor of Biology and Biological Engineering; Chen Scholar

Dean Mobbs

Professor of Cognitive Neuroscience; Allen V. C. Davis and Lenabelle Davis Leadership Chair, Caltech Brain Imaging Center; Director, Caltech Brain Imaging Center

Yuki Oka

Professor of Biology and Chen Scholar

Supporting Scientists

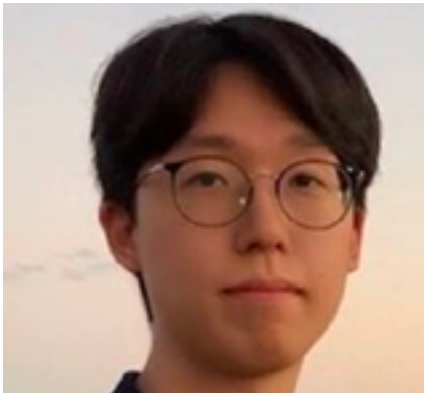
2022 Graduate Scholars

Yun Chiu

Chen Graduate Fellow;
Neurobiology

Honami Tanaka

Chen Graduate Fellow;
Neurobiology



Wongyo Jung

Chen Graduate Fellow;
Neurobiology

Aman Bhargava

Chen Graduate Fellow;
Computation and Neural
Systems

Yingxi Jin

Chen Graduate Fellow; Computation and Neural Systems

Nathaniel Nyema

Chen Institute Director's Fellow; Computation and Neural Systems

Panagiota Loizidou

Chen Graduate Fellow; Computation and Neural Systems

Supporting Scientific Meetings and Conferences

Since its inception, TCCI® has supported a wide range of conferences and meetings in North America, Asia and Europe because we believe there is great power in face-to-face meetings which can spark new conversations and collaborations. TCCI® is currently accepting funding requests for conferences, meetings and workshops that are relevant to our mission. And if you'd like to know what's being discussed at other meetings, check out our Chen Science Writer meeting reports.

Meeting Organizers We Work With

Listed here are just some of the conference and meeting organizers we are happy to support in order to facilitate scientific collaboration and information sharing.

ACII 2022

Carnegie Mellon University

Arizona State University

Chapman University

Australasian Neuroscience Society

Chinese Neuroscience Society

Boston Children's Hospital

Chinese Sleep Society

CAJAL Advanced Neuroscience Training

Cognitive Computational Neuroscience

Cold Spring Harbor Laboratories

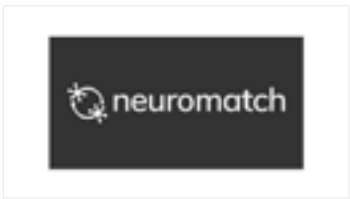
FENS

Molecular Psychiatry Association

University of Southern California

Columbia University

Imperial College of London



Neuromatch Academy

European Brain and Behaviour Society

International Regulatory Peptide Society

Science AAAS

European Brain Council

International Society for Research on Emotion

Society for Neuroscience

eWear

Japan Neuroscience Society

UMass Chan Medical School

Chen Science Writer Fellowship

The Chen Science Writer Fellowship helps to extend the value of discussions taking place at science meetings and conferences by summarizing the conversation, highlighting key themes and promoting innovative research presentations.

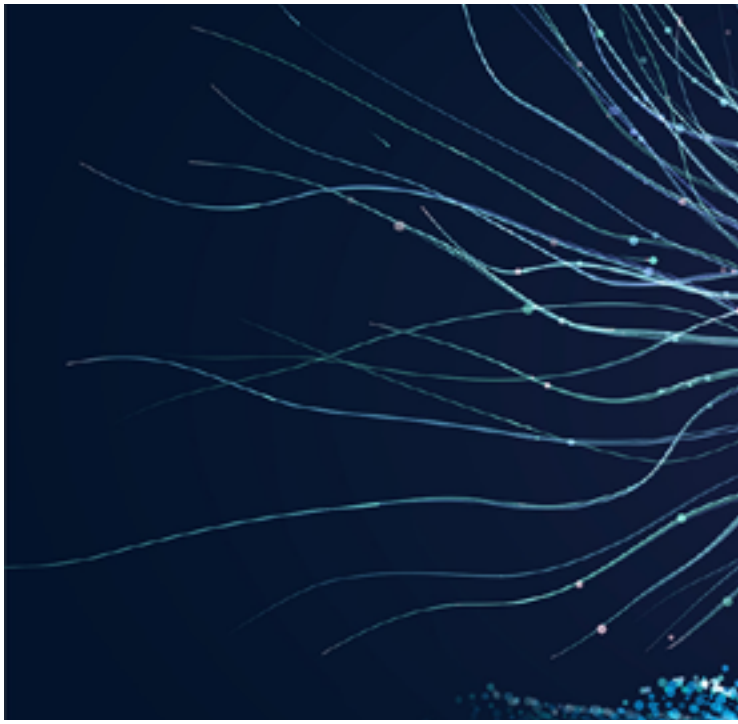
Program objectives:

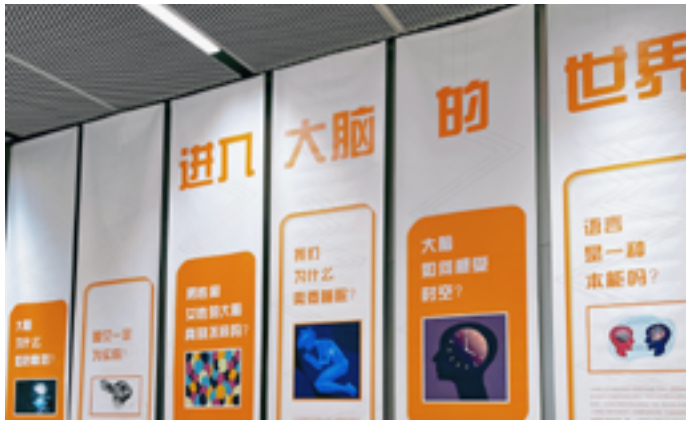
- To increase the value of the scientific discussions at each meeting beyond just those who attended.
- To offer exposure to the young scientists writing the meeting reports.
- To spark new interdisciplinary dialogue and partnerships.

Funding for Chen Science Writers covers entrance fees and travel to and from the meeting. Candidates apply through an open call that conference or meeting organizers post and disseminate. The Fellowship recipient, who is selected by the Committee, will receive practical guidance, advice and mentorship from conference committee members.

Science Education & Advocacy

Increasing support for fundamental brain science. Scientists are making significant progress in unlocking the mysteries of the human brain but more support is needed if we are to achieve the breakthroughs we are closer than ever to achieving. TCCI® advocates for more support from other philanthropists, thought leaders and engaged members of the public.





The Tianqiao & Chrissy Chen Institute welcomed thousands of people to "Popular Science," an interactive exhibition about the latest developments in brain science and key TCCI initiatives held at the East Branch of Shanghai Library in October, 2022.

Read more detail

The Chen Institute Brain & Mind Lectures series held its inaugural event at the California Academy of Sciences in April 2022. The series brings leading experts in to educate and explore advances in brain science and mind health in the rapidly changing world.

Watch the inaugural lecture

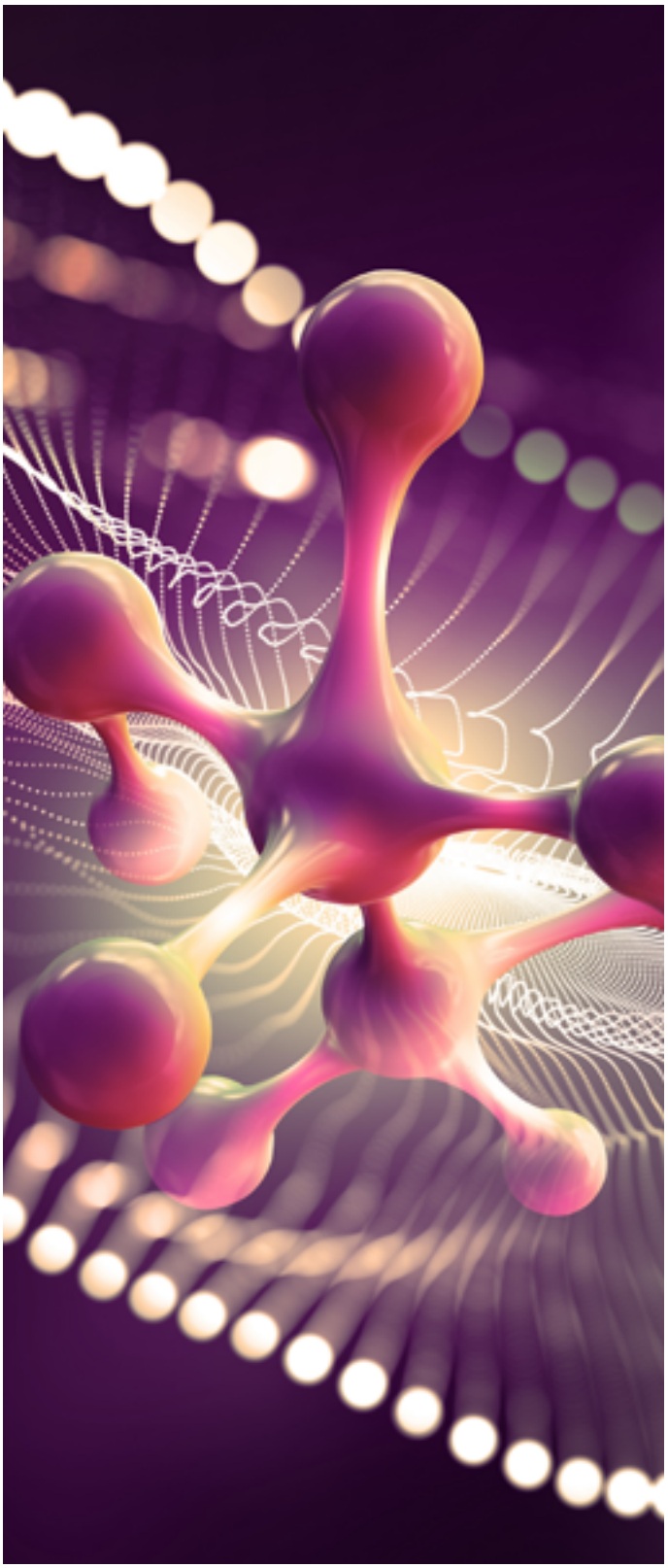
Minds Wide Open, a documentary commissioned by TCCI® to showcase exciting advances brain science around the world, won eight international awards after its debut in 2018, showing just how much interest and excitement there is regarding brain science.

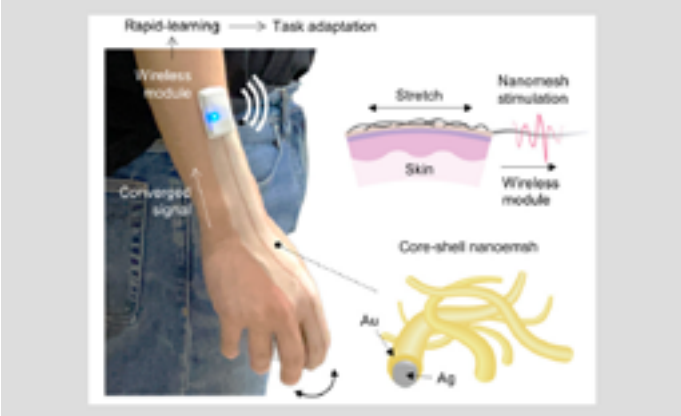
Watch the film for free

To help promote the Chen Frontier Lab for A.I. and Mental Health, TCCI released a short film in February 2022 which explores what we do and don't know about human cognition. The Institute worked with kurzgesagt GmbH, the creators of the popular Youtube series In a Nutshell to produce the video.

Watch the video

2022 Research



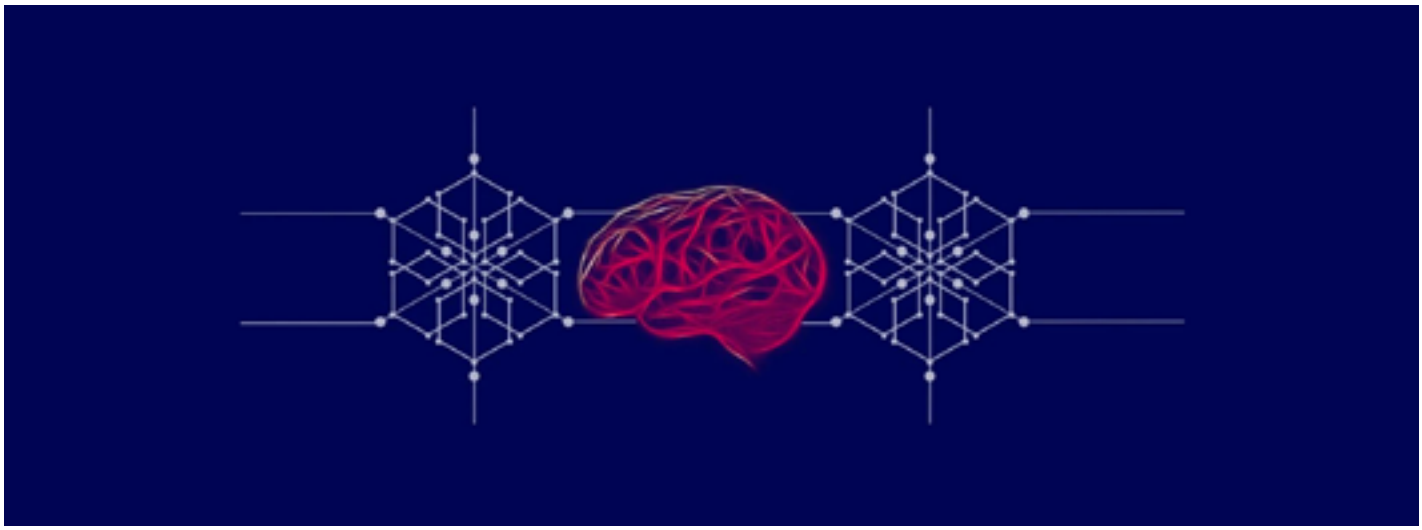


Spray-on smart skin uses AI to rapidly understand hand tasks

A new smart skin developed at Stanford University might foretell a day when people type on invisible keyboards, identify objects by touch alone, or allow users to communicate by hand gestures with apps in immersive environments.

Gut Microbes Influence Binge-Eating of Sweet Treats in Mice

A Caltech study shows that the absence of certain gut bacteria causes mice to binge eat palatable foods: Mice with microbiotas disrupted by oral antibiotics consumed 50 percent more sugar pellets over two hours than mice with gut bacteria.



Toward a fully implantable ecosystem for adaptive neuromodulation in humans

Recently, Gerwin Schalk, Director of the Chen Frontier Lab for Applied Neurotechnology which is affiliated with the Tianqiao and Chrissy Chen Institute (TCCI), was the lead author on an article which describes initial work done towards creating an ecosystem for adaptive neuromodulation in humans.

Brain-Machine Interface Device Predicts Internal Speech

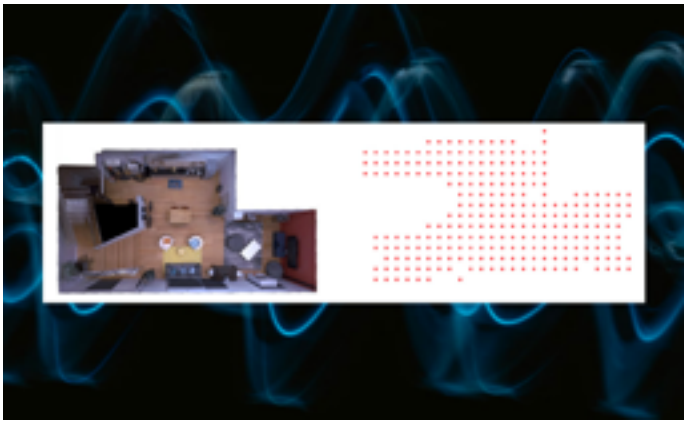
Caltech research shows how BMI devices implanted into people's brains could one day help patients who have lost their ability to speak. Researchers demonstrated that they could use a BMI to accurately predict which words a tetraplegic participant was thinking (not speaking or miming).

TCCI Investigator Identifies Important Switch for REM Sleep

Professor Huang Zhili, Director of the Department of Pharmacology at Fudan University and TCCI investigator, published a study in the journal Cell Discovery, reporting a new nucleus that can terminate REM sleep and its neural circuit mechanism.

TCCI Investigator Yu Jintai's team Reveals the Correlation between Muscle Health and Dementia

Professor Yu Jintai at Fudan University-affiliated Huashan Hospital and TCCI investigator published a study in the journal Alzheimer's & Dementia entitled which aims to shed more light on the correlation between grip strength, walking pace and dementia.



Using sound to model the world

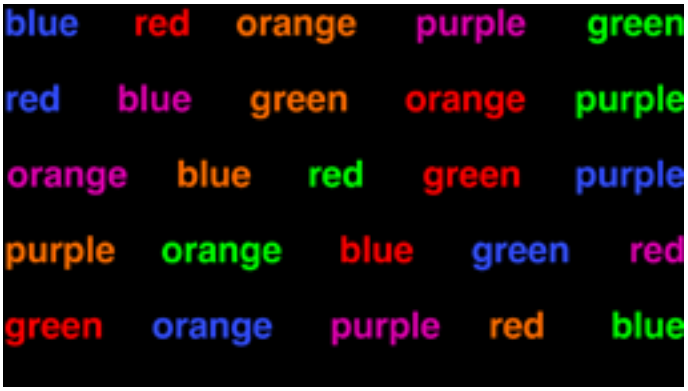
Researchers at MIT and the MIT-IBM Watson AI Lab are exploring the use of spatial acoustic information to help machines better envision their environments. Their machine-learning model can capture how any sound in a room will propagate through the space.

TCCI Researcher Develops New Dementia Risk Prediction Model

Professor Jintai Yu at Fudan University-affiliated Huashan Hospital and TCCI researcher, co-authored a paper titled which aims to develop a novel dementia prediction model to improve early identification of the disease among high-risk populations.

TCCI Investigator Jintai Yu Publishes First Study on Correlation between Serum Clinical Laboratory Tests and Dementia

Professor Jintai Yu, at Fudan University-affiliated Huashan Hospital, published a cohort study in Translational Psychiatry with 407,190 individuals which was designed to investigate the association of common serum laboratory tests with the risk of incident dementia.



A Behavioral Test to Detect Early Risk of Alzheimer's

A team from Caltech and the Huntington Medical Research Institutes made progress towards developing a simple behavioral test to measure an individual's risk of developing Alzheimer's before any symptoms arise.

Friend or Foe? How Mice Decide to Make Love or War

A study from Caltech examined how a male mouse sniffing a newly encountered fellow mouse decides whether to "make love or war" (or neither). The research revealed the neural circuitry that connects olfactory information to decision-making points in the mouse brain that determine its behavior.

TCCI Investigator Jintai Yu's Team Reveals Distribution and Risk Factors of Alzheimer's Disease Continuum in Northern Chinese Han Population

Professor Jintai Yu at Fudan University-affiliated Huashan Hospital conducted research to analyze the distribution and risk factors of Alzheimer's Disease (AD) continuum in northern Chinese Han population in the journal Annals of Neurology.

How Fruit Flies Sniff Out Their Environments

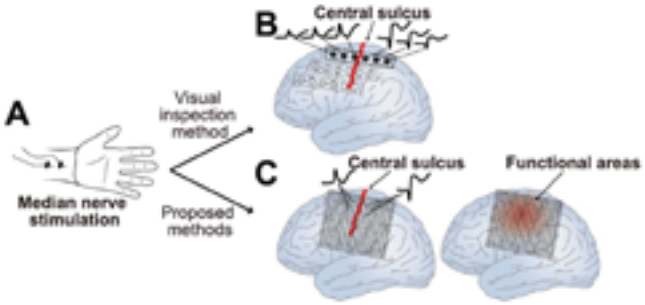
A Caltech study revealed that fruit fly olfactory neurons—responsible for sensing chemical "smells" such as CO2—have the ability to talk to each other through a previously undiscovered pathway. The work provides insights into the fundamental processes by which brain cells communicate with one another.

Caltech to Study How the Brain Responds to Virtual Environments

The rise of social media has meant that social and professional interactions are increasingly online. To understand how the human brain is affected by this shift, Professor Dean Mobbs is leading a new project that will explore the relationship between social media use and mental health.

A Large-Scale Prospective Cohort Study on Dementia Reveals Three Cups of Tea Per Day Produces the Strongest Protective Effect

To investigate the association between tea consumption and the risk of dementia, Professor Jintai Yu, at Fudan University-affiliated Huashan Hospital conducted a large-scale prospective cohort study with over 370,000 participants during a 9-year period.

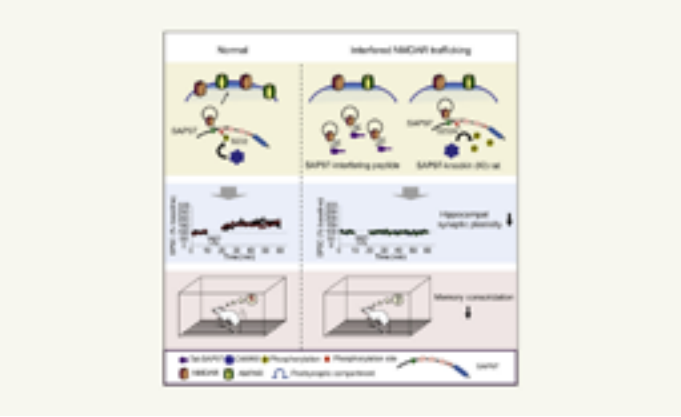


Automated intraoperative central sulcus localization and somatotopic mapping using median nerve stimulation

Dr. Gerwin Schalk, Director of the Chen Frontier Lab for Applied Neurotechnology, and researchers from other universities developed a new, automated procedure that uses median nerve stimulation (MNS) to rapidly localize the central sulcus and create somatotopic maps.

Cataracts May Increase Risk of Incident Dementia: A Prospective Cohort Study by Chinese Scholars

Professor Jintai Yu of Fudan University-affiliated Huashan Hospital and a collaborative team surveyed over 300,000 participants between the ages of 37 and 73 looking into the association between cataracts, the surgical treatment for cataracts and the risk of dementia.



Cell Reports: Wei Lu and Tifei Yuan Collaborate on Research in New Mechanism behind Synaptic Plasticity and Memory Consolidation

Research done by Dr. Wei Lu from Fudan University and Southeast University and Tifei Yuan, a TCCI Investigator and professor at Shanghai Jiao Tong University, analyzed the function of postsynaptic NMDA receptor (NMDAR) membrane trafficking.

Good Sleep, More Physical Activity, Fewer Sedentary Behaviors Can Reduce Risk of Dementia by 41%: A Cohort Study

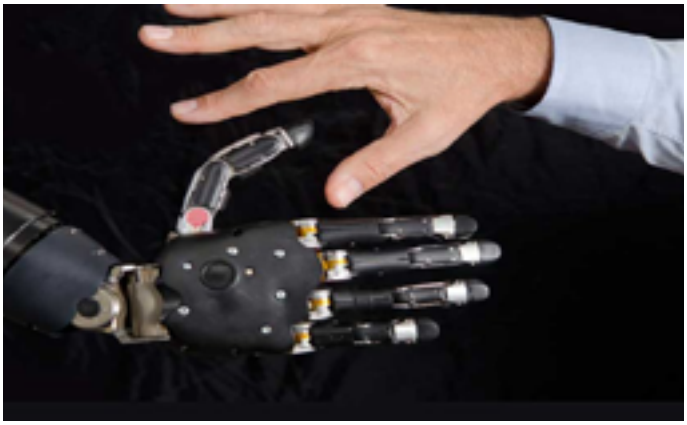
Chinese medical experts discovered that a combination of seven hours of sleep/day, moderate-to-high leisure-time physical activity (LPTA), and low-to-moderate sedentary behavior can reduce the risk of dementia by 41%.

TCCI® Investigator Jintai Yu's Team Reveals New Approach to Prevent Dementia, Insomnia and Depression

Chinese medical experts discovered through a cohort study including more than 430,000 participants that a combination of seven hours of sleep/day, moderate-to-high leisure-time physical activity, and low-to-moderate sedentary behavior can reduce the risk of dementia by 41%.

TCCI Investigator Yang Zhi Publishes Paper on a Technology Dynamically Tracking State Anxiety via Multi-modal Data and Machine Learning

Professor Yang Zhi, TCCI Investigator and a member of Jiao Tong University School of Medicine affiliated Shanghai Mental Health Center Shanghai recently published a paper in Frontiers in Psychiatry, which introduces a tracking model of state anxiety with high temporal resolution.

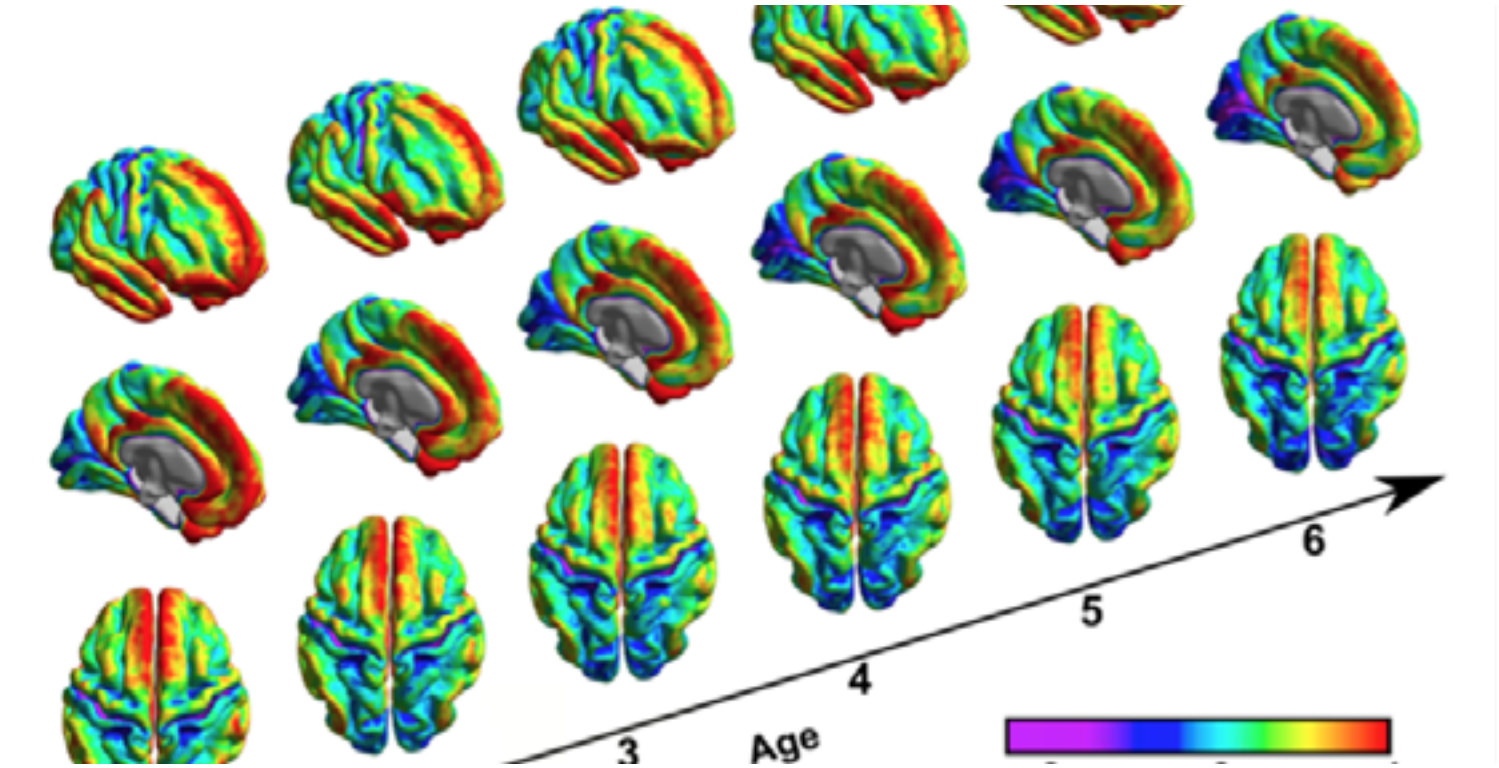


Decoding Movement and Speech from the Brain of a Tetraplegic Person

Caltech neuroscientists in the lab of Richard Andersen are studying how the brain encodes movements and speech, in order to potentially restore these functions to those individuals who have lost them.

New Insights into the Neuroscience Behind Conscious Awareness of Choice

A study from the laboratory of Richard Andersen, James G. Boswell Professor of Neuroscience, and Leadership Chair and Director of the T&C Chen Brain–Machine Interface Center, gives new insights into how the brain encodes for our choices about movement.



Chinese Scientists Draw Growth Curve of Golden Phase of Brain Development for the First Time

TCCI Investigators, Professor Yang Zhi and Professor Yuan Tifei and other co-authors jointly published the first growth curve model of the brain development of children aged one to six years old based on the accumulation of imaging data from children over the past decade.

Promoting computational psychiatry in China

In a paper recently published in the journal Nature Human Behavior, TCCI scientist and Director of Academic Operations, Haiyang Geng and his colleagues discuss why China needs computational psychiatry and why its development in China will benefit the field globally.

How Gut Neurons Communicate with the Brain to Control Thirst

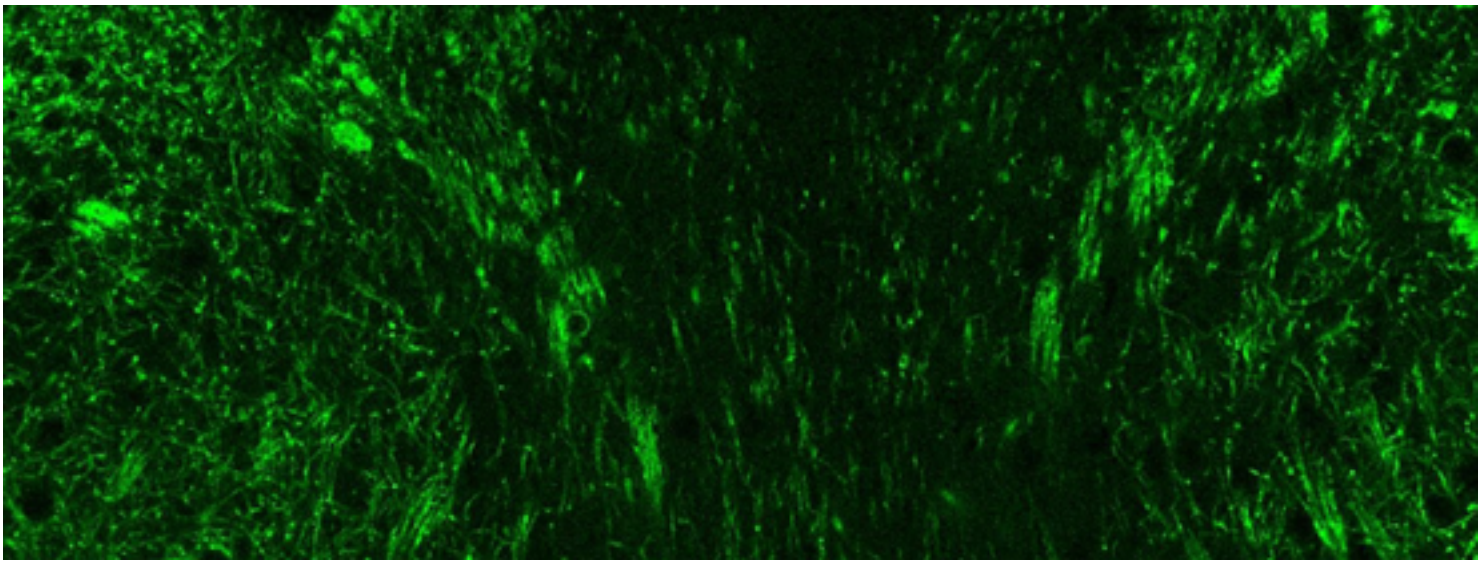
Caltech biologist Yuki Oka and his team have worked to learn more about the gut-to-brain osmolality signaling that regulates thirst and his team has discovered the major sensory pathway that mediates this process.

Risk Factors for non-suicidal self-injury (NSSI) in adolescents: A meta-analysis

Professor Yuan Tifei, TCCI Investigator at Shanghai Mental Health Center and a collaborative team published an article in eClinicalMedicine summarizing risk factors correlated to adolescent non-suicidal self-injuries which provides important references for the prevention and intervention of NSSI behaviors.

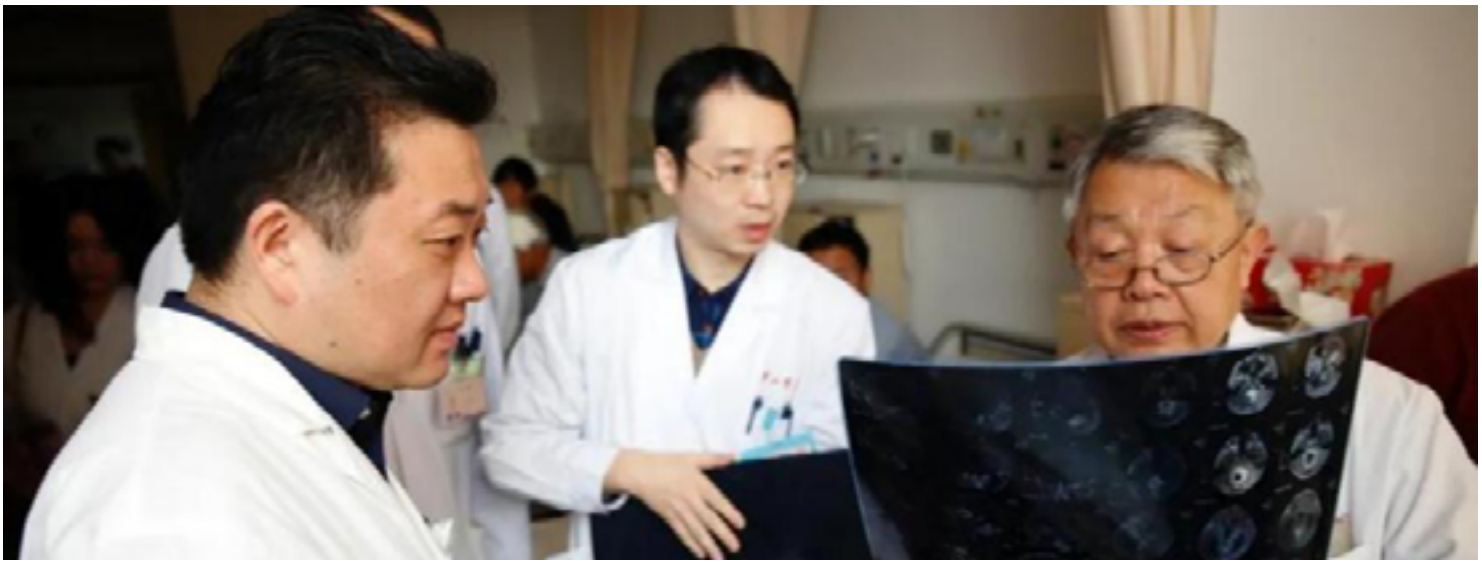
Tiger Tao's team develops bioinspired intelligent sensory system for rescue and recovery work

Tiger H. Tao, Deputy Director of Shanghai Institute of Microsystems and Information Technology (SIMIT) developed a "tactile-olfactory bionic intelligent mechanical hand", which can recognize 11 types of objects including a human body in search and rescue scenarios.



A Microbial Compound in the Gut Leads to Anxious Behaviors in Mice

Caltech researchers in the lab of Sarkis Mazmanian, Luis B. and Nelly Soux Professor of Microbiology have discovered that a small-molecule metabolite, produced by bacteria that reside in the mouse gut, can travel to the brain and alter the function of brain cells, leading to increased anxiety in mice.



Modern Neurosurgery (3rd Edition), Published under General Editorship of Academician Liangfu Zhou

Modern Neurosurgery was updated by Fudan University Press under the editorship of Liangfu Zhou, Director of National Medical Center of Nerve Diseases, Director of the Neurosurgery Department of Huashan Hospital and Vice Chairman of Translational Center of the Tianqiao and Chrissy Chen Institute.

2022

Follow us: