Caltech

2025 Year in Review

DIVISION OF THE HUMANITIES AND SOCIAL SCIENCES

Bright Future

Featuring undergraduate summer research with HSS faculty

Credit: Bob Paz

GREETINGS from the Chair

It's been a challenging year. On January 7, 2025, the Eaton Fire tore through Altadena and surrounding areas, leaving hundreds of Caltech and JPL families without homes. Many others were displaced; surviving homes were uninhabitable. The long process of recovery continues against a backdrop of uncertainty and tumult in higher education in the United States.

The larger Caltech community has been an invaluable source of support in these times. So have the tools of our trades. In the halls of Baxter and Dabney, one can hear conversations about improving insurance markets, developing better policies for managing extreme weather events, and taking lessons from history. One hears discussions of literature and art and music and what they can teach us about human responses to tragedy. Just as questions about the world guide our research, perspectives from our research can help us navigate the challenges we face, whether it's recovery from disaster or a new policy landscape for research universities. The work highlighted in these pages reflects our shared aim to understand and improve the world we live in.

One of our most rewarding endeavors is introducing Caltech students to research in HSS, so that they, too, can develop the tools they'll need to face future challenges and to anticipate and prevent them where possible. I hope you'll find this year's special feature on students' summer research projects as inspiring as I do.

With best wishes to you and yours for this holiday season,

Tracy Dennison
Edie and Lew Wasserman Professor of Social Science History
Ronald and Maxine Linde Leadership Chair, Division of the Humanities and Social Sciences

How Different Learning Modes May Explain Problem Gambling

Learning happens at different speeds—fast learning helps us quickly adapt to sudden changes, while slow learning allows us to gather reliable knowledge over time. Fletcher Jones Professor of Decision Neuroscience **John O'Doherty** and his

colleagues explored whether an imbalance between fast and slow learning could contribute to poor decision-making in individuals with problem gambling habits. "The big picture for computational psychiatry is to start to understand dysfunction in terms of precise computational mechanisms that we can see operating in the brain," O'Doherty explained to *Caltech News*. "Perhaps then we can map those specific mechanisms to particular neural circuits that can potentially be modulated via brain stimulation methods or pharmacological interventions." The paper appeared in the *Journal of Neuroscience* in January, and the co-authors included former postdoctoral scholar in the O'Doherty lab **Kiyohito Iigaya**, who is now an assistant professor of neurobiology at Columbia University.

Remembering Jenijoy La Belle

Professor of English, Emeritus, **Jenijoy La Belle** passed away on January 28 at the age of 81. Born on November 5, 1943, in Olympia, Washington, she earned her BA from the University of Washington in 1965 and her PhD in English from UC

San Diego in 1969. La Belle specialized in the works of William Blake, William Shakespeare, and Theodore Roethke and explored themes of women's identity and physical appearance in 19th- and 20th-century literature. In 1969, she was the first woman hired into a tenure-track teaching position at Caltech, and she became the first woman to be awarded tenure at Caltech in 1977, a hard-won recognition of her academic achievements.

*La Belle teaching in the pool outside Caltech Hall in 1970.*

What Data-Driven Science Reveals About the Twisted Saga of Western Water Rights

During her time at Caltech, **Laura Taylor**, a former postdoctoral instructor in the social sciences, examined the complex relationship between Indigenous water rights and environmental degradation in the American West. She uncovered a troubling trend from analyzing satellite imagery and historical data: Pollution levels rise during prolonged legal battles over tribal water rights. While the 1908 U.S. Supreme Court ruling in *Winters v. United States* codified certain water rights for Native Americans, many tribes still struggle to enforce them. Taylor's research suggests that legal uncertainty discourages stakeholders from maintaining water quality, and her findings highlight the need for faster, fairer resolutions. "The federal government has taken a soft approach to these negotiations," she told *Caltech* magazine. "But we now have empirical evidence that this delay is actually harming the environment." Taylor, who has since joined the University of Miami as a faculty lecturer in the department of environmental science and policy, hopes her work will lead to policies that protect both Indigenous communities and the broader population reliant on these water sources.

The Cinema of Extractions

In his book published in February, *The Cinema of Extractions: Film Materials and Their Forms*, Professor of Visual Culture **Brian Jacobson** traces the deep connections between filmmaking and the extractive industries that power it. "My book aims to change how we look at films—not by looking at the films but by starting first with all the extracted materials that filmmaking required and the industries that were required to make these materials available," Jacobson explained to *Caltech News*. He examines how cinema has both depicted and depended on mining, oil drilling, and industrial production, especially in early Hollywood. Drawing from the environmental humanities, Jacobson argues that understanding film's material foundations reveals the broader social and ecological systems that make visual culture possible. On March 26, he shared this research with the Caltech community in an Earnest C. Watson Lecture. Media coverage of the book included an interview with Jacobson in *The Hollywood Reporter* and a review in *PopMatters*.

The
Cinema
of Extractions

Film Materials
and Their
Forms

Brian Jacobson
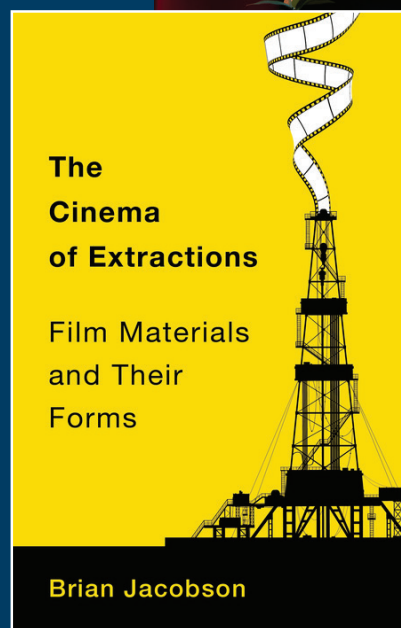
Is Competition Good for Trade?

A study led by Rea A. and Lela G. Axline Professor of Economics **Marina Agranov** shed light on how emotions like guilt and disappointment might influence the decisions of buyers and sellers. Agranov and her collaborators used a communication game in which one side (sellers) have information that the other side (buyers) need in order to make a good decision. Their study introduced payoffs and costs associated with psychological states in an attempt to test the role that emotions play in these interactions. "In the game that had no competition, emotions worked in the same direction as economic forces," Agranov said in an interview with *Caltech News*. "Boosting the moral character of interactions between sellers and buyers by imposing costs for guilt for lying and disappointment over being fooled led to more trade and better trade. But competition neutralizes the effectiveness of emotions.
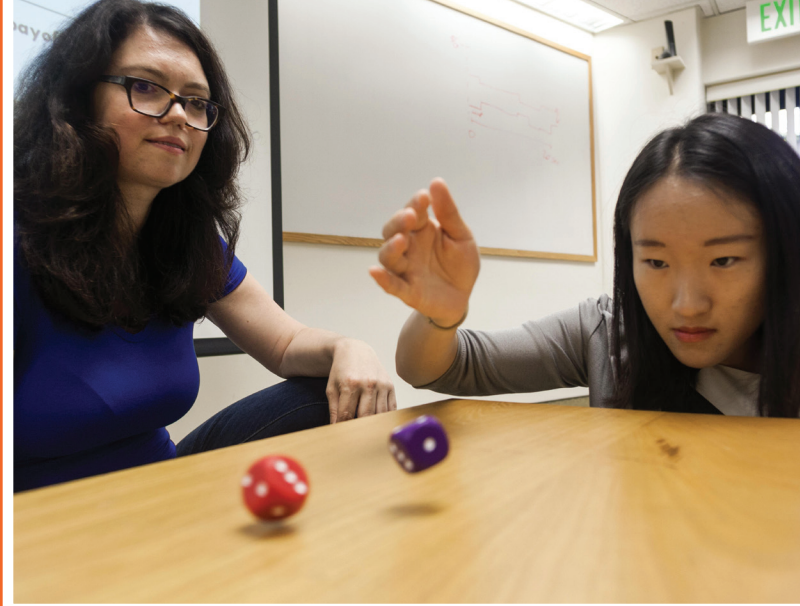
In essence, competition forces are stronger than psychological ones in competitive markets." The study, co-written with Utteeyo Dasgupta (Fordham University) and Andrew Schotter (New York University), appeared in the February issue of the *Journal of the European Economic Association.*

Modeling Violent Terrorism as a Tug-of-War Between Competing Groups

In a study published in the winter 2025 issue of *International Organization*, Professor of Political Science **Michael Gibilisco** and Casey Crisman-Cox (Texas A&M University) examine how competition between terrorist organizations affects levels of violence. Focusing on the rivalry between Fatah and Hamas from 1994 to 2018, they developed a mathematical "outbidding" model in which groups use violent attacks to vie for recruits, resources, and popular support. They argue that competition may either increase violence (an "encouragement effect") or suppress it (a "discouragement effect"), depending on group dynamics. This knowledge can help policymakers choose approaches that are more likely to decrease violence. Gibilisco explained to *Caltech News*, "Policymakers need to be sensitive to how competition and the relative popularity of different terrorist groups means that the same disincentives to terrorist violence, such as increasing the cost of attacks, may not have the desired effect on each competing group."

The Price to Live: A Video Game Takes on Healthcare

In his last year as an undergraduate at Caltech, **Pranav Patil** (BS '24, computer science and information and data sciences (minor)) set out to merge his technical skills with real-world issues in a final project for his Visual Activism course, taught by former Weisman Postdoctoral Scholar Teaching Fellow in Visual Culture **Anna Stielau**. Drawing on personal experience and his computer science and public health economics courses, he created a video game that critiques the U.S. healthcare system in the style of the original *Super Mario Bros*. Patil designed a game in which coins represent medical costs, "Goombas" represent structural healthcare barriers, and the player has only one life. Stielau encouraged Patil to send the game, which he called *The Price to Live*, along with an artist's statement, to *InVisible Culture: A Journal for Visual Culture*, where it was accepted for publication in April of this year. In a *Caltech* magazine story posted in May, Patil shared that some of his friends "wouldn't stop
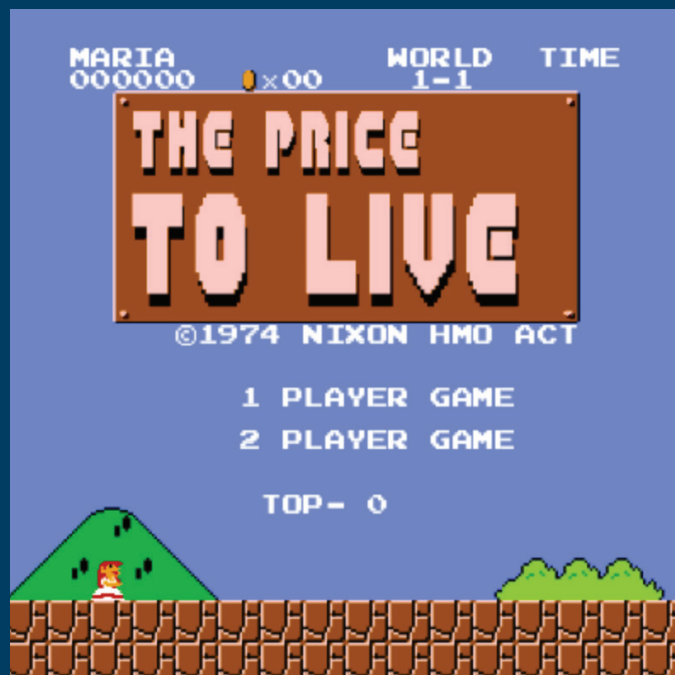

playing the game because they were determined to find a way to win—ultimately realizing it was impossible. After playing the game, you might say 'This is too hard! That's not fair!' And that's precisely my point."

Free Creations of the Human Mind

Diana Kormos Buchwald, the Robert M. Abbey Professor of History, and her co-author Michael Gordin (Princeton University) published a condensed biography of Albert Einstein, *Free Creations of the Human Mind: The Worlds of Albert Einstein*, in May. The book takes on two key tasks: telling Einstein's story in under 35,000 words and separating myth from archival evidence. Kormos

Buchwald, who is also the director and general editor of the Einstein Papers Project, and Gordin whittled down decades of research (including 17 volumes of Einstein's collected papers) into a narrative accessible to a wide readership. "Past scholarship on Einstein has been criticized for being hagiographic," Kormos Buchwald explained to *Caltech News*. "We wanted to document a middle way, not simply to bring balance but to be true to what we actually know about his life." The result is a biography that invites readers to view Einstein not only as a scientific icon but as a fully engaged individual whose life encompassed science, politics, travel, and everyday responsibilities.
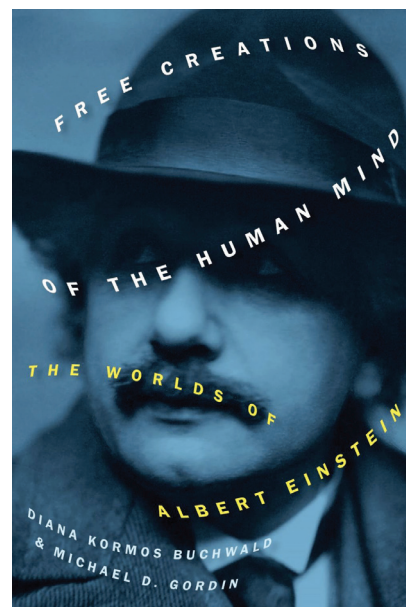
What Makes Us Persist Toward Long-Term Goals?

In a study from the O'Doherty lab, an online gameplay experiment conducted by social and decision neuroscience graduate student **Sneha Aenugu** explored why people persist in pursuing long-term goals when switching goals might be more favorable. In the game that Aenugu and O'Doherty designed, players collected cards in three suits, and the odds of acquiring cards from each suit shifted over blocks of play. The study found that human players tended to stick with a suit nearing completion despite it not being the best choice—a phenomenon the researchers describe as over-persistence. "It's not like we are doomed to persist," Aenugu said to *Caltech News*. "If we know that we have a tendency to over-persist, and if we have more details about the environment in which we are making choices, maybe we can shift our strategies to be more effective. Even in our experiment, giving players instructions about the odds of having a dominant suit in any particular block shifted their behavior." *PLOS Computational Biology* published the study in May.

Calculating the Electron's Magnetic Moment

In exploring foundational questions about physics, Professor of Philosophy **Charles "Chip" Sebens** has refined the calculation of the electron's magnetic strength, or moment, using the Dirac equation as a starting point to take account of two phenomena affecting electrons that have long been a part of the calculations within quantum field theory. One is self-interaction, in which an electron interacts with its own electromagnetic field, and the other is mass renormalization, a way of adjusting the electron's mass to account for the electromagnetic field that surrounds it. His efforts yielded an interesting conclusion, though not necessarily the one he desired. "The project that remains is to explain why you have a particular magnetic moment in quantum field theory when, in the context of the Dirac equation, the magnetic moment varies depending on the state of the electron," Sebens said to *Caltech News*. "How does quantum field theory nail down what is a state-dependent magnetic moment when calculated from the classical Dirac field?" The journal *Foundations of Physics* published Sebens's article in June.

Festival Sparks Conversations on AI, Ethics, and Storytelling

At MACH 33: The Festival of New Science-Driven Plays, hosted at Caltech this spring, independent playwrights paired with science advisors from Caltech and JPL to develop plays that are grounded in science or technology and benefit from targeted expertise. Professor of Philosophy **Frederick Eberhardt** served as the science advisor for *The Null Test*, a play by Ashley Quach that delves into the ethical complexities of artificial intelligence. The narrative centers on a fatal accident involving a self-driving car and the ensuing court case that questions the culpability and agency of the algorithm. In addition to a staged reading of the play, the festival featured a symposium on AI, ethics, and playwriting, as well as a panel discussion between the playwrights and science advisors on their experiences working together to explore scientific and creative ideas.


The panelists, featuring Ashley Quach and Frederick Eberhardt (far right).

Imaging Ecological Futures with Artist Jessica Segall

Jessica Segall visited HSS as an artist-in-residence with the Caltech Program in Visual Culture during the spring term. Segall is a multimedia artist inspired by hostile and threatened landscapes who has exhibited her work internationally. In her course Imaging Ecological Futures: Visual Art and Ecology, she asked students to think about old and new ways of representing nature. She told *Caltech News*, "We looked at art history from the earliest depictions of the hunt, 20th-century nature photography, and contemporary ecofeminist art and asked questions like, 'Were these depictions intended to show nature as sublime, as romantic? Did they depict ideas of the ownership or cultivation of nature?' Then we asked, 'How do we depict nature with new knowledge that we can't endlessly extract resources from the planet?'"

Kaleidoscope Vision: Seeing the Multifaceted Future of Artificial Intelligence (AI)
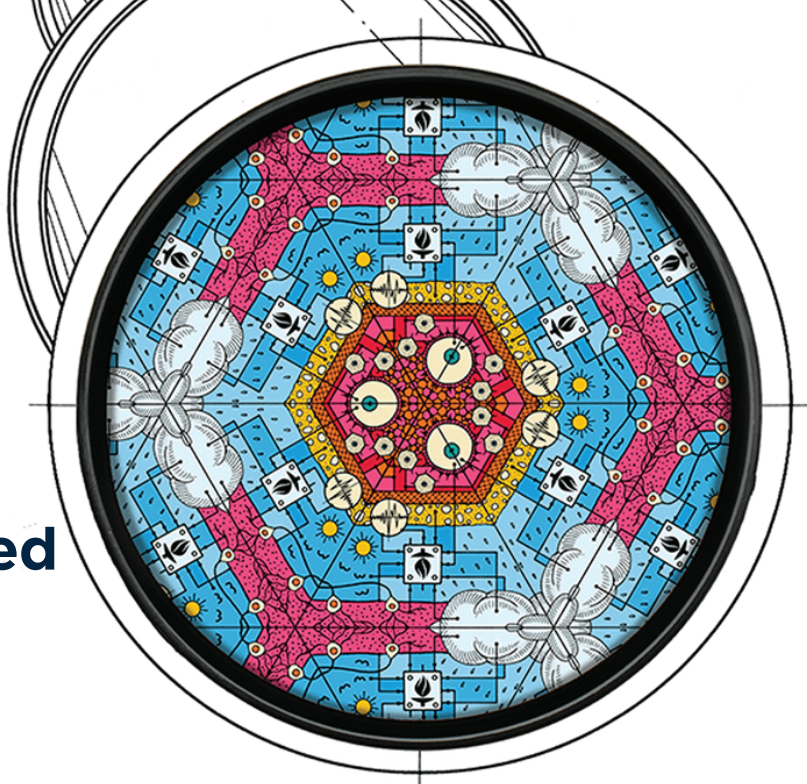
The spring edition of *Caltech* magazine featured the work of the following HSS researchers in its survey of the technical, ethical, and societal implications of rapidly advancing artificial intelligence:

• Robert Kirby Professor of Behavioral Economics **Colin Camerer**, who is also the leadership chair and director of the T&C Chen Center for Social and Decision Neuroscience, collaborated with engineer Pietro Perona (EAS) to develop a new method to measure algorithmic bias in vision language models, which can analyze both images and text. Now, AI engineers and researchers can use the study's datasets and methodology to test their own vision language models for algorithmic bias, providing a benchmark to evaluate and improve upon.

• Generative AI programs produce much of the misinformation found online, which, when combined with social media algorithms, creates a perfect storm for potential mass manipulation. Flintridge Foundation Professor of Political and Computational Social Science **Michael Alvarez**'s research turns the tables, using generative AI to combat misinformation around elections. He and fellow researchers used generative AI to help people "build the mental muscle," as Alvarez says, to identify online falsehoods with a technique called "pre-bunking" that can enable real-time responses to rapidly evolving online rumors and thereby prevent the spread of conspiracies.

• Alvarez and **Frederick Eberhardt** are co-directors of The Ronald and Maxine Linde Center for Science, Society, and Policy (LCSSP), which brings together researchers, policy stakeholders, and industry professionals to discuss topics in AI, among other initiatives. "One of our goals is to try to understand, as best we can, how all of these new artificial intelligence technologies are driving this broad area of social, political, and economic change," Alvarez said to *Caltech* magazine.

• Since the launch of ChatGPT in 2022, the Caltech community has been navigating how large language models (LLMs) fit into the classroom. Eberhardt teaches a dedicated Ethics and AI course for undergraduates that covers topics like free speech and misinformation, algorithmic fairness, data ethics, and privacy and surveillance. Edie and Lew Wasserman Professor of Social Science History and Ronald and Maxine Linde Leadership Chair of the Division of the Humanities and Social Sciences **Tracy Dennison** views the emergence of LLMs as a chance to reemphasize to students the value of writing and critical thinking skills, as well as ethics in science and technology.
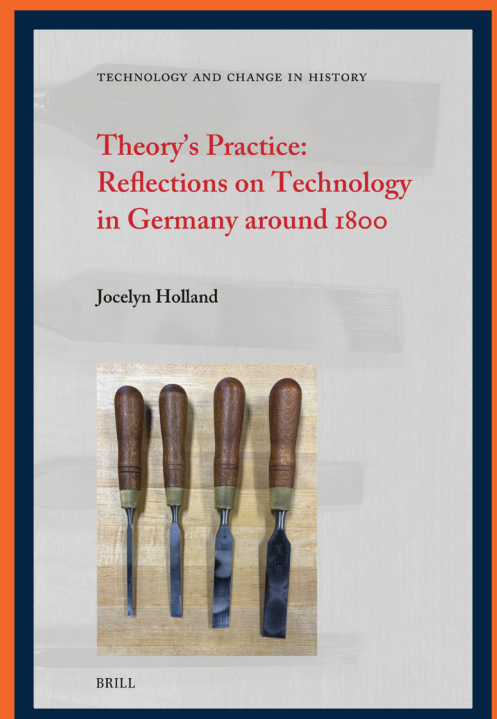
Behavioral Economics Meets AI

Colin Camerer uses AI to garner insights about how people make decisions (like whether to go to the gym) and form habits (like handwashing). He enhances the traditional economics approach of observation and questionnaires with a combination of eye tracking and functional magnetic resonance imaging (fMRI). From there, his team can analyze objective measurements instead of relying on subjective reports. Camerer explained to *Caltech* magazine in its spring edition, "What machine learning is really good at is taking a lot of possible predictor variables and winnowing down the ones that really are solid to make good predictions." Camerer lab researchers created a machine learning algorithm to see if they could tell how long it might take someone to develop a habit of going to the gym. While day of the week influenced the decision, the algorithm indicated that the best predictor was how many days had elapsed since someone had gone to the gym.

The Concept of Technology in Late 18th-Century Germany

Professor of Comparative Literature **Jocelyn Holland** is an expert on the intellectual history of 18th- and 19th-century Germany. In her latest book, published in June, *Theory's Practice: Reflections on Technology in Germany Around 1800*, Holland shows that the concept of "technology" began to shift in Germany decades earlier than is commonly assumed. While mid-18th-century Germans would have described technology as a compendium of technical terms across various crafts, by the late 1770s scholars and educators were treating it as a specific course taught in universities and captured in handbooks. "People who write broad histories of technology, who are taking the long view, sometimes gloss over the details," Holland said to *Caltech News*. "What I wanted to do with this book was fine-tune this history by taking a close look at a few important decades. I show that there are various ways in which people tried to move from the nuts and bolts of technology toward more general questions about what technology is."

TECHNOLOGY AND CHANGE IN HISTORY

Theory's Practice:
Reflections on Technology
in Germany around 1800

Jocelyn Holland

BRILL

When School Is Out, Research Is In

How undergraduates spent their summer break working with HSS faculty

By Katie Neith

For many undergraduate students, the opportunity to participate in research is rare. But at Caltech, it's the norm, with roughly 90% of students contributing to a research project before they graduate.

This past summer, 11 Caltech undergraduates completed a summer research project with faculty in the Division of the Humanities and Social Sciences (HSS) through the Institute's Summer Undergraduate Research Fellowships (SURF) program, which gives scholars the opportunity to conduct research under the guidance of experienced mentors working at the frontier of their fields. Two more students from outside universities came to campus to work with HSS faculty as WAVE Fellows,

a program that gives visiting students from groups that are comparatively underrepresented in science and engineering the chance to conduct research with the intention of encouraging their interest in pursuing a PhD.

Both programs provide participants with a 10-week, immersive research experience, during which they design, develop, and carry out independent research projects with the help of faculty, graduate student, and postdoc mentors. We talked to seven of the 2025 HSS SURF/WAVE participants to learn about their summer projects.

Investigating Decision-Making Through Comics

A love for poker—a game all about making calculated choices under uncertainty—is one of the main reasons that sophomore **Brendan Lee** says he is drawn to economics and decision-making research. This summer, the computer science major joined the lab of **Colin Camerer**, the Robert Kirby Professor of Behavioral Economics and director and leadership chair of the T&C Chen Center for Social and Decision Neuroscience.

"When I saw the chance to work in such an amazing lab that studies how human perception and preferences are formed, it felt like the perfect way to explore my interests in a formal academic setting," Lee says. "The opportunity to contribute to this kind of research was one I simply couldn't miss."

His project asked if exaggerated art on comic book covers leads to higher sales. Lee built a system that automatically collects covers online, then uses AI to score artistic features such as muscularity and action. Finally, the system checks for a correlation between this "exaggeration score" and real sales data.

"Early results hint at a positive link, but we need more data to be certain," says Lee, who plans to stay engaged with the research. "The project has a clear road map for future work, like expanding to other publishers or even building a model that could predict a new cover's commercial potential."

He notes that the experience has been indispensable, teaching him invaluable skills in data science, like building a web scraper, using multiple AI models, and performing statistical analysis.

"It has solidified my passion for using quantitative, computational tools to investigate questions in the humanities and social sciences," Lee says. "It's shown me a career path where I can merge my interests in technology and human behavior in a meaningful way."

But, he adds, the most memorable part of the experience was getting to work in a collaborative environment.

"Meeting everyone and hearing Professor Camerer's stories about the history of behavioral economics gave so much context to our work," Lee says. "It connected the technical challenges of my project to the bigger, foundational questions we're all trying to answer."

Testing Tolerance Through Video Games

Nandi Chase also worked with Colin Camerer this summer, traveling across the country from Washington, D.C., where she is a sophomore at Howard University. As a WAVE Fellow, she was inspired by the work of American psychologist Gordon Allport to investigate the use of online gaming interfaces to facilitate improved intergroup contact.

"Allport suggested that contact between members of different or opposing groups can reduce prejudice and promote tolerance under the right conditions," explains Chase, who is studying economics. "My mentors and I explored whether gameplay can increase positive attitudes between players and whether experiencing team flow—a shared state of immersion, focus, and enjoyment—during the game predicts improvements in intergroup attitudes."

Over the summer, Chase helped develop the study, working with a neurobiology graduate student in Camerer's lab, Katelyn Haly, to decide how to analyze dialogue between participants and
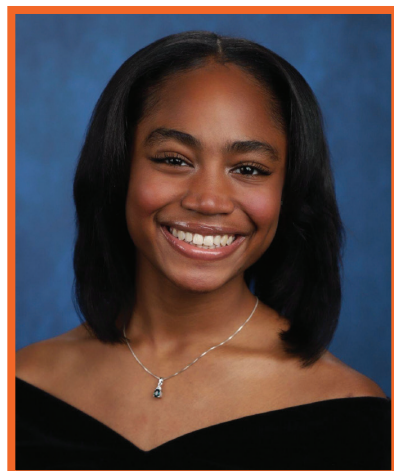
deduce whether their attitudes changed while interacting. One of the approaches involves using acoustic features of speech like pitch to detect markers of collaboration, emotional tone, and potential shifts in intergroup attitudes over time. Chase says she hopes that the pilot data she collected will help Haly secure grant funding to carry the project forward to an implementation stage.

The WAVE fellowship was the first time that Chase experienced a research setting, and she says she would not have known to pursue this type of opportunity without encouragement from peers at her home institution who had participated in the program in the past. She says that navigating the lab space and learning from those around her were highlights of the summer.

"I have been inspired by the graduate students in the lab whose work spans neuroscience, decision science, and economics, and who have designed rigorous research across these disciplines," explains Chase, who plans to pursue a PhD in the future. "They each employ a range of methods and tools in their research, like eye-tracking mechanisms and fMRI, to investigate different concepts. Before my time here, I did not know the breadth of research that exists across these fields, but I see myself expanding my research interests to include their use, making my research more creative and rigorous."

Exploring the Challenges of Emerging Technologies Through a Sci-Fi Lens

To explore how science fiction can help us think about legal and ethical challenges raised by emerging technologies such as artificial intelligence, senior **Elizabeth Won** turned to literature. A dual major in English and applied and computational math, she paired up with **Jennifer Jahner**, professor of English and dean of undergraduate students, whose research spans the long histories of rhetoric, law, and natural philosophy.

"Novels like *Frankenstein*, *I, Robot*, and *Story of Your Life* imagine technologies that didn't exist when they were written, like AI and genetic modification, but that we're now beginning to see in real life," says Won, who plans to go to law school after Caltech. "I paired these fictional works with real legal cases and current court decisions to analyze how the law is responding to rapid technological change."

She adds that while she expected to focus primarily on legal doctrine and technological developments, she came to realize that the way we talk about technology, through metaphors, legal definitions, and even fictional narratives, shapes the way we understand and regulate it. Ultimately, Won says, the project was an attempt to use topics in literature to assist the law in keeping pace with innovation.

"Because law and literature both seek precision in language, they become interesting partners in dissecting the operative metaphors of our technological present," says Jahner, noting that she was very impressed with Won's work. "The paradigms and terminology that courts draw upon to render decisions in AI cases have important implications for researchers, companies, and all of us in our daily lives, so in this instance especially, the language matters."

Won says the experience gave her a newfound appreciation for the complexities of the English language in both literature and law, which she believes bodes well for her plan to go to law school.

"I've learned that language can reframe our assumptions about what technology can do and who should be held responsible for it," explains Won. "Analyzing these texts has helped me see that legal frameworks aren't just built on statutes and precedent but are also deeply influenced by the narratives and language we use to describe innovation."

Using Video Games to Uncover the Neuroscience of Goal Pursuits

Aleksandar Marinkovic's research journey began his first day on Caltech's campus through the First-Year Success Research Institute, a program sponsored by the Center for Inclusion and Diversity that gives incoming undergraduate students the opportunity to build a solid research foundation. For his SURF project, Marinkovic, who is now a sophomore, continued work that he began that previous summer with **John O'Doherty**, Fletcher Jones Professor of Decision Neuroscience.

Personal motivations based on family health struggles inspired Marinkovic, an electrical engineering major, to explore cognitive neuroscience as a path that might enable him to use some of his technical skills to help solve medical problems. His main ongoing project involves studying how the brain understands its surroundings and re-prioritizes different choices based on that information to make decisions.

"A good example is a driver seeing traffic ahead; this new information causes the brain to favor an alternate route more than staying on the original path," Marinkovic says. "By having people play a detective-like video game while in an fMRI machine, we can identify the specific brain regions that are active when we process new information and change our course of action simultaneously."

Marinkovic designed the video game with his mentor, **Sneha Aenugu**, a graduate student in the O'Doherty lab, and spent this past summer building it from scratch and refining its features. In the game, players navigate through a castle, making decisions based on clues to complete a mission. It's currently being played online by paid participants so that the researchers can understand and model players' behavior as they proceed through the game.

"The way we usually study learning and decision-making in the lab is with very simplified behavioral tasks," O'Doherty says. "The task that Aleks is working on is a step up in richness and complexity, which allows us to get a handle on how some of these brain processes might operate in more realistic settings."

Eventually, the research team aims to have people play the game while in an fMRI machine to see what regions of the brain are active as they exhibit the behaviors of interest.

"I've had a very nice opportunity to grow in terms of my personal research capabilities, and that's been absolutely fantastic," Marinkovic says. "I'm also learning that proper, novel research takes a long time, a lot of feedback from experts, many failures, strong determination, and acceptance that not everything you do will be exhilarating. It is imperative that the research is enjoyable and that there is a driving passion; otherwise, the challenges associated with research can be impossible to overcome."

Testing Economic Theories Using Math

Yuexin Liao, a senior studying math, also investigated decision-making for her SURF project. With **Kota Saito**, professor of economics, she wanted to test whether the elegant theories she learned in math and economics still hold once confronted with the messy way that real data are constructed.

"In a complex world, I'm fascinated by using advanced mathematics and computation to uncover patterns and distributions hidden in the data," Liao says. "The SURF program gave me the chance to turn that curiosity into a concrete project."

According to Liao, in economic studies of decision-making where an individual selects one option from a finite set of mutually exclusive alternatives, many datasets group choices into broad labels—for example, a car model with many trims, or the

single "outside option" that stands for "anything else." Her project asked: When does this kind of aggregation faithfully reflect how people actually choose?

With Saito and **Alec Sandroni** (BS '25, mathematics and economics), who is now a graduate student at MIT, Liao showed that aggregation creates an ambiguity of composition, meaning that the grouped label may hide different underlying options for different people or markets. Under this ambiguity, the standard random-utility model—a framework widely used in empirical analysis in economics, marketing, and many other fields—has surprisingly weak testable implications. A recent paper by the group is the first to formally study the implications of this ambiguity in the composition of aggregated alternatives.

"Yuexin brought strong programming skills as well as mathematical insight to our group," Saito says. "Her contributions allowed us to extend our research into areas we had not previously explored."

One of the most thrilling results of her work, Liao says, was seeing a sharp, counterintuitive phenomenon in the code that the theory she was studying predicted. "It's exciting to discover that tools from pure math and computing can give rigorous shape to long-standing economic questions about decision theory," says Liao, who plans to pursue a PhD in economics and applied math. "I've learned that genuine progress often comes from embracing uncertainty and iteration—trying many approaches, failing, and then realizing that the key is often in reformulating the question itself."

Applying Machine Learning to Land Use Regulation

Sophomore **Henry Gaston** first heard **Hannah Druckenmiller**, assistant professor of economics and William H. Hurt Scholar, speak about her work using machine learning to predict which waterways and wetlands the Clean Water Act (CWA) regulates as a freshman in a computer science seminar class. When it came time to choose a SURF project, he knew exactly where to start.

"I saw that I could use my interest in computer science and machine learning to do something that's actually impacting laws and helping do real good to protect the environment and to justify environmental protection laws," says Gaston, who is a computer science major. "I basically hopped on a call with Hannah and said I would really love to be involved with her work."

While the CWA is a critical piece of legislation protecting U.S. water quality, it also serves as a major regulatory barrier for new construction. However, Gaston says there is no current method to monitor and enforce regulations laid out by the CWA or a good understanding of the scope of noncompliance. Building on Druckenmiller's work that uses machine learning to assess satellite imagery and geophysical data to monitor land use, Gaston is designing a construction detection model that predicts where and when people might be building in areas that are likely to be regulated by the CWA without obtaining the appropriate permits.

The first model that Gaston designed didn't work very well. But his poor results coincided with the release of a new

tool from Google called AlphaEarth Foundations that is being used to distill remotely sensed data into interpretable vectors for machine learning applications. This means that changes, such as new construction, can be detected much more easily. By incorporating this tool into his model, Gaston is seeing powerful results.

"We're getting really high accuracy right now," says Gaston, who plans to continue working on the project. "We're working to improve that model so that we can scale it and then run inference on the entire country to hopefully get pretty good counts of where the new construction is occurring."

Gaston, who has been doing research since high school, says that the opportunity to do undergraduate research is particularly important for applying knowledge learned in the classroom and figuring out next steps. "It has inspired me to continue down an academic and career path where I can continue to apply new, exciting technology to meaningful issues that I care about," he says.

Fighting Misinformation in Politics with Chatbots

Sophomore **Samantha Chang** first became interested in politics in high school when she interned with a state assembly member. When she heard about the SURF program, she knew that working in the lab of **Michael Alvarez**, Flintridge Foundation Professor of Political and Computational Social Science, would be a great way to fuse her political science curiosities with her intended major in computer science.

"I knew spearheading my own research project would be a challenge, but I was also excited to learn new skills and contribute to work that could make a difference," Chang says. "I was lucky enough to be given two projects to work on by Professor Alvarez that are both related to election misinformation."

The first project was about profiling misinformation susceptibility within the American electorate through analysis of a nationally representative dataset of about 5,000 participants who were asked to review headlines and label them as fake or real news. The goal was to identify the characteristics of people—such as age, gender, education, political affiliation, or ideology—who are more likely to believe false information with the hope that these insights can guide strategies to reach them and reduce their vulnerability.

"I was able to be the main contributor to this study because Professor Alvarez is an amazing mentor and encouraged me to take on a lot of responsibility to lead the project to where I thought it would be most interesting," Chang says.

The second project involved analyzing conversations between a chatbot and participants in a study that Caltech conducted last year focused on pre-bunking election myths. "Pre-bunking" involves giving people information to prepare them *before* they are exposed to misinformation. In this work, Chang helped to examine how interactions between the user and the chatbot vary based on treatment effects, demographic factors, and the chatbot's approach within the conversation, with the aim of understanding how to make pre-bunking messages more effective for different audiences.

"Working on projects that combine statistical methods and real-world issues has shown me how research can contribute to understanding and solving societal challenges," says Chang, who is helping to prepare several publications based on her summer projects. "I would love to continue pursuing research in political science, and the skills I learned from my SURF work will prepare me to take on more advanced research opportunities in college and beyond."

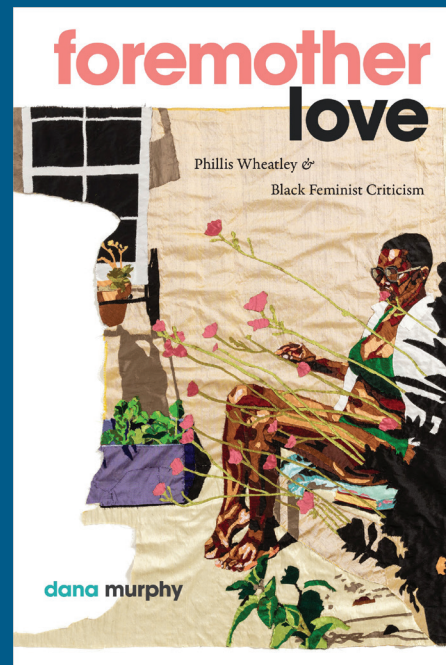- -

These projects represent just a small sample of student research that takes place in HSS on a wide variety of topics. In fact, nearly every research group in the division has help from at least one undergraduate during the academic year.

"Interest in summer research projects in HSS continues to grow, even among prospective students," says **Tracy Dennison**, Edie and Lew Wasserman Professor of Social Science History and Ronald and Maxine Linde Leadership Chair of the Division of the Humanities and Social Sciences. "And our faculty welcome the opportunity to show Caltech undergraduates how new knowledge is generated in our fields and to have them participate in that process. Working with SURF students is one of the most rewarding things we do. Everyone learns something from the experience."

Foremother Love

Foremother Love: Phillis Wheatley and Black Feminist Criticism, published in July and authored by **Dana Murphy**, assistant professor of Black studies and English, honors the writing of Phillis Wheatley (Peters)—a Black woman who lived in colonial New England in the latter half of the 18th century whose work was integral to Black feminist criticism in the 20th century. "Future Black feminist critics, after Phillis died, overarchingly reestablished her with a seat of honor at their table," Murphy said to *Caltech News*. "So the book is about how care for Phillis, a tradition crafted from a practice of foremother love broadly, contributed to establishing Black feminist criticism—a tradition that itself helped establish African American literature as a field."
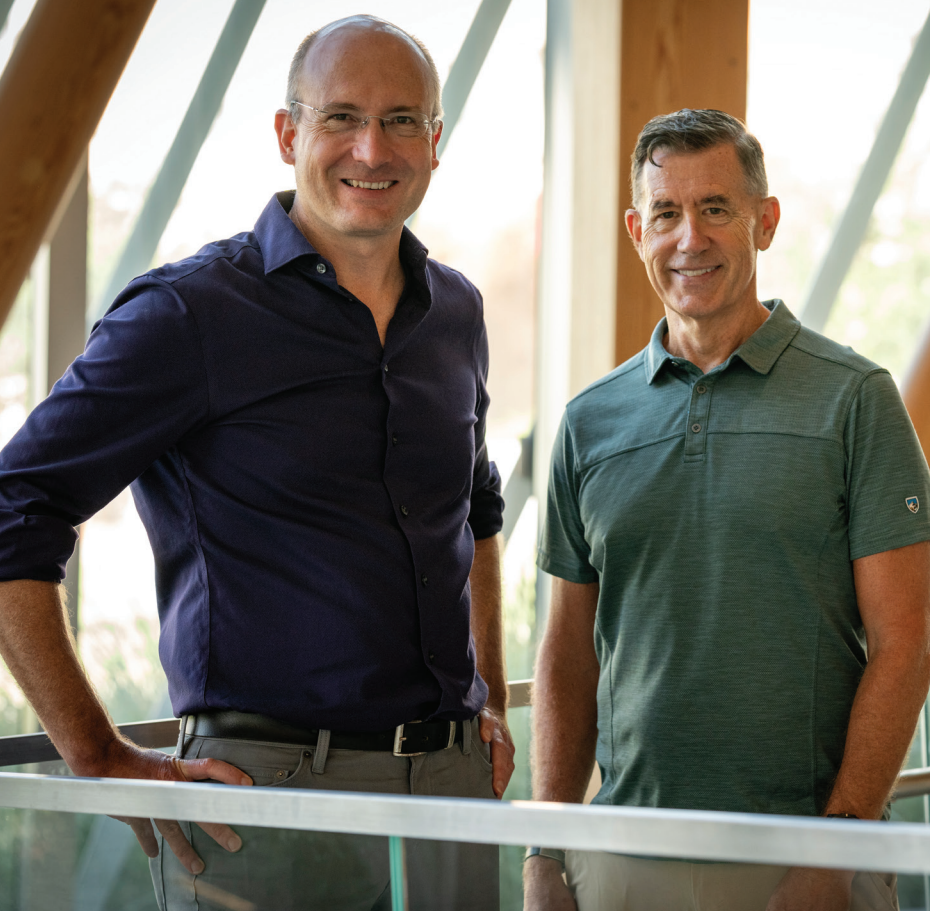

New HSS Courses Encourage Curiosity

In time for fall term, HSS welcomed six new postdoctoral scholar teaching fellows who bring an array of fresh topics to the undergraduate curriculum. Their course offerings span visual culture, literature, history, political science, and environmental studies, emphasizing interdisciplinary inquiry and archival or experiential learning.

One of the six is the inaugural Eleanor Searle Postdoctoral Scholar Teaching Fellow in the History of Science and Technology, **Cristiano Zanetti**. His courses include Leonardo da Vinci & Co.: How to Understand Technological Invention in the Long Renaissance (Hum/H 38) in the winter term, and Instruments of Knowledge from Antiquity to the Early Modern World (H 115) in the spring. "I am thrilled and honored by the chance to engage with future technological innovators—some of whom may go on to change the world—in conversations about the history of inventions," Zanetti said. "My hope is that these courses will empower students to contextualize phenomena, draw inspiration from their predecessors, and critically challenge established narratives."

A group of the new postdoctoral scholar teaching fellows (from left): Tanya Schmidt Morstein, Cristiano Zanetti, Raquel Centeno, and Nick Earhart.

LCSSP co-directors Frederick Eberhardt and Michael Alvarez.

LCSSP Launches New Biopolicy Initiative

The Ronald and Maxine Linde Center for Science, Society, and Policy (LCSSP) formally launched its biopolicy initiative with a kickoff event on October 14, which featured a keynote address by synthetic biologist Drew Endy of Stanford University and the Hoover Institution. The initiative was made possible through the generosity of Ronald and Maxine Linde and Eric and Wendy Schmidt. "Biopolicy/bioethics is one of three foundational initiatives at the LCSSP, the others being climate and sustainability, and artificial intelligence," **Frederick Eberhardt**, professor of philosophy and co-director of the LCSSP, told *Caltech News*. "This new biopolicy initiative will allow us to create a robust platform to address the societal impact of the rapid evolution in biotechnology and related fields and can serve as a blueprint for our other areas of science-for-policy." The initiative is structured around three interlocking programs: a series of workshops convening scientists and regulators from academia, industry, government, and funding organizations; seed funding for scientists researching areas directly relevant to questions raised by policy issues; and internships for graduate students and postdoctoral scholars working within government agencies or non-governmental organizations.

LCSSP hosted several conferences, workshops, and panels in 2025, furthering its mission to foster conversation about and shape science policy by building on Caltech's scientific expertise. Event highlights included:

2024 Election Integrity Project Conference
January 16–17, 2025

Southern California Wildfires and Water Quality Panel
May 20, 2025

Biotech Beyond Conventional Containment Workshop
October 6–7, 2025

Protecting the Election: AI & Governance Conference
October 16–17, 2025

Election Science Office Hours webinar series, hosted by **Michael Alvarez**, Flintridge Foundation Professor of Political and Computational Social Science and co-director of the LCSSP.

Climate Solutions Seminar series, organized by **Hannah Druckenmiller**, assistant professor of economics and William H. Hurt Scholar, in conjunction with her winter class Climate Change Impacts, Mitigation, and Adaptation.

SOUTHERN CA WILDFIRES AND WATER QUALITY:
SCIENCE MEETS POLICY

MAY 20, 2025
6:00-7:30PM
BAXTER LECTURE HALL
PUBLIC EVENT

FEATURING PANELISTS:
HANNAH DRUCKENMILLER, CALTECH
STACIE TAKEGUCHI, PASADENA WATER & POWER
ANDREW WHELTON, PURDUE UNIVERSITY
MODERATED BY ANDREW THOMPSON, CALTECH

SPONSORED BY THE LINDE CENTER FOR GLOBAL ENVIRONMENTAL SCIENCE, THE RESNICK INSTITUTE, AND THE LINDE CENTER FOR SCIENCE, SOCIETY, & POLICY

Writing in the Age of AI

Susanne Hall, teaching professor of writing and director of the Hixon Writing Center, spearheaded the HSS policy on generative AI and served as an advisor for the Institute's guidance on the use of AI and LLMs (which was released in October 2023). Over the summer, Hall spoke with *Caltech* magazine about how the HSS policy impacts students and faculty and how these tools are changing the collegiate learning experience. "The models themselves are evolving rapidly, and our understanding of how they affect student learning is expanding," Hall said in the interview. "I'm excited to continue to work with our students on exploring what is possible and where the dangers lie, and I take seriously my responsibility to protect their ability to learn and grow during their time in college."

Essential Einstein

A carefully curated two-volume set of the selected writings of Albert Einstein, titled *The Essential Einstein*, was released this fall. Edited by **Diana Kormos Buchwald** and **Tilman Sauer**, a visiting associate in history at Caltech and professor at Johannes Gutenberg University in Germany, the volumes bring together what the historians regard as Einstein's most significant writings—both his scientific papers and his public-oriented essays. The *Scientific Writings* volume includes 38 key documents covering Einstein's seminal contributions to relativity, quantum theory, statistical mechanics, patents, and unified-field research. The *Public Writings* volume presents 96 pieces in English translation, spanning essays on physics, pacifism, Zionism, and Jewish identity. Each volume has an introduction by the editors, and each document within has a headnote offering historical context. While the full *Collected Papers* series exceeds 14,000 documents, *The Essential Einstein* offers a more accessible and compact entry point for both specialists and general readers.
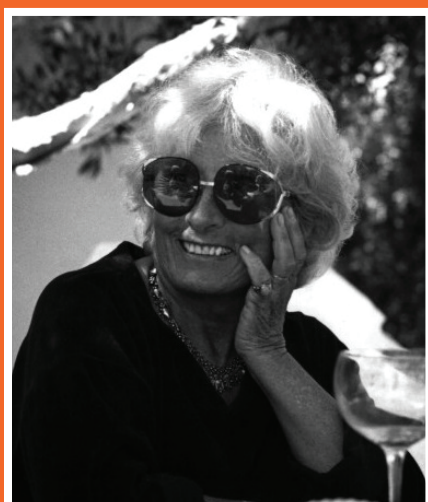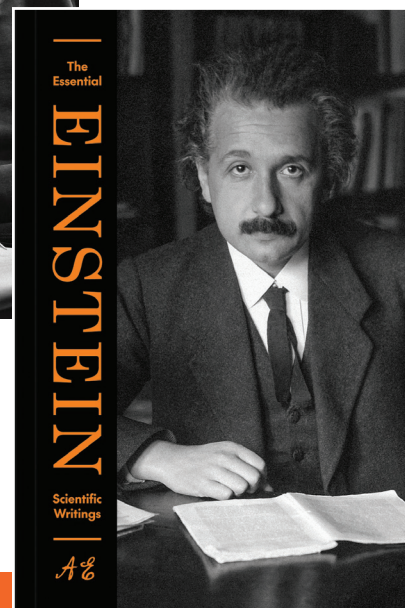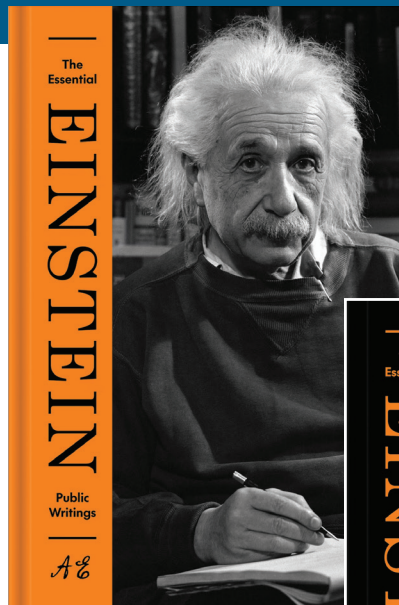
Remembering Annette Smith

Annette Smith, professor of literature, emeritus, died on October 18 at the age of 100. Born and raised in colonial Algeria, Smith earned a master's and PhD in literature from the Sorbonne in Paris, France. She met her husband, David, in Paris and later joined him on the faculty at Caltech as a lecturer in French language and literature in 1970. Smith demanded better salaries and benefits for women working at Caltech and helped to mentor the first women to attend the Institute as undergraduates in the early 1970s. Caltech promoted her to associate professor and awarded her tenure in 1985. Smith's scholarly worked included a book on 19th-century writer Arthur de Gobineau, and she translated and published nearly the entire corpus of Aimé Césaire's poetry from French to English (in collaboration with poet Clayton Eshleman). She retired from Caltech in 1993.

Where Are They Now?

After earning their PhDs in 2025 . . .

Polina Detkova is a postdoctoral research assistant at Royal Holloway, University of London.

Weilun Ding is continuing his research in the O'Doherty lab as a postdoctoral scholar research associate in social and decision neuroscience at Caltech.

Peter Doe is an assistant professor of economics at Hope College.

Brenden Eum is a postdoctoral fellow in marketing at the University of Toronto's Rotman School of Management.

Kexin Feng is a postdoctoral associate at the Yale Economic Growth Center.

Jacob Morrier is an associate at Analysis Group.

Ke Shi is an assistant professor of finance in the Shanghai Advanced Institute of Finance at Shanghai Jiao Tong University.

Fan Wu is an assistant professor at Peking University HSBC Business School.

Sanghyun Yi is an applied scientist at SynthBee.

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After completing their postdoctoral appointments in 2025 . . .

Patrick Burauel is a quantitative researcher at Citadel.

Cong Cao is a postdoctoral associate in the department of population medicine and diagnostic sciences at Cornell University.

Ozan Gurcan is a clinical research associate in bioethics at St. Jude Children's Research Hospital in Memphis, Tennessee.

Na Yeon Kim is an assistant professor in the department of psychology at UC Riverside.

Beatrice Magistro is an assistant professor in AI governance at Northeastern University.

Vincent Man is a machine learning scientist at Apple.

Travis McKenna is an assistant professor of philosophy at North Carolina State University.

Swati Pandita is a postdoctoral researcher at the University of Illinois Urbana-Champaign's Siebel School of Computing and Data Science.

Tessa Rusch is a senior AI research scientist at Vorwerk Elektrowerke GmbH & Co. KG.

Saeedeh Sadeghi is a postdoctoral research associate and Rothenberg Research Fellow in the division of perceptual studies at the University of Virginia.

Anna Stielau is an assistant professor of art history and visual culture at OCAD University.

Laura Taylor is a faculty lecturer in the department of environmental science and policy at the University of Miami and a National Bureau of Economic Research fellow (2025–2026).

Awards & Honors

The Economic History Association elected Rea A. and Lela G. Axline Professor of Business Economics and director of The Ronald and Maxine Linde Institute of Economic and Management Sciences **Jean-Laurent Rosenthal** as its president and into its Society of Fellows.

Four HSS staff members were recognized for the important work they do to advance the mission of the Institute at the 70th annual Staff Service and Impact Awards on May 22. The honorees included:

Erin Burkett (10 years)
STEM Writing Specialist
and Lecturer

Sini Elvington (15 years)
Associate Editor & Office Manager for
the Einstein Papers Project

Fran Tise (15 years)
Administrative Assistant

Chris Crabbe (20 years)
Computer Program and
Software Developer

Chaired professorships are considered the Institute's most distinguished award for individual faculty. This year, Caltech named **Marina Agranov** as the Rea A. and Lela G. Axline Professor of Economics and **Charles Sprenger** as the William D. Hacker Professor of Economics.

On the occasion of Caltech's 131st commencement exercises, the Division of the Humanities and Social Sciences celebrated 10 outstanding PhD recipients (listed with their dissertations):

Polina Detkova ("Essays in Experimental Economics")

Weilun Ding ("Core Reinforcement Learning Computations Underlying Distinct Behavioral Strategies and Their Implications in Psychiatry")

Peter Doe ("Essays in Matching Theory")

Brenden Eum ("Essays on Sequential Sampling in Value-Based Choice")

Kexin Feng ("Tensions, Trade, and Transformation: Essays on Chinese Economic History During the Warlord Era")

Jacob Morrier ("Essays on Political Accountability and Representation")

Marcos Nazareth Gallo ("Psychological Insights into Decisions Relevant to Public Policy")

Ke Shi ("Essays in Empirical Industrial Organization and Corporate Finance")

Fan Wu ("Essays on Information Economics")

Sanghyun Yi ("Neurocomputational Understanding of Decision-Making in Novel Environments")

The American Philosophical Association awarded **Mahmoud Jalloh**, postdoctoral scholar research associate in history and philosophy of science, its 2025 Routledge, Taylor & Francis Prize for his article "Metaphysics and Convention in Dimensional Analysis, 1914–1917." The prize is awarded for the two best published articles in philosophy written by adjunct professors. (At the time of his paper's publication in 2024, Mahmoud was with St. John's College.)

The HSS student prize winners recognized at Caltech's commencement on June 13 included:

Katherine Avanesov (Hallett Smith Prize)

Chi Cap (Mary A. Earl McKinney Prize in Poetry)

Luke Kottom (Gordon McClure Memorial Communications Prize in History)

Mia Mutadich (Rodman W. Paul History Prize)

Sreeyutha Ratala (Mary A. Earl McKinney Prize in Fiction)

Edward Speer (Gordon McClure Memorial Communications Prize in Philosophy)

Mariana Vale Taveira (Alexander P. and Adelaide F. Hixon Prize for Writing)

Elizabeth Won (Gordon McClure Memorial Communications Prize in English)

The list of impressive HSS-affiliated undergraduates continues with **Sulekha Kishore** (BS '25, computer science and political science), who received the David M. Grether Prize in Social Science and the Mabel Beckman Prize. Kishore is continuing her education at MIT's Institute for Data, Systems, and Society.

At the holiday gathering on December 4, HSS presented the Brass Division Awards to the following honorees, recognizing their outstanding service and teaching:

Sara Ballance, Lecturer in Music

Susanne Hall, Teaching Professor of Writing and Director of the Hixon Writing Center

Andrew Sinclair, Visiting Assistant Professor of Finance

Social science graduate students **Binyamin (Ben) Wincelberg** and **Po Hyun Sung** received the 2024–2025 third-year paper prize for their joint work, titled "Comparing Risk Attitudes in Stochastic Choice."

The Society for Political Methodology honored **Michael Alvarez** with its Career Achievement Award for his research into modeling election dynamics and his service to the profession.

Social science graduate student **Guillaume Wegmueller** received the John O. Ledyard Prize for Graduate Research in Social Science for his second-year paper, titled "Dockside Knowledge Versus Lloyd's Grades: Pricing Marine Insurance in Liverpool (1804–1805)."

Kexin Feng (PhD '25) received the 2025 Eleanor Searle Prize in Law, Politics, and Institutions, which honors a student whose work in history or the social sciences exemplifies Searle's interests in the use of power, government, and law. Jean-Laurent Rosenthal nominated Feng for the rigorous dissertation project she completed on trade in China from 1900 to 1930.

The following HSS graduate students received named fellowships during Caltech's 2024–2025 academic year:

Polina Detkova (Lance E. Davis Graduate Fellowship)

Peter Doe (The Stephen A. Ross Memorial Fellowship)

Camila Farres Rodriguez (James and Karen Gerard Fellowship in Social Sciences)

Kexin Feng (Repetto-Figueroa Family Graduate Fellowship)

Aniek Fransen (A. Michael and Ruth C. Lipper Graduate Fellowship)

Yi Chuang Lin (J. William Fulbright Foreign Scholarship Grant)

Sota Minowa (Heiwa Nakajima Foundation Award)

Noah Okada (National Science Foundation Graduate Research Fellowship)

Po Hyun Sung (Citadel Global Fixed Income Graduate Fellowship)

**Yu-Hsiang Wang** (Ministry of Education Taiwan/Caltech Fellowship)

Binyamin (Ben) Wincelberg (Citadel Global Fixed Income Graduate Fellowship)

Fan Wu (Roger and Marjorie Davisson Graduate Fellowship)

Also In The News

In a *Politico* article, Flintridge Foundation Professor of Political and Computational Social Science **Michael Alvarez** commented on the push by some California legislators to allow digital signatures on petitions for ballot measures. He noted that there are difficulties associated with moving away from print—both technical ones and sociological ones having to do with how people currently get signatures on ballot measure petitions (for example, standing in a public place with a clipboard) and how such efforts might function in a world of online influencers.

In the spring, the Caltech Library published an oral history interview with **David Grether** (1938–2021), professor of economics, emeritus, in which he reflected on his upbringing in Berkeley, California, and his path into behavioral and experimental economics. He also shared his thoughts and observations about the role and evolution of liberal arts studies at the Institute from his unique vantage point as two-time chair of the Division of the Humanities and Social Sciences (1982–1992, 2006–2007).
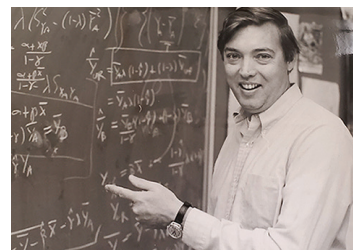
This year marks the 60th anniversary of the Voting Rights Act, and **J. Morgan Kousser**, professor of history and social science, emeritus, continues to serve as an expert on the topic. He was featured in articles in *The Los Angeles Times*, WBHM (Public Radio for the Heart of Alabama), and *National Newswatch* and was interviewed on NPR's *On Point with Meghna Chakrabarti*.

The California Tech published an interview with **Daniel Lewis**, lecturer in history at Caltech and Dibner Senior Curator for the History of Science and Technology at The Huntington. He discussed how environmental history can inspire practical action, reflected on consumer culture's ecological impact, and described his current book project on extinction and the planet's future.

Beatrice Magistro, former postdoctoral scholar in computational social science and current assistant professor of AI governance at Northeastern University, and **Michael Alvarez** published an article in *Foreign Affairs*, "The Coming AI Backlash: How the Anger Economy Will Supercharge Populism," which discussed their work on the political and economic implications of AI's rapid development. The project was supported by the Linde Center for Science, Society, and Policy (LCSSP), and their co-authors were Bart Bonikowski (New York University), Sophie Borwein (University of British Columbia), and Peter John Loewen (Cornell University).

Assistant Professor of Black Studies and English **Dana Murphy** penned a short essay titled "So Good" about growing up in Altadena for a collection in *The Los Angeles Times* about life in Los Angeles in the wake of the Eaton and Palisades fires in January.

Charles "Chip" Sebens, professor of philosophy, appeared on the *Blue Dot* podcast in August with host Dave Schlom for an engaging conversation on how philosophical thought and methodology can help unravel the mysteries of modern physics.

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