# SCI-TECH

*"My wish is to stay always like this, living quietly in a corner of nature."*
**CLAUDE MONET** IMPRESSIONIST PAINTER

## Researchers head NSF center studying human-robot interactions

**BY ISABELLA TRAN AND RIYASHI VARIA**
CONTRIBUTING REPORTERS

Yale researchers are helping to establish a field of study investigating how humans and robots mutually influence behavior through long-term interactions.

A $30 million grant from the National Science Foundation, awarded to "exceptionally innovative, complex research," helped to establish a new Science and Technology Center last July. It brings together researchers across six universities and industry partners including Amazon, Google DeepMind and NVIDIA. Brian Scassellati, a professor of computer science, is a co-principal investigator leading the center.

"The center is focused around the idea of how is it that when we put robots out there in the world, how do the robots adapt and change so that they can best address the needs of the people that they work with, and also how do the people change as a result of that," Scassellati said.

Past human-robot interaction research typically held one side constant: researchers either kept the robot's behavior fixed while studying human responses or had people repeat the same actions while the robot learned.

The new center will examine what happens when both change simultaneously.

"And this new project, the STC, is actually trying to break that assumption and see how both the robot and the human can change and adapt in tandem — that's what we call co-adaptation," said Marynel Vázquez, an assistant professor of computer science.

The need for that collaboration stems from a growing problem in robotics: robots are increasingly being developed for environments that cannot be reduced to controlled laboratory experiments.

A robot in a home or workplace must respond not only to what one person explicitly tells it, but also to the constantly changing social environment around it.

"If I put a robot in a public setting, in a museum, in a university campus, in a workplace, even in a home, then there's probably going to be multiple people," Vázquez said. "And the behavior of the robot may not just influence one person, but it actually may influence how people interact with other people nearby."

She described that possibility as a "ripple effect," in which a robot's behavior influences relationships and interactions beyond its immediate user. As a result, researchers in the new center are looking beyond the individual robot-user relationship and toward the broader environments in which robots operate.

According to Vázquez, understanding those environments requires expertise that extends beyond computer science and robotics. The Yale team — which includes seven faculty members — brings together researchers in engineering and computer science with scholars in psychology, cognitive science, sociology and public health.

The range of disciplines within the center is intended to allow researchers to study not only how robots learn, but also how people perceive them, and how their presence can alter group behavior. The center will also collect data across different environments, something Vázquez said is not typical of human-robot interaction research.

Vázquez said the center will allow researchers to connect those different perspectives in ways that smaller projects cannot.

"The fact that you can now have that network, share what you're discovering, say at Yale, with this big crowd of people, get feedback, collaborate with them to validate hypotheses, sites, and things like that is something that is really only possible because of the magnitude of this center," Vázquez said.

Before the center was established, Vázquez studied human-robot interaction at the Yale Peabody Museum, where researchers had the opportunity to conduct their research in an open, public environment.

During the summer, researchers placed a robot near museum exhibits and used it as a photographer, allowing visitors to interact with it and have the robot take their photo.



COURTESY OF SASHA LEW

Through a $30 million National Science Foundation grant to create a Science and Technology Center, Yale professors Brian Scassellati and Marynel Vázquez will help lead the newly established Center for Human and Robot Co-Adaptation.

"It was a very simple interaction, and that was great because the simplicity of it allows us to see how rich the social context of the museum is," Vázquez said.

The simplicity of the robot's task allowed researchers to observe the social environment around it rather than focusing on a complicated robotic function. Vázquez said the interactions demonstrated how much can happen around a robot even when the robot itself is performing a relatively straightforward task.

In another past experiment, Scassellati recalled deploying a dragon-like robot in a kindergarten classroom for a month to teach children about nutrition. When researchers returned to remove it, a teacher warned that the children viewed the robot as part of their class and would need help understanding its departure. Following her advice, the team arranged a going-away party and exchanged postcards between the robot and the children.

Vázquez said one goal for the future is to build robots that can respond not only to explicit instructions but also to the subtler signals people provide during interawctions. Humans, she noted, constantly communicate information through their reactions and behavior even when they are not deliberately providing feedback to a robot.

Learning to interpret that implicit feedback, Vázquez added, could allow robots to adapt more effectively to the people around them. But the same principle applies beyond individual interactions: a robot's behavior can influence relationships among the people who encounter it.

"Robots are an interesting sort of middle ground," Scassellati said. "They're real things in our real world, not something you see on a screen, not just something imaginary. But sometimes we treat them like objects, and sometimes we treat them like agents."

Scassellati emphasized that objects are treated as if they lack thoughts, beliefs and knowledge, but agents are interacted with differently.

For the researchers, studying these effects is part of preparing for a future in which robots are not confined to factories or laboratories but become participants in everyday environments.

Scassellati said the accelerating pace of technological adoption leaves researchers with less time to understand its effects before it becomes widely used. For example, Scassellati described how ChatGPT gained 1 million users within a few days of release, and the effects of the diffusion of similar technologies are not properly understood ahead of time.

The center aims to help researchers anticipate those effects during the design process.

"That's the kind of thing we're hoping to be able to study, so that not only can we predict those things, you know, when they're about to happen, but also so that we can shape them so that they don't have unintended consequences," Scassellati said.

The first digital, programmable modern robot was invented in 1954.

*Contact*
**ISABELLA TRAN** *at*
*i.tran@yale.edu and*
**RIYASHI VARIA** *at*
*riyashi.varia@yale.edu.*

## Yale New Haven Hospital celebrates two centuries of care

**BY YOO-MIN KOH**
CONTRIBUTING REPORTER

Two centuries after opening its doors as a charitable institution, Yale New Haven Hospital is preparing for another period of expansion in New Haven.

Across those 200 years, the hospital has grown from an institution founded to care for the sick into a major academic medical center that has wrought developments in chemotherapy, antibiotics and prenatal diagnosis. An expansion to the hospital's Saint Raphael campus expected next year will add heart and vascular facilities and nearly double emergency room capacity.

"The hospital was founded as a charitable institution in 1826 on the basic principle that care for the sick was a public responsibility," Alan Friedman, the chief medical officer of YNHH, said.

The first permanent building, originally called the State Hospital, contained just 13 beds and cost $13,000. It served the busy sailors of the New Haven seaport, eventually expanding in its care to more than 25,000 soldiers in the Civil War.

Its original mission, Friedman explained, contained three central goals: providing comfort and care to people suffering from illness, educating those learning to practice medicine and benefiting the broader community.

"They remain an essential part of who we are as an organization in 2026," Friedman said.

By the time Friedman arrived in 1991 as a pediatric cardiology fellow, he said, the hospital was already entering another period of change.

The Yale New Haven Children's Hospital opened in 1993. Friedman described it as the first hospital in Connecticut whose sole mission was providing care for infants, children, adolescents and young adults.

The hospital's history has also been shaped by an increasingly close relationship with the Yale School of Medicine.

In the early 1990s, the hospital and medical school shared objectives but operated more independently than they do today. Over the following decades, greater alignment between the two institutions strengthened the connection between laboratory research and clinical treatment, according to Friedman.

"Those discoveries — those innovations — are then brought to the bedside of patients in the hospital," Friedman said.

Some of those discoveries became milestones in modern medicine.

In 1942, Yale researchers Alfred Gilman '62 and Louis Goodman worked with physician Gustaf Lindskog to bring an experimental cancer treatment from the laboratory to a patient at Yale New Haven Hospital. The work helped launch what became the era of clinical chemotherapy.

That same year, penicillin was used clinically in the United States for the first time at the hospital. A patient who was gravely ill with a bacterial infection that had entered her bloodstream received the antibiotic after other treatments had failed, and ultimately recovered.

Another development began decades later with an idea from Yale medical student Frederick Morin MED '76. In the 1970s, Morin proposed using the still-emerging technology of ultrasound to examine the developing fetal heart. Working with physicians including John Hobbins, Norman Talner and Charles Kleinman, the project helped establish the field of fetal echocardiography and the prenatal diagnosis of congenital heart disease.

That history eventually directly guided Friedman's career path. Advances in fetal cardiology at Yale were part of what attracted him to New Haven, where he later trained with Kleinman and Talner and is now a professor of pediatric cardiology.

The hospital's physical footprint has expanded alongside its clinical work. In 2012, Yale New Haven Hospital acquired the Hospital of Saint Raphael in the city's Dwight neighborhood, creating another major campus in the city. That campus is now at the center of one of the hospital's largest current expansions.

Emily Jameyfield, an emergency medicine physician who grew up in the New Haven area, said the construction at the Saint Raphael campus is among the most visible changes she has witnessed.

"There's a whole new tower being built there for neurosciences, and we're also building an entirely new emergency department," Jameyfield said.

The Adams Neurosciences Center is scheduled to open at the end of February 2027. Friedman said it will expand neurosurgery, advanced neuroimaging, neurological intensive care and rehabilitation services while bringing together specialists in neurology, neurosurgery, psychiatry and related fields.

Jameyfield's early experiences at YNHH directly influenced her decision to pursue a medical career.

At age 15, she recalled the experience of her mother driving her to the hospital and volunteering for a program providing patients with free books and magazines. After her first day, Jameyfield announced that she never wanted to work anywhere other than a hospital.

Years later, she returned to Yale New Haven as a physician.

Being able to care for patients and educate medical students and residents during the hospital's bicentennial feels "rewarding," she said, because the same institution played a role in shaping her own career in medicine.

"It feels like things have really come full circle in my own life and career," Jameyfield said.

For current Yale students, new relationships with the hospital and its patients are being built through volunteering.

Daniel Lee '29, who has been volunteering at YNHH since April, said he has had meaningful experiences interacting with a diverse range of patients.

"You meet patients who come from many different backgrounds, and a lot of the time, they're not in the privileged position you enjoy by being a Yale student," Lee said. "By talking to them and hearing their stories, you can reflect on your own values and your own life."

As Yale New Haven Hospital begins its third century, Friedman said its buildings, technology and treatments will continue to change. What he expects to remain is the mission established at its founding.

YNHH has 1,541 licensed beds.

*Joseph Hwang contributed reporting.*

*Contact*
**YOO-MIN KOH** *at*
*yoo-min.koh@yale.edu.*



YULIN ZHEN / PHOTOGRAPHY EDITOR

Physicians and students reflect on the history of Yale New Haven Hospital's expansion, research advancements and role in educating future doctors. The hospital expects to increase its emergency room capacity through an expansion planned for next year.